

# EHDSeries AC Servo User's Manual

(Version: V1.06)



ESTUN AUTOMATION TECHNOLOGY CO., LTD

— Total Solution Supplier

Revision History

| Date      | Rev. No.    | Section | Revised Content | Remark |
|-----------|-------------|---------|-----------------|--------|
| 2015/4/25 | V1.00~V1.05 | —       | First edition   |        |
| 2015/5/15 | V1.06       | -       |                 |        |

Copyright © 2011 ESTUN AUTOMATION TECHNOLOGY CO., LTD

---

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form, or by any means, mechanical, electronic, photocopying, recording, or otherwise, without the prior written permission of ESTUN.

No patent liability is assumed with respect to the use of the information contained herein.

## About this manual

This manual describes the following information required for designing and maintaining EHD series servo drives.

- Specification of the servo drives and servomotors.
- Procedures for installing the servo drives and servomotors.
- Procedures for wiring the servo drives and servomotors.
- Procedures for operating of the servo drives.
- Procedures for using the panel operator.
- Communication protocols.
- Ratings and characteristics of the servo drives and servomotors.

Intended Audience:

- Those designing EHD series servo drive systems.
- Those installing or wiring EHD series servo drives.
- Those performing trial operation or adjustments of EHD series servo drives.
- Those maintaining or inspecting EHD series servo drives.

## Safety Precautions

---

- Do not connect the servomotor directly to the local electrical network.

Failure to observe this may result in damage to servomotor.

- Do not plug or unplug connectors from servo drive when power is on.

Failure to observe this may result in damage to servo drive and servomotor.

- Please note that even after power is removed, residual voltage still remains in the capacitor inside the servo drive. If inspection is to be performed after power is removed, please wait 15 minutes to avoid risk of electrical shock.

- Keep servo drives and other devices separated by at least 10mm.

The servo drive generates heat. Install the servo drive so that it can radiate heat freely. When installing servo drives with other devices in a control panel, provide at least 10mm space between them and 50mm space above and below them. Please install servo drives in an environment free from condensation, vibration and shock.

- Perform noise reduction and grounding properly.

Please comply with the following instructions to avoid noise generated by signal lines.

1. Separate high-voltage cables from low-voltage cables.
2. Use cables as short as possible.
3. Single point grounding is required for the servomotor and servo drive (grounding resistance 100Ω or below).
4. Never use a line filter for the power supply in the circuit.

- Conduct a voltage resistance test for the servo drive under the following conditions:

1. Input voltage: AC 1500Vrms, 1 minute
2. Braking current: 100mA
3. Frequency: 50/60Hz
4. Voltage applied point: Between L1, L2, L3 terminals and frame ground.

- Use a fast-response type ground-fault interrupter.

For a ground-fault interrupter, always use a fast-response type or one designed for PWM inverters. Do not use a time-delay type.

- Do not make any extreme adjustments or setting changes of parameters.

Failure to observe this caution may result in injury or damage to the product due to unstable operation.

- The servomotor cannot be operated by turning the power on and off.

Frequently turning the power ON and OFF causes the internal circuit elements to deteriorate, resulting in unexpected problems. Always start or stop the servomotor by using reference pulses.

—Contents—

|   |        |
|---|--------|
| About this manual .....                                   | - 1 -  |
| Safety Precautions .....                                  | - 2 -  |
| Chapter 1 .....   | - 7 -  |
| 1.1 Checking Products on Delivery .....                   | - 7 -  |
| 1.1.1 Servomotor .....                                    | - 7 -  |
| 1.1.2 Servo drive .....                                   | - 8 -  |
| 1.2 Part Names .....                                      | - 10 - |
| 1.2.1 Servomotor .....                                    | - 10 - |
| 1.2.2 Servo drive .....                                   | - 10 - |
| Chapter 2 .....   | - 11 - |
| Installation .....  | - 11 - |
| 2.1 Servomotor .....                                      | - 11 - |
| 2.1.1 Storage .....                                       | - 11 - |
| 2.1.2 Installation Sites .....                            | - 11 - |
| 2.1.3 Installation Alignment .....                        | - 12 - |
| 2.1.4 Installation Orientation .....                      | - 12 - |
| 2.1.5 Handling Oil and Water .....                        | - 12 - |
| 2.1.6 Cable Tension .....                                 | - 13 - |
| 2.1.7 Install to the Client .....                         | - 13 - |
| 2.2 Servo Drive .....                                     | - 13 - |
| 2.2.1 Storage .....                                       | - 13 - |
| 2.2.2 Installation Sites .....                            | - 13 - |
| 2.2.3 Installation Orientation .....                      | - 14 - |
| 2.2.4 Magnetism-circle twist Method .....                 | - 14 - |
| 2.3 Capacitancetrunk .....                                | - 14 - |
| 2.3.1 Capacitancetrunk spec .....                         | - 14 - |
| 2.3.2 Installationdimension .....                         | - 15 - |
| 2.3.3 Installation Orientation .....                      | - 15 - |
| 2.3.4 MultipleCapacitancetrunk Installation .....         | - 15 - |
| Chapter 3 .....   | - 17 - |
| Wiring .....  | - 17 - |
| 3.1 Main Circuit Wiring .....                             | - 17 - |
| 3.1.1 Names and Functions of Main Circuit Terminals ..... | - 17 - |
| 3.1.2 Typical Main Circuit Wiring Examples .....          | - 18 - |
| 3.2 I/O Signals .....                                     | - 19 - |
| 3.2.1 Examples of I/O Signal Connections .....            | - 19 - |
| 3.2.2 I/O Signal Names and Functions .....                | - 19 - |
| 3.2.3 I/O Signal Connector (CN1) Terminal Layout .....    | - 21 - |
| 3.2.4 Interface Circuit .....                             | - 22 - |
| 3.3 Wiring Encoders .....                                 | - 23 - |
| 3.3.1 Connecting an Encoder(CN2) .....                    | - 23 - |

|   |        |
|---|--------|
| 3.3.2 Encoder Connector(CN2) Terminal Layout .....                          | - 24 - |
| 3.4 Communication Connection .....  | - 24 - |
| 3.4.1 Communication Connector(CN3) Terminal Layout .....                    | - 24 - |
| 3.4.2 Communication Connector(CN4) Terminal Layout .....                    | - 25 - |
| 3.5 Motor Wiring .....  | - 25 - |
| 3.6 Standard Wiring Examples .....  | - 26 - |
| 3.6.1 Position Control Mode .....   | - 27 - |
| 3.6.2 Speed Control Mode .....  | - 28 - |
| 3.6.3 Torque Control Mode .....   | - 28 - |
| 3.7 Wiring for Noise Control .....  | - 29 - |
| 3.7.1 Noise Control .....   | - 29 - |
| 3.7.2 Precautions on Connecting Noise Filter .....                          | - 31 - |
| 3.8 Installation Conditions of EMC Directives .....                         | - 32 - |
| 3.9 Using More than One Servo Drive .....                                   | - 34 - |
| Chapter 4 .....   | - 36 - |
| Operation .....   | - 36 - |
| 4.1 Trial Operation .....   | - 36 - |
| 4.1.1 Trial Operation for Servomotor Without Load .....                     | - 38 - |
| 4.1.2 Trial Operation for Servomotor without Load from Host Reference ..... | - 40 - |
| 4.1.3 Trial Operation with the Servomotor Connected to the Machine .....    | - 44 - |
| 4.1.4 Trial Operation for Servomotor with Brakes .....                      | - 45 - |
| 4.1.5 Position Control by Host Controller .....                             | - 45 - |
| 4.2 Control Mode Selection .....  | - 46 - |
| 4.3 Setting Common Basic Functions .....                                    | - 47 - |
| 4.3.1 Setting the Servo ON Signal .....                                     | - 47 - |
| 4.3.2 Switching the Servomotor Rotation Direction .....                     | - 47 - |
| 4.3.3 Setting the Overtravel Limit Function .....                           | - 48 - |
| 4.3.4 Setting for Holding Brakes .....                                      | - 50 - |
| 4.3.5 Instantaneous Power Loss Settings .....                               | - 54 - |
| 4.4 Operating Using Speed Control with Analog Reference .....               | - 54 - |
| 4.4.1 Setting Parameters .....  | - 54 - |
| 4.4.2 Setting Input Signals .....   | - 55 - |
| 4.4.3 Adjusting Reference Offset .....                                      | - 55 - |
| 4.4.4 Soft Start .....  | - 58 - |
| 4.4.5 Speed Reference Filter Time Constant .....                            | - 58 - |
| 4.4.6 S-curve Risetime .....  | - 58 - |
| 4.4.7 Using the Zero Clamp Function .....                                   | - 59 - |
| 4.4.8 Encoder Signal Output .....   | - 60 - |
| 4.4.9 Speed coincidence output .....  | - 62 - |
| 4.5 Operating Using Position Control .....                                  | - 62 - |
| 4.5.1 Basic Setting in Position Control .....                               | - 63 - |
| 4.5.2 Setting the Clear Signal .....  | - 66 - |
| 4.5.3 Setting the Electronic Gear .....                                     | - 66 - |
| 4.5.4 Smoothing .....   | - 68 - |
| 4.5.5 Positioning Completion Output Signal .....                            | - 69 - |
| 4.5.6 Reference Pulse Inhibit Function(INHIBIT) .....                       | - 70 - |

|                |  |         |
|----------------|--|---------|
| 4.5.7          | Position Control (contact reference)                       | - 71 -  |
| 4.6            | Operating Using Torque Control                             | - 73 -  |
| 4.6.1          | Setting Parameters   | - 73 -  |
| 4.6.2          | Torque Reference Input                                     | - 74 -  |
| 4.6.3          | Adjusting the Reference Offset                             | - 74 -  |
| 4.6.4          | Limiting Servomotor Speed During Torque Control            | - 75 -  |
| 4.7            | Operating Using Speed Control with an Internally Set Speed | - 76 -  |
| 4.7.1          | Setting Parameters   | - 77 -  |
| 4.7.2          | Input Signal Settings                                      | - 78 -  |
| 4.7.3          | Operating Using an Internally Set Speed                    | - 78 -  |
| 4.8            | Limiting Torque  | - 78 -  |
| 4.8.1          | Internal Torque Limit                                      | - 79 -  |
| 4.8.2          | External Torque Limit                                      | - 79 -  |
| 4.8.3          | Torque Limiting Using an Analog Voltage Reference          | - 80 -  |
| 4.9            | Control Mode Selection                                     | - 81 -  |
| 4.9.1          | Setting Parameters   | - 81 -  |
| 4.9.2          | Switching the Control Mode                                 | - 81 -  |
| 4.10           | Other Output Signals                                       | - 82 -  |
| 4.10.1         | Servo alarm output   | - 82 -  |
| 4.10.2         | Rotation Detection Output Signal (/TGON)                   | - 83 -  |
| 4.10.3         | Servo Ready (/S-RDY) Output                                | - 83 -  |
| 4.10.4         | Encoder C Pulse Output (/PGC)                              | - 83 -  |
| 4.10.5         | Over travel signal output (OT)                             | - 83 -  |
| 4.10.6         | Servo Enabled Motor Excitation Output (/RD)                | - 84 -  |
| 4.10.7         | Torque Limit Detection Output (/CLT)                       | - 84 -  |
| 4.11           | Online Autotuning  | - 85 -  |
| 4.11.1         | Online Autotuning Function                                 | - 85 -  |
| 4.11.2         | Online Autotuning Procedure                                | - 86 -  |
| 4.11.3         | Setting Online Auto-tuning                                 | - 87 -  |
| 4.11.4         | Machine Rigidity Setting for Online Auto-tuning            | - 88 -  |
| Chapter 5      |  | - 89 -  |
| Panel Operator |  | - 89 -  |
| 5.1            | Basic Operation  | - 89 -  |
| 5.1.1          | Functions on Panel Operator                                | - 89 -  |
| 5.1.2          | Resetting Servo Alarms                                     | - 89 -  |
| 5.1.3          | Basic Mode Selection                                       | - 90 -  |
| 5.1.4          | Status Display Mode  | - 90 -  |
| 5.1.5          | Operation in Parameter Setting Mode                        | - 91 -  |
| 5.1.6          | Operation in Monitor Mode                                  | - 92 -  |
| 5.2            | Operation in Utility Function Mode                         | - 94 -  |
| 5.2.1          | Alarm Traceback Data Display                               | - 94 -  |
| 5.2.2          | Parameter Settings Initialization                          | - 95 -  |
| 5.2.3          | Operation in JOG Mode                                      | - 95 -  |
| 5.2.5          | Manual Adjustment of the Speed Reference Offset            | - 97 -  |
| 5.2.6          | Offset-adjustment of Servomotor Current Detection Signal   | - 98 -  |
| 5.2.7          | Software Version Display                                   | - 100 - |



|   |         |
|---|---------|
| 5.2.8 Position Teaching Function.....                       | - 100 - |
| 5.2.9 Static Inertia Detection .....                        | - 100 - |
| 5.2.10 Absolute Encoder Multiturn Data and Alarm Reset..... | - 101 - |
| 5.2.11 Absolute Encoder Related Alarms Reset .....          | - 101 - |
| Chapter 6 .....   | - 102 - |
| MODBUS Communication.....                                   | - 102 - |
| 6.1RS-485 Communication Wiring.....                         | - 102 - |
| 6.2MODBUS Communication Related Parameters.....             | - 103 - |
| 6.3 MODBUS Communication Protocol .....                     | - 103 - |
| 6.3.1 Code Meaning .....                                    | - 103 - |
| 6.3.2 Communication Error Disposal.....                     | - 109 - |
| 6.3.3 Data Communication Address of Servo State.....        | - 110 - |
| Chapter 7 .....   | - 113 - |
| Specifications and Characters.....                          | - 113 - |
| 7.1 Servo drive Specifications and Models .....             | - 113 - |
| 7.2 Servo drive Dimensional Drawings .....                  | - 116 - |
| 7.3Motor technical spec and model .....                     | - 116 - |
| 7.4 Motor Installation Dimension.....                       | - 116 - |
| Appendix A.....   | - 120 - |
| Parameter .....   | - 120 - |
| A.1 Parameter List .....                                    | - 120 - |
| A.2 Description of Parameter Type .....                     | - 126 - |
| A.3 Parameters in detail.....                               | - 127 - |
| Appendix B.....   | - 146 - |
| Alarm Display .....   | - 146 - |
| Appendix C.....   | - 149 - |
| Encoder Wire .....  | - 149 - |

# Chapter 1

## Checking Products and Parts Names

### 1.1 Checking Products on Delivery

| Check Items  | Comments   |
|--|--|
| Are the delivered products the ones that were ordered? | Check the model numbers marked on the nameplate on the servomotor and servo drive.   |
| Is there any damage?                                   | Check the overall appearance, and check for damage or scratches that may have occurred during shipping.  |
| Does the servomotor shaft rotate smoothly?             | If the servomotor shaft can be easily rotated by hand, then the motor is working normally. However, if a brake is installed on the servomotor, then it cannot be turned by hand. |

If any of the above items are faulty or incorrect, contact your ESTUN representative or the dealer from whom you purchased the products.

#### 1.1.1 Servomotor

Appearance and Nameplate for Example



Servomotor Model Designation

EMT- 050DRA33

ESTUN Servomotor

EMT Model

【1+2+3】      【4】      【5】      【6】      【7】      【8】

【1+2+3】

Rated Output

| Code | Spec. |
|------|-------|
| 035  | 35kW  |
| 050  | 50kW  |

【5】 Encoder

| Code | Spec.                           |
|------|---------------------------------|
| R    | R esolver transformer (Stander) |
| S    | Absolute encoder :              |

【6】 Designing Sequence

| Code | Spec.                |
|------|----------------------|
| A    | Designing sequence A |
| B    | Designing sequence B |

|     |       |
|-----|-------|
| 053 | 53KW  |
| 070 | 70kW  |
| 100 | 100kW |
| 105 | 105kW |

|           |
|-----------|
| 131072P/R |
| 131072P/R |

|  |  |
|--|--|
|  |  |
|--|--|

**【7】 Shaft End**

| Code | Spec.                         |
|------|-------------------------------|
| 1    | Flat, Without Keys (Standard) |
| 2    | With Screw Thread keys        |
| 3    | With rectangle Keys           |
| 4    | With Double Flat Keys         |
| 5    | With single Flat Keys         |

**【8】 Option**

| Code | Spec.  |
|------|--|
| 1    | None   |
| 2    | With oil seal                                    |
| 3    | With brake                                       |
| 4    | With oil seal and brake                          |
| 5    | Without oil seal or brake, but obligate key slot |

**【4】 Voltage**

| Code | Spec.  |
|------|--------|
| D    | 400VAC |

EMT2- 200GW -L A V A 3 O-001

Servomotor

**【1+2+3】 【4】 【5】 【6】 【7】 【8】 【9】 【10】 【11】 【12+13+14】**

EMT2 Mode

**【1+2+3】中心高/机座号**

| Code | Spec  |
|------|-------|
| 200  | 200mm |

**【7】 Position sensor**

| Code | Spec     |
|------|----------|
| A    | Resolver |

**【11】 Outlet mode**

| Code | Spec                                   |
|------|--|
| L    | Outlet box lay left, underside outlet  |
| R    | Outlet box lay right, underside outlet |
| X    | Outlet box lay upside, left outlet     |
| Y    | Outlet box lay upside, right outlet    |
| O    | others                                 |

**【4】 Motor Length**

| Code | Spec         |
|------|--------------|
| G, H | Motor Length |

**【8】 Shaft End form**

| Code | Spec  |
|------|-------|
| V    | solid |

**【5】 Cooling Method**

| Code | Spec       |
|------|------------|
| W    | Water-cool |

**【9】 Shaft End option (key configure)**

| Code | Spec    |
|------|---------|
| A    | No keys |

**【12+13+14】 Customization option**

| Code | Spec                                  |
|------|---------------------------------------|
| 000  | NO                                    |
| XXX  | Customization Design ( Internal code) |

**【6】 Speed**

| Code | Spec   |
|------|--------|
| L    | 500rpm |

**【10】 Structure Form (IM)**

| Code | Spec   |
|------|--------|
| 3    | IM B14 |

## 1.1.2 Servo drive

Appearance and Nameplate for Example



Servodrive model  
Applicable power supply  
Serial number



EHDServo drive Model Designation

EHD-5ZDMB

ESTUN

EHD SERIES

【1+2】 【3】 【4】 【5】

【1+2】

Rated Output

| Code | Spec |
|------|------|
| 3E   | 35kW |
| 5Z   | 50kW |

【4】 Control Mode

| Code | Spec   |
|------|--|
| M    | Speed control, torque control, position control                          |
| E    | Speed control, torque control, position control(support extended module) |

【3】 Power Voltage

| Code | Spec   |
|------|--------|
| D    | 400VAC |

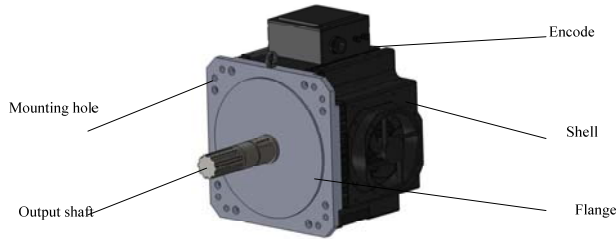
【5】 Encoder

| Code | Spec     |
|------|----------|
| B    | Resolver |

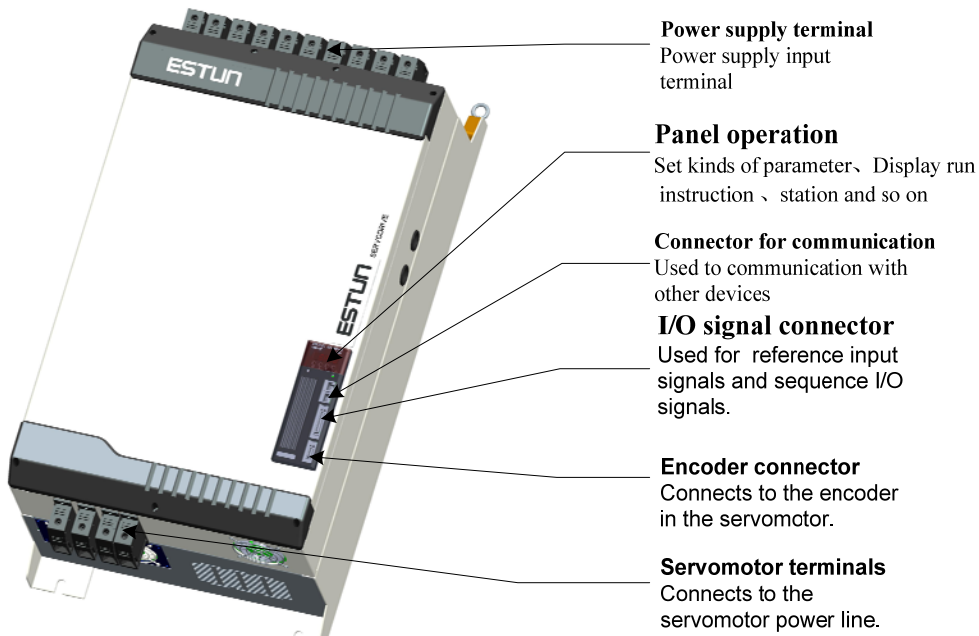
## 1.2 Part Names

### 1.2.1 Servomotor

Servomotor without gear and brake.



### 1.2.2 Servo drive



## Chapter 2

---

# Installation

## 2.1 Servomotor

Servomotor can be installed either horizontally or vertically. However, if the servomotor is installed incorrectly, the service life of the servomotor will be shortened or unexpected problems may occur.

Please observe the installation instructions described below to install the servomotor correctly.

Before installation:

Anticorrosive paint is coated on the edge of the servomotor shaft. Clean off the anticorrosive paint thoroughly using a cloth moistened with thinner.

Avoid getting thinner on other parts of the servomotor when cleaning the shaft.

### 2.1.1 Storage

When the servomotor is not being used, store it in an area with a temperature between  $-20^{\circ}\text{C}$  and  $60^{\circ}\text{C}$  with the power cable disconnected.

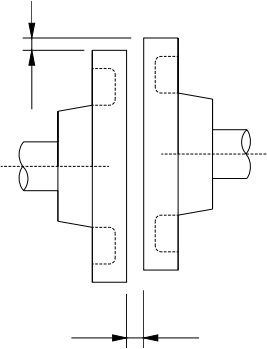
### 2.1.2 Installation Sites

The servomotor is designed for indoor use. Install the servomotor in an environment which meets the following conditions.

- Free from corrosive and explosive gases.
- Well-ventilated and free from dust and moisture.
- Ambient temperature from  $0$  to  $40^{\circ}\text{C}$ .
- Relative humidity from 26% to 80% (non-condensing).
- Facilitates inspection and cleaning.

## 2.1.3 Installation Alignment

Align the shaft of the servomotor with that of the machinery shaft to be controlled. Then connect the two shafts with an elastic coupling. Install the servomotor so that alignment accuracy falls within the range shown below.



Measure this distance at four different positions in the circumference. The difference between the maximum and minimum measurements must be 0.03mm or less. (Turn together with couplings.)

---

**Note:**

- If the alignment accuracy is incorrect, vibration will occur, resulting in damage to the bearings.
  - Mechanical shock to the shaft end is forbidden, otherwise it may result in damage to the encoder of the servomotor.
- 

## 2.1.4 Installation Orientation

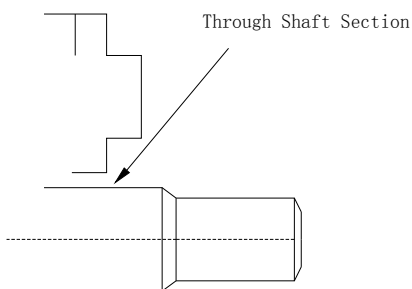
Servomotor can be installed either horizontally or vertically.

## 2.1.5 Handling Oil and Water

If the servomotor is used in a location that is subject to water or oil drops, make sure of the servomotor protective specification. If the servomotor is required to meet the protective specification to the through shaft section by default, use a servomotor with an oil seal.

Through shaft section:

It refers to the gap where the shaft protrudes from the end of the servomotor.

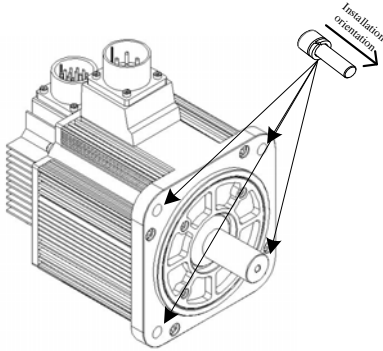


## 2.1.6 Cable Tension

When connecting the cables, the bending radius should not be too small, do not bend or apply tension to cables. Since the conductor of a signal cable is very thin (0.2 mm or 0.3 mm), handle it with adequate care.

## 2.1.7 Install to the Client

When the servo motor is mounted to the client, please firmly secure the servo motor by the screws with backing rings as shown in the figure.



## 2.2 Servo Drive

EHD series servo drive is a base-mounted type. Incorrect installation will cause problems. Always observe the installation instructions described below.

### 2.2.1 Storage

When the servomotor is not being used, store it in an area with a temperature between  $-20^{\circ}\text{C}$  and  $85^{\circ}\text{C}$  with the power cable disconnected.

### 2.2.2 Installation Sites

Notes on installation are shown below.

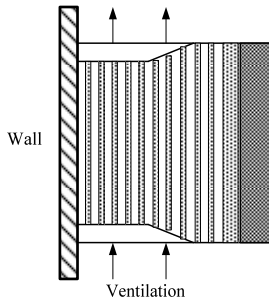
| Situation                                 | Notes on installation  |
|---|--|
| When installed in a control panel         | Design the control panel size, unit layout, and cooling method so that the temperature around the periphery of the servo drive does not exceed $55^{\circ}\text{C}$ .                            |
| When installed near a heating unit        | Suppress radiation heat from the heating unit and a temperature rise caused by convection so that the temperature around the periphery of the servo drive does not exceed $55^{\circ}\text{C}$ . |
| When installed near a source of vibration | Install a vibration isolator underneath the servo drive to prevent it from receiving vibration.  |
| When installed in a location subject to   | Take appropriate action to prevent corrosive gases. Corrosive gases do not immediately affect the servo drive, but will eventually cause contactor-related                                       |



|                 |  |
|-----------------|--|
| corrosive gases | devices to malfunction.  |
| Others          | Avoid installation in a hot and humid site or where excessive dust or iron powder is present in the air. |

## 2.2.3 Installation Orientation

Install the servo drive perpendicular to the wall as shown in the figure. The servo drive must be oriented this way because it is designed to be cooled by natural convection or a cooling fan if required.



## 2.2.4 Magnetism-circle twist Method

Encoder wire magnetism-circle twist: put Encoder wire end twist magnetism-circle 将编码器线一端绕大磁环上 6 圈，再将这段插头焊接上。磁环位置靠近电机侧。请见下图实例：



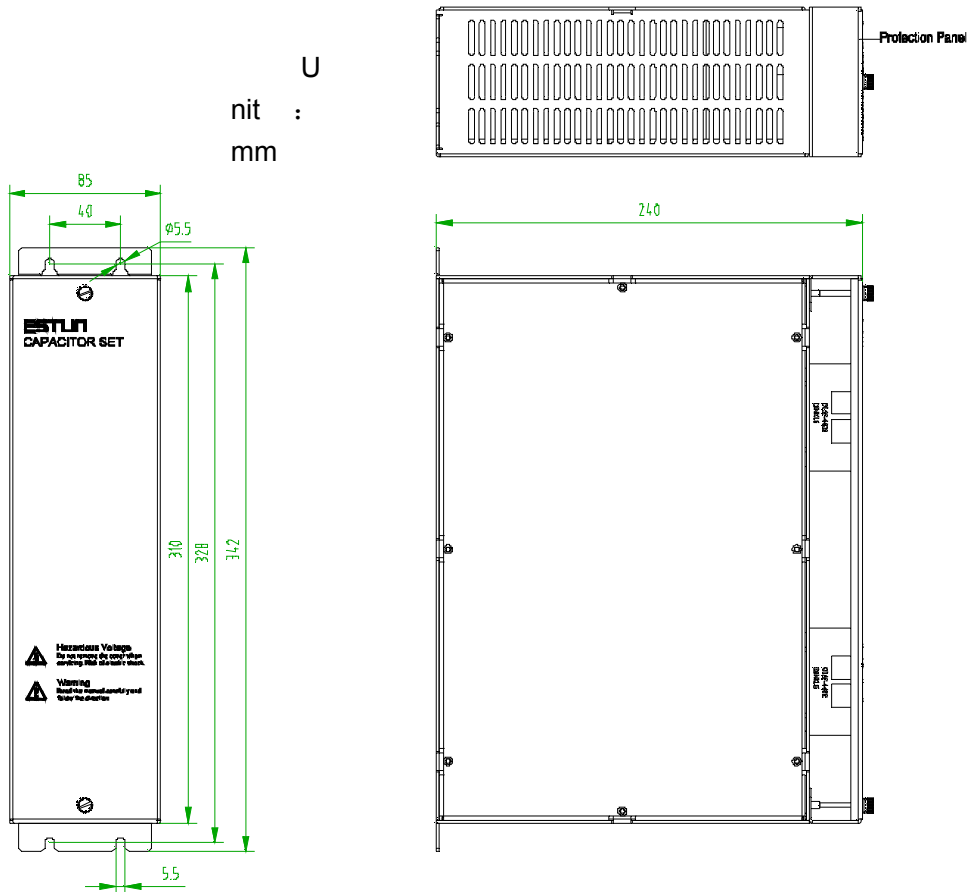
## 2.3 Capacitancetrunk

### 2.3.1 Capacitancetrunk spec

|               |                        |
|---------------|------------------------|
| Model         | CAP5400                |
| capacity      | 5400 $\mu$ F $\pm$ 20% |
| Rated Voltage | 720VDC                 |

|                      |             |
|----------------------|-------------|
| Overvoltage          | 900VDC max  |
| Current Load         | 53Aeff.max  |
| Range of temperature | -10 ~ +55°C |

### 2.3.2 Installation Dimension



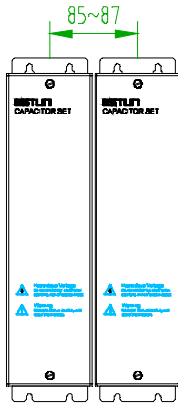
### 2.3.3 Installation Orientation

Capacitancetrunk should be installed to face to operator ,and being vertical to installation base level.

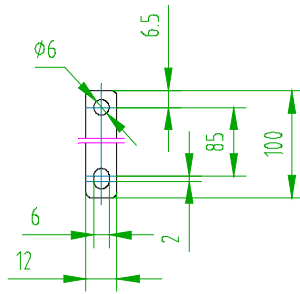
### 2.3.4 MultipleCapacitancetrunk Installation

When installing servo drives side by side, provide at least 50mm space above and below each one as well as shown in the following installation method, assure cooling effect by fan or nature convection.

扩展方式



扩展铜条



## Chapter 3

# Wiring

### 3.1 Main Circuit Wiring

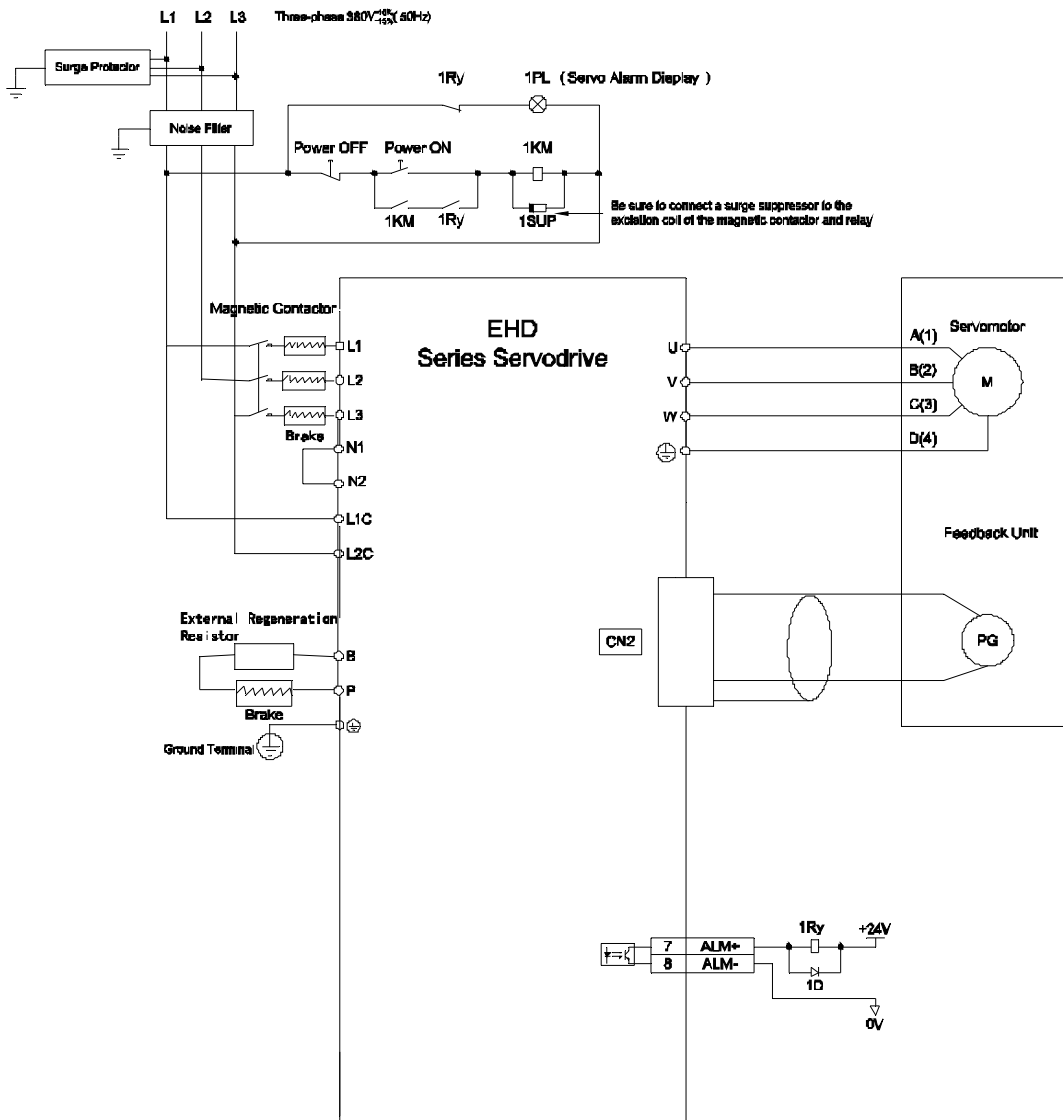
Please observe the following instructions while wiring the main circuit.

- Do not bundle or run power and signal lines together in the same duct. Keep power and signal lines separated by at least 300 mm.
- Use twisted-pair shielded wires or multi-core twisted-pair shielded wires for signal and encoder feedback lines.
- The maximum length is 3 m for reference input lines and 20 m for encoder feedback lines.
- Do not touch the power terminals for 15 minutes after turning power OFF because high voltage may still remain in the servo drive.

#### 3.1.1 Names and Functions of Main Circuit Terminals

| Terminal Symbol | Name   | Main Circuit Voltage(V) | Functions   |
|-----------------|--|-------------------------|---|
| L1, L2, L3      | Main circuit power supply input terminal           | 400                     | Three-phase 380~440VAC <sup>+10%</sup> <sub>-15%</sub> (50Hz)   |
| U, V, W         | Servomotor connection terminals                    | —                       | Connect to the servomotor.  |
| L1C, L2C        | Control circuit power supply input terminal        | 400                     | Single-phase 380~440VAC <sup>+10%</sup> <sub>-15%</sub> (50Hz)  |
|                 | Ground terminals                                   | —                       | Connects to the power supply ground terminals and servomotor ground terminal.                           |
| P, B            | External regenerative resistor connection terminal | —                       | Connect an external regenerative resistor between P and B   |
| N1, N2          | DC reactor for harmonic suppression terminal       | —                       | Normally short, If a countermeasure against power supply harmonic waves is needed, connect a DC reactor |

### 3.1.2 Typical Main Circuit Wiring Examples

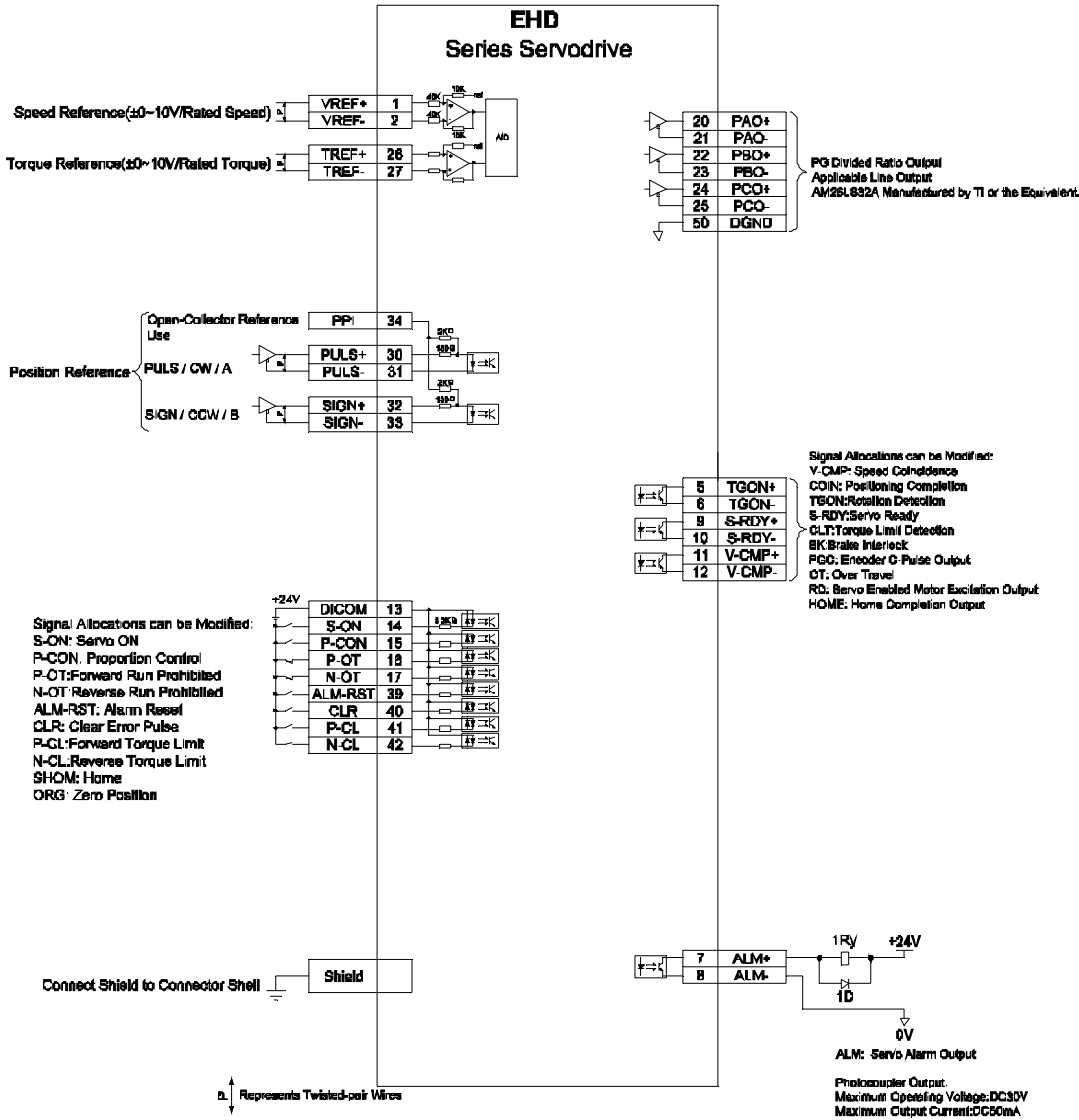


Note

- The L1,L2,L3 terminals wiring suggested brake type is: 3NE1 225-0 200A; Stand type suggest is: 3NH3 230 2C
- Connect an external regenerative resistor between Pand B,in series with brake, suggested brake type is:3NE4 118 63A;Stand type suggest is: 3NH3 120.Make sure that brake is connected between DCP terminal (P) an external regenerative resistor.
- Reactor or quickly melt is selected betweenN1 and N2
- Capacitance trunk is selected between P andN1(N2)

## 3.2 I/O Signals

### 3.2.1 Examples of I/O Signal Connections



### 3.2.2 I/O Signal Names and Functions

#### Input Signals

| Control Mode                | Signal Name | Pin No. | Function   |
|-----------------------------|-------------|---------|--|
| Speed<br>Position<br>Torque | /S-ON       | 14      | Servo ON: Turns the servomotor on.   |
|                             | /P-CON      | 15      | Function selected by parameter.<br>Proportional control reference<br>Switches the speed control loop from PI to P control when ON. |

|          |              |  |   |  |
|----------|--------------|--|---|--|
|          |              |  | Direction reference   | With the internally set speed selection: Switch the rotation direction.        |
|          |              |  | Control mode switching  | Enables control mode switching.  |
|          |              |  | Zero-clamp reference  | Speed control with zero-clamp function: Reference speed is zero when ON.       |
|          |              |  | Reference pulse block   | Position control with reference pulse: Stops reference pulse input when ON.    |
|          | P-OT         | 16   | Forward run prohibited  | Overtravel prohibited: Stops servomotor when OFF.                              |
|          | N-OT         | 17   | Reverse run prohibited  |  |
|          | /PCL<br>/NCL | 41<br>42   | Function selected by parameter.   |  |
|          |              |  | Forward external torque limit ON<br>Reverse external torque limit ON  | Current limit function enabled when ON.  |
|          |              |  | Internal speed switching  | With the internally set speed selection: Switches the internal speed settings. |
|          | /ALM-RST     | 39   | Alarm reset: Releases the servo alarm state.  |  |
| DICOM    | 13           | Control power supply input for I/O signals: Provide the +24V DC power supply |   |  |
| Speed    | VREF+        | 1  | Speed reference input: $\pm 10V$ .  |  |
|          | VREF-        | 2  |   |  |
| Position | PULS+        | 30   | Pulse reference input mode:<br>Sign + pulse train<br>CCW + CW pulse<br>Two-phase pulse (90° phase differential) |  |
|          | PULS-        | 31   |   |  |
|          | SIGN+        | 32   |   |  |
|          | SIGN-        | 33   |   |  |
|          | PPI          | 34   | Power supply input for open collector reference (2K $\Omega$ /0.5W resistor is built into the servo drive).     |  |
|          | /CLR         | 40   | Positional error pulse clear input: Clear the positional error pulse during position control.                   |  |
|          | SHOM         | -  | Homing trigger signal (effective at the rising edge), allocated by Pn509 or Pn510                               |  |
| ORG      | -            | Zero Position (effective at high level), allocated by Pn509 or Pn510         |   |  |
| Torque   | T-REF+       | 26   | Torque reference input: $\pm 10V$ .   |  |
|          | T-REF-       | 27   |   |  |

Output signals

| Control Mode | Signal Name | Pin No. | Function   |
|--------------|-------------|---------|--|
| Speed        | /TGON+      | 5       | Detects when the servomotor is rotating at a speed higher than the motor |

|                    |         |   |   |   |
|--------------------|---------|---|---|---|
| Position<br>Torque | /TGON-  | 6   | speed setting.  |   |
|                    | ALM+    | 7   | Servo alarm:  |   |
|                    | ALM-    | 8   | Turns off when an error is detected.  |   |
|                    | /S-RDY+ | 9   | Servo ready:  |   |
|                    | /S-RDY- | 10  | ON if there is no servo alarm when the control/main circuit power supply is turned ON.  |   |
|                    | PAO+    | 20  | Phase-A signal  | Converted two-phase pulse(phases A and B) encoder output. |
|                    | PAO-    | 21  |   |   |
|                    | PBO+    | 22  | Phase-B signal  |   |
|                    | PBO-    | 23  |   |   |
|                    | PCO+    | 24  | Phase-C signal  | Zero-point pulse(Phase-C) signal                          |
|                    | PCO-    | 25  |   |   |
| FG                 | Shell   | Connect frame to ground if the shield wire of the I/O signal cable is connected to the connector shell. |   |   |
| Speed              | /V-CMP+ | 11  | Speed coincidence:  |   |
|                    | /V-CMP- | 12  | Detects whether the motor speed is within the setting range and if it matches the reference speed value.  |   |
| Position           | /COIN+  | 11  | Positioning completion:   |   |
|                    | /COIN-  | 12  | Turns ON when the number of positional error pulses reaches the value set. The setting is the number of positional error pulses set in the reference units.   |   |
| Reserved           | /CLT    | —   | Reserved terminals:<br>The functions allocated to /TGON, /S-RDY, and /V-CMP (/COIN) can be changed by using the parameters.<br>/CLT: Torque limit output<br>Turns on when it reaches the value set. |   |
|                    | /BK     |   | /BK: Brake interlock output<br>Releases the brake when ON,<br>/PGC: C pulse output<br>OT: Over travel signal output<br>/RD: Servo enabled motor excitation output<br>/HOME: Home completion output  |   |
|                    | —       | 4,18,19,29,35<br>36,37,38,43<br>44,45,47,49   | Not used.   |   |

### 3.2.3 I/O Signal Connector (CN1) Terminal Layout

| Terminal No. | Name  | Function                   | Terminal No. | Name   | Function                    |
|--------------|-------|----------------------------|--------------|--------|-----------------------------|
| 1            | VREF+ | Speed reference input:±10V | 26           | T-REF+ | Torque reference input:±10V |
| 2            | VREF- |                            | 27           | T-REF- |                             |
| 3            | DGND  | DGND                       | 28           | DGND   | DGND                        |



|    |         |                                  |                          |    |          |                                       |
|----|---------|----------------------------------|--------------------------|----|----------|---------------------------------------|
| 4  | —       | Reserved                         |                          | 29 | —        | Reserved                              |
| 5  | /TGON+  | Running signal output            |                          | 30 | PULS+    | Reference pulse input                 |
| 6  | /TGON-  |                                  |                          | 31 | PULS-    |                                       |
| 7  | ALM+    | Servo alarm                      |                          | 32 | SIGN+    | Reference sign input                  |
| 8  | ALM-    |                                  |                          | 33 | SIGN-    |                                       |
| 9  | /S-RDY+ | Servo ready                      |                          | 34 | PPI      | Open collector reference power supply |
| 10 | /S-RDY- |                                  |                          | 35 | —        | Reserved                              |
| 11 | /COIN+  | Positioning completion           |                          | 36 | —        | Reserved                              |
| 12 | /COIN-  |                                  |                          | 37 | —        | Reserved                              |
| 13 | DICOM   | I/O signal power supply 24V DC   |                          | 38 | —        | Reserved                              |
| 14 | /S-ON   | Servo ON                         |                          | 39 | /ALM-RST | Alarm reset                           |
| 15 | /P-CON  | P/PI control input               |                          | 40 | /CLR     | Position error pulseclear input       |
| 16 | P-OT    | Forward run prohibited           |                          | 41 | /PCL     | Forward torque limitinput             |
| 17 | N-OT    | Reverse run prohibited           |                          | 42 | /NCL     | Reverse torque limitinput             |
| 18 | —       | Reserved                         |                          | 43 | —        | Reserved                              |
| 19 | —       | Reserved                         |                          | 44 | —        | Reserved                              |
| 20 | PAO+    | PG dividing pulse output phase A | PG dividing pulse output | 45 | —        | Reserved                              |
| 21 | PAO-    | PG dividing pulse output phase B |                          | 46 | DGND     | DGND                                  |
| 22 | PBO+    | PG dividing pulse output phase C |                          | 47 | —        | Reserved                              |
| 23 | PBO-    | PG dividing pulse output phase A | Zero-point pulse         | 48 | DGND     | DGND                                  |
| 24 | PCO+    | PG dividing pulse output phase B |                          | 49 | —        | Reserved                              |
| 25 | PCO-    | PG dividing pulse output phase C |                          | 50 | DGND     | DGND                                  |

**Note:**The functions allocated to the following input and output signals can be changed by using the parameters.

- Input signals:/S-ON,/P-CON,P-OT,N-OT,/ALM-RST,/CLR,/PCL,/NCL,SHOM,ORG
- Output signals:/TGON,/S-RDY,/COIN,/HOME

Please refer to **A.3 Parameters in details** for detailed information.

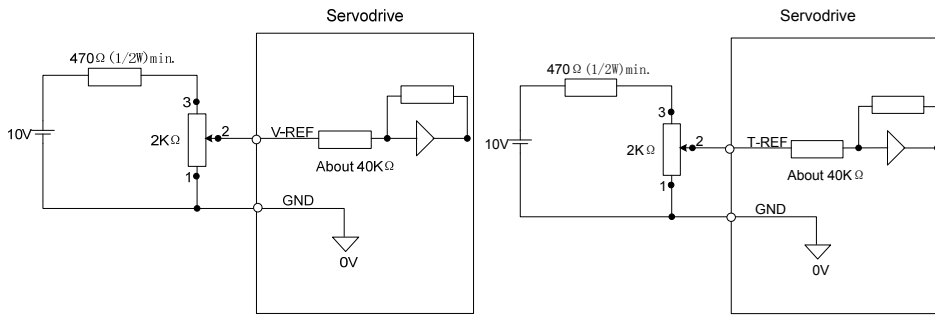
### 3.2.4 Interface Circuit

This section shows examples of servo drive I/O signal connection to the host controller.

#### ■Interface for Analog Reference Input Circuit

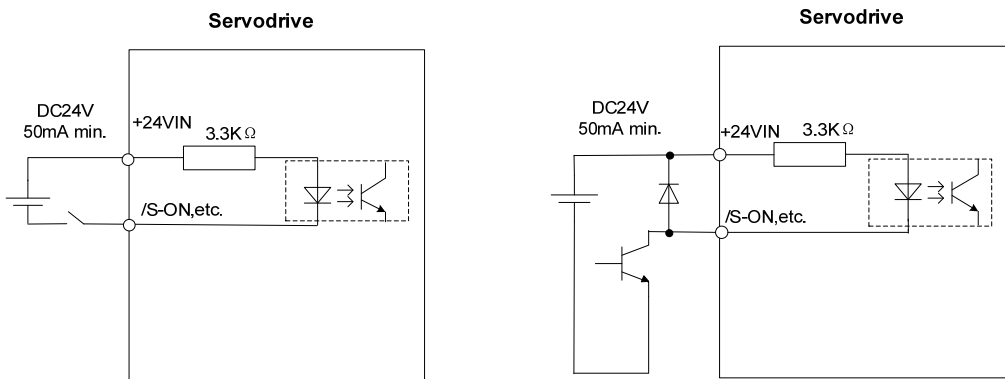
Analog signals are either speed or torque reference signals at about 40kΩimpedance, and the maximum allowable voltages for input signals is ±10V.

Reference speed input    Reference torque input



**Interface for sequence input circuit**

The sequence input circuit interface connects through a relay or open-collector transistor circuit. Select a low-current relay otherwise a faulty contact will result.



**Interface for line driver output circuit**

The amount of two-phase (phase A and phase B) pulse output signals (PAO,/PAO,PBO,/PBO) and zero-point pulse signals(PCO,/PCO) are output via line-driver output circuits. Normally, the servo drive uses this output circuit in speed control to comprise the position control system at the host controller. Connect the line-driver output circuit through a line receiver circuit at the host controller.

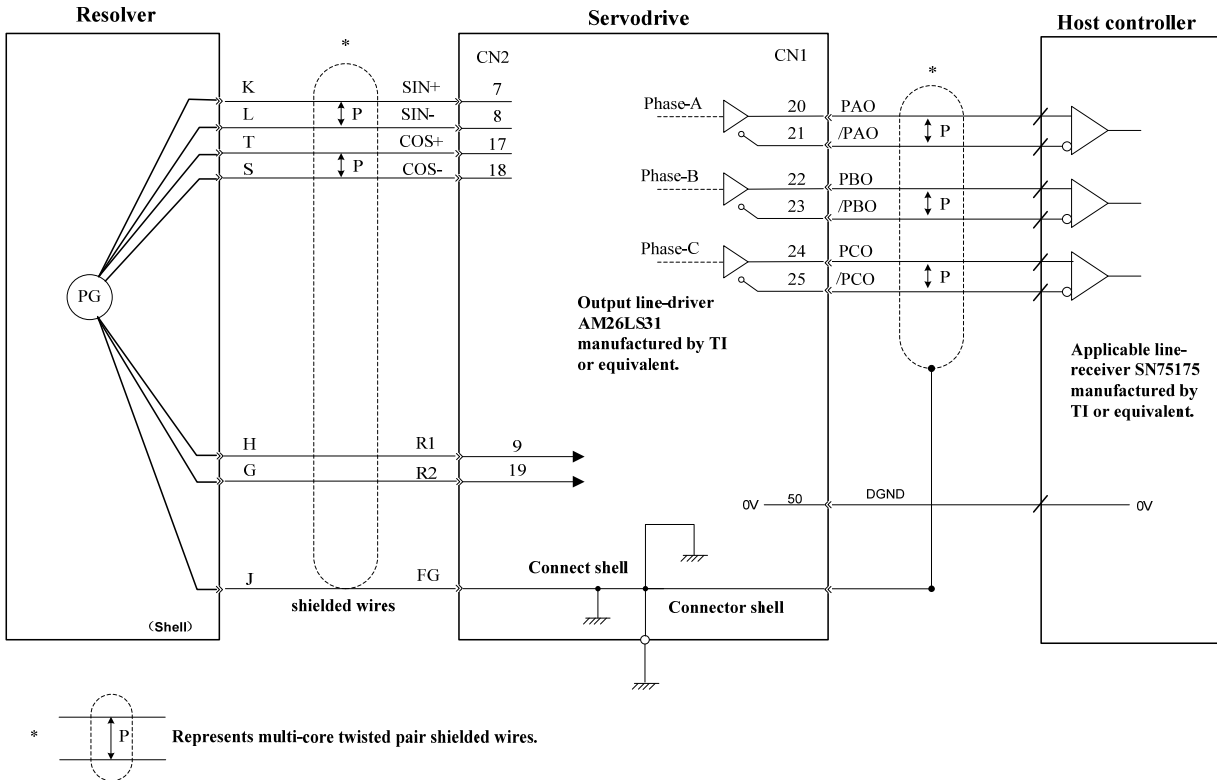
**Interface for sequence output circuit**

Photocoupler output circuits are used for Servo Alarm (ALM), Servo Ready(S-RDY), and other sequence output signal circuits. Connect a photocoupler output circuit through a relay circuit.

### 3.3 Wiring Encoders

#### 3.3.1 Connecting an Encoder(CN2)

Resolver



### 3.3.2 Encoder Connector(CN2) Terminal Layout

Resolver

| Terminal No. | Name | Function                 | Terminal No. | Name | Function                   |
|--------------|------|--------------------------|--------------|------|----------------------------|
| 7            | SIN+ | Differential Sine Signal | 17           | COS+ | Differential Cosine Signal |
| 8            | SIN- | Differential Sine Signal | 18           | COS- | Differential Cosine Signal |
| 9            | R1   | Excitation signal        | 19           | R2   | Excitation Signal          |

## 3.4 Communication Connection

### 3.4.1 Communication Connector(CN3) Terminal Layout

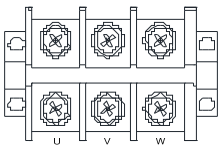
| Terminal No. | Name    | Function                      |
|--------------|---------|-------------------------------|
| 1            | —       | Reserved                      |
| 2            | —       |                               |
| 3            | 485+    | RS-485 communication terminal |
| 4            | ISO_GND | Isolated ground               |
| 5            | ISO_GND |                               |
| 6            | 485-    | RS-485 communication terminal |
| 7            | CANH    | CAN communication terminal    |
| 8            | CANL    | CAN communication terminal    |

### 3.4.2 Communication Connector(CN4) Terminal Layout

| Terminal No. | Name    | Function                      |
|--------------|---------|-------------------------------|
| 1            | —       | Reserved                      |
| 2            | —       |                               |
| 3            | 485+    | RS-485 communication terminal |
| 4            | ISO_GND | Isolated ground               |
| 5            | ISO_GND |                               |
| 6            | 485-    | RS-485 communication terminal |
| 7            | CANH    | CAN communication terminal    |
| 8            | CANL    | CAN communication terminal    |

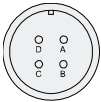
### 3.5 Motor Wiring

Motor Plug Spec



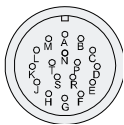
| Signal | Colour       |
|--------|--------------|
| U      | Red          |
| V      | Yellow       |
| W      | Blue         |
| FG     | Green/Yellow |

Encoder Plug Spec



HMS3106A14S-2S  
(Including Cable nip)

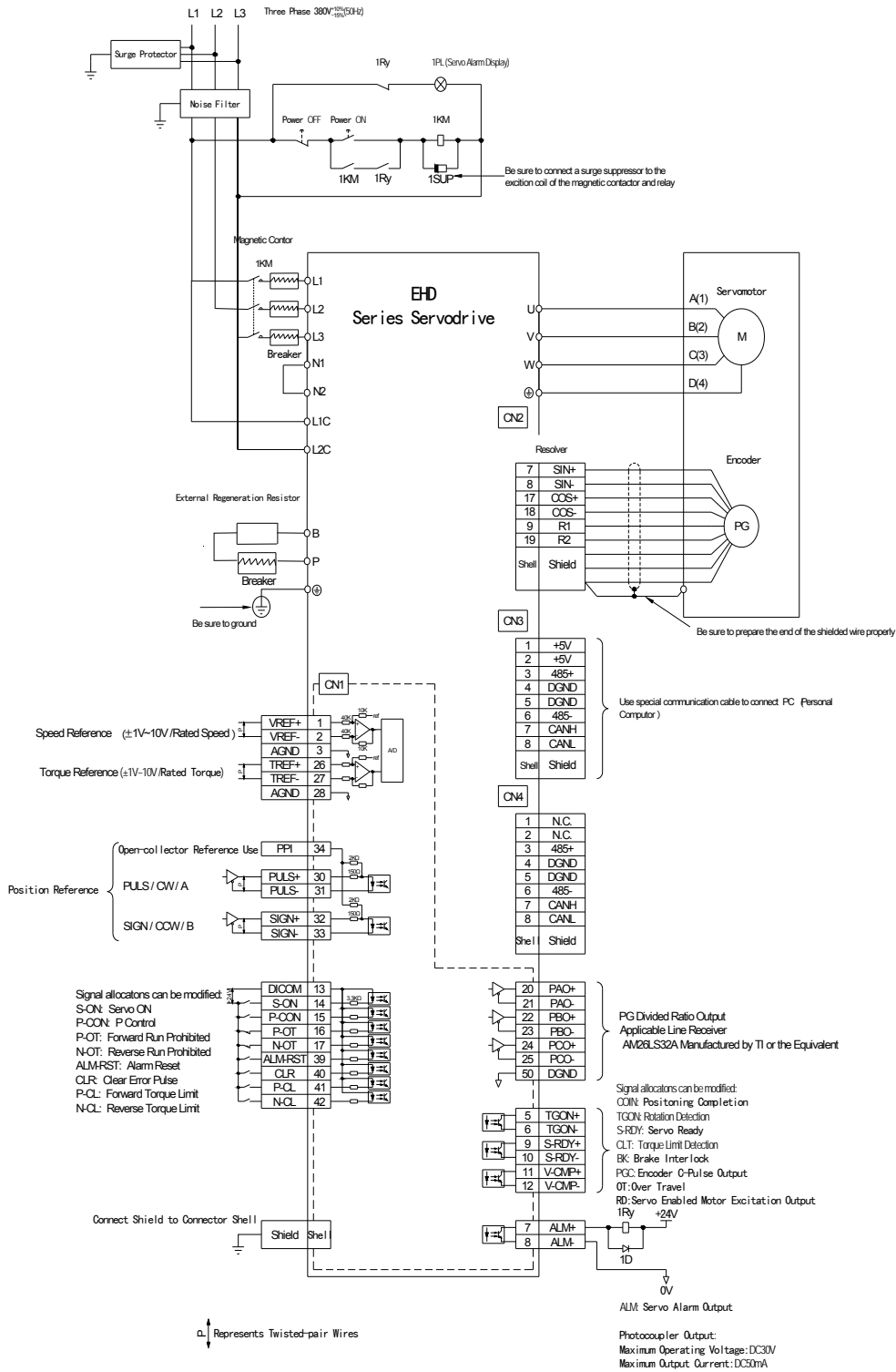
| Needle Number | Signal  | Colour |
|---------------|---------|--------|
| B             | Sensor1 | Brown  |
| A             | Sensor2 | Orange |
| C             | FG      | shield |



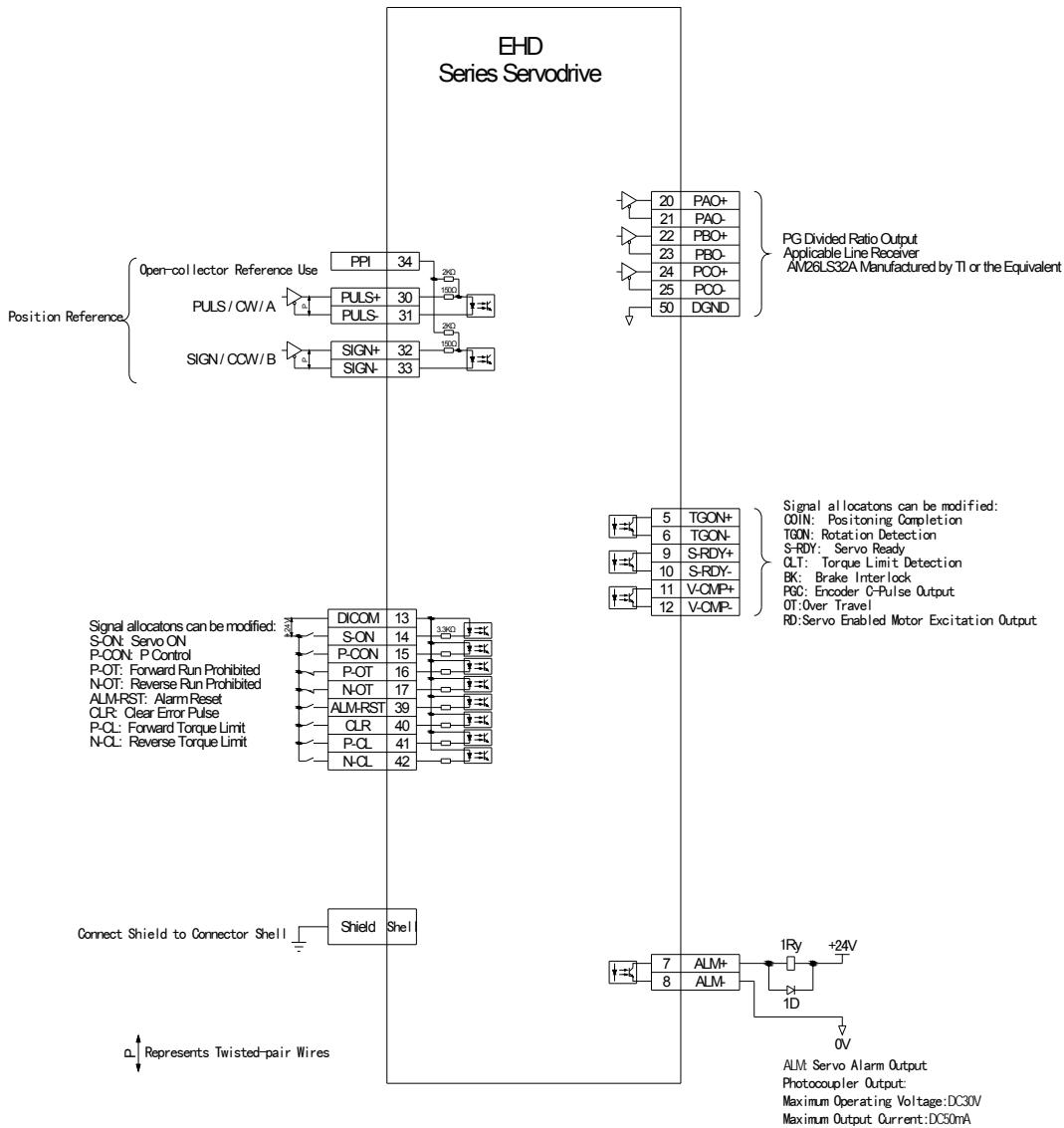
HMS3108B20-29S  
(Including Cable nip)

| NeedleNumber | Signal  | Colour |
|--------------|---------|--------|
| K            | SIN+    | Green  |
| L            | SIN-    | White  |
| T            | COS+    | Blue   |
| S            | COS-    | Yellow |
| H            | R1      | Red    |
| G            | R2      | Black  |
| N            | Sensor1 | Brown  |
| R            | Sensor2 | Orange |
| J            | FG      | Shied  |

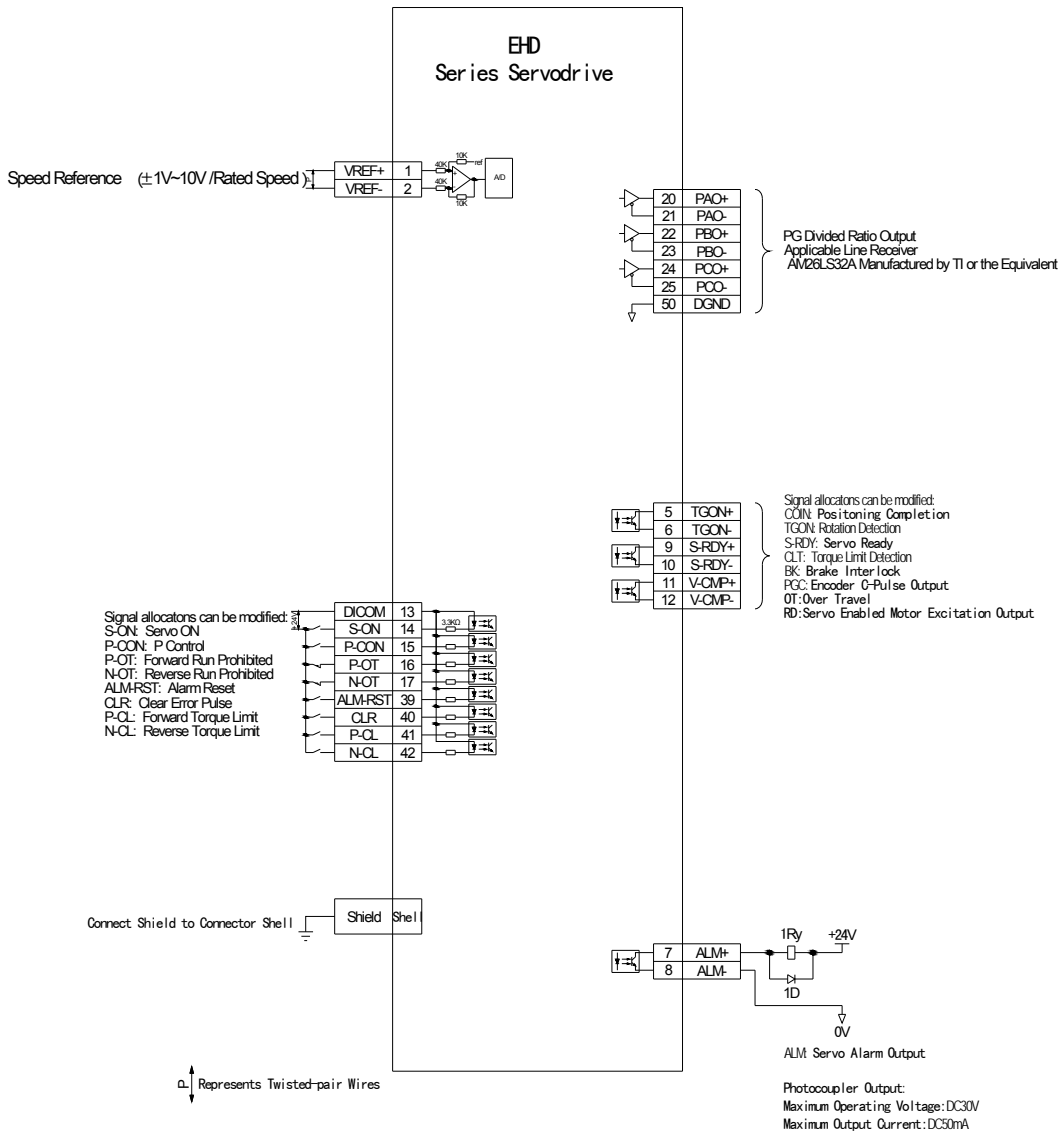
### 3.6 Standard Wiring Examples



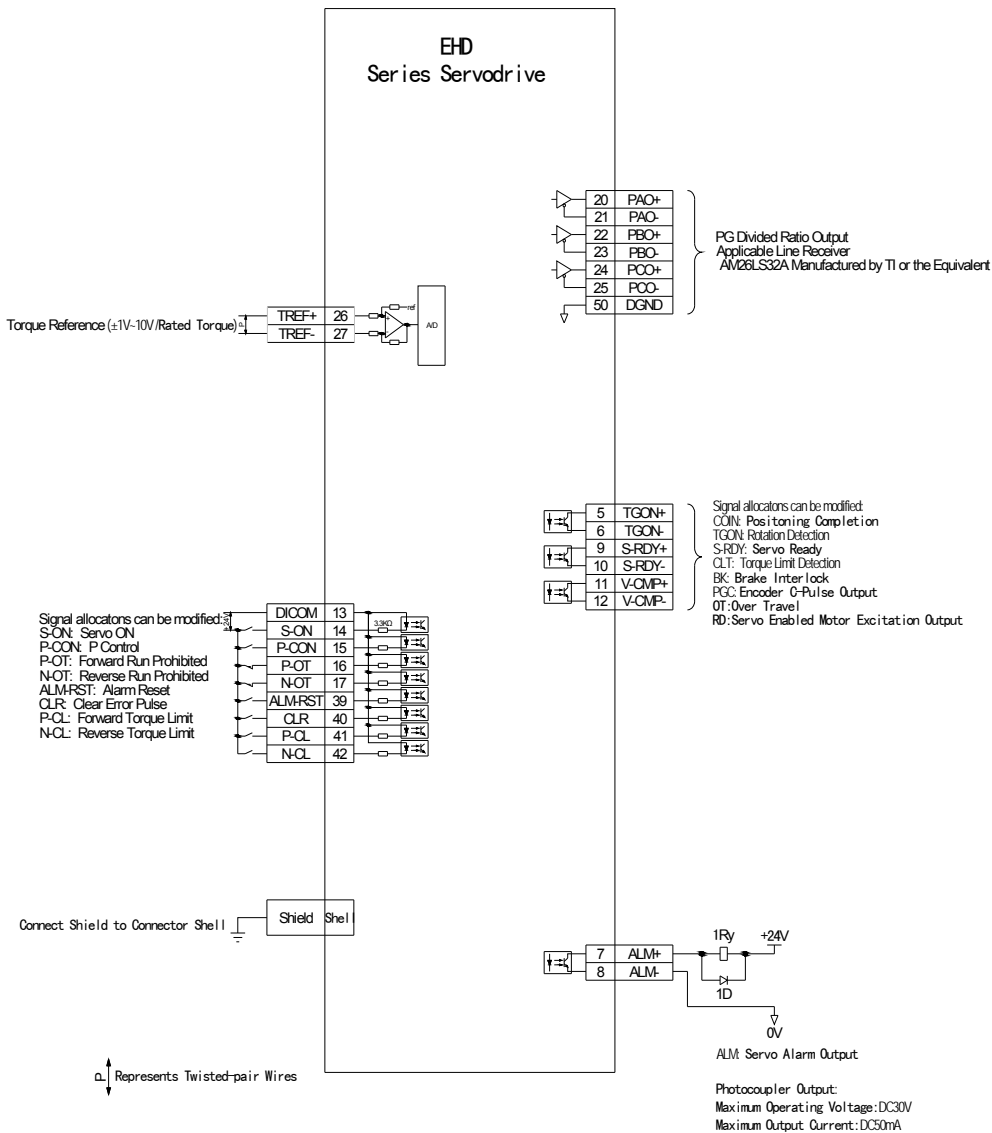
### 3.6.1 Position Control Mode



### 3.6.2 Speed Control Mode



### 3.6.3 Torque Control Mode



## 3.7 Wiring for Noise Control

### 3.7.1 Noise Control

The servodrive uses high-speed switching elements in the main circuit. It may receive "switching noise" from these high-speed switching elements.

To prevent malfunction due to noise, take the following actions:

- Position the input reference device and noise filter as close to the servo drive as possible.
- Always install a surge absorber in the relay, solenoid and electromagnetic contactor coils.
- The distance between a power line (servomotor main circuit cable) and a signal line must be at least 30 cm. Do not put the power and signal lines in the same duct or bundle them together.
- Do not share the power supply with an electric welder or electrical discharge machine. When the servo drive is placed near a high-frequency generator, install a noise filter on the input side of the power supply line. As for the wiring of noise filter, refer to **(1) Noise Filter** shown below.
- For proper grounding technique, refer to **(2) Correct Grounding**.

#### (1) Noise Filter

Please install a noise filter in the appropriate place to protect the servo drive from external noise interference.





### 3.7.2 Precautions on Connecting Noise Filter

(1) Noise Filter Brake Power Supply

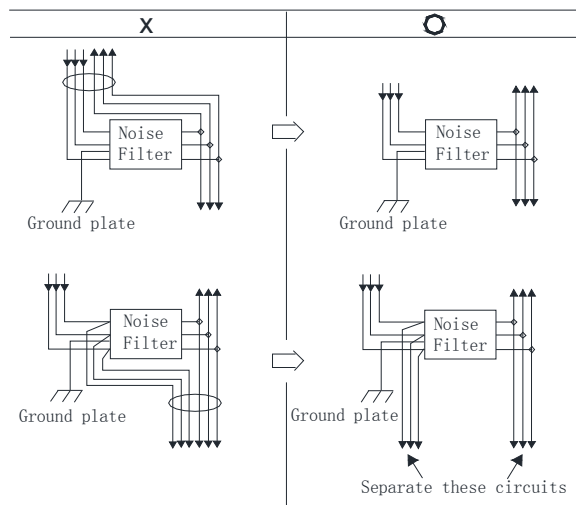
Use the noise filter Manufactured by SCHAFFNER at the brake power input for servomotors with holding brakes.

Relationship between servo drive power and noise filter current:

| Servo Drive Power | Noise Filter Current |
|-------------------|----------------------|
| 35kW              | 200A                 |
| 50kW              | 300A                 |

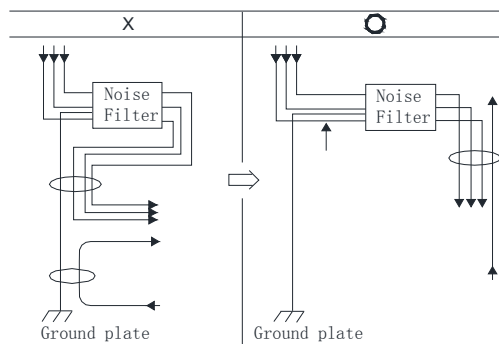
(2) Precautions on Using Noise Filters

Do not put the input and output lines in the same duct or bundle them together.

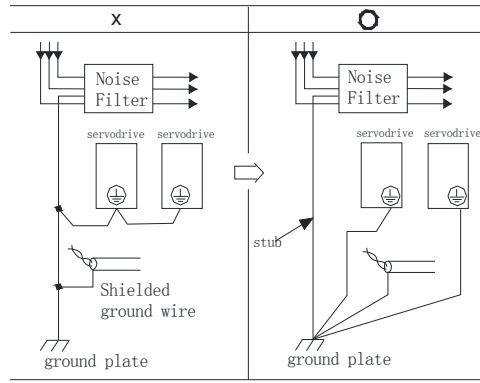


Separate the noise filter ground wire from the output lines.

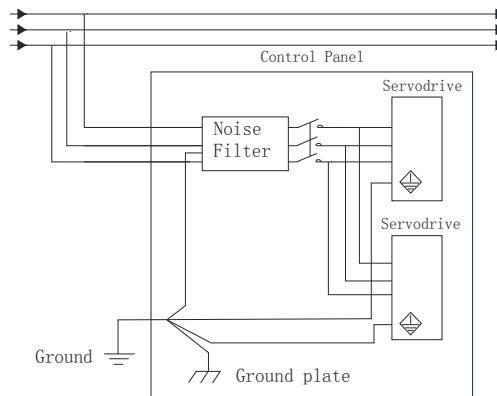
Do not accommodate the noise filter ground wire, output lines and other signal lines in the same duct or bundle them together.



Connect the noise filter ground wire directly to the ground plate. Do not connect the noise filter ground wire to other ground wires.



If a noise filter is located inside a control panel, connect the noise filter ground wire and the groundwires from other devices inside the control panel to the ground plate for the control panel first, then ground these wires.



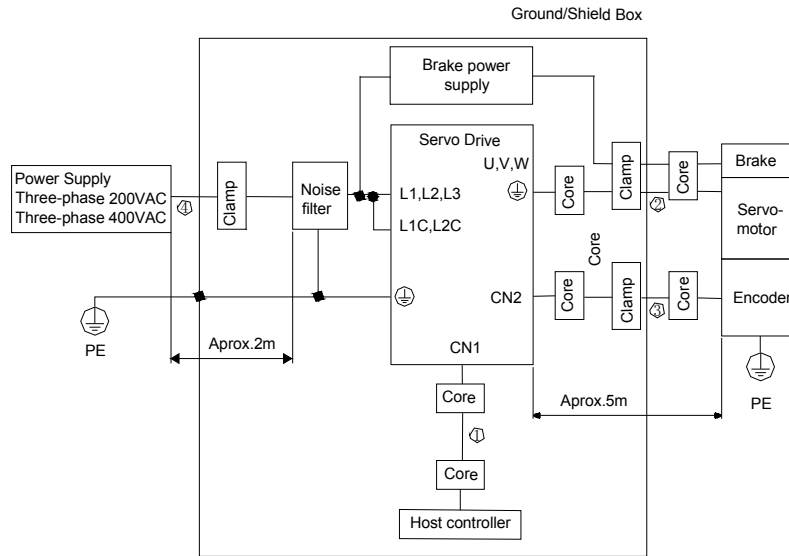
### 3.8 Installation Conditions of EMC Directives

To adapt a combination of a servomotor and a servodrive to EMC Directives (EN61326-1:2006), the following conditions must be satisfied.

(1) EMC Installation Conditions

This section describes the installation conditions that satisfy EMC guidelines for each servo drive model.

This section describes the EMC installation conditions satisfied in test conditions prepared by ESTUN. The actual EMC level may differ depending on the actual system's configuration, wiring, and other conditions.



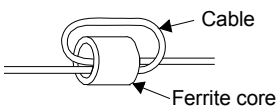
| Symbol | Cable Name       | Specifications |
|--------|------------------|----------------|
| ①      | I/O signal cable | Shield cable   |
| ②      | Servomotor cable | Shield cable   |
| ③      | Encoder cable    | Shield cable   |
| ④      | AC line cable    | Shield cable   |

(2) Cable Core and Cable Clamp

(a) Attaching the Ferrite Core

The diagram shows two turns in the cable.

The table shows the cable and the position where the ferrite core is attached.



| Cable Name        | Mounting Position of the Core            |
|-------------------|--|
| I/O signals cable | Near the host controller and servodrive. |
| Motor cable       | Near the servodrive and servomotor.      |
| Encoder cable     | Near the servodrive and servomotor.      |

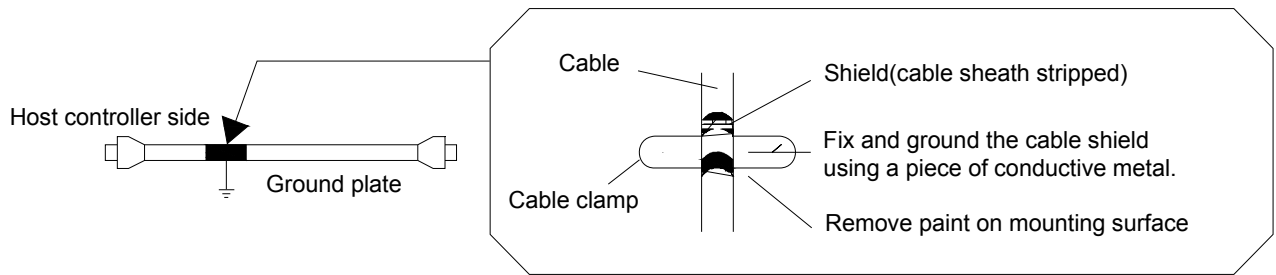
(b) Recommended Ferrite-core

| Cable Name        |              | Ferrite Core Model | Manufacturer |
|-------------------|--------------|--------------------|--------------|
| I/O signals cable |              | ESD-SR-25          | TOKIN        |
| Encoder cable     |              |                    |              |
| Motor cable       | 400W or less | PC40T96 × 20 × 70  | TDK          |
|                   | 750W or less |                    |              |

(c) Fixing the Cable

Fix and ground the cable shield using a piece of conductive metal.

- Example of Cable Clamp



#### (d) Shield Box

A shield box, which is a closed metallic enclosure, should be used for shielding magnetic interference. The structure of the box should allow the main body, door, and cooling unit to be attached to the ground. The box opening should be as small as possible.

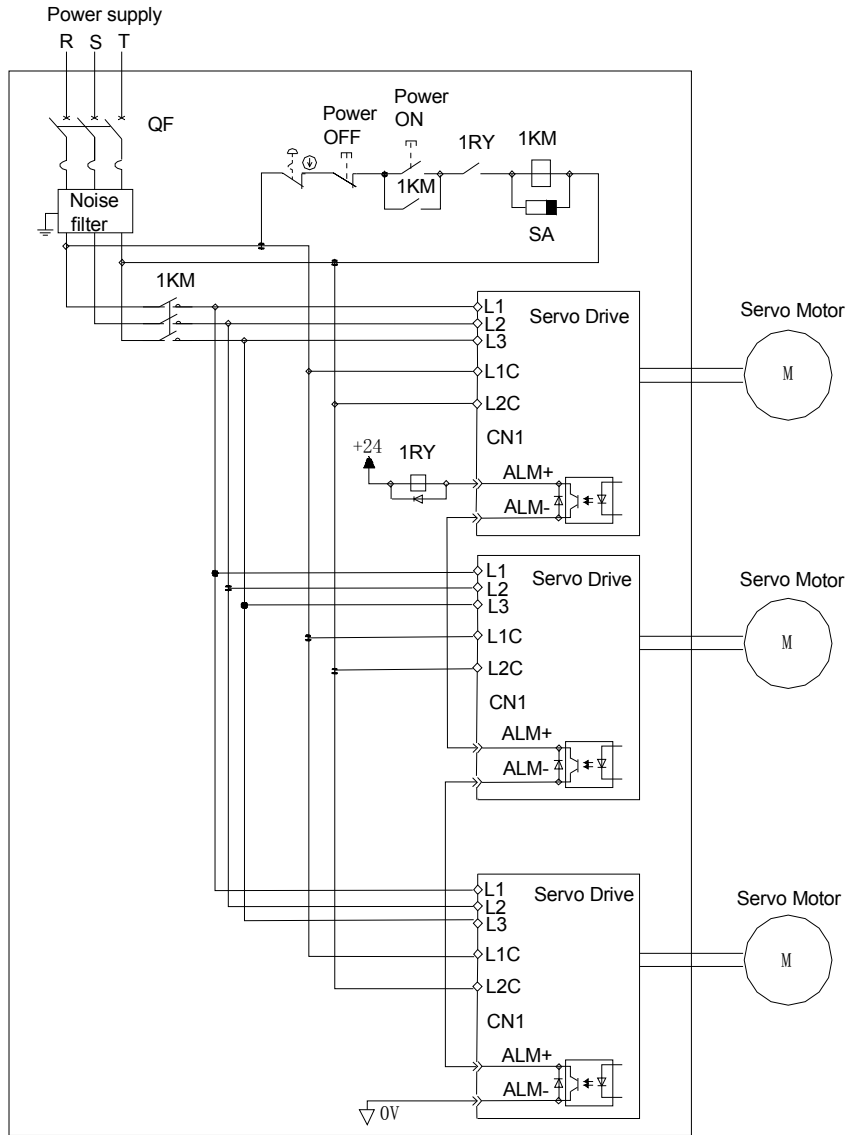
## 3.9 Using More than One Servo Drive

The following diagram is an example of the wiring when more than one Servodrive is used.

Connect the alarm output (ALM) terminals for the three Servodrives in series to enable alarm detection relay1RY to operate.

When the alarm occurs, the ALM output signal transistor is turned OFF.

Multiple servos can share a single molded-case circuit breaker (QF) or noise filter. Always select a QF or noise filter that has enough capacity for the total power capacity (load conditions) of those servos.



Notes:

1. Power supply phase-S should connect to ground terminals.

# Chapter 4

## Operation

### 4.1 Trial Operation

Make sure that all wiring has been completed prior to trial operation.

Perform the following three types of trial operation in order. Instructions are given for speed control mode (standard setting) and position control mode. Unless otherwise specified, the standard parameters for speed control mode (factory settings) are used.

|   |  |
|---|--|
| (1) Trial Operation for Servomotor Without Load (Refer to 4.1.1)          |  |
|   | <p>■ Purpose</p> <p>The servomotor is operated without connecting the shaft to the machine in order to confirm the following wiring is correct.</p> <ul style="list-style-type: none"> <li>• Power supply circuit wiring</li> <li>• Servomotor wiring</li> <li>• Encoder wiring</li> <li>• Rotation direction and speed of servomotor.</li> </ul> <p>(Please refer to step 1-4)</p>  |
| (2) Trial operation for servomotor with host reference (Refer to 4.1.2)   |  |
|   | <p>■ Purpose</p> <p>The servomotor is operated without connecting the shaft to the machine in order to confirm the following wiring is correct.</p> <ul style="list-style-type: none"> <li>• I/O signal wiring with host controller</li> <li>• Rotation direction, speed and number of rotations of servomotor.</li> <li>• Check the operation of the brake, overtravel and other protective functions.</li> </ul> <p>(Please refer to step 5-8)</p> |
| (3) Trial operation for servomotor and machine combined. (Refer to 4.1.3) |  |
|   | <p>■ Purpose</p> <p>Perform the trial operation with the servomotor connected to the machine. The servo drive is adjusted to match the machine characteristics.</p> <ul style="list-style-type: none"> <li>• Servomotor speed and machine travel distance.</li> <li>• Set the necessary parameters.</li> </ul> <p>(Please refer to step 9-11)</p>  |

| Step | Item         | Description   | Reference |
|------|--------------|---|-----------|
| 1    | Installation | Install the servomotor and servo drive according to the installation conditions. (Do not connect the servomotor to the machine because the servomotor will be operated first under the no-load condition for checking.) | -         |



|   |        |   |   |
|---|--------|---|---|
| 2 | Wiring | Connect the power supply circuit (L1, L2 and L3), servomotor wiring (U, V, W), I/O signal wiring (CN1), and encoder wiring (CN2). But during (1) Trial Operation for Servomotor Without Load, disconnect the CN1 connector. | - |
|---|--------|---|---|



|   |                   |  |   |
|---|-------------------|--|---|
| 3 | Turn the power ON | Turn the power ON. Using the panel operator to make sure that the servo drive is running normally. If using a servomotor equipped with an absolute encoder, please perform the setup for the absolute encoder. | - |
|---|-------------------|--|---|



|   |                       |  |               |
|---|-----------------------|--|---------------|
| 4 | Execute JOG operation | Execute JOG operation with the servomotor alone under the no-load condition. | JOG Operation |
|---|-----------------------|--|---------------|



|   |                       |   |   |
|---|-----------------------|---|---|
| 5 | Connect input signals | Connect the input signals (CN1) necessary for trial operation to the servo drive. | - |
|---|-----------------------|---|---|



|   |                     |   |   |
|---|---------------------|---|---|
| 6 | Check input signals | Use the internal monitor function to check the input signals. Turn the power ON, and check the emergency stop, brake, overtravel, and other protective functions for the correct operation. | - |
|---|---------------------|---|---|



|   |                           |  |                |
|---|---------------------------|--|----------------|
| 7 | Input the Servo-ON signal | Input the Servo-ON signal, and turn ON the servomotor. | Host Reference |
|---|---------------------------|--|----------------|





|    |                           |  |                |
|----|---------------------------|--|----------------|
| 8  | Input Reference           | Input the reference necessary for control mode, and check the servomotor for correct operation.  | Host Reference |
| ↓  |                           |  |                |
| 9  | Protective operation      | Turn the power OFF, and connect the servomotor to the machine.<br>If using a servomotor equipped with an absolute encoder, set up the absolute encoder and make the initial settings for the host controller to match the machine's zero position.       | -              |
| ↓  |                           |  |                |
| 10 | Set necessary parameters. | Using the same procedure as you did to input a reference in step 8, operate the servomotor via the host controller and set the parameter to make sure the machine's travel direction, travel distance, and travel speed all correspond to the reference. | Host Reference |
| ↓  |                           |  |                |
| 11 | Operation                 | The servomotor can now be operated. Adjust the servo gain if necessary.  | Host Reference |


### 4.1.1 Trial Operation for Servomotor Without Load

|   |
|---|
|   |
| <ul style="list-style-type: none"> <li>• Release the coupling between the servomotor and the machine, and secure only the servomotor without a load.</li> <li>• To prevent accidents, initially perform the trial operation for servomotor under no-load conditions (with all couplings and belts disconnected).</li> </ul> |

In this section, confirm the cable connections of the main circuit power supply, servomotor and encoder. Incorrect wiring is generally the reason why servomotors fail to operate properly during the trial operation.

Confirm the wiring, and then conduct the trial operation for servomotor without load according to the following steps.

| Step | Description | Check Method and Remarks |
|------|-------------|--------------------------|
|------|-------------|--------------------------|

|   |  |  |
|---|--|--|
| 1 | Secure the servomotor.   | Secure the servomotor flange to the machine in order to prevent the servomotor from moving during operation.<br>Do not connect the servomotor shaft to the machine. The servomotor may tip over during rotation.   |
| 2 | Check the power supply circuit, servomotor, and encoder wiring.  | With the I/O signal connector (CN1) disconnected, check the power supply circuit and servomotor wiring. Refer to 3.1 Main Circuit Wiring.  |
| 3 | <p>Turn ON the control power supply and main circuit power supply.</p> <p>Normal Display</p> <div style="text-align: center;">  </div> <p>Alternate Display</p> <p>Example of Alarm Display</p> | <p>If the power is correctly supplied, the panel operator display on the front panel of the servo drive will appear as shown on the left. The display on the left indicates that forward run prohibited (P-OT) and reverse run prohibited (N-OT).</p> <p>If an alarm display appears, the power supply circuit, servomotor wiring, or encoder wiring is incorrect. If an alarm is displayed, turn OFF the power, find the problem, and correct it.</p>   |
| 4 | <p>When using a servomotor with a brake, release the brake first before driving the servomotor.</p> <p>When using a servomotor equipped with an absolute encoder, the encoder setup is required before driving the servomotor.</p>   | <p>Please refer to 4.3.4 Setting for Holding Brakes</p> <p>Please refer to 4.5 Operating Using Speed Control with Analog Reference</p>   |
| 5 |  | <p>Use the panel operator to operate the servomotor with utility function Fn002 (JOG Mode Operation). Check that the servomotor rotates in the forward direction by pressing the INC key, and reverse direction by pressing the DEC key.</p> <p>The operation is completed when the operation is performed as described below and the alarm display does not appear.</p> <p>Complete the Fn002 (JOG Mode Operation) and turn OFF the power.</p> <p>For the operation method of the panel operator, refer to <b>Chapter 5 Panel Operator</b></p> <p>The servomotor speed can be changed using the Pn305 (JOG Speed). The factory setting for JOG speed is 500rpm.</p> |

JOG Mode Operation (Fn002)

| Step | Display after operation | Panel operator | Description |
|------|-------------------------|----------------|-------------|
|------|-------------------------|----------------|-------------|

|   |  |                |  |
|---|--|----------------|--|
| 1 |  | MODE key       | Press the MODE key to select the function mode.  |
| 2 |  | INC or DEC key | Press the INC key or DEC key to select Fn002.  |
| 3 |  | ENTER key      | Press the ENTER key, and the servomotor will enter JOG operation mode.   |
| 4 |  | MODE key       | Press the MODE key. This will turn ON the power to the servomotor.   |
| 5 |  | INC or DEC key | The servomotor will run in forward direction when INC key is pressed or in reverse direction when DEC key is pressed. The servomotor will operate as long as the key is pressed. |
| 6 |  | MODE key       | Press the MODE key. This will turn OFF the power to the servomotor.  |
| 7 |  | ENTER key      | Press the ENTER key to return to the Fn002 display of the utility function mode. Now, the servo drive is OFF.  |

Note:

The servomotor's rotation direction depends on the setting of parameter Pn001.0(Direction Selection).

The example above describes operation with Pn001.0 in the factory setting.

|   |               |              |                 |                    |   |   |    |
|---|---------------|--------------|-----------------|--------------------|---|---|----|
| Pn305   | JOG Speed     |              |                 |                    | S | P | To |
|   | Setting Range | Setting Unit | Factory Setting | Setting Validation |   |   |    |
|   | 0~6000        | rpm          | 500             | Immediately        |   |   |    |
| Set the utility function Fn002 (JOG Mode Operation) to the reference value of servomotor speed. |               |              |                 |                    |   |   |    |

The servomotor can be operated using only the panel operator without reference from the host controller.

Please note that the Forward Run Prohibited (P-OT) and Reverse Run Prohibited (N-OT) signals are invalid during JOG mode operation.

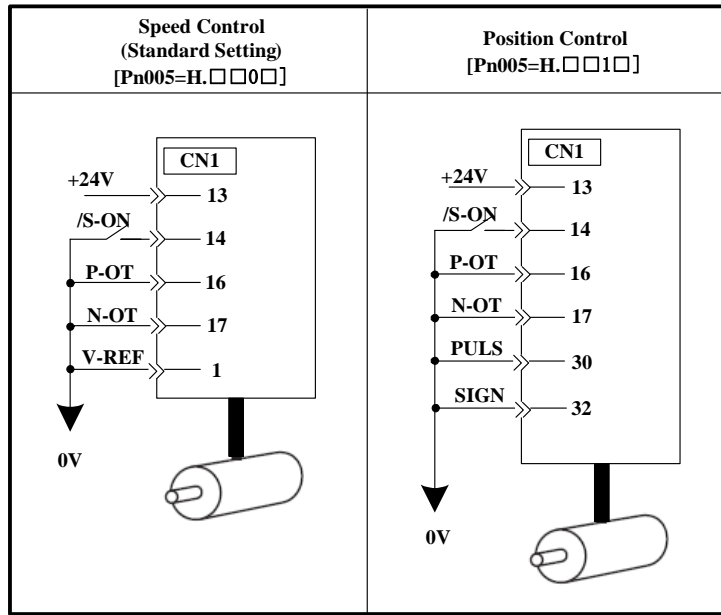
## 4.1.2 Trial Operation for Servomotor without Load from Host Reference

Check that the servomotor move reference or I/O signals are correctly set from the host controller to the servo drive.

Also check the wiring and polarity between the host controller and servo drive, and the servo drive operation settings are correct. This is the final check before connecting the servomotor to the machine.

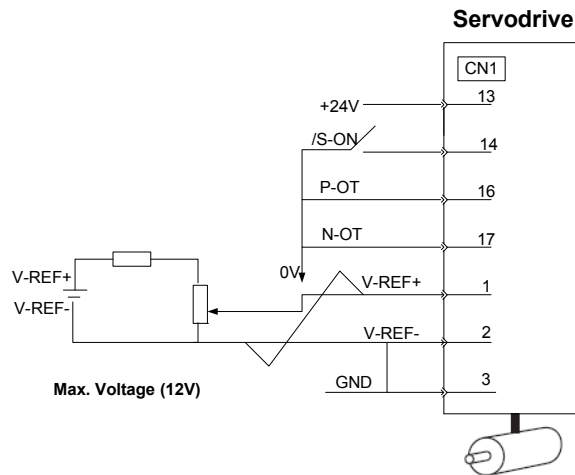
(1) Servo ON Command from the Host

The following circuits are required: External input signal circuit or equivalent.



(2) Operating Procedure in Speed Control Mode (Pn005=H. □□0□)

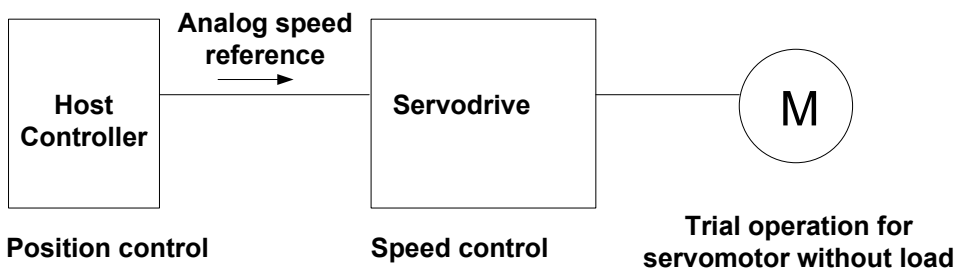
The following circuit is required: External input signal circuit or equivalent.



| Step | Description  | Check Method and Remarks   |
|------|--|--|
| 1    | Check the power and input signal circuits again, and check that the speed reference input (voltage between the V-REF+ and V-REF-) is 0V. | Refer to the above figure for the input signal circuit.  |
| 2    | Turn ON the servo ON (/S-ON) input signal.   | If the servomotor rotates at an extremely slow speed, refer to <b>4.4.3 Adjusting Reference Offset</b> , and use thereference voltage offset to keep the servomotor from moving. |
| 3    | Generally increase the speed reference input voltage between V-REF+ and V-REF- from 0 V.   | The factory setting is 6V/rated rotation speed.  |
| 4    | Check the speed reference input to the servo drive (Un001[rpm])  | Refer to 5.1.6 Operation in Monitor Mode.  |
| 5    | Check the Un000 (motor speed [rpm])  | Refer to 5.1.6 Operation in Monitor Mode.  |
| 6    | Check that the Un001 and Un000 values in steps 4 and 5 are equal.  | Change the speed reference input voltage and check that Un001 and Un000 are equal for multiple speed references.   |

|   |   |  |
|---|---|--|
| 7 | Check the speed reference input gain and servomotor rotation direction.   | Refer to the following equation to change the speed reference input gain (Pn300).<br>$Un001 = (V-REF \text{ Voltage})[V] \times Pn300$ To change the servomotor rotation direction without changing polarity for speed reference input voltage, refer to <b>4.3.2 Switching the Servomotor Rotation Direction</b> .<br>Perform the operation from step 2 again after the servomotor rotation direction is changed. |
| 8 | When the speed reference input is set to 0 V and servo OFF status enters, trial operation for servomotor without load is completed. |  |

■ When Position Control is configured at the Host

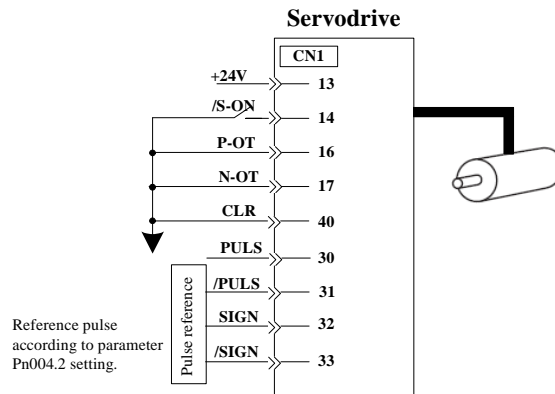


When the servo drive conducts speed control and position control is conducted at the host controller, perform the operation below, following the operation in **Operation Procedure in Speed Control Mode (Pn005=H. □□0□)**.

| Step | Description   | Check Method and Remarks  |
|------|---|---|
| 9    | Check the input signal circuit again, and check that the speed reference input (between the V-REF+ and V-REF-) is 0 V.  | Refer to the above figure for input signal circuit.   |
| 10   | Turn the servo ON input signal (/S-ON) ON.  | If the servomotor rotates at an extremely slow speed, refer to <b>4.5.3 Adjusting Reference Offset</b> , and use the reference voltage offset to keep the servomotor from moving. |
| 11   | Send the command for the number of servomotor rotations. Check the sent number of rotations, the actual number of rotations by visual inspection, and the Un004 (rotation angle)[pulse] | Refer to <b>5.1.6 Operation in Monitor Mode</b> for how it is displayed.<br>Un004(rotation angle)[pulse]: The number of pulses from the zero point.                               |
| 12   | If the sent number of rotations and actual number of rotations in step 11 are not equal, correctly set the Pn200 (PG divided ratio) outputting the encoder pulse from the servo drive.  | Refer to <b>4.5.8 Encoder Signal Output</b> for how to set PG divided ratio (Pn200[P/Rev]): The number of encoder pulses per revolution.  |
| 13   | When the speed reference input is set to 0 V and servo OFF status is entered, the trial operation for position control with the host controller is completed.                           | —   |

(3) Operating Procedure in Position Control Mode (Pn005=H. □□1□)

The following circuit is required: External input signal circuit or equivalent.



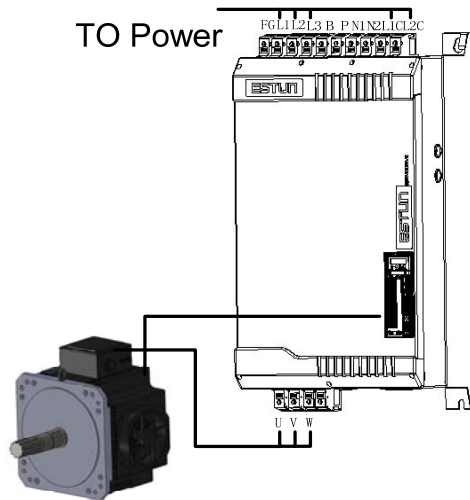
| Step | Description   | Check Method and Remarks   |
|------|---|--|
| 1    | Match the reference pulse form with the pulse output form from the host controller.   | Set the reference pulse form with Pn004.2.   |
| 2    | Set the reference unit and electronic gear ratio so that it coincides with the host controller setting.   | Set the electronic gear ratio with Pn201(or Pn203)/Pn202.  |
| 3    | Turn the power and the servo ON input signal ON.  |  |
| 4    | Send the slow speed pulse reference for the number of servomotor rotation easy to check (for example, one servomotor revolution) from the host controller in advance.         | Set the servomotor speed to 100rpm for the reference pulse speed because such speed is safe.   |
| 5    | Check the number of reference pulses input to the servo drive by the changed amount before and after the Un013 and Un014(input reference pulse counter)[pulse] were executed. | Refer to <b>5.1.6 Operation in Monitor Mode</b> for how it is displayed.   |
| 6    | Check whether the actual number of servomotor rotations Un009、Un010 coincides with the number of input reference pulses.  | Refer to <b>5.1.6 Operation in Monitor Mode</b> for how it is displayed.   |
| 7    | Check that the servomotor rotation direction is the same as the reference.  | Check the input pulse polarity and input reference pulse form.   |
| 8    | Input the pulse reference with the large number of servomotor rotation from the host controller to obtain the constant speed.   | Set the servomotor speed to 100rpm for the reference pulse speed because such speed is safe.   |
| 9    | Check the reference pulse speed input to the servo drive using the Un008 in Monitor Mode. (input reference pulse speed)[rpm].   | Refer to <b>5.1.6 Operation in Monitor Mode</b> for how it is displayed.   |
| 10   | Check the servomotor speed using the Un000 in Monitor Mode. (servomotor speed) [rpm].   | Refer to <b>5.1.6 Operation in Monitor Mode</b> for how it is displayed.   |
| 11   | Check the rotation of the servomotor shaft.   | To change the servomotor rotation direction without changing the input reference pulse form, refer to <b>4.3.2 Switching the Servomotor Rotation Direction</b> . Perform the operation from step 8 again after the servomotor rotation direction is changed. |
| 12   | When the pulse reference input is stopped and servo OFF status is entered, the trial operation for servomotor without load in position control mode is complete.              | —  |

## 4.1.3 Trial Operation with the Servomotor Connected to the Machine

**! WARNING**

- Follow the procedure below for trial operation precisely as given.
- Malfunctions that occur after the servomotor is connected to the machine not only damage the machine, but may also cause an accident resulting in death or injury.

Follow the procedure below to perform the trial operation.



| Step | Description   | Check Method and Remarks  |
|------|---|---|
| 1    | Turn the power ON, and make the settings for the mechanical configuration related to protective functions such as overtravel and brake. | Refer to 4.3 Setting Common Basic Functions.<br>When a servomotor with brake is used, take advance measures to prevent vibration due to gravity acting on the machine or external forces before checking the brake operation. Check that both servomotor and brake operations are correct.<br>For details, refer to 4.3.4 Setting for Holding Brakes. |
| 2    | Set the necessary parameters for the control mode used.   | Refer to 4.4 Operating Using Speed Control with Analog Reference, 4.5 Operating Using Position Control, and 4.6 Operating Using Torque Control for control mode used.   |
| 3    | Connect the servomotor to the machine with the coupling, etc., while the power is OFF.  |   |

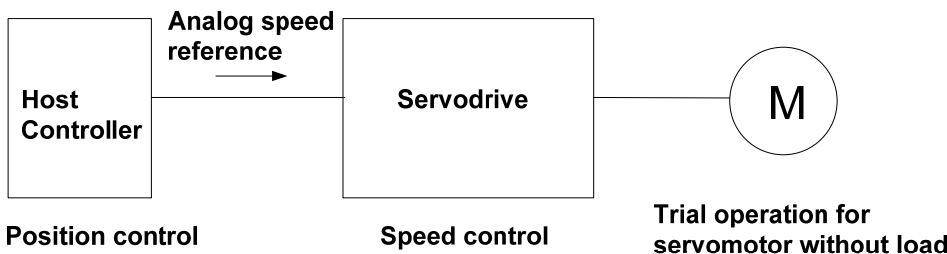
|   |   |   |
|---|---|---|
| 4 | Check that the servo drive is servo OFF status and then turn ON the power to the machine (host controller). Check again that the protective function in step 1 operates normally. | Refer to 4.3 Setting Common Basic Functions.<br>For the following steps, take advanced measures for an emergency stop so that the servomotor can stop safely when an error occurs during operation. |
| 5 | Perform trial operation with the servomotor connected to the machine, following each section in <b>4.1.2 Trial Operation for Servomotor without Load from Host Reference</b> .    | Check that the trial operation is completed according to the trial operation for servomotor without load. Also, check the settings for machine such as reference unit.                              |
| 6 | Check the parameter settings for control mode used in step 2.   | Check that the servomotor rotates matching the machine operating specifications.  |
| 7 | Adjust the servo gain and improve the servomotor response characteristics, if necessary.  | The servomotor will not be broken in completely during trial operation. Therefore, let the system run for a sufficient amount of time to ensure that it is properly broken in.                      |
| 8 | Thus, the trial operation with the servomotor connected to the machine is complete.   |   |

#### 4.1.4 Trial Operation for Servomotor with Brakes

Holding brake operation of the servomotor can be controlled with the brake interlock output (/BK) signal of the servo drive. When checking the brake operation, take advance measures to prevent vibration due to gravity acting on the machine or external forces. Check the servomotor operation and holding brake operation with the servomotor separated from the machine. If both operations are correct, connect the servomotor to the machine and perform trial operation. Refer to **4.3.4 Setting for Holding Brakes** for wiring on a servomotor with brakes and parameter settings.

#### 4.1.5 Position Control by Host Controller

As described above, be sure to separate the servomotor and machine before performing trial operation of the servomotor without a load. Refer to the following table, and check the servomotor operation and specifications in advance.



| Reference from the Host Controller                                  | Check Item       | Check Method   | Review Items  |
|---|------------------|--|---|
| JOG Operation (Constant speed reference input from host controller) | Servomotor speed | Check servomotor speed as follows:<br>• Use the servomotor speed | Check the parameter setting at Pn300 to see if reference speed gain is correct. |



|                                 |   |   |   |
|---------------------------------|---|---|---|
|                                 |   | <p>monitor(Un000) on the panel operator.</p> <ul style="list-style-type: none"> <li>• Run the servomotor at a low speed.</li> </ul> <p>For example, input a reference speed of 60rpm, and check to see if the servomotor makes one revolution per second.</p> |   |
| Simple positioning              | Number of servomotor rotation   | Input a reference equivalent to one servomotor rotation, and visually check to see if the shaft makes one revolution.   | Check the parameter setting at Pn200 to see if the number of PG dividing pulses is correct. |
| Overtravel (P-OT and N-OT Used) | Whether the servomotor stops rotating when P-OT and N-OT signals are input. | Check to see if the servomotor stops when P-OT and N-OT signals are input during continuous servomotor operation.   | Review P-OT and N-OT wiring if the servomotor does not stop.                                |

## 4.2 Control Mode Selection

The control modes supported by the EHD series servo drives are described below.

| Parameter | Control Mode  | Reference Section |
|-----------|---|-------------------|
| Pn005     | <p>Speed Control (Analog voltage reference)</p> <p>Controls servomotor speed using analog voltage speed reference. Use in the following instances.</p> <ul style="list-style-type: none"> <li>• To control speed</li> <li>• For position control using the encoder feedback division output from the servo drive to form a position loop in the host controller.</li> </ul> | 4.4               |
|           | <p>Position Control (Pulse train reference)</p> <p>Controls the position of the servomotor using pulse train position reference. Controls the position with the number of input pulses, and controls the speed with the input pulse frequency. Use when positioning is required.</p>  | 4.5               |
|           | <p>Torque Control (Analog voltage reference)</p> <p>Controls the servomotor's output torque with analog voltage torque reference. Use to output the required amount of torque for operations such as pressing.</p>  | 4.6               |
|           | <p>Speed Control (contact reference) Speed Control (zero reference)</p> <p>Use the three input signals /P-CON, /P-CL and /N-CL to control the speed as set in advance in the servo drive. Three operating speeds can be set in the servo drive. (In this case, an analog reference is not necessary.)</p>   | 4.7               |

|  |                                 |  |     |
|--|---------------------------------|--|-----|
|  | H.□□4□<br>•<br>•<br>•<br>H.□□E□ | These are switching modes for using the four control methods described above in combination. Select the control method switching mode that best suits the application. | 4.9 |
|--|---------------------------------|--|-----|

## 4.3 Setting Common Basic Functions

### 4.3.1 Setting the Servo ON Signal

This sets the servo ON signal (/S-ON) that determines whether the servomotor power is ON or OFF.

(1) Servo ON signal(/S-ON)

| Type  | Name  | Connector Number            | Pin | Setting         | Meaning  |
|-------|-------|-----------------------------|-----|-----------------|--|
| Input | /S-ON | CN1-14<br>(Factory setting) |     | ON(low level)   | Servomotor power ON. Servomotor can be operated.     |
|       |       |                             |     | OFF(high level) | Servomotor power OFF. Servomotor cannot be operated. |

■ Important

Always input the servo ON signal before inputting the input reference to start or stop the servomotor.

Do not input the input reference first and then use the /S-ON signal to start or stop. Doing so will degrade internal elements and may cause the servo drive to malfunction.

A parameter can be used to re-allocate the input connector number for the /S-ON signal. Refer to **3.2.2 I/O Signal Names and Functions**.

(2) Enabling/Disabling the Servo ON Signal

A parameter can be always used to set the servo ON condition. This eliminates the need to wire /S-ON, but care must be taken because the servo drive can operate as soon as the power is turned ON.

| Parameter |        | Meaning  |
|-----------|--------|--|
| Pn000     | b.□□□0 | External S-ON signal enabled (Factory setting)   |
|           | b.□□□1 | External S-ON signal disabled, the servomotor excitation signal is opened automatically after outputting the S-RDY signal. |

After changing these parameters, turn OFF the main circuit and control power supplies, and then turn them ON again to enable the new settings.

### 4.3.2 Switching the Servomotor Rotation Direction

The rotation direction of the servomotor can be switched without changing the reference pulse to the servo drive or the reference voltage polarity.

This causes the rotation the servo motor shaft is rotating to change. The output signal polarity, such as the encoder pulse output and the analog monitor signal from the servo drive do not change.

The standard setting for “forward rotation” is counterclockwise as viewed from the servomotor load end.

| Parameter | Name | Reference         |                   |
|-----------|------|-------------------|-------------------|
|           |      | Forward reference | Reverse reference |
|           |      |                   |                   |

|       |        |  |  |  |
|-------|--------|--|--|--|
| Pn001 | b.□□□0 | Standard setting<br>(CCW=forward)<br>(factory setting) |  |  |
|       | b.□□□1 | Reverse rotation mode<br>(CW=forward)                  |  |  |

The direction of P-OT and N-OT change. For Pn001=b.□□□0(standard setting), counterclockwise is P-OT. For Pn001=b.□□□1(reverse rotation mode), clockwise is P-OT.

### 4.3.3 Setting the Overtravel Limit Function

The overtravel limit function forces movable machine parts to stop if they exceed the allowable range of motion and turn ON a limit switch.

#### (1)Connecting the overtravel signal

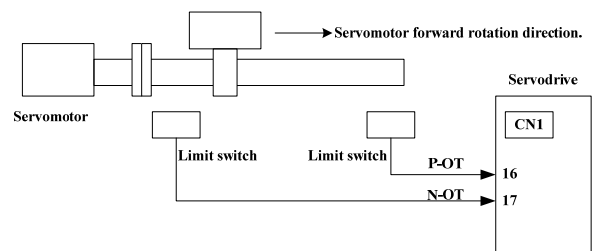
To use the overtravel function, connect the following overtravel limit switch to the corresponding pin number of servo drive CN1 connector correctly.

| Type  | Signal Name | Pin No.                     | Setting         | Meaning  |
|-------|-------------|-----------------------------|-----------------|--|
| Input | P-OT        | CN1-16<br>(factory setting) | ON(low level)   | Forward rotation allowed. (Normal operation status.) |
|       |             |                             | OFF(high level) | Forward rotation prohibited. (Forward overtravel)    |
| Input | N-OT        | CN1-17<br>(factory setting) | ON(low level)   | Reverse rotation (Normal operation status.)          |
|       |             |                             | OFF(high level) | Reverse rotation prohibited. (Reverse overtravel)    |

Connect limit switches as shown below to prevent damage to the devices during linear motion.


Rotation in the opposite direction is possible during overtravel.

For example, reverse rotation is possible during forward overtravel.



■Important

When using overtravel to stop the servomotor during position control, the position error pulses are present. A clear signal (CLR) input is required to clear the error pulses.

 CAUTION

When using the servomotor on a vertical axis, the workpiece may fall in the overtravel condition. To prevent this, always set the zero clamp after stopping with Pn004.0=5.

**(2) Enabling/Disabling the Overtravel Signal**

A parameter can be set to disable the overtravel signal. If the parameter is set, there is no need to wire the overtravel input signal.

| Parameter |        | Meaning   |
|-----------|--------|---|
| Pn000     | b.□□0□ | Inputs the forward rotation prohibited (P-OT) signal from CN1-16 (factory setting).         |
|           | b.□□1□ | Disables the forward rotation prohibited (P-OT) signal. (Allows constant forward rotation.) |
|           | b.□0□□ | Inputs the reverse rotation prohibited (N-OT) signal from CN1-17. (factory setting)         |
|           | b.□1□□ | Disables the reverse rotation prohibited (N-OT) signal. (Allows constant reverse rotation.) |

- Applicable control modes: Speed control, position control, and torque control.
- After changing these parameters, turn OFF the main circuit and control power supplies, and then turn them ON again to enable the new settings.
- A parameter can be used to re-allocate input connector number for the P-OT and N-OT signals. Refer to **3.2.2 I/O Signal Names and Functions**.

**(3) Selecting the Servomotor Stop Method**

This is used to set the stop method when an overtravel (P-OT, N-OT) signal is input while the servomotor is operating.

| Parameter |                  | Stop Mode             | Mode After Stopping | Meaning  |
|-----------|------------------|-----------------------|---------------------|--|
| Pn004     | H.□□□0           | Stop by dynamic brake | Coast               | Rapidly stops the servomotor by dynamic braking (DB), then places it into coast (power OFF) mode.  |
|           | H.□□□1           | Coast to a stop       |                     | Stops the servomotor in the same way as when the servo is OFF (coast to a stop), then places it into coast (power OFF) mode.                                     |
|           | H.□□□2<br>H.□□□3 | S-OFF<br>/Overtravel  | Coast               | Makes the servomotor coast to a stop state when servo OFF, stops the servomotor by plug braking when overtravel, and then places it into coast (power OFF) mode. |
|           |                  |                       |                     |  |

|   |                  |  |            |   |
|---|------------------|--|------------|---|
|   | H.□□□4<br>H.□□□5 |  | Zero Clamp | Makes the servomotor coast to a stop state when servo OFF, stops the servomotor by plug braking when overtravel, then places it into zero clamp mode. |
| <ul style="list-style-type: none"> <li>• After changing these parameters, turn OFF the main circuit and control power supplies, and then turn them ON again to enable the new settings.</li> <li>• Stop by dynamic brake: Stops by using the dynamic brake (short circuiting its electrical circuit).</li> <li>• Coast to a stop: Stops naturally, with no brake, by using the friction resistance of the servomotor in operation.</li> <li>• Plug braking: Stops by using plug braking limit torque.</li> <li>• Zero Clamp Mode: A mode forms a position loop by using the position reference zero.</li> </ul> |                  |  |            |   |

- Dynamic brake is an emergency stop function, and one of the general methods to cause a servomotor sudden stop.
- Dynamic brake suddenly stops a servomotor by shorting its electrical circuit.
- If the servomotor is frequently started and stopped by turning the power ON/OFF or using the servo ON signal(/S-ON), the DB circuit will also be repeatedly operated, degrading the servo drive's internal elements.
- Use the speed input reference and position reference to control the starting and the stopping of the servomotor.

#### (4) Setting the Stop Torque for Overtravel

|  |                            |              |                 |                    |   |   |    |
|--|----------------------------|--------------|-----------------|--------------------|---|---|----|
| Pn405  | Plug braking torque limit` |              |                 |                    | S | P | To |
|  | Setting Range              | Setting Unit | Factory Setting | Setting Validation |   |   |    |
|  | 0~300                      | 1%           | 300             | Immediately        |   |   |    |
| <ul style="list-style-type: none"> <li>• This sets the stop torque for when the overtravel signal(P-OT,N-OT) is input.</li> <li>• The setting unit is a percentage of the rated torque.(the rated torque is 100%)</li> <li>• The value large enough to be the servomotor maximum torque, 300% is set as the factory setting for plug braking limit torque.However, the actual output plug braking limit torque is determined by servomotor ratings.</li> </ul> |                            |              |                 |                    |   |   |    |

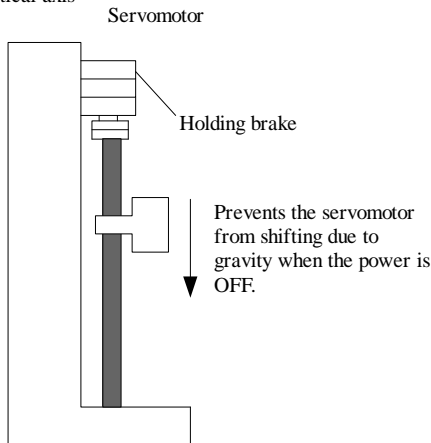
### 4.3.4 Setting for Holding Brakes

The holding brake is used when the servo drive controls a vertical axis.

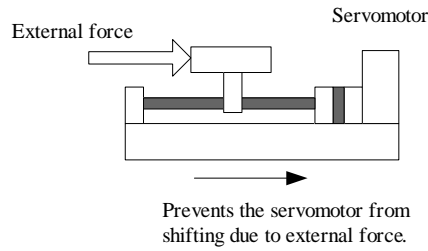
A servomotor with the brake option helps prevent movable parts from shifting due to gravity when power is removed from the servo drive.

(Refer to 4.1.4 Trial Operation for Servomotor with Brakes.)

● Vertical axis



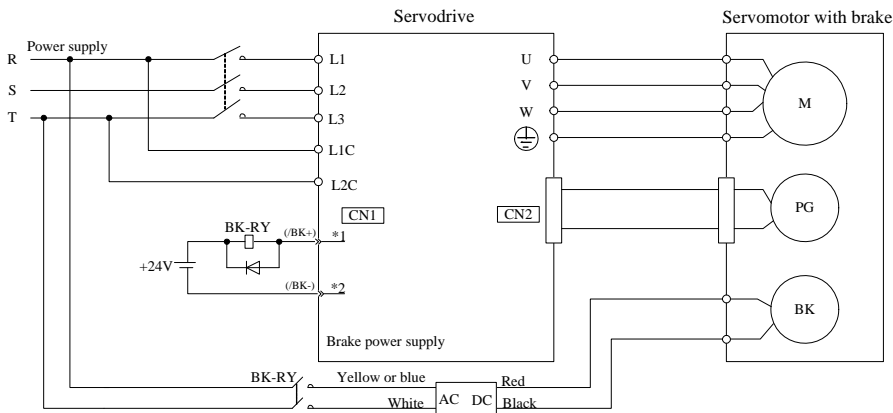
● Shaft with external force applied



1. The servomotor with the built in brake, is a de-energization brake. It is used to hold the servomotor and cannot be used as a braking purposes. Use the holding brake only to hold a stopped servomotor.
2. When operating using only a speed loop, turn OFF the servo and set the input reference to 0V when the brake is applied.
3. When forming a position loop, do not use a mechanical brake while the servomotor is stopped because the servomotor enters servolock status.

(1) Wiring Example

Use the servo drive sequence output signal /BK and the brake power supply to form a brake ON/OFF circuit. The following diagram shows a standard wiring example.



BK-RY: Brake control relay

\*1、\*2: The output terminals allocated with Pn511.

(2) Brake interlock output

| Type   | Signal Name | Connector Pin Number | Setting         | Meaning             |
|--------|-------------|----------------------|-----------------|---------------------|
| Output | /BK         | Must be allocated    | ON(Low level)   | Releases the brake. |
|        |             |                      | OFF(High level) | Applies the brake.  |

This output signal controls the brake and is used only for a servomotor with a brake. This output signal is not used with the factory setting. The output signal must be allocated by Pn511. It does not need to be connected for servomotor without a brake.

(3) Allocating Brake Interlock Output (/Bk)

Brake interlock output (/BK) is not used with the factory setting. The output signal must be allocated.

| Parameter |        | Connector Pin Number |            | Meaning  |
|-----------|--------|----------------------|------------|--|
|           |        | + Terminal           | - Terminal |  |
| Pn511     | H.□□□4 | CN1-11               | CN1-12     | The /BK signal is output from output terminal CN1-11,12. |
| Pn511     | H.□□4□ | CN1-5                | CN1-6      | The /BK signal is output from output terminal CN1-5,6.   |
| Pn511     | H.□4□□ | CN1-9                | CN1-10     | The /BK signal is output from output terminal CN1-9,10.  |

■ Important

When set to the factory setting, the brake signal is invalid.

For the allocation of servo drive output signals other than /BK signal, refer to **3.2.2 I/O Signal Names and Functions**.

Parameter Pn511 description as following:

|   |   |
|---|---|
| 0 | /COIN(/V-CMP)output                       |
| 1 | /TGON rotation detecting output           |
| 2 | /S-RDY servo drive get ready output       |
| 3 | /CLT torque limit output                  |
| 4 | /BK brake interlock output                |
| 5 | /PGC encoder C pulse output               |
| 6 | OT overtravel signal output               |
| 7 | /RD servo enabled motor excitation output |
| 8 | /HOME home completion output              |
| 9 | /TCR Torque Detection Output              |

Related parameter:

| Parameter No. | Name                  | Unit | Setting Range | Default |
|---------------|-----------------------|------|---------------|---------|
| Pn505         | Servo ON waiting time | ms   | -2000~2000    | 0       |
| Pn506         | Basic waiting flow    | 10ms | 0~500         | 0       |
| Pn507         | Brake waiting speed   | rpm  | 10~100        | 100     |
| Pn508         | Brake waiting time    | 10ms | 10~100        | 50      |

**(4) Setting the Brake ON/OFF Timing after the Servomotor Stops**

With the factory setting, the /BK signal is output at the same time as the servo is turned OFF. The servo OFF timing can be changed with a parameter.

|  |                       |              |                 |                    |
|--|-----------------------|--------------|-----------------|--------------------|
| Pn505  | Servo ON waiting time |              |                 |                    |
|  |                       | S            | Position        | To                 |
|  | Setting Range         | Setting Unit | Factory Setting | Setting Validation |
|  | -2000~2000            | ms           | 0               | Immediately        |
| Instruction:<br>Pn505 为正时, 当有伺服 ON 输入时首先输出/BK 信号, 然后延时该参数设置的时间再给出电机励磁信号;<br>Pn505 为负时, 当有伺服 ON 输入时立即给出电机励磁信号, 然后延时该参数设置的时间再输出/BK 信号。 |                       |              |                 |                    |

|  |   |              |                 |                    |
|--|---|--------------|-----------------|--------------------|
| Pn506  | Basic waiting flow <span style="border: 1px solid black; padding: 2px 10px;">S</span> |              |                 |                    |
|  | Setting Range   | Setting Unit | Factory Setting | Setting Validation |
|  | 0~500   | 10ms         | 0               | Immediately        |
| <ul style="list-style-type: none"> <li>When using the servomotor to control a vertical axis, the machine movable parts may shift slightly depending on the brake ON/ OFF timing due to gravity or an external force. By using this parameter to delay turning the servo ON/ OFF, this slight shift can be eliminated.</li> <li>For details on brake operation while the servomotor is operating, refer to (5) Setting the Brake ON/ OFF Timing When Servomotor Running in this section.</li> </ul> |   |              |                 |                    |
|  |   |              |                 |                    |
| <p>■ Important</p> <ul style="list-style-type: none"> <li>The servomotor will turn OFF immediately when an alarm occurs, regardless of the setting of this parameter.</li> <li>The machine movable part may shift due to gravity or external force during the time until the brake operates.</li> </ul>  |   |              |                 |                    |

**(5) Setting the Brake ON/OFF Timing When Servomotor Running**

The following parameters can be used to change the /BK signal output conditions when a stop reference is output during servomotor operation due to the servo OFF or an alarm occurring.

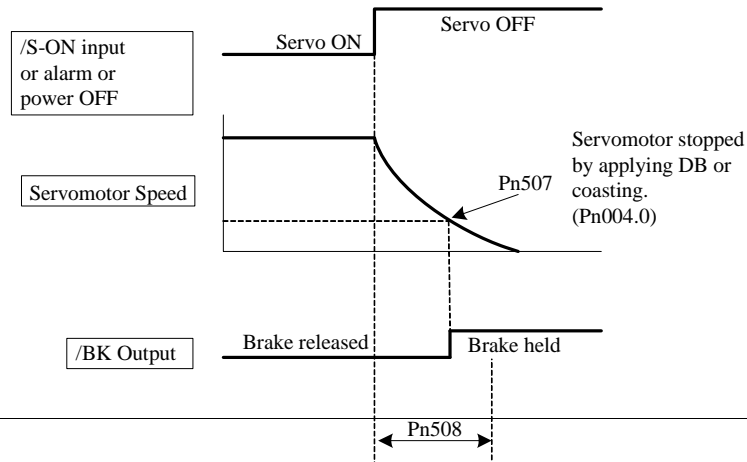
|       |   |              |                 |                    |
|-------|---|--------------|-----------------|--------------------|
| Pn507 | Brake Waiting Speed <span style="border: 1px solid black; padding: 2px 10px;">S</span> <span style="border: 1px solid black; padding: 2px 10px;">P</span> <span style="border: 1px solid black; padding: 2px 10px;">To</span> |              |                 |                    |
|       | Setting Range   | Setting Unit | Factory Setting | Setting Validation |
|       | 10~100  | 1rpm         | 100             | Immediately        |
| Pn508 | Brake Waiting Time <span style="border: 1px solid black; padding: 2px 10px;">S</span> <span style="border: 1px solid black; padding: 2px 10px;">P</span> <span style="border: 1px solid black; padding: 2px 10px;">To</span>  |              |                 |                    |
|       | Setting Range   | Setting Unit | Factory Setting | Setting Validation |
|       | 10~100  | 10ms         | 50              | Immediately        |



**/BK Signal Output Conditions When Servomotor Running**

The /BK signal goes to high level(brake ON) when either of the following conditions is satisfied:

- When the servomotor speed falls below the level set in Pn507 after servo OFF.
- When the time set in Pn508 is exceeded after servo OFF.



### 4.3.5 Instantaneous Power Loss Settings

Determines whether to continue operation or turn the servo OFF when the power supply voltage to the servo drive main circuit is instantaneously interrupted.

| Parameter | Signal Name and Meaning  |
|-----------|--|
| Pn000     | b.0□□□<br>Continue operation when the power supply voltage to servo drive main circuit is instantaneously interrupted. |
|           | b.1□□□<br>An alarm occurs when the power supply voltage to servo drive main circuit is instantaneously interrupted.    |

## 4.4 Operating Using Speed Control with Analog Reference

### 4.4.1 Setting Parameters

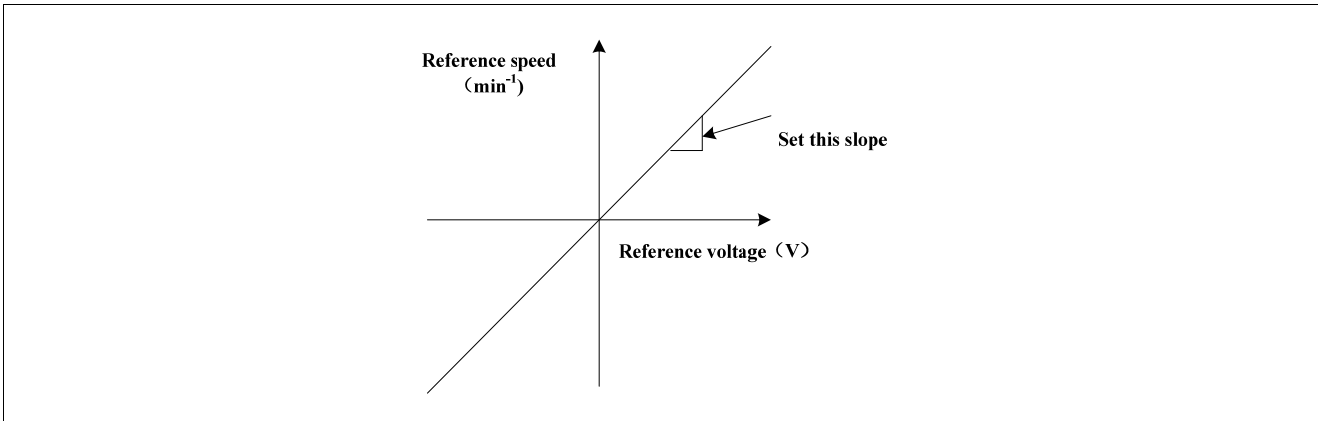
| Parameter | Meaning   |
|-----------|---|
| Pn005     | H.□□0□<br>Control mode selection:Speed control(analog reference)(factory setting) |

|       |                            |              |                 |                    |
|-------|----------------------------|--------------|-----------------|--------------------|
| Pn300 | Speed Reference Input Gain |              |                 |                    |
|       |                            | S            | P               | To                 |
|       | Setting Range              | Setting Unit | Factory Setting | Setting Validation |
|       | 0~3000                     | rpm/v        | 50              | Immediately        |

Sets the analog voltage level for the speed reference(V-REF) necessary to operate the servomotor at the rated speed.

■ EXAMPLE

Pn300=50: 1V input is equivalent to the servomotor speed of 150rpm(factory setting).



## 4.4.2 Setting Input Signals

### (1) Speed Reference Input

Input the speed reference to the servo drive using the analog voltage reference to control the servomotor speed in proportion to the input voltage.

| Type  | Signal Name | Connector Pin Number | Name                  |
|-------|-------------|----------------------|-----------------------|
| Input | V-Ref+      | CN1-1                | Speed Reference Input |
|       | V-Ref-      | CN1-2                | Speed Reference Input |

The above inputs are used for speed control(analog voltage reference).(Pn005.1=0, 4, 7, 9, A)Pn300 is used to set the speed reference input gain.Refer to **4.4.1 Setting Parameters**.

### (2) Proportional Control Reference (/P-CON)

| Type  | Signal | Connector Pin Number | Setting         | Meaning  |
|-------|--------|----------------------|-----------------|--|
| Input | /P-CON | CN1-15               | ON(low level)   | Operates the servo drive with proportional control           |
|       |        |                      | OFF(high level) | Operates the servo drive with proportional integral control. |

/P-CON signal selects either the PI(proportional integral) or P(proportional) Speed Control Mode.

Switching to P control reduces servomotor rotation and minute vibrations due to speed reference input drift.

Input reference: At 0V, the servomotor rotation due to drift will be reduced, but servomotor rigidity (holding force) drops when the servomotor is stopped.

Note: A parameter can be used to reallocate the input connector number for the /P-CON signal. Refer to **3.2.2 I/O Signal Names and Functions**.

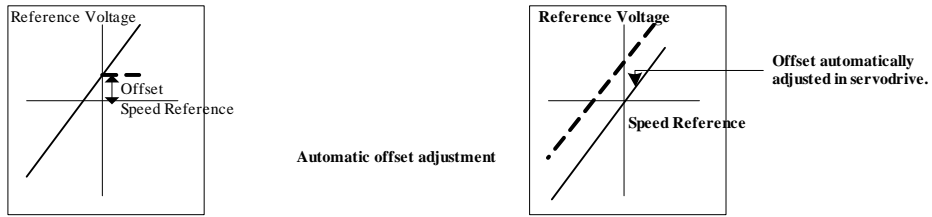
## 4.4.3 Adjusting Reference Offset

When using the speed control, the servomotor may rotate slowly even if 0V is specified as the analog voltage reference.

This happens if the host controller or external circuit has a slight offset (in the unit of mV) in the reference voltage.

Adjustments can be done manually or automatically by using the panel operator. Refer to **5.2 Operation in Utility Function Mode**.

The servo drive automatically adjusts the offset when the host controller or external circuit has the offset in the reference voltage.



After completion of the automatic adjustment, the amount of offset is stored in the servo drive. The amount of offset can be checked in the speed reference offset manual adjustment mode (Fn004). Refer to **4.5.3 (2) Manual Adjustment of the Speed Reference Offset**.

**(1) Automatic Adjustment of the Speed Reference Offset**

The automatic adjustment of reference offset (Fn003) cannot be used when a position loop has been formed with a host controller and the error pulse is changed to zero at the servomotor stop due to servolock. Use the speed reference offset manual adjustment (Fn004) described in the next section for a position loop.

The zero-clamp speed control function can be used to force the servomotor to stop while the zero speed reference is given. Refer to **4.4.7 Using the Zero Clamp Function**.

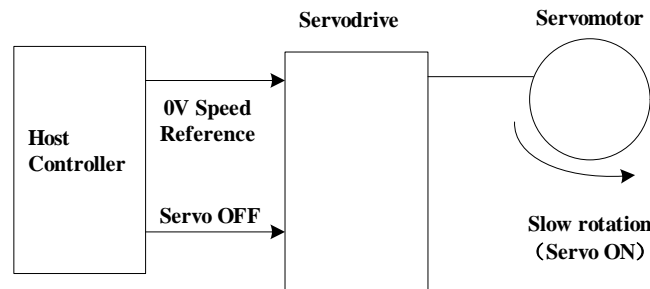
---

**Note:** The speed reference offset must be automatically adjusted with the servo OFF.

---

Adjust the speed reference offset automatically in the following procedure.

1. Turn OFF the servo drive and input the 0V reference voltage from the host controller or external circuit.



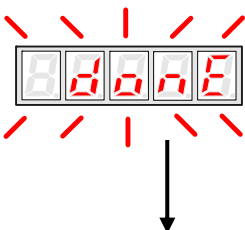
2. Press the MODE key to select the utility function mode.
3. Press the INC or DEC key to select parameter Fn003.



4. Press the ENTER key to enter into the speed reference offset automatic adjustment mode.



5. Press the MODE key for more than one second, the reference offset will be automatically adjusted.





6. Press ENTER key to return to the Fn003 display of the utility function mode.



7. Thus, the speed reference offset automatic adjustment is completed.

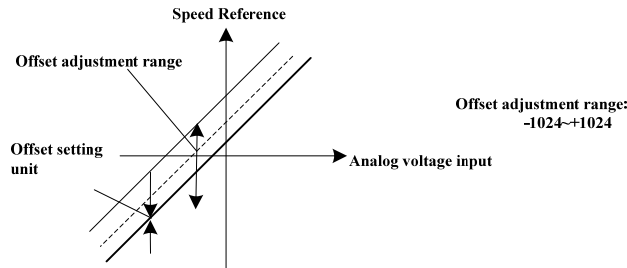
**(2) Manual Adjustment of the Speed Reference Offset**

Use the speed reference offset manual adjustment (Fn004) in the following situations:

- If a loop is formed with the host controller and the position error pulse is set to be zero when servolock is stopped.
- To deliberately set the offset to some value
- To check the offset data set in the speed reference offset automatic adjustment mode.

This function operates in the same way as the reference offset automatic adjustment mode (Fn003), except that the amount of offset is directly input during the adjustment.

The offset setting range and setting unit are as follows:



Adjust the speed reference offset manually in the following procedure.

1. Press the MODE key to select the utility function mode.
2. Press the INC or DEC key to select parameter Fn004.



3. Press the ENTER key to enter into the speed reference offset manual adjustment mode.



4. Turn ON the servo ON (/S-ON) signal. The display will be shown as below.



5. Press the ENTER key for one second to display the speed reference offset amount.



6. Press the INC or DEC key to adjust the amount of offset.
7. Press the ENTER key for one second to return to the display in step 4.
8. Press the ENTER key to return to the Fn004 display of the utility function mode.



Thus, the speed reference offset manual adjustment is completed.

### 4.4.4 Soft Start

The soft start function converts the stepwise speed reference inside the servo drive to a consistent rate of acceleration and deceleration.

Pn310 can be used to select the soft start form:

0: Slope; 1: S curve; 2: 1<sup>st</sup>-order filter; 3: 2<sup>nd</sup>-order filter

|       |  |              |                 |                    |
|-------|--|--------------|-----------------|--------------------|
| Pn306 | Soft Start Acceleration Time <span style="float: right; border: 1px solid black; padding: 2px;">S</span> |              |                 |                    |
|       | Setting Range  | Setting Unit | Factory Setting | Setting Validation |
|       | 0~10000  | 1ms          | 0               | Immediately        |
| Pn307 | Soft Start Deceleration Time <span style="float: right; border: 1px solid black; padding: 2px;">S</span> |              |                 |                    |
|       | Setting Range  | Setting Unit | Factory Setting | Setting Validation |
|       | 0~10000  | 1ms          | 0               | Immediately        |

The soft start function enables smooth speed control when inputting a stepwise speed reference or when selecting internally set speeds. Set both Pn306 and Pn307 to "0" for normal speed control.

Set these parameters as follows:

- Pn306: The time interval from the time the servomotor starts until the servomotor maximum speed is reached.
- Pn307: The time interval from the time the servomotor is operating at the servomotor maximum speed until it stops.

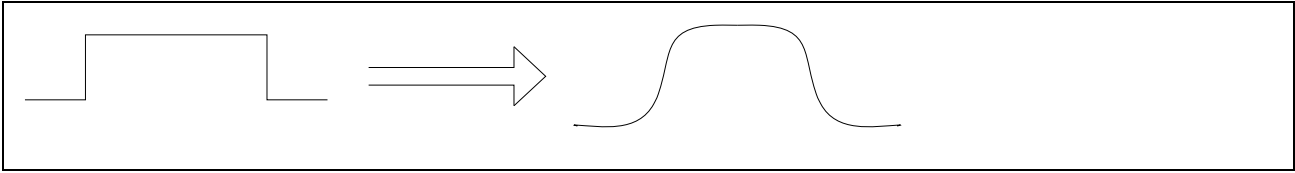
### 4.4.5 Speed Reference Filter Time Constant

|       |  |              |                 |                    |
|-------|--|--------------|-----------------|--------------------|
| Pn308 | Speed Reference Filter Time Constant <span style="float: right; border: 1px solid black; padding: 2px;">S</span> |              |                 |                    |
|       | Setting Range  | Setting Unit | Factory Setting | Setting Validation |
|       | 0~10000  | 1ms          | 0               | Immediately        |

This smooths the speed reference by applying a 1<sup>st</sup>-order delay filter to the analog speed reference (V-REF) input. A value that is too large, however, will decrease response.

### 4.4.6 S-curve Risetime

|       |  |              |                 |                    |
|-------|--|--------------|-----------------|--------------------|
| Pn309 | S-curve Risetime <span style="float: right; border: 1px solid black; padding: 2px;">S</span> |              |                 |                    |
|       | Setting Range  | Setting Unit | Factory Setting | Setting Validation |
|       | 0~10000  | 1ms          | 0               | Immediately        |

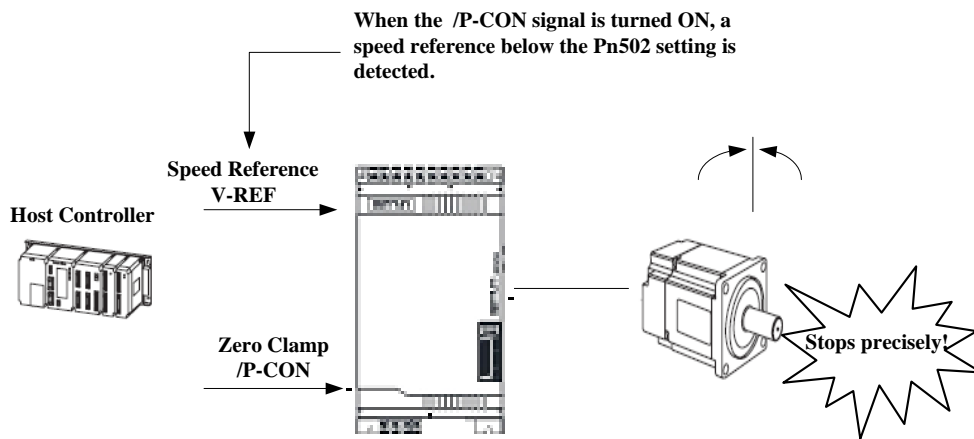


## 4.4.7 Using the Zero Clamp Function

### (1) Zero Clamp Function

The zero clamp function is used for systems where the host controller does not form a position loop for the speed reference input. When the zero clamp signal (/P-CON) is ON, a position loop is formed inside the servo drive as soon as the input voltage of the speed reference (V-REF) drops below the servomotor zero clamp speed. The servomotor ignores the speed reference and quickly stops and locks the servomotor.

The servomotor is clamped within  $\pm 1$  pulse when the zero clamp function is turned ON, and will still return to the zero clamp position even if it is forcibly rotated by an external force.



### (2) Parameter Setting

| Parameter   | Meaning   |
|---|---|
| Pn005   | H. □□A□ Control mode: Speed control(analog voltage reference) Zero ↔ mp |
| Zero Clamp Conditions:  |   |
| Zero clamp is performed with Pn005=H. □□A□ when the following two conditions are both satisfied:  |   |
| <ul style="list-style-type: none"> <li>• /P-CON is ON (low level)</li> <li>• Speed reference (V-REF) drops below the setting in Pn502.</li> </ul> |   |
|   |   |

|       |  |              |                 |                    |
|-------|--|--------------|-----------------|--------------------|
| Pn502 | Zero clamp speed <span style="float: right; border: 1px solid black; padding: 2px;">S</span> |              |                 |                    |
|       | Setting Range  | Setting Unit | Factory Setting | Setting Validation |
|       | 0~3000   | rpm          | 10              | Immediately        |

Sets the servomotor speed at which the zero clamp is performed if zero clamp speed control(Pn005=H.□□A□) is selected. Even if this value is set higher than the maximum speed of the servomotor, the maximum speed will be used.

**(3) Input Signal Setting**

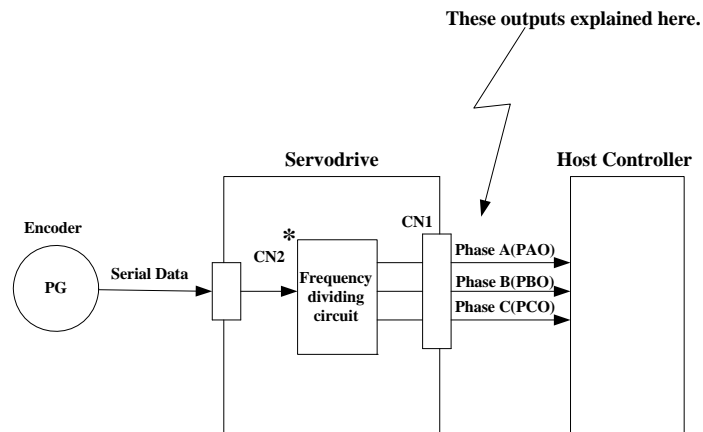
| Type  | Signal name | Connector Pin Number | Setting         | Meaning                           |
|-------|-------------|----------------------|-----------------|-----------------------------------|
| Input | /P-CON      | CN1-15               | ON(low level)   | Zero clamp function ON(enabled)   |
|       |             |                      | OFF(high level) | Zero clamp function OFF(disabled) |

/P-CON is the input signals to switch to the zero clamp function.

### 4.4.8 Encoder Signal Output

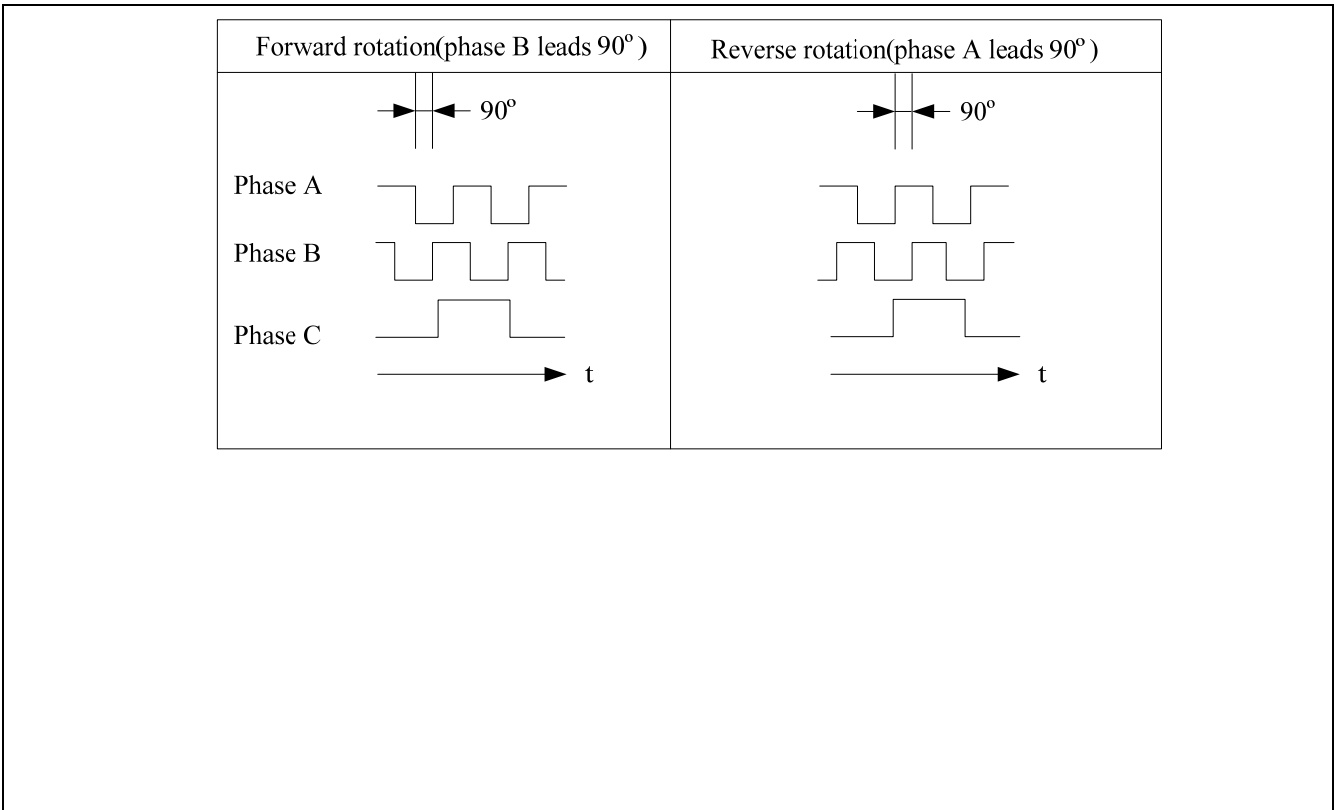
Encoder feedback pulses processed inside the servo drive can be output externally.

| Type   | Signal Name | Connector Pin Number | Name                                      |
|--------|-------------|----------------------|---|
| Output | PAO         | CN1-20               | Encoder output phase A                    |
|        | /PAO        | CN1-21               | Encoder output phase /A                   |
| Output | PBO         | CN1-22               | Encoder output phase B                    |
|        | /PBO        | CN1-23               | Encoder output phase /B                   |
| Output | PCO         | CN1-24               | Encoder output phase C(zero-point pulse)  |
|        | /PCO        | CN1-25               | Encoder output phase /C(zero-point pulse) |



\*The dividing output phase form is the same as the standard setting(Pn001.0=0) even if inreverse rotation mode(Pn001.0=1).

■ Output phase form



If the servomotor is not equipped with an absolute encoder, the servomotor needs two full rotations before using the servo drive's Phase-C pulse output as the zero point reference.

**Dividing:** Dividing means that the divider converts data into the pulse density(Pn200) based on the pulse data of the encoder installed on the servomotor, and outputs it. The setting unit is number of pulses/revolution.



Pulse Dividing Ratio Setting

|       |                   |              |                 |                    |   |   |   |
|-------|-------------------|--------------|-----------------|--------------------|---|---|---|
| Pn200 | PG Dividing Ratio |              |                 |                    | S | P | T |
|       | Setting Range     | Setting Unit | Factory Setting | Setting Validation |   |   |   |
|       | 16~16384          | 1Puls        | 16384           | After restart      |   |   |   |

Set the number of pulses for PG output signals(PAO,/PAO,PBO,/PBO) externally from the servo drive.  
 Feedback pulses from the encoder per revolution are divided inside the servo drive by the number set in Pn200 before being output. (Set according to the system specifications of the machine or host controller.)  
 The setting range varies with the number of encoder pulses for the servomotor used.

■ Output Example  
 Pn200=16(when 16 pulses are output per revolution)

### 4.4.9 Speed coincidence output

The speed coincidence (/V-CMP) output signal is output when the actual servomotor speed during speed control is the same as the speed reference input. The host controller uses the signal as an interlock.

| Type   | Signal Name   | Connector Pin Number            | Setting         | Meaning                  |
|--------|---------------|---------------------------------|-----------------|--------------------------|
| Output | /V-CMP(/COIN) | CN1-11, 12<br>(factory setting) | ON(low level)   | Speed coincides.         |
|        |               |                                 | OFF(high level) | Speed does not coincide. |

|       |                        |              |                 |                    |
|-------|------------------------|--------------|-----------------|--------------------|
| Pn501 | Coincidence Difference |              |                 |                    |
|       | Setting Range          | Setting Unit | Factory Setting | Setting Validation |
|       | 0~100                  | rpm          | 10              | Immediately        |

The /V-CMP signal is output when the difference between the speed reference and actual servomotor speed is less than Pn501.

■ Example

The /V-CMP signal turns ON at 1900 to 2100rpm if the Pn501 parameter is set to 100 and the reference speed is 2000rpm.

■ Note

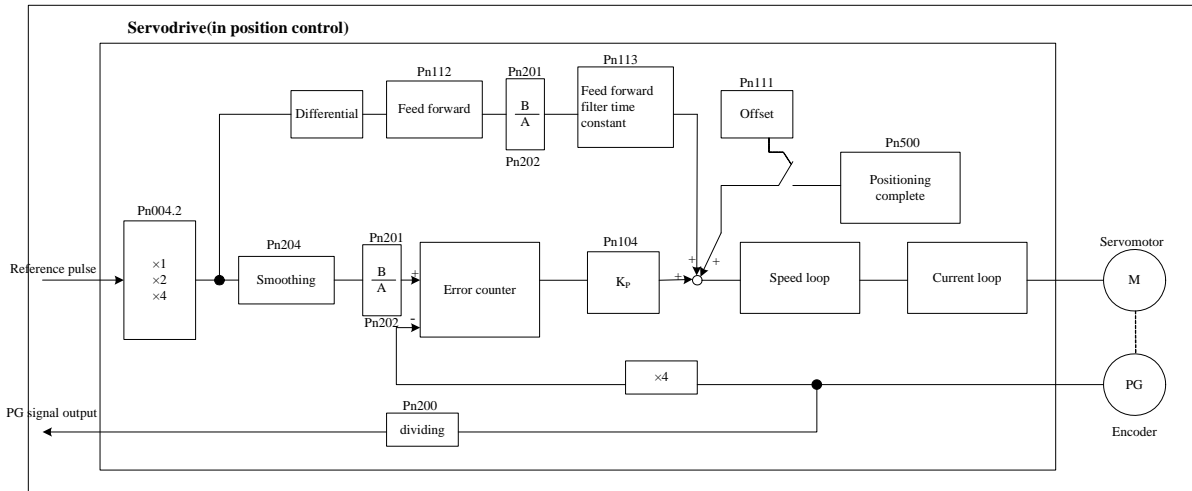
This pin outputs the /COIN signal in position control mode, and the /V-CMP signal in speed control mode.

### 4.5 Operating Using Position Control

Set the following parameters for position control using pulse trains.

|           |         |   |
|-----------|---------|---|
| Parameter | Meaning |   |
| Pn005     | H.□□1□  | Control mode selection: position control(pulse train reference) |

A block diagram for position control is shown as below.



## 4.5.1 Basic Setting in Position Control

### (1) Setting a reference pulse sign

| Type  | Signal Name | Connector Pin Number | Name                  |
|-------|-------------|----------------------|-----------------------|
| Input | PULS        | CN1-30               | Reference pulse input |
|       | /PULS       | CN1-31               | Reference pulse input |
|       | SIGN        | CN1-32               | Reference sign input  |
|       | /SIGN       | CN1-33               | Reference sign input  |

### (2) Setting reference input filter for open collector signal

When Pn840.0=3/4/5

|       |      |  |
|-------|------|--|
| Pn006 | 0□□□ | when pulse is difference input, servo receiving pulse frequency≤400K |
|       | 1□□□ | when pulse is difference input, servo receiving pulse frequency≤4M   |

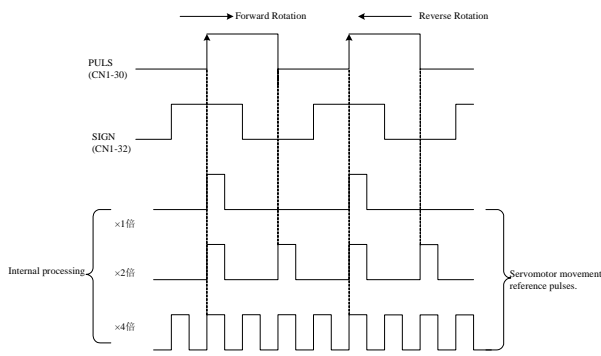
### (3) Setting a Reference Pulse Form

Set the input form for the servo drive using parameter Pn004.2 according to the host controller specifications.

| Parameter | Reference Pulse Form  | Input Pulse Multiplier  | Forward Rotation Reference | Reverse Rotation Reverse |  |
|-----------|---|---|----------------------------|--------------------------|--|
| Pn004     | H.□0□□<br>Sign+pulse train<br>(positive logic)<br>(factory setting) | —   |                            |                          |  |
|           | H.□1□□<br>CW+CCW<br>(positive logic)                                | —   |                            |                          |  |
|           | H.□2□□  | Two-phase pulse train with 90° phase differential<br>(positive logic) | ×1                         |                          |  |
|           | H.□3□□  |   | ×2                         |                          |  |
|           | H.□4□□  |   | ×4                         |                          |  |

■ Note:

The input pulse multiplier can be set for the two-phase pulse train with 90° phase differential reference pulse form.



(4) Inverse PULS and SIGN reference

|       |      |   |
|-------|------|---|
| Pn004 | 0□□□ | Do not invert PULS reference and SIGN reference     |
|       | 1□□□ | Do not invert PULS reference; Invert SIGN reference |
|       | 2□□□ | Invert PULS reference; Do not invert SIGN reference |
|       | 3□□□ | Invert PULS reference and SIGN reference            |

(5) Reference Pulse Input Signal Timing

| Reference pulse signal form  | Electrical specifications  | Remarks  |
|--|--|--|
| <p>Sign+pulse train input (SIGN+PULS signal)</p> <p>Maximum reference frequency : 500kpps (For open-collector output: 200kpps)</p>   | <p>Forward reference<br/>Reverse reference</p> <p><math>t_1, t_2=0.1\mu s</math><br/><math>t_3, t_7=0.1\mu s</math><br/><math>t_4, t_5, t_6=3\mu s</math><br/><math>t=1.0\mu s</math><br/><math>(t/T) \times 100 = 50\%</math></p> | <p>SIGN<br/>H=forward reference<br/>L=reverse reference</p>                          |
| <p>CW pulse+CCW pulse Maximum reference frequency: 500kpps (For open-collector output: 200kpps)</p>  | <p>Forward reference<br/>Reverse reference</p> <p><math>t_1, t_2=0.1\mu s</math><br/><math>t_3=3\mu s</math><br/><math>t=1.0\mu s</math><br/><math>(t/T) \times 100 = 50\%</math></p>  |  |
| <p>Two-phase pulse train with 90° phase differential (phase A +B)</p> <p>Maximum reference frequency:<br/>×1 input pulse multiplier: 500kpps<br/>×2 input pulse multiplier: 400kpps<br/>×4 input pulse multiplier: 200kpps</p> | <p>Forward reference<br/>Reverse reference</p> <p>Phase B leads A by 90°.<br/>Phase B lags B by 90°.</p> <p><math>t_1, t_2=0.1\mu s</math><br/><math>t=1.0\mu s</math><br/><math>(t/T) \times 100 = 50\%</math></p>                | <p>A parameter Pn004.2 can be used to switch of the input pulse multiplier mode.</p> |

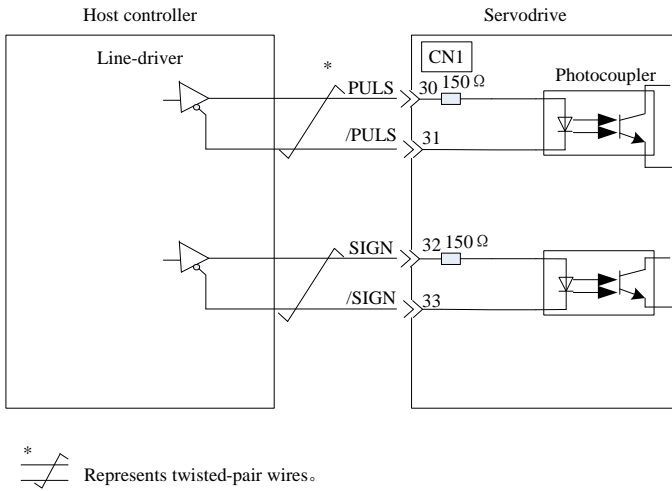
(6) Connection Example

The pulse train output form from the host controller corresponds to the following:

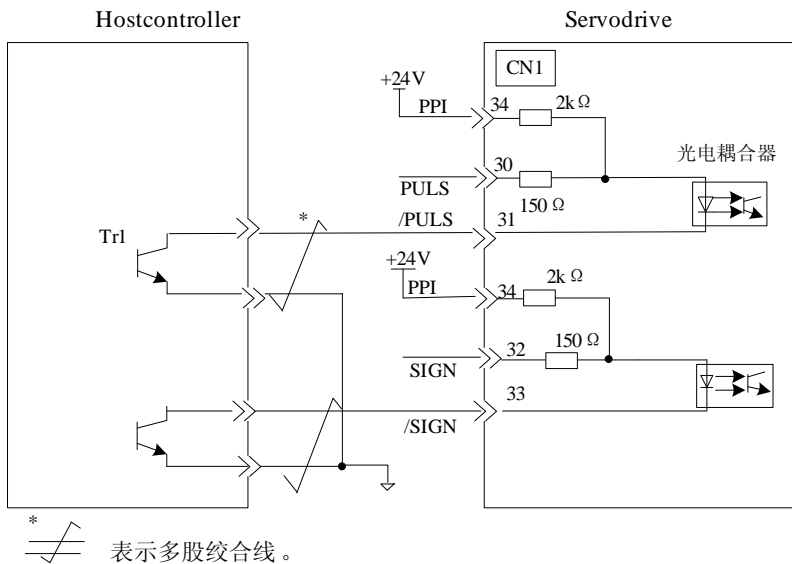
- Line-driver Output
- +24V Open-collector output
- +12V/+5V Open-collector output

**(a) Connection Example for Line-driver Output**

Applicable line driver: SN75174 manufactured by TI or MC3487 or the equivalent.



**(b) Connection Example for Open-Collector Gate Output**



电压为+12V时，需分别在PULS、SIGN外部串接一个电阻，阻值为1kΩ  
电压为+5V时，需分别在PULS、SIGN外部串接一个电阻，阻值为180Ω

(注) 光电耦合器输出时，信号的逻辑如下所示：

|          |          |
|----------|----------|
| Tr1为ON时  | 相当于H电平输入 |
| Tr1为OFF时 | 相当于L电平输入 |

**Note** : When the host controller is applied by open-collector signal output, the input signal noise margin lowers. When a position error caused by the noise occurs, set the parameter Pn006.3.

## 4.5.2 Setting the Clear Signal

### (1) Setting the Clear Signal

| Type  | Sign Name | Connector Pin Numbe | Function            |
|-------|-----------|---------------------|---------------------|
| Input | /CLR      | 1CN-40              | error counter clear |

When the /CLR signal is set to low level, clear error counter:

- The error counter inside the servo drive is set to "0"
- Position loop operation is disabled.

### (2) Setting the Clear Signal Mode

In position control mode, pulses will be still presented in the servo drive when servo OFF, thus it should be cleared when servo drive is turned ON. Setting Pn004 to choose whether clearing the pulses automatically when servo OFF.

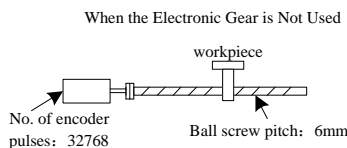
|       |  |  |
|-------|--|--|
| Pn004 | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Clear the error pulse when S-OFF, donot when overtravel.               |
|       | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Do not clear the error pulse.  |
|       | <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> | Clear the error pulse when S-OFF or overtravel (except for zero clamp) |

## 4.5.3 Setting the Electronic Gear

### (1) Electronic Gear

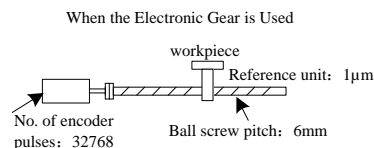
The electronic gear enables the workpiece travel distance per input reference pulse from the host controller to be set to any value.

One reference pulse from the host controller, i.e., the minimum position data unit, is called a reference unit.



To move a workpiece 10mm :

One revolution is 6mm. Therefore  $10 \div 6 = 1.6666$  revolutions.  
 $32768 \times 4$  pulses is one revolution.  
 Therefore,  $1.6666 \times 32768 \times 4 = 218445$  pulses. 218445 pulses are input as reference pulses.  
 The equation must be calculated at the host controller.



To move a workpiece 10mm using reference units:

The reference unit is 1µm. Therefore, to move the workpiece 10mm (10000µm),  
 $1 \text{ pulse} = 1 \mu\text{m}$ , so  $10000 / 1 = 10000$  pulses.  
 Input 10000 pulses per 10mm of workpiece movement.

### (2) Related Parameters

|       |                                    |              |                 |                    |          |
|-------|------------------------------------|--------------|-----------------|--------------------|----------|
| Pn201 | Electronic Gear Ratio(Numerator)   |              |                 |                    | Position |
|       | Setting Range                      | Setting Unit | Factory Setting | Setting Validation |          |
|       | 1~65535                            | —            | 1               | After restart      |          |
| Pn202 | Electronic Gear Ratio(Denominator) |              |                 |                    | Position |
|       | Setting Range                      | Setting Unit | Factory Setting | Setting Validation |          |
|       | 1~65535                            | —            | 1               | After restart      |          |

The deceleration ratio of the servomotor and the load shaft is given as n/m where m is the rotation of the servomotor and n is the rotation of the load shaft.

$$\text{Electronic gear ratio: } \frac{B}{A} = \frac{Pn201}{Pn202}$$

$$= \frac{\text{No. of encoder pulses} \times 4}{\text{Travel distance per load shaft revolution (reference units)}} \times \frac{m}{n}$$

- If the ratio is outside the setting range, reduce the fraction (both numerator and denominator) until you obtain integers within the range.
- Be careful not to change the electronic gear ratio (B/A).

■ Important

- Electronic gear ratio setting range:  $0.01 \leq \text{electronic gear ratio (B/A)} \leq 100$
- If the electronic gear ratio is outside this range, the servo drive will not operate properly. In this case, modify the load configuration or reference unit.

**(3) Procedure for Setting the Electronic Gear Ratio**

Use the following procedure to set the electronic gear ratio.

| Step | Operation  | Description   |
|------|--|---|
| 1    | Check machine specifications.                            | Check the deceleration ratio, ball screw pitch and pulley diameter.   |
| 2    | Check the number of encoder pulses.                      | Check the number of encoder pulses for the servomotor used.   |
| 3    | Determine the reference unit used.                       | Determine the reference unit from the host controller, considering the machine specifications and positioning accuracy.                     |
| 4    | Calculate the travel distance per load shaft revolution. | Calculate the number of reference units necessary to turn the load shaft one revolution based on the previously determined reference units. |
| 5    | Calculate the electronic gear ratio.                     | Use the electronic gear ratio equation to calculate the ratio (B/A).  |
| 6    | Set parameters.  | Set parameters using the calculated values.   |

**(4) Electronic Gear Ratio Setting Examples**

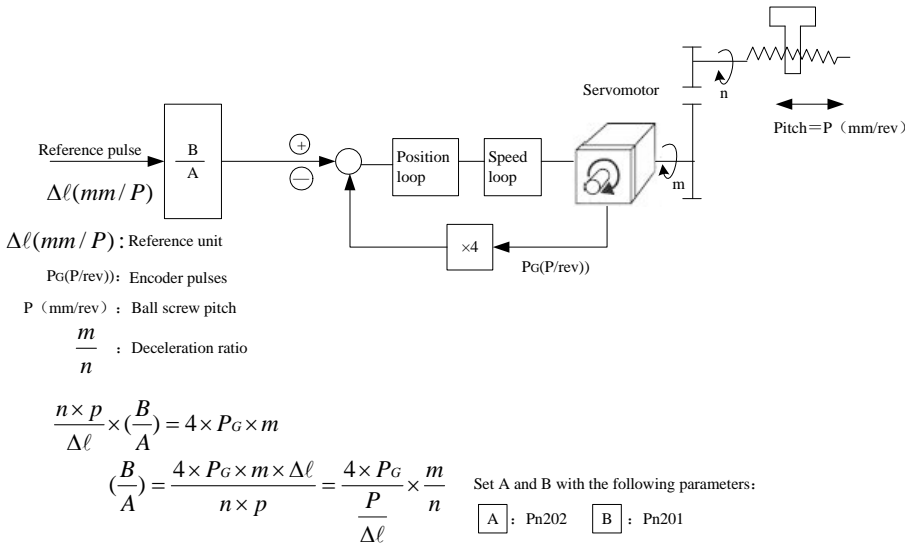
The following examples show electronic gear ratio settings for different load configurations.

| Step | Operation                                    | Load Configuration   |  |   |
|------|--|--|--|---|
|      |  | Ball Screw   | Disc Table   | Belt and Pulley   |
|      |  | <p>Reference unit: 0.001mm<br/>Load shaft<br/>17-bit encoder<br/>Ball screw pitch: 6mm</p> | <p>Reference unit: 0.1°<br/>Deceleration ratio: 3: 1<br/>Load shaft<br/>17-bit encoder</p> | <p>Reference unit: 0.01mm<br/>Load shaft<br/>Deceleration ratio: 2: 1<br/>Pulley diameter: F 100mm<br/>17-bit encoder</p> |
| 1    | Check machine specifications.                | Ball screw pitch:mm<br>Deceleration ratio:1/1  | Rotation angle per revolution :360°<br>Deceleration ratio:3/1                              | Pulley diameter:100 mm<br>(pulley circumference:314 mm)<br>·Deceleration ratio:2/1  |
| 2    | Encoder                                      | Revolve:16384P/R   | Revolve:16384P/R   | Revolve:16384P/R  |
| 3    | Determine the reference unit used            | 1 reference unit:<br>0.001mm(1μm)  | 1 reference unit:0.1°  | 1 reference unit:0.01mm   |
| 4    | Calculate the travel distance per load shaft | 6mm/0.001mm=6000   | 360°/0.1°=3600   | 314mm/0.01mm=31400  |

|   |                                     |  |  |   |        |       |        |
|---|-------------------------------------|--|--|---|--------|-------|--------|
|   | revolution                          |  |  |   |        |       |        |
| 5 | Calculate the electronic gear ratio | $\frac{B}{A} = \frac{16384 \times 4}{6000} \times \frac{1}{1}$ | $\frac{B}{A} = \frac{16384 \times 4}{3600} \times \frac{3}{1}$ | $\frac{B}{A} = \frac{16384 \times 4}{31400} \times \frac{2}{1}$ |        |       |        |
| 6 | Set parameters                      | Pn201  | 65536  | Pn201   | 196608 | Pn201 | 131072 |
|   |                                     | Pn202  | 6000   | Pn202   | 3600   | Pn202 | 31400  |
| 7 | Final Result                        | Pn201  | 16384  | Pn201   | 16384  | Pn201 | 16384  |
|   |                                     | Pn202  | 1500   | Pn202   | 300    | Pn202 | 3925   |

- Reduce the fraction (both numerator and denominator) if the calculated result will not be within the setting range.
- For example, reduce the above numerators and denominators by four or other numbers to obtain the final results in step 7 and complete the settings.

(5)Electronic Gear Ratio Equation



### 4.5.4 Smoothing

A filter can be applied in the servo drive to a constant-frequency reference pulse.

(1)Selecting a Position Reference Filter

| Parameter | Description                      |
|-----------|----------------------------------|
| Pn205     | 0: 1 <sup>st</sup> -order filter |
|           | 1: 2 <sup>nd</sup> -order filter |

\* After changing the parameter, turn OFF the power once and turn it ON again to enable the new setting.

(2)Filter-related Parameters

|             |  |              |                 |                    |   |
|-------------|--|--------------|-----------------|--------------------|---|
| Pn204       | Position Reference Acceleration/Deceleration Time Constant |              |                 |                    | P |
|             | Setting Range  | Setting Unit | Factory Setting | Setting Validation |   |
|             | 0~32767  | 0.1ms        | 0               | Immediately        |   |
| ■ Important |  |              |                 |                    |   |

When the position reference acceleration/deceleration time constant (Pn204) is changed, a value with no reference pulse input and a position error of 0 will be enabled. To ensure that the setting value is correctly reflected, stop the reference pulse from the host controller and input the clear signal (CLR), or turn OFF to clear the error.

This function provides smooth servomotor operation in the following cases.

- When the host controller that outputs a reference that cannot perform acceleration/deceleration processing.
- When the reference pulse frequency is too low.
- When the reference electronic gear ratio is too high (i.e., 10× or more)

## 4.5.5 Positioning Completion Output Signal

This signal indicates that servomotor movement has been completed during position control. Use the signal as an interlock to confirm that positioning has been completed at the host controller.

| Type   | Signal Name | Connector Pin Number                | Setting          | Meaning                         |
|--------|-------------|-------------------------------------|------------------|---------------------------------|
| Output | /COIN       | CN1-11, CN1-12<br>(Factory setting) | ON (low level)   | Positioning has been completed. |
|        |             |                                     | OFF (high level) | Positioning is not completed.   |

• This output signal can be allocated to an output terminal with parameter Pn511. Refer to **3.2.2 I/O Signal Names and Functions**.

- The factory setting is allocated to CN1-11, 12.

|       |                   |              |                 |                    |
|-------|-------------------|--------------|-----------------|--------------------|
| Pn500 | Positioning Error |              |                 | P                  |
|       | Setting Range     | Setting Unit | Factory Setting | Setting Validation |
|       | 0~5000            | 1Puls        | 10              | Immediately        |

• The positioning completion (/COIN) signal is output when the difference (position error pulse) between the number of reference pulses output by the host controller and the travel distance of the servomotor is less than the value set in this parameter and the stabilization time is more than the value of Pn520.

- Set the number of error pulses in reference unit (the number of input pulses defined using the electronic gear).
- Too large a value at this parameter may output only a small error during low-speed operation that will cause the /COIN signal to be output continuously.
- The positioning error setting has no effect on final positioning accuracy.

■ Note

- /COIN is a position control signal.
- This signal is used for the speed coincidence output /V-CMP for speed control, and it always OFF (high level) for torque control.

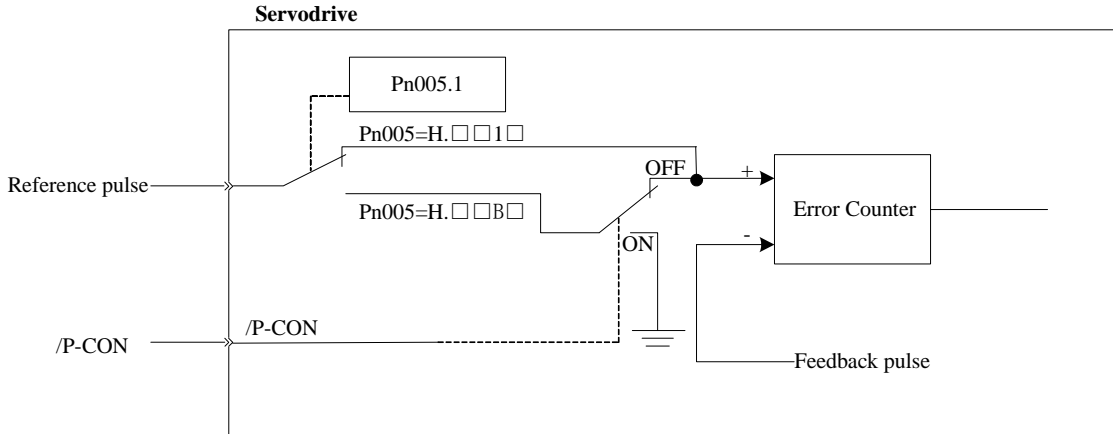


## 4.5.6 Reference Pulse Inhibit Function(INHIBIT)

### (1)Description

This function inhibits the servo drive from counting input pulses during position control.

The servomotor remains locked (clamped) while pulses are inhibited.



### (2)Setting Parameters

| Parameter  | Meaning  |
|--|--|
| Pn005  | H.□□B□ Control mode selection: position control(pulse train reference)⇔INHIBIT |
| <p>■ Inhibit(INHIBIT) switching condition</p> <ul style="list-style-type: none"> <li>• /P-CON signal ON (low level)</li> </ul> |  |
| <p>Input reference pulses are not counted during this period.</p> <p><math>t1, t2 \leq 0.5ms</math></p>                        |  |

### (3)Setting Input Signals

| Type  | Signal Name | Connector Number | Pin | Setting         | Meaning  |
|-------|-------------|------------------|-----|-----------------|--|
| Input | /P-CON      | CN1-15           |     | ON(low level)   | Turns the INHIBIT function ON.<br>(Inhibit the servo drive from counting reference pulses) |
|       |             |                  |     | OFF(high level) | Turns the INHIBIT function OFF.<br>(Counts reference pulses.)                              |

## 4.5.7 Position Control (contact reference)

Position control under contact reference (parameter Pn005.1=C). In this mode, servo drive can position with a single axes without a host controller.

There are 16 position control points with each being able to set move distance, running speed, constants for position reference filter time, and the stop time when positioning completed. Two speeds (1. speed moving toward distance switch "speed of looking for reference point". 2. Speed moving away from distance switch "moving speed.") of reference points could be set as:

Two position modes: 1. Absolute position mode 2. Relative position mode

Two running modes: 1. Circling mode 2. Non-circling mode

Two step switching method: 1. Delay step switching 2. /P-CON signal switching

Method of looking for reference points: 1. Forward direction 2. Reverse direction

### ■ Adjusting offset

Offset of each points has two correspondent parameters: one unit of the parameter is 【x 10000 reference pulse】 and the other is 【x 1 reference pulse】. Setting range of both parameters is: (-9999----+9999), while offset value equals sum of those two values.

For example:

No.0 offset correspond to parameter Pn600 【x 10000 reference pulse】 and Pn601 【x 1 reference pulse】. Set Pn600 = 100, Pn601=-100.

$$\begin{aligned} \text{No.0 offset value} &= \text{Pn600} \times 10000 \text{ reference pulse} + \text{Pn601} \times 1 \text{ reference pulse} \\ &= 100 \times 10000 \text{ reference pulse} + (-100) \times 1 \text{ reference pulse} \\ &= 999900 \text{ reference pulse} \end{aligned}$$

With the same principle, we can conclude: in order to get the same results, we also can set Pn600 = 99 and Pn601 = 9900.

Thus, we can see when the two parameters are not zero; we can get same result by two ways: one is to set the two parameters both negative or both positive, or one negative the other positive.

### ■ Speed

Speed mentioned here refers to the steady speed during which the motor is running, which is similar to the pulse frequency given from the external pulse reference in position control. However, this speed has nothing to do with the electronic gear; it is the actual speed of the motor.

### ■ Position reference filter time constant

Same as position reference filter time constant Pn204 in common position control.

### ■ Time for change steps after desired position reached

Apply internal delay to change steps to a valid value in parameter Pn681.1.

Time for change steps outputs from positioning completed signal CON/, from Servo ON, or from the time when reference point is found till the Servo performs the program to control position of the point. Such period of time depends on step changing time required by a point number among start point in program.

When running point control program, if error counter is set as "not clear error counter when Servo OFF", then the error counter might flood. If it does not flood, then the servo drive will probably run at the max. running speed when Servo ON again. **PLEASE PAY ATTENTION TO THE SAFETY OF INSTRUMENT.**

| Para. No. | Name and description   | Setting range | Default |
|-----------|--|---------------|---------|
| Pn004.1   | [0] Clear error pulse when S-OFF, not clear error pulse when overtravel.<br>[1] Not clear error pulse<br>[2] Clear error pulse When S-OFF or over travel | 0~2           | 0       |

**■Looking for the reference point**

Looking for the reference point is for establishing a zero physical point of the operating platform, which is used as zero point in the coordinates during point position control. And users may choose to find a reference point either in forward or reverse side.

**How to find a reference point**

Mount a limit switch in the forward or reverse side. Find a reference point in the forward direction after connecting to /PCL and in the reverse direction after connecting to /NCL. When the operating platform bumps into the limit the switch, the motor will first stop according to the way set by Pn004.0, and then rotate again against limit the switch. When the operating platform leaves the limit switch and the motor reaches the position of first photo encoder Phase C pulse, then position of operating platform is set to be the zero point of the coordinates.

**How to find related parameters of reference point**

Speed towards limit switch is called “speed of looking for reference point”, and the moving speed away from limit switch is called “moving speed”. These two speeds could be set by the following parameters:

| Para. No. | Description  | Unit | Setting range | Default |
|-----------|--|------|---------------|---------|
| Pn685     | Speed of looking for reference point (hits the limit switch) | rpm  | 0~500         | 200     |
| Pn686     | Moving speed (move away from limit switch)                   | rpm  | 0~500         | 30      |

Usually, the set speed of the reference point (Pn685) is high, and the moving speed (Pn686) is low. Note: if moving speed is too high, precision of finding a reference point would be affected.

When looking for a reference point, /PCL and /NCL are no longer programmed to limit external current.

**■Related parameter**

| Para. No. | Description  | Observation  |
|-----------|--|--|
| Pn681.0   | Choose between cycle run and single run.<br>0: Cycle run, /PCL as start signal, /NCL reverse to look for reference point.<br>1: Single run, /PCL as start signal, /NCL reverse to look for reference point.<br>2. Cycle run, /NCL as start signal, /PCL reverse to look for reference point.<br>3. Single run, /NCL as start signal, /PCL reverse to look for reference point. | Changing steps will be performed till the end point is completed comma and the next change will start from the start point during multi-points cycle run.<br>Point control program will not change steps after the end point is completed during multi- points single run. |

|         |  |   |
|---------|--|---|
| Pn681.1 | <p>Change step and start mode</p> <p>0: Delay changing steps, the start signal is not needed.</p> <p>1: Change steps by /P-CON, start signal not needed.</p> <p>2. Delay changing steps, need start signal.</p> <p>3. Change steps by /P-CON, need start signal.</p> | <p>Change steps by external /P-CON signals. The signal will be valid when drive output reaches the desired position. When input signal changes, the signal is valid, then steps will be changed by consequence from start point to end point.</p> |
| Pn681.2 | <p>Change step input signal mode</p> <p>[0] High or low level</p> <p>[1] sign pulse</p>  |   |
| Pn682   | <p>0: Incremental</p> <p>1: Absolute</p>   | <p>Incremental: relative moving distance (distance from current point to next point) programming.</p> <p>Absolute: absolute moving distance (distance between operating platform and the reference point) programming.</p>                        |

## 4.6 Operating Using Torque Control

### 4.6.1 Setting Parameters

The following parameters must be set for torque control operation with analog voltage reference.

| Parameter | Meaning  |
|-----------|--|
| Pn005     | H.□□2□<br>Control mode selection: Torque control(analog voltage reference) |

|       |                             |              |                 |                    |   |   |   |
|-------|-----------------------------|--------------|-----------------|--------------------|---|---|---|
| Pn400 | Torque Reference Input Gain |              |                 |                    | S | P | T |
|       | Setting Range               | Setting Unit | Factory Setting | Setting Validation |   |   |   |
|       | 10~100                      | 0.1V/100%    | 33              | Immediately        |   |   |   |

This sets the analog voltage level for the torque reference(T-REF) that is necessary to operate the servomotor at the rated torque.

■ Example

Pn400=30: The servomotor operates at the rated torque with 3V input (factory setting).

Pn400=100: The servomotor operates at the rated torque with 10V input.

Pn400=20: The servomotor operates at the rated torque with 2V input.

## 4.6.2 Torque Reference Input

By applying a torque reference determined by the analog voltage reference to the servo drive, the servomotor torque can be controlled in proportion with the input voltage.

| Type  | Signal Name | Connector Pin Number | Meaning                |
|-------|-------------|----------------------|------------------------|
| Input | T-REF+      | CN1-26               | Torque Reference Input |
|       | T-REF-      | CN1-27               |                        |

Used during torque control (analog voltage reference)  
(Pn005.1=2, 6, 8, 9)

The torque reference input gain is set in Pn400. For setting details, refer to **4.6.1 Setting Parameters**.

### ■ Input specifications

- Input range:DC±0~±10V/rated torque
- Factory setting

Pn400=30: Rated torque at 3V

+3V input: Rated torque in forward direction

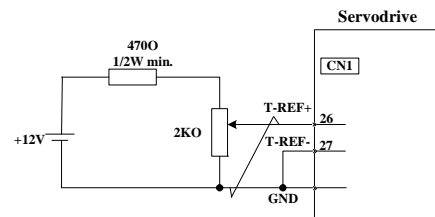
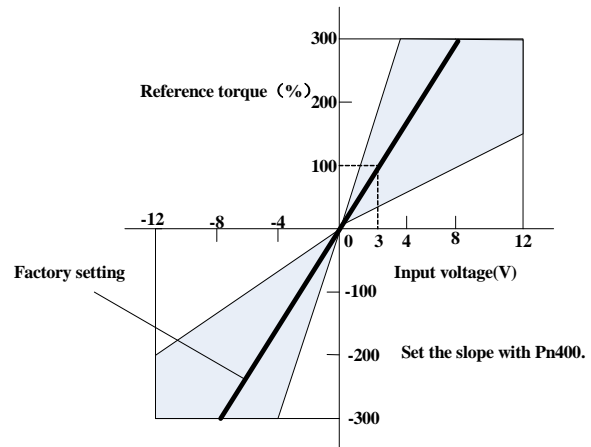
+9V input: 300% rated torque in forward direction

-0.3V input: 10% rated torque in reverse direction

The voltage input range can be changed with parameter Pn400.

### ■ Input circuit example

Use twisted-pair wires as a countermeasure against noise.



Checking the internal torque reference

1. Checking the internal torque reference with the panel operator.

Use the Monitor Mode(Un003). Refer to **5.1.6 Operation in Monitor Mode**.

2. Checking the internal torque reference with an analog monitor.

The internal torque reference can also be checked with an analog monitor.

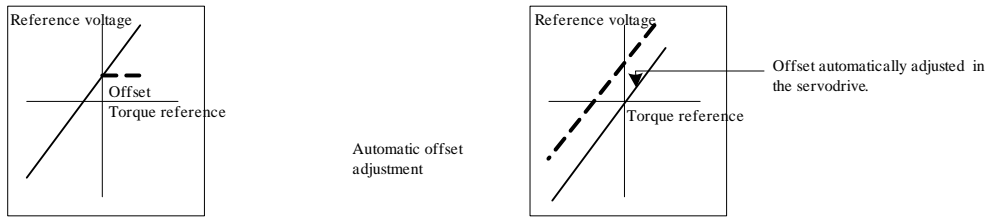
## 4.6.3 Adjusting the Reference Offset

### (1) Automatic Adjustment of the Torque Reference Offset

When using torque control, the servomotor may rotate slowly even when 0V is specified as the analog reference voltage. This occurs when the host controller or external circuit has a slight offset (measured in mv) in the reference voltage. In this case, the reference offset can be adjusted automatically and manually using the panel operator.

The automatic adjustment of analog(speed,torque) reference offset(Fn003) automatically measures the offset and adjusts the reference voltage.

The servo drive performs the following automatic adjustment when the host controller or external circuit has an offset in the reference voltage.



After completion of the automatic adjustment, the amount of offset is stored in the servo drive. The amount of offset can be checked in the manual adjustment of torque reference offset(Fn004).

The automatic adjustment of analog reference offset(Fn003) cannot be used when a position loop has been formed with the host controller and the error pulse is changed to zero at the servomotor stop due to servolock.

Use the torque reference offset manual adjustment(Fn004).

**Note:**

The analog reference offset must be automatically adjusted with the servo OFF.

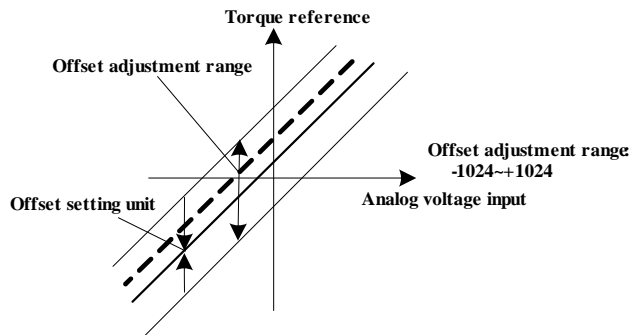
**(2)Manual Adjustment of the Torque Reference Offset**

Manual adjustment of the torque reference offset(Fn004) is used in the following cases.

- If a position loop is formed with the host controller and the error is zeroed when servolock is stopped.
- To deliberately set the offset to some value.
- Use this mode to check the offset data that was set in the automatic adjustment mode of the torque reference offset.

This mode operates in the same way as the automatic adjustment mode(Fn003), except that the amount of offset is directly input during the adjustment.

The offset adjustment range and setting unit are as follows.



**4.6.4 Limiting Servomotor Speed During Torque Control**

During torque control, the servomotor is controlled to output the specified torque, which means that the servomotor speed is not controlled. Accordingly, when an excessive reference torque is set for the mechanical load torque, it will prevail over the mechanical load torque and the servomotor speed will greatly increase.

This function serves to limit the servomotor speed during torque control to protect the machine.

|                     |                  |
|---------------------|------------------|
| Without Speed Limit | With Speed Limit |
|---------------------|------------------|

|  |  |
|--|--|
|  |  |
|--|--|

**(1)Speed Limit Enable**

| Parameter |        | Description   |
|-----------|--------|---|
| Pn001     | b.□□0□ | Use the value set in Pn406 as the speed limit (Internal speed limit)                                |
|           | b.□□1□ | Use the lower speed between V-REF and Pn406 as an external speed limit input.(External speed limit) |

**(2)Speed Limit During Torque Control**

|   |                                   |              |                 |                    |        |
|---|-----------------------------------|--------------|-----------------|--------------------|--------|
| Pn406   | Speed Limit During Torque Control |              |                 |                    | Torque |
|   | Setting Range                     | Setting Unit | Factory Setting | Setting Validation |        |
|   | 0~6000                            | rpm          | 200             | Immediately        |        |
| <ul style="list-style-type: none"> <li>Set the servomotor speed limit value during torque control.</li> <li>Pn005=H. □□1□, Pn406 is motor speed limit value.</li> <li>The servomotor's maximum speed will be used when the setting in this parameter exceeds the maximum speed of the servomotor used.</li> </ul> |                                   |              |                 |                    |        |

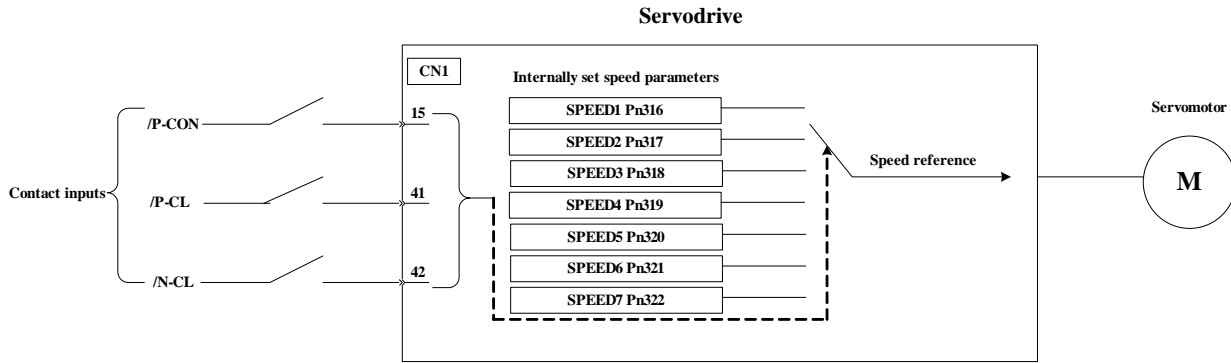
**(3)External Speed Limit Function**

| Type   | Signal Name | Connector Pin Number | Name                       |
|--|-------------|----------------------|----------------------------|
| Input  | V-REF+      | CN1-1                | External Speed Limit Input |
|  | V-REF-      | CN1-2                |                            |
| <ul style="list-style-type: none"> <li>Inputs an analog voltage reference as the servomotor speed limit value during torque control.</li> <li>The smaller value is enabled, the speed limit input from V-REF or the Pn406 (speed limit during torque control) when Pn005=H.□□1□.</li> <li>The setting in Pn300 determines the voltage level to be input as the limit value. Polarity has no effect.</li> </ul> |             |                      |                            |

|   |                            |              |                 |                    |   |   |    |
|---|----------------------------|--------------|-----------------|--------------------|---|---|----|
| Pn300   | Speed Reference Input Gain |              |                 |                    | S | P | To |
|   | Setting Range              | Setting Unit | Factory Setting | Setting Validation |   |   |    |
|   | 0~3000                     | rpm/v        | 50              | Immediately        |   |   |    |
| <ul style="list-style-type: none"> <li>Set the voltage level for the speed that is to be externally limited during torque control.</li> <li>Pn300=150(出厂时的设定)时, 如果输入 V-REF(CN1-1, 2)的 6V 电压, 则将实际转速限制为所用伺服电机的额定转速。</li> </ul> |                            |              |                 |                    |   |   |    |

## 4.7 Operating Using Speed Control with an Internally Set Speed

The function of internally set speed selection allows speed control operation by externally selecting an input signal from among seven servomotor speed setting made in advance with parameters in the servo drive. The speed control operations within the three settings are valid. There is no need for an external speed or pulse generator.



### 4.7.1 Setting Parameters

| Parameter | Meaning   |
|-----------|---|
| Pn005     | H. <input type="checkbox"/> <input type="checkbox"/> 3 <input type="checkbox"/>           |
|           | Control mode selection:<br>Speed control(contact reference) Speed control(zero reference) |

|       |                      |              |                 |                    |                                 |
|-------|----------------------|--------------|-----------------|--------------------|---------------------------------|
| Pn316 | Internal set speed 1 |              |                 |                    | <input type="text" value="sp"/> |
|       | Setting Range        | Setting Unit | Factory Setting | Setting Validation |                                 |
|       | -6000~6000           | rpm          | 30              | Immediately        |                                 |
| Pn317 | Internal set speed 2 |              |                 |                    | <input type="text" value="sp"/> |
|       | Setting Range        | Setting Unit | Factory Setting | Setting Validation |                                 |
|       | -6000~6000           | rpm          | 50              | Immediately        |                                 |
| Pn318 | Internal set speed 3 |              |                 |                    | <input type="text" value="sp"/> |
|       | Setting Range        | Setting Unit | Factory Setting | Setting Validation |                                 |
|       | -6000~6000           | rpm          | 100             | Immediately        |                                 |
| Pn319 | Internal set speed 4 |              |                 |                    | <input type="text" value="sp"/> |
|       | Setting Range        | Setting Unit | Factory Setting | Setting Validation |                                 |
|       | -6000~6000           | rpm          | -30             | Immediately        |                                 |
| Pn320 | Internal set speed 5 |              |                 |                    | <input type="text" value="sp"/> |
|       | Setting Range        | Setting Unit | Factory Setting | Setting Validation |                                 |
|       | -6000~6000           | rpm          | -50             | Immediately        |                                 |
| Pn321 | Internal set speed 6 |              |                 |                    | <input type="text" value="sp"/> |
|       | Setting Range        | Setting Unit | Factory Setting | Setting Validation |                                 |
|       | -6000~6000           | rpm          | -100            | Immediately        |                                 |
| Pn322 | Internal set speed 7 |              |                 |                    | <input type="text" value="sp"/> |
|       | Setting Range        | Setting Unit | Factory Setting | Setting Validation |                                 |
|       | -6000~6000           | rpm          | 200             | Immediately        |                                 |

(Note):The servomotor's maximum speed will be used whenever a speed setting for the Pn316~Pn322 exceeds the maximum speed.



## 4.7.2 Input Signal Settings

The following input signals are used to switch the operating speed.

| Type  | Signal Name | Connector Pin Number | Meaning                           |
|-------|-------------|----------------------|-----------------------------------|
| Input | /P-CON      | CN1-15               | Selects the internally set speed. |
| Input | /P-CL       | CN1-41               | Selects the internally set speed. |
| Input | /N-CL       | CN1-42               | Selects the internally set speed. |

## 4.7.3 Operating Using an Internally Set Speed

Use ON/OFF combinations of the following input signals to operate with the internally set speeds.

When Pn005.1=3: Selects the internally set speed (contact reference)  $\longleftrightarrow$  control (zero reference)

| Input Signal |        |        | Speed                          |
|--------------|--------|--------|--------------------------------|
| /P-CON       | /P-CL  | /N-CL  |                                |
| OFF(H)       | OFF(H) | OFF(H) | Speed control (zero reference) |
|              | OFF(H) | ON(L)  | SPEED1                         |
|              | ON(L)  | OFF(H) | SPEED2                         |
|              | ON(L)  | ON(L)  | SPEED3                         |
| ON(L)        | OFF(H) | OFF(H) | SPEED4                         |
|              | OFF(H) | ON(L)  | SPEED5                         |
|              | ON(L)  | OFF(H) | SPEED6                         |
|              | ON(L)  | ON(L)  | SPEED7                         |

Note: OFF= High level; ON= Low level

### ■ Control Mode Switching

When Pn005.1 = 4, 5, 6, and either /P-CL or /N-CL is OFF (high level), the control mode will switch.

Example:

When Pn005.1=5: Speed control(contact reference)  $\longleftrightarrow$  n control (pulse train)

| Input Signal |        |        | Speed  |
|--------------|--------|--------|--|
| /P-CON       | /P-CL  | /N-CL  |  |
| OFF(H)       | OFF(H) | OFF(H) | Pulse train reference input (position control) |
|              | OFF(H) | ON(L)  | SPEED1   |
|              | ON(L)  | OFF(H) | SPEED2   |
|              | ON(L)  | ON(L)  | SPEED3   |
| ON(L)        | OFF(H) | OFF(H) | SPEED4   |
|              | OFF(H) | ON(L)  | SPEED5   |
|              | ON(L)  | OFF(H) | SPEED6   |
|              | ON(L)  | ON(L)  | SPEED7   |

## 4.8 Limiting Torque

The servo drive provides the following three methods for limiting output torque to protect the machine.

| NO. | Limiting Method | Reference Section |
|-----|-----------------|-------------------|
|-----|-----------------|-------------------|

|   |   |       |
|---|---|-------|
| 1 | Internal torque limit                       | 4.8.1 |
| 2 | External torque limit                       | 4.8.2 |
| 3 | Torque limiting by analog voltage reference | 4.8.3 |

## 4.8.1 Internal Torque Limit

Maximum torque is always limited to the values set in the following parameters.

|   |                      |              |                 |                    |   |   |    |
|---|----------------------|--------------|-----------------|--------------------|---|---|----|
| Pn401   | Forward Torque Limit |              |                 |                    | S | P | To |
|   | Setting Range        | Setting Unit | Factory Seeting | Setting Validation |   |   |    |
|   | 0~300                | 1%           | 300             | Immediately        |   |   |    |
| Pn402   | Reverse Torque Limit |              |                 |                    | S | P | To |
|   | Setting Range        | Setting Unit | Factory Seeting | Setting Validation |   |   |    |
|   | 0~300                | 1%           | 300             | Immediately        |   |   |    |
| <ul style="list-style-type: none"> <li>• The setting unit is a percentage of rated torque.</li> <li>• The maximum torque of the servomotor is used, even though the torque limit is set higher than the maximum torque of the servomotor. (as is the case with the 300% factory setting)</li> </ul> |                      |              |                 |                    |   |   |    |
| <p>■Note:<br/>Too small a torque limit setting will result in insufficient torque during acceleration and deceleration.</p>   |                      |              |                 |                    |   |   |    |

## 4.8.2 External Torque Limit

This function allows the torque to be limited at specific times during machine operation, for example, during press stops and hold operations for robot workpieces.

An input signal is used to enable the torque limits previously set in parameters.

### (1) Related Parameters

|       |                               |              |                 |                    |   |   |    |
|-------|-------------------------------|--------------|-----------------|--------------------|---|---|----|
| Pn403 | Forward External Torque Limit |              |                 |                    | S | P | To |
|       | Setting Range                 | Setting Unit | Factory Setting | Setting Validation |   |   |    |
|       | 0~300                         | 1%           | 100             | Immediately        |   |   |    |
| Pn404 | Reverse External Torque Limit |              |                 |                    | S | P | To |
|       | Setting Range                 | Setting Unit | Factory Setting | Setting Validation |   |   |    |
|       |                               |              |                 |                    |   |   |    |

|  |       |    |     |             |
|--|-------|----|-----|-------------|
|  | 0~300 | 1% | 100 | Immediately |
|--|-------|----|-----|-------------|

Note: The setting unit is a percentage of rated torque (i.e., the rated torque is 100%).

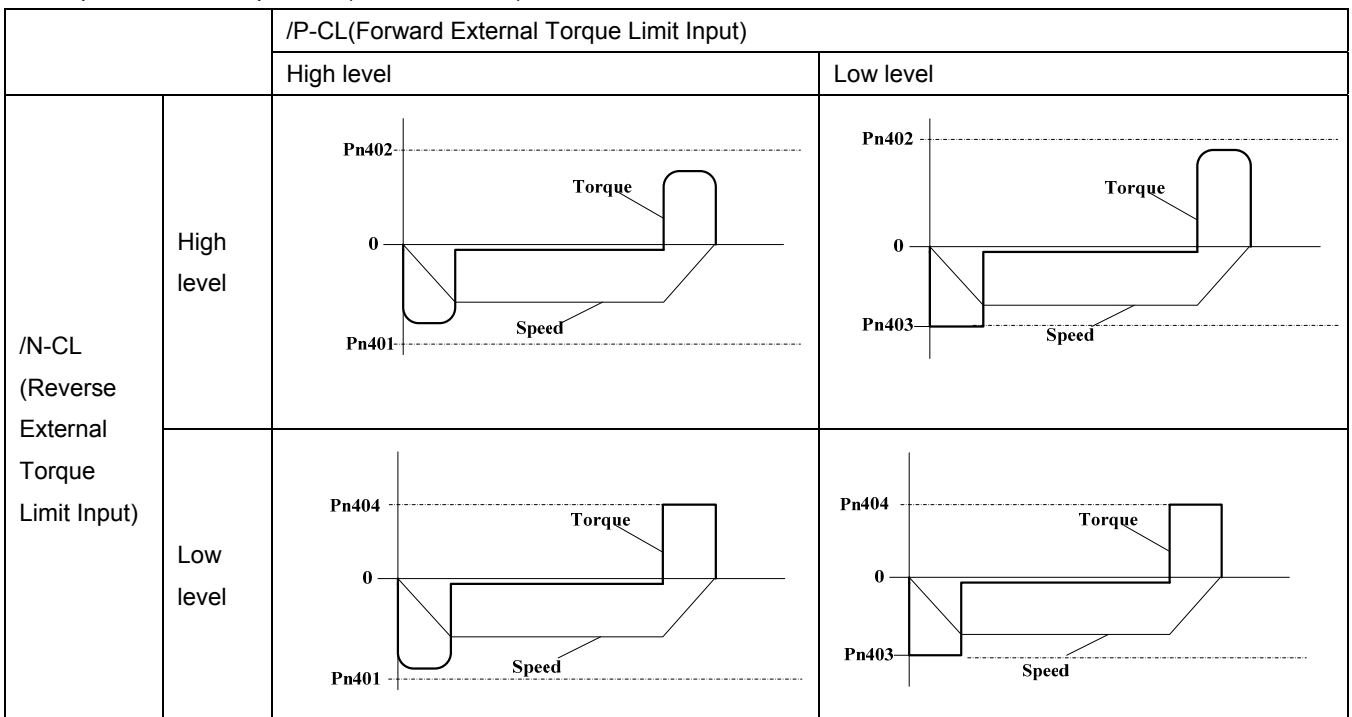
**(2) Input Signals**

| Type  | Signal Name | Connector Pin Number        | Setting         | Meaning                       | Limit Value |
|-------|-------------|-----------------------------|-----------------|-------------------------------|-------------|
| Input | /P-CL       | CN1-41<br>(factory setting) | ON(low level)   | Forward external torque limit | Pn403       |
|       |             |                             | OFF(high level) | Forward internal torque limit | Pn401       |
| Input | /N-CL       | CN1-42<br>(factory setting) | ON(low level)   | Reverse external torque limit | Pn404       |
|       |             |                             | OFF(high level) | Reverse internal torque limit | Pn402       |

When using this function, make sure that there are no other signals allocated to the same terminals as /P-CL and /N-CL.

**(3) Changes in Output Torque during External Torque Limiting**

Example: External torque limit (Pn401, Pn402) set to 300%

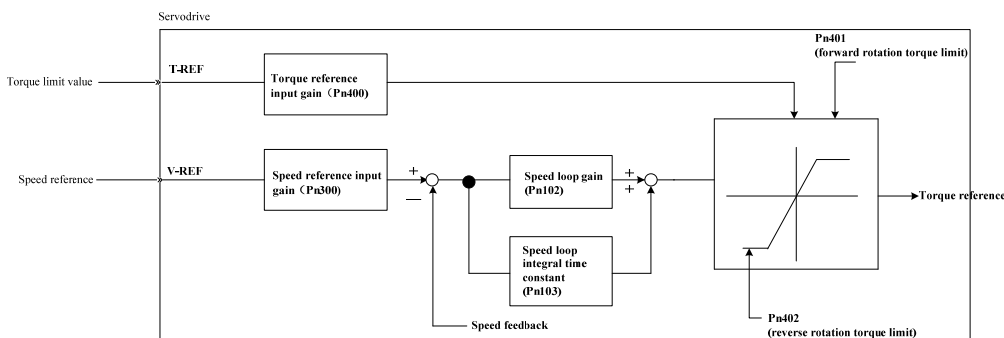


Note: Select the servomotor rotation direction by setting Pn001=b.□□□0 (standard setting, CCW=Forward direction).

### 4.8.3 Torque Limiting Using an Analog Voltage Reference

Torque limiting by analog voltage reference limits torque by assigning a torque limit in an analog voltage to the T-REF terminals (CN1-26,27). This function can be used only during speed or position control, not during torque control.

Refer to the following block diagram when the torque limit with an analog voltage reference is used for speed control.



**Important:**

- There is no issue with input voltage polarity of the analog voltage reference for torque limiting.
- The absolute values of both + and – voltages are input, and a torque limit value corresponding to that absolute value is applied in the forward or reverse direction.

**Related Parameters**

| Parameter       | Meaning  |
|-----------------|--|
| Pn001    b.□1□□ | Use the T-REF terminal to be used as an external torque limit input. |

## 4.9 Control Mode Selection

The methods and conditions for switching the servo drive control modes are described below.

### 4.9.1 Setting Parameters

The following control mode combinations can be selected according to the individual application of the user.

| Parameter | Control Method   |
|-----------|--|
| Pn005     | H.□□4□    Speed control (contact reference) ⇄ Speed control (analog voltage reference)         |
|           | H.□□5□    Speed control (contact reference) ⇄ Position control (pulse train reference)         |
|           | H.□□6□    Speed control (contact reference) ⇄ Torque control (analog voltage reference)        |
|           | H.□□7□    Position control (pulse train reference) ⇄ Speed control (analog voltage reference)  |
|           | H.□□8□    Position control (pulse train reference) ⇄ Torque control (analog voltage reference) |
|           | H.□□9□    Torque control (analog voltage reference) ⇄ Speed control (analog voltage reference) |
|           | H.□□A□    Speed control (analog voltage reference) ⇄ Zero clamp                                |
|           | H.□□B□    Position control (pulse train reference) ⇄ Position control (inhibit)                |

### 4.9.2 Switching the Control Mode

Switching Speed Control (Pn005.1=4, 5, 6)

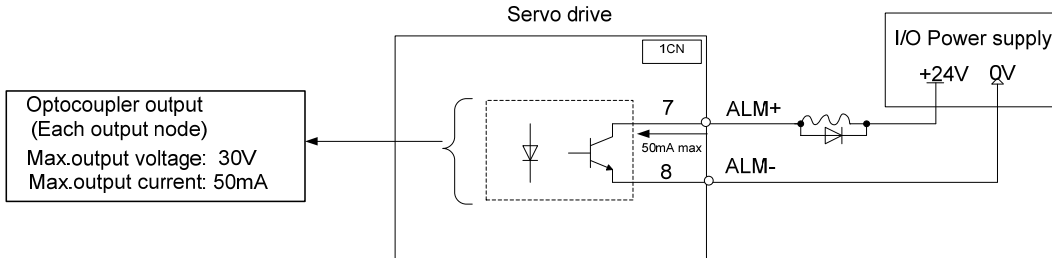
With the sequence input signals in the factory setting, the control mode will switch when both /P-CON and /P-CL, /N-CL signals are OFF (high level).

| Type  | Signal Name | Connector Pin Number     | Setting          | Meaning                |
|-------|-------------|--------------------------|------------------|------------------------|
| Input | /P-CL       | CN1-41 (factory setting) | OFF (high level) | Switches control mode. |
| Input | /N-CL       | CN1-42 (factory setting) | OFF (high level) |                        |

## 4.10 Other Output Signals

### 4.10.1 Servo alarm output

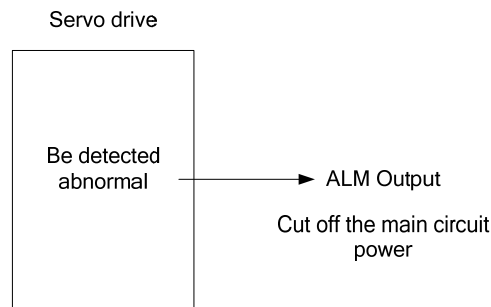
The following diagram shows the right way to connect the Alarm Output.



An external +24V I/O power supply is required since there is no +24V power source available inside the servo drive.

|                      |  |
|----------------------|--|
| Output → ALM+ 1CN- 7 | Servo alarm output                       |
| Output → ALM- 1CN- 8 | Servo alarm output uses grounding signal |

ALM outputs a signal when the servo drive is detected in an abnormal state.



Normally, the external circuit consists of /ALM should be able to switch off the power of servo drive.

| Signal | Status | Output level     | Comments     |
|--------|--------|------------------|--------------|
| ALM    | ON     | 1CN-7: "L" level | Normal state |
|        | OFF    | 1CN-8: "H" level | Alarm state  |

When "servo alarm(ALM)" happens, always remove alarm reasons first, and then turn the input signal "/ALM-RST" to ON position to reset alarm status.

|                         |                   |
|-------------------------|-------------------|
| → Input/ALM-RST 1CN- 39 | alarm reset input |
|-------------------------|-------------------|

| Signal   | Status | Input level       | Comments                 |
|----------|--------|-------------------|--------------------------|
| /ALM-RST | ON     | 1CN-39: "L" level | Reset servo alarm        |
|          | OFF    | 1CN-39: "H" level | Do not reset servo alarm |

Normally, the external circuit can switch off the power supply of the servo drive when an alarm occurs. When powered on again, the servo drive removes the alarm automatically, so the alarm reset is not required to be connected. In addition, the alarm reset is enabled with the panel operator.

**Note: When an alarm occurs, remove the alarm reason before resetting the alarms.**

## 4.10.2 Rotation Detection Output Signal (/TGON)

| Type   | Signal Name | Connector Pin Number              | Setting          | Meaning   |
|--------|-------------|-----------------------------------|------------------|---|
| Output | /TGON       | CN1-5, CN1-6<br>(Factory setting) | ON (low level)   | Servomotor is operating (Servomotor speed is above the setting in Pn503).     |
|        |             |                                   | OFF (high level) | Servomotor is not operating (Servomotor speed is below the setting in Pn503). |

This signal output indicates that the servomotor is currently operating above the setting set in parameter Pn503.

- Related parameter

|       |                               |              |                 |                    |
|-------|-------------------------------|--------------|-----------------|--------------------|
| Pn503 | Rotation Detection Speed TGON |              |                 |                    |
|       |                               | S            | P               | To                 |
|       | Setting range                 | Setting unit | Factory setting | Setting validation |
|       | 0~3000                        | rpm          | 20              | Immediately        |

- This parameter sets the range in which the rotation detection output signal (/TGON) is output
- When the servomotor rotation speed is above the value set in the Pn503, the servomotor rotation speed signal (/TGON) is output.
- The rotation detection signal can also be checked on the panel operator.

## 4.10.3 Servo Ready (/S-RDY) Output

| Type   | Signal Name | Connector Pin Number               | Setting          | Meaning             |
|--------|-------------|------------------------------------|------------------|---------------------|
| Output | /S-RDY      | CN1-9, CN1-10<br>(factory setting) | ON (low level)   | Servo is ready.     |
|        |             |                                    | OFF (high level) | Servo is not ready. |

- This signal indicates that the servo drive received the servo ON signal and completed all preparations.
- It is an output when there are no servo alarms and the main circuit power supply is turned ON.

## 4.10.4 Encoder C Pulse Output (/PGC)

| Type   | Signal Name | Connector Pin Number   | Setting          | Meaning                        |
|--------|-------------|--|------------------|--------------------------------|
| Output | /PGC        | Not including this setting in the default setting, please choose terminal output by setting parameter Pn511. | ON (low level)   | With encoder C pulse output    |
|        |             |  | OFF (high level) | Without encoder C pulse output |

This signal indicates when the servo drive circumrotates to the C pulse position; there is a correlation between the width of the C pulse and the speed of the servo drive.

## 4.10.5 Over travel signal output (OT)

| Type | Signal Name | Connector Pin | Setting | Meaning |
|------|-------------|---------------|---------|---------|
|------|-------------|---------------|---------|---------|

|   |    | Number  |                 |  |
|---|----|---|-----------------|--|
| Output  | OT | Not including this setting in the default setting, please choose terminal output by setting parameter Pn511 | ON(low level)   | Without forward rotation Prohibited(POT)and reverserotationprohibited(NOT)signal |
|   |    |   | OFF(high level) | With forward rotation Prohibited(POT)and reverse rotation prohibited(NOT)signal  |
| When machine is on over travel state,OUT signal is OFF;Host controller can use this signal to stop sending reference. |    |   |                 |  |

Related parameter

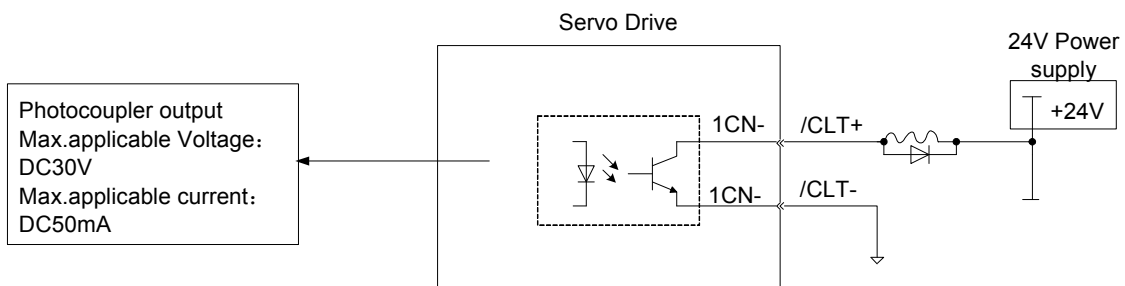
| Pn000   | POT/NOT       | S    | P               | To                 |
|---|---------------|------|-----------------|--------------------|
|   | Setting Range | Unit | Factory Setting | Setting Validation |
|   | 0~1111        | —    | 0               | After restart      |
| Pn000.1=1,external POT disabled;Pn000.2=1, external NOT disabled;<br>Pn000.1=1 and Pn000.2=1,OT signal is ON. |               |      |                 |                    |

### 4.10.6 Servo Enabled Motor Excitation Output(/RD)

| Type   | Signal Name | Connector Pin Number  | Setting | Meaning                             |
|--|-------------|---|---------|-------------------------------------|
| Output   | /RD         | Not including this setting in the default setting, please choose terminal output by setting parameter Pn511 | ON=L    | Servo enabled motor excitation      |
|  |             |   | OFF=H   | Servo disabled motor not excitation |
| /RD is on when servo enabled motor excitation. |             |   |         |                                     |

### 4.10.7 Torque Limit Detection Output (/CLT)

The application of output signal /CLT is as follows:



|               |                     |   |
|---------------|---------------------|---|
| —>Output /CLT | Torque limit output | Speed, torque control, position control |
|---------------|---------------------|---|

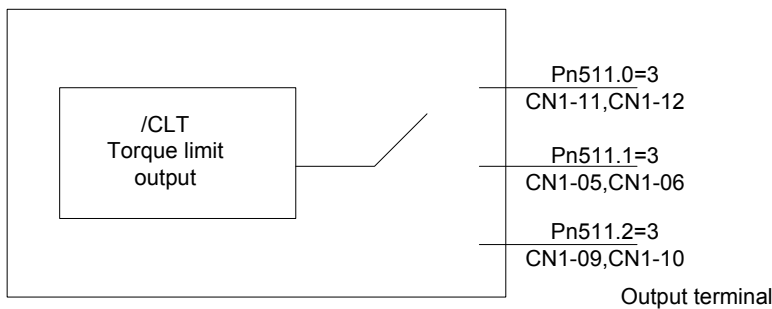
Indicates the output torque (current) of motor is limited.

| Type   | Signal Name | Connector Pin Number                                      | Setting | Meaning   |
|--------|-------------|---|---------|---|
| Output | /CLT        | Not including this setting in the default setting, please | ON=L    | Motor output torque under limit (Internal torque reference is higher than setting |

|  |   |       |  |
|--|---|-------|--|
|  | choose terminal output by setting parameter Pn511 |       | value).  |
|  |   | OFF=H | No torque limit (Internal torque reference is lower than setting value). |

Please use the following user constants to define output signals and pins when using /CLT signal.

| Para. No. |        | Connector Pin Number |           | Meaning                                 |
|-----------|--------|----------------------|-----------|---|
|           |        | +Terminal            | -Terminal |   |
| Pn511     | H.□□□3 | CN1-11               | CN1-12    | Output signal of CN1-11, CN1-12 is /CLT |
| Pn511     | H.□□3□ | CN1-05               | CN1-06    | Output signal of CN1-5, CN1-6 is /CLT   |
| Pn511     | H.□3□□ | CN1-09               | CN1-10    | Output signal of CN1-9, CN1-10 is /CLT  |



Parameter Pn511 description as following:

|   |   |
|---|---|
| 0 | /COIN(/V-CMP) output                      |
| 1 | /TGON rotation detecting output           |
| 2 | /S-RDY servo drive get ready output       |
| 3 | /CLT torque limit output                  |
| 4 | /BK brake interlock output                |
| 5 | /PGC encoder C pulse output               |
| 6 | OT overtravel signal output               |
| 7 | /RD servo enabled motor excitation output |
| 8 | /HOME home completion output              |
| 9 | /TCR Torque Detection Output              |

## 4.11 Online Autotuning

### 4.11.1 Online Autotuning Function

Online autotuning calculates the load moment of inertia during operation of the servo drive and sets parameters so that the servo gains are consistent with the machine rigidity.

Online autotuning may not be effective in the following cases:

- The motor high speed is lower than 100 rpm.
- The motor acceleration or deceleration is lower than 5000rpm/s.



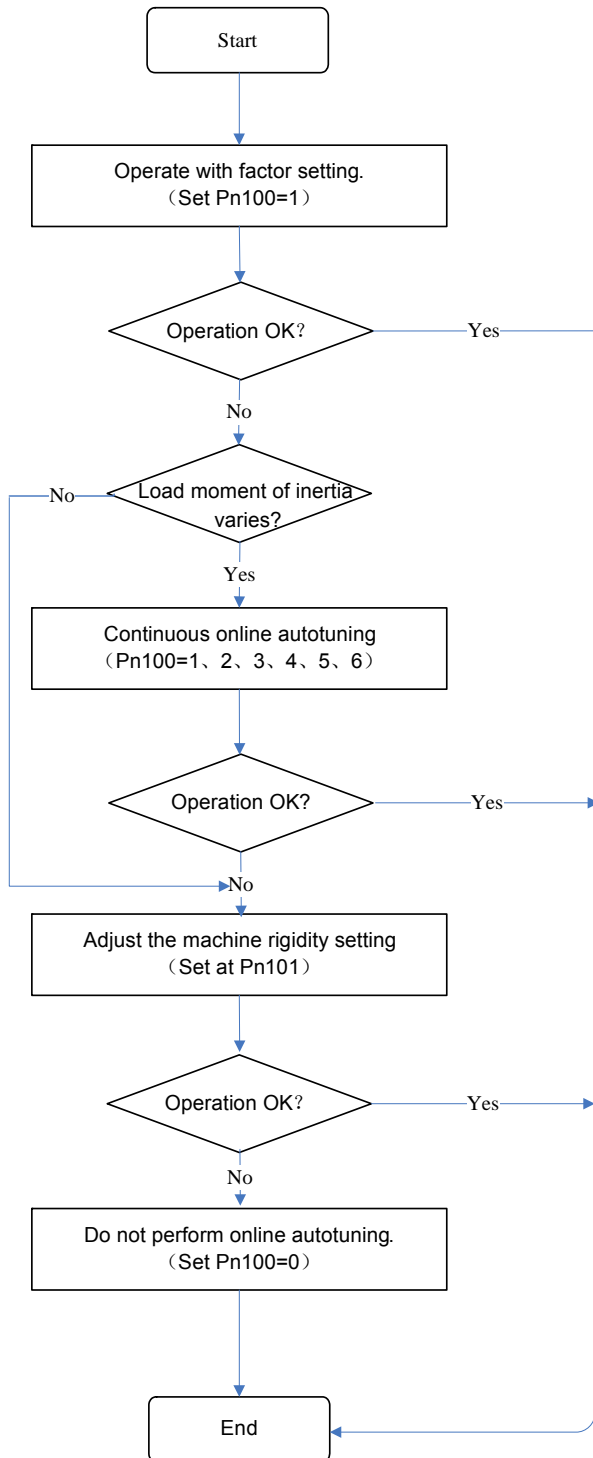
- Load rigidity is low and mechanical vibration occurs easily or friction is high.
- The speed load moment is changed greatly.
- Mechanical gas is very large.

If the condition meets one of the above cases or the desired operation cannot be achieved by the online autotuning, set the value in Pn106 (Load inertia percentage) and perform the adjustment manually.

## 4.11.2 Online Autotuning Procedure



- Do not perform extreme adjustment or setting changes causing unstable servo operation. Failure to observe this warning may result in injury and damages to the machine.
- Adjust the gains slowly while confirming motor operation.



### 4.11.3 Setting Online Auto-tuning

Related parameters:

| Parameter No. | Name   | Unit | Setting Range | Factory Setting | Setting Invalidation |
|---------------|--|------|---------------|-----------------|----------------------|
| Pn100         | Setting Online Auto-tuning<br>Pn100.0: Load inertia setting<br>0:User Manual setting | —    | 0~0x0006      | 0               | After restart        |

|       |  |   |      |   |             |
|-------|--|---|------|---|-------------|
|       | 1,2,3: Normal mode<br>4,5,6: Vertical load<br>1,4 :Load inertia without variation<br>2,5 :Load inertia with little variation<br>3,6: Load inertia with great variation |   |      |   |             |
| Pn101 | Machine rigidity setting   | — | 0~15 | 5 | Immediately |
| Pn128 | Speed gain acceleration relationship during online autotuning<br>If the setting is greater, the servo gain will increase.  | — | 0~3  | 3 | Immediately |

### 4.11.4 Machine Rigidity Setting for Online Auto-tuning

There are 16 machine rigidity settings for online auto-tuning, When the machine rigidity setting is selected, the servo gains (speed loop gain, speed loop integral time constant, position loop gain) are determined automatically. The factory setting for the machine rigidity setting is 5.

| Machine Rigidity Setting | Position Loop Gain 【s <sup>-1</sup> 】<br>Pn104 | Speed Loop Gain 【Hz】<br>Pn102=Pn104*( Pn128+1) | Speed Loop Integral Time Constant 【0.1ms】<br>Pn103 |
|--------------------------|--|--|--|
| 0                        | 10   | 40   | 800  |
| 1                        | 15   | 60   | 600  |
| 2                        | 20   | 80   | 450  |
| 3                        | 25   | 100  | 400  |
| 4                        | 30   | 120  | 300  |
| 5                        | 40   | 160  | 200  |
| 6                        | 65   | 260  | 140  |
| 7                        | 80   | 320  | 110  |
| 8                        | 100  | 400  | 90   |
| 9                        | 120  | 480  | 80   |
| 10                       | 140  | 560  | 70   |
| 11                       | 160  | 640  | 60   |
| 12                       | 180  | 720  | 55   |
| 13                       | 210  | 840  | 50   |
| 14                       | 250  | 1000   | 40   |
| 15                       | 300  | 1200   | 30   |

# Chapter 5

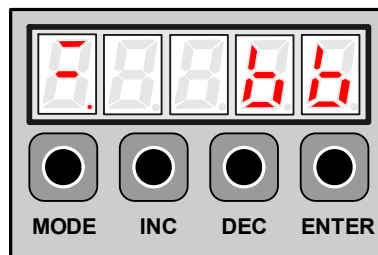
## Panel Operator

### 5.1 Basic Operation

#### 5.1.1 Functions on Panel Operator

The panel operator is a built-in operator that consists of display section and keys located on the front panel of the servo drive. Parameter setting, status display, and execution of utility function are enabled using the panel operator.

The names and functions of the keys on the panel operator are shown as follows:



| Panel Symbol | Corresponding Key Name | Function  |
|--------------|------------------------|---|
| ▲            | INC key                | <ul style="list-style-type: none"> <li>To display the parameter settings and setting values.</li> <li>To increase the setting value.</li> <li>To decrease the setting value.</li> </ul>   |
| ▼            | DEC key                |   |
| M            | MODE key               | <ul style="list-style-type: none"> <li>To select a basic mode, such as the display mode, parameter setting mode, monitor mode, or utility function mode.</li> <li>To save the setting during parameter setting and exit.</li> </ul> |
| ◀            | ENTER key              | To display the parameter settings and setting values, and release alarm.  |

Note: In this manual, the Panel Symbol is represented by Corresponding Key Name for easy understanding.

#### 5.1.2 Resetting Servo Alarms

Servo alarms can be reset by pressing the ENTER key when the panel operator is in display mode. Servo alarms can also be reset using the CN1-39(/ALM-RST) input signal.

There is no need to clear the servo alarms if it turns the main circuit power supply OFF.

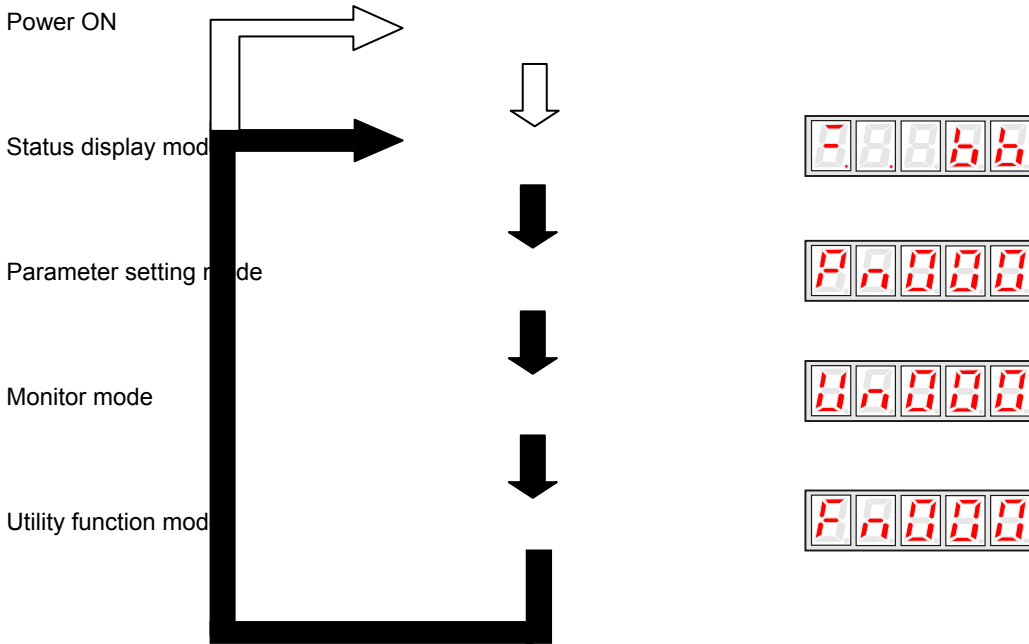
**Note:** After an alarm occurs, remove the cause of the alarm before resetting it.

### 5.1.3 Basic Mode Selection

The basic modes include status display mode, parameter setting mode, monitor mode, and utility function mode. Each time the MODE key is pressed, the next mode in the sequence is selected.

Select a basic mode to display the operation status, set parameters and operation references.

The basic mode is selected in the following order.



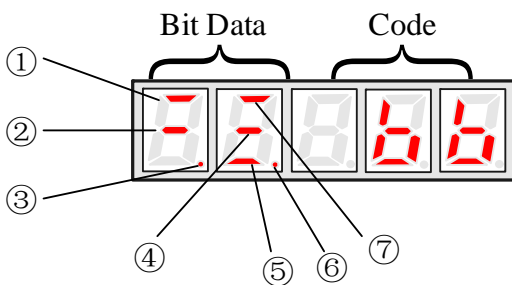
### 5.1.4 Status Display Mode

The status display mode displays the servo drive status as bit data and codes.

Selecting Status Display Mode

The status display mode is selected when the power supply is turned ON. If it is not displayed, select this mode by pressing MODE key.

Note that the display differs between the speed/torque control and position control types.



Bit Data Display

| No. | Speed/Torque Control Mode |  | Position Control Mode  |   |
|-----|---------------------------|--|------------------------|---|
|     | Bit Data                  | Description  | Bit Data               | Description   |
| 1   | Speed Coincidence         | Lit when the difference between the servomotor and reference speed is the same as or less than the preset value. | Positioning Completion | Lit if error between position reference and actual servomotor position is below preset value. |

|   |                          |   |                                  |  |
|---|--------------------------|---|----------------------------------|--|
|   |                          | Present value:Pn501(factory setting is 10rpm)<br>Always lit in torque control mode.   |                                  | Present value:Pn500(10 pulse isfactory setting)  |
| 2 | Base lock                | Lit for base block. Not lit at servo ON.  | Base block                       | Lit for base block. Not lit at servo ON.   |
| 3 | Control power ON         | Lit when servo drive control power is ON.   | Control power ON                 | Lit when servo drive control power is ON.  |
| 4 | Speed reference input    | Lit if input speed reference exceeds preset value.Not lit if input speed reference is below preset value.<br>Preset value: Pn503(factory setting is 20 rpm) | Reference pulse input            | Lit if reference pulse is input.<br>Not lit if no reference pulse is input.  |
| 5 | Torque reference input   | Lit if input torque reference exceeds preset value.<br>Not lit if input torque reference is below preset value.<br>Preset value: 10% of rated torque        | Error counter clear signal input | Lit when error counter clear signal is input. Not lit when error counter clear signal is not input.  |
| 6 | Power ready              | Lit when main circuit power supply is ON and normal.<br>Not lit when main circuit power supply is OFF.  | Power ready                      | Lit when main circuit power supply is ON and normal.<br>Not lit when main circuit power supply is OFF.   |
| 7 | Rotation detection /TGON | Lit if servomotor speed exceeds preset value.Not lit if servomotor speed is below preset value.<br>Preset value:Pn503(factory setting is 20 rpm)            | Rotation detection /TGON         | Lit if servomotor speed exceeds preset value.Not lit if servomotor speed is below preset value.<br>Preset value:Pn503(factory setting is 20 rpm) |

### Codes Display

| Code | Meaning   |
|------|---|
|      | Baseblock<br>Servo OFF(servomotor power OFF)    |
|      | Run<br>Servo ON (servomotor power ON)           |
|      | Forward Run Prohibited<br>CN1-16 (P-OT) is OFF. |
|      | Reverse Run Prohibited<br>CN1-17 (N-OT) is OFF. |
|      | Alarm Status<br>Displays the alarm number.      |

Press ENTER key to clear the present servo alarm.

## 5.1.5 Operation in Parameter Setting Mode

The servo drive offers a large number of functions, which can be selected or adjusted by the parameter settings. Refer to **A.1 Parameter List** for details.

### ■Parameter Setting Procedures

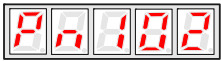
The parameter settings can be used for changing parameter data. Before changing the data, check the permitted range of the parameter.

The example below shows how to change parameter Pn102 from “100” to “85”.

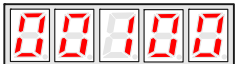
Press MODE key to select the parameter setting mode.



Press INC key or DEC key to select parameter number.



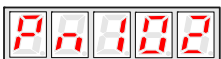
Press ENTER key to display the current data of Pn102.



Press the INC or DEC key to change the data to the desired number 00085. Hold the key to accelerate the changing of value. When the maximum value or minimum value is reached, pressing INC or DEC key respectively, will have no effect.



Press the ENTER or MODE key once to return to the display of Pn102.



In addition, We can press MODE and ENTER keys at the same time in the second step, enter into parameter number shift station, modify parameter number through shift. After modification completion, press MODE and ENTER keys at the same time exit from parameter number shift station. Parameter shift operation can be executed in the third and fourth steps, namely, long-pressing ENTER key enter into parameter shift edited station, then shift edit parameter, after finishing edit, directly press MODE key save and exit setting parameter, or long-pressing ENTER key exit parameter shift editing station, again gentle-pressing ENTER key exit to parameter number displaying picture.

## 5.1.6 Operation in Monitor Mode

The monitor mode allows the reference values input into the servo drive, I/O signal status, and servo drive internal status to be monitored.

### ■Using the Monitor Mode

The example below shows how to display the value (1500) stored in Un001.

1. Press MODE key to select the monitor mode.



2. Press the INC or DEC key to select the monitor number to display.



3. Press the ENTER key to display the data for the monitor number selected at step 2.



4. Press the ENTER key once more to return to the monitor number display.



■ List of Monitor Modes

Contents of Monitor Mode Display

| Monitor Number | Monitor Display   |  |
|----------------|---|--|
| Un000          | Actual servomotor speed Unit: rpm                                   |  |
| Un001          | Input speed reference Unit: rpm                                     |  |
| Un002          | Input torque reference Unit: %<br>(with respect to rated torque)    |  |
| Un003          | Internal torque reference Unit: %<br>(with respect to rated torque) | Internal status bit display                              |
| Un004          | Number of encoder rotation angle pulses                             |  |
| Un005          | Input signal monitor  |  |
| Un006          | Encoder signal monitor  |  |
| Un007          | Output signal monitor   |  |
| Un008          | Frequency given by pulse Unit: 1kHz                                 |  |
| Un009          | Number of servomotor rotation pulses                                |  |
| Un010          | Pulse rate of servomotor rotated (x10 <sup>4</sup> )                |  |
| Un011          | Error pulse counter lower 16 digit                                  |  |
| Un012          | Error pulse counter higher 16 digit                                 |  |
| Un013          | Number of pulses given  |  |
| Un014          | Number of pulses given (x10000)                                     |  |
| Un015          | Load inertia percentage   |  |
| Un016          | Servomotor overload ratio   |  |
| Un017          | Servomotor winding temperature                                      | Only used in EHD-7.5kW~22kW when equipped with resolver. |
| Un018          | Generatrix Voltage Inspection                                       |  |
| Un019          | Generatrix Voltage Maximum  |  |

Contents of Bit Display:

| Monitor Number | Display LED Number | Content           |
|----------------|--------------------|-------------------|
| Un005          | 0                  | /S-ON (CN1-14)    |
|                | 1                  | /PCON (CN1-15)    |
|                | 2                  | P-OT (CN1-16)     |
|                | 3                  | N-OT (CN1-17)     |
|                | 4                  | /ALM-RST (CN1-39) |
|                | 5                  | /CLR (CN1-40)     |
|                | 6                  | /PCL (CN1-41)     |
|                | 7                  | /NCL (CN1-42)     |

| Monitor Number | Display LED Number | Content    |
|----------------|--------------------|------------|
| Un006          | 0                  | (Not used) |
|                | 1                  | (Not used) |



|  |   |              |
|--|---|--------------|
|  | 2 | ( Not used ) |
|  | 3 | Phase-C      |
|  | 4 | Phase-B      |
|  | 5 | Phase-A      |
|  | 6 | ( Not used ) |
|  | 7 | ( Not used ) |

| Monitor Number | Display LED Number | Content        |
|----------------|--------------------|----------------|
| Un007          | 0                  | CN1_05, CN1_06 |
|                | 1                  | CN1_07, CN1_08 |
|                | 2                  | CN1_09, CN1_10 |
|                | 3                  | CN1_11, CN1_12 |

## 5.2 Operation in Utility Function Mode

In utility function mode, the panel operator can be used to run and adjust the servo drive and servomotor.

The following table shows the parameters in the utility function mode.

| Parameter No. | Function   |
|---------------|--|
| Fn000         | Alarm traceback data display                         |
| Fn001         | Parameter setting initialization                     |
| Fn002         | JOG mode operation                                   |
| Fn003         | Automatic adjustment of speed reference offset       |
| Fn004         | Manual adjustment of speed reference offset          |
| Fn005         | Automatic adjustment of servomotor current detection |
| Fn006         | Manual adjustment of servomotor current detection    |
| Fn007         | Software version display                             |
| Fn008         | Position teaching                                    |
| Fn009         | Static inertia detection                             |
| Fn010         | Absolute encoder multiturn data and alarm reset      |
| Fn011         | Absolute encoder related alarms reset                |

---

Note: Fn010、Fn011 only can be used when the servomotor mounted the absolute encoder.

---

### 5.2.1 Alarm Traceback Data Display

The alarm traceback display can display up to 10 previously occurred alarms. The alarm is displayed on Fn000, which is stored in the alarm traceback data.

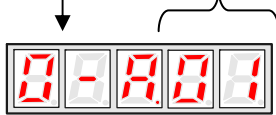
Follow the procedures below to confirm alarms which have been generated.

1. Press the MODE key to select the utility function mode.
2. Press the INC or DEC key to select the function number of alarm traceback data display.

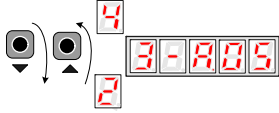


3. Press the ENTER key once, the latest alarm data is displayed.

Alarm Sequence Number Alarm Code



4. Press the INC or DEC key to display other recent alarms that have occurred.



5. Press the ENTER key, the display will return to Fn000.



**Note:** Hold the ENTER key for one second with alarm code displaying, all the alarm traceback data will be cleared.



### 5.2.2 Parameter Settings Initialization

Follow the procedures below to execute the parameter settings initialization.

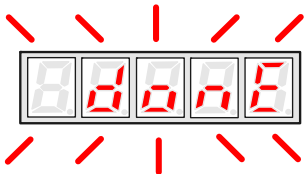
1. Press the MODE key to select the utility function mode.
2. Press the INC or DEC key to select the function number of parameter settings initialization.



3. Press the ENTER key to enter into parameter settings mode.




4. Hold the ENTER key for one second, the parameters will be initialized.



5. Release the ENTER key to return to the utility function mode display Fn001.



**Note:**

When display  on Motor is on electrical station, does not initialize the parameter settings.

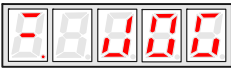
### 5.2.3 Operation in JOG Mode

Follow the procedures below to operate the servomotor in JOG mode.

1. Press the MODE key to select the utility function mode.
2. Press the INC or DEC key to select the function number of JOG mode operation.



3. Press the ENTER key to enter into JOG operation mode.

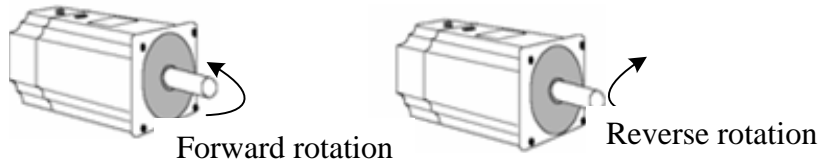


4. Press the MODE key to enter into servo ON(servomotor power ON) status.



5. Press the MODE key to switch between the servo ON and servo OFF status. The servo drive must be in servo ON status when the servomotor is running.

6. Press the INC or DEC key to rotate the servomotor.



7. Press the ENTER key to return to utility function mode display Fn002. Now the servo is OFF(servomotor power OFF).



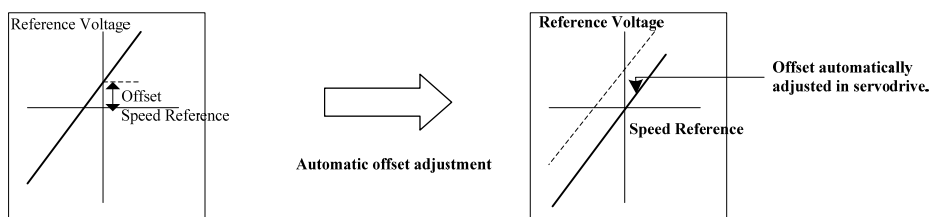
## 5.2.4 Automatic Adjustment of the Speed Reference Offset

When using the speed/torque (analog reference) control, the servomotor may rotate slowly even if 0V is specified as the analog voltage reference.

This happens if the host controller or external circuit has a slight offset (in the unit of mV) in the reference voltage.

The reference offset automatic adjustment mode automatically measures the offset and adjusts the reference voltage. It can adjust both speed and torque reference offset.

The servo drive automatically adjusts the offset when the host controller or external circuit has the offset in the reference voltage.



After completion of the automatic adjustment, the amount of offset is stored in the servo drive. The amount of offset can be checked in the speed reference offset manual adjustment mode (Fn004). Refer to **4.5.3 (2) Manual Adjustment of the Speed Reference Offset**.

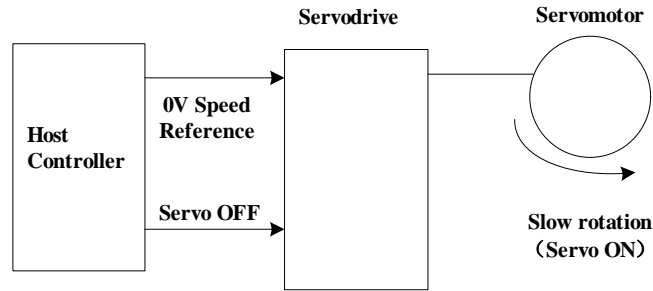
The automatic adjustment of reference offset (Fn003) cannot be used when a position loop has been formed with a host controller and the error pulse is changed to zero at the servomotor stop due to servolock. Use the speed reference offset manual adjustment for a position loop.

The zero-clamp speed control function can be used to force the servomotor to stop while the zero speed reference is given.

**Note:** The speed reference offset must be automatically adjusted with the servo OFF.

Adjust the speed reference offset automatically in the following procedure.

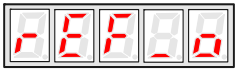
1. Turn OFF the servo drive, and input the 0V reference voltage from the host controller or external circuit.



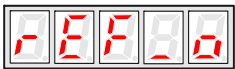
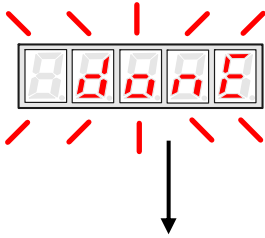
2. Press the MODE key to select the utility function mode.
3. Press the INC or DEC key to select the utility function number Fn003.



4. Press the ENTER key to enter into the speed reference offset automatic adjustment mode.



5. Press the MODE key for more than one second, the reference offset will be automatically adjusted.



6. Press the ENTER key to return to the utility function mode display Fn003.



7. Thus, the speed reference offset automatic adjustment is complete.

## 5.2.5 Manual Adjustment of the Speed Reference Offset

Manual adjustment of the speed/torque reference offset is used in the following cases:

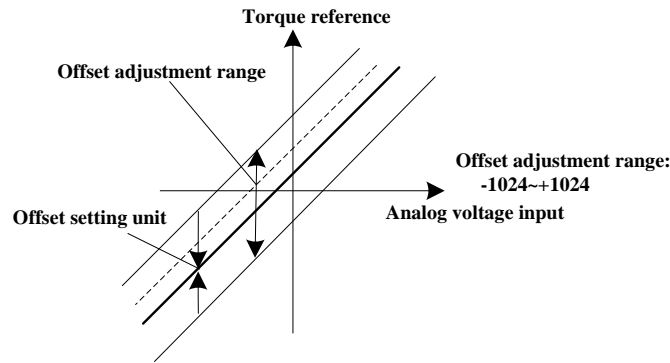
If a position loop is formed with the host controller and the error is zeroed when servolock is stopped.

To deliberately set the offset to some value.

Use this mode to check the offset data that was set in the automatic adjustment mode of the speed/torque reference offset.

This mode operates in the same way as the automatic adjustment mode, except that the amount of offset is directly input during the adjustment.

The offset adjustment range and setting unit are as follows.



**Note:**

**When the offset using in automatic adjustment exceeds the manual adjustment range (-1024~+1024), manual adjustment will be invalid.**

Adjust the analog reference offset manually in the following procedure:

1. Press the MODE key to select the utility function mode.
2. Press the INC or DEC key to select the utility function number Fn004.



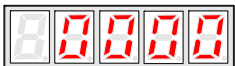
3. Press the ENTER key to enter into the speed reference offset manual adjustment mode.



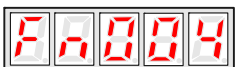
4. Turn ON the servo-ON signal, the display is shown as follows:



5. Hold the ENTER key, the speed reference offset will be displayed.



6. Press the INC or DEC key to change the offset.
7. Hold the ENTER key to return to the display in step 4.
8. Press ENTER key to return to the utility function mode display Fn004..



Thus, the speed reference offset manual adjustment is complete.

## 5.2.6 Offset-adjustment of Servomotor Current Detection Signal

Automatic servomotor current detection offset adjustment is performed at ESTUN before shipping. Basically, the user does not need to perform this adjustment.

Perform this adjustment only if highly accurate adjustment is required for reducing torque ripple caused by current offset.

This section describes the automatic and manual servomotor current detection offset adjustment.

**Note:**

- Offset-adjustment of the servomotor current detection signal is possible only while power is supplied to the main circuit power supply and with the servo is the OFF state.
- Execute the automatic offset adjustment if the torque ripple is too big when compared with that of other servo drives.

- If this function, particularly manual adjustment, is executed carelessly, it may worsen the characteristics.

### ■ Automatic Offset-adjustment of Servomotor Current Detection Signal

Adjust the servomotor current detection signal automatically in the following procedure:

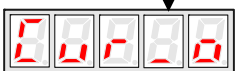
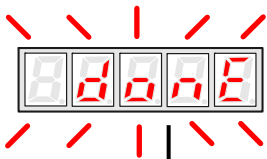
1. Press the MODE key to select the utility function mode.
2. Press the INC or DEC key to select the utility function number Fn005.



3. Press the ENTER key to enter into the automatic adjustment of the servomotor current detection signal mode.



4. Press the MODE key, the display will blink for one second. The offset will be automatically adjusted.



5. Press the ENTER key to return to the utility function mode display Fn005.



Thus, the automatic offset-adjustment of the servomotor current detection signal is complete.

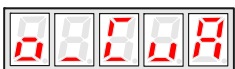
### ■ Manual Offset-adjustment of Servomotor Current Detection Signal

Adjust the servomotor current detection signal manually in the following procedure.

1. Press the MODE key to select the utility function mode.
2. Press the INC or DEC key to select the utility function number Fn006.



3. Press the ENTER key to enter into the manual adjustment of the servomotor current detection signal.



4. Press the MODE key to switch between the phase U(o \_ CuA) and phase V(1\_ Cub) servomotor current detection offset adjustment.



5. Hold the ENTER key for one second to display the phase V offset amount.



6. Press the INC or DEC key to adjust the offset.



7. Press the ENTER key for one second to return to the display in step 3 or 4.
8. Press the ENTER key to return to the utility function mode display Fn006.



Thus, the manual offset-adjustment of the servomotor current detection signal is completed.

**Note:**

The adjusting range of the servomotor current detection offset is -1024 to +1024.

## 5.2.7 Software Version Display

Select Fn007 in utility function mode to check the current software version of the drive.

1. Press the MODE key to select the utility function mode.
2. Press the INC or DEC key to select the utility function number Fn007.



3. Press the ENTER key to display the DSP software version (the highest bit displays 1).



4. Press the MODE key to display the FPGA/CPLD software version (the highest bit displays P).



5. Press the MODE key to return to DSP software version display.
6. Press the ENTER key to return to the utility function mode display Fn007.

## 5.2.8 Position Teaching Function

Perform the position teaching function in the following procedure.

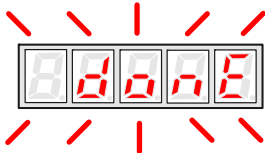
1. Press the MODE key to select the utility function mode.
2. Press the INC or DEC key to select the utility function number Fn008.



3. Press the ENTER key, the display will be shown as below.



4. Press the ENTER key, the display will be shown as below.

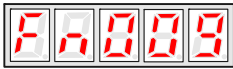


5. Release the ENTER key to complete position teaching function.

## 5.2.9 Static Inertia Detection

1. Press the MODE key to select the utility function mode.

2. Press the INC or DEC key to select the utility function number Fn009.



3. Press the ENTER key, the display will be shown as below.



4. Press the MODE key to rotate the servomotor, and the servomotor dynamic speed will be displayed.
5. The unit of the servomotor and load total inertia displayed when servomotor stops is kg.cm<sup>2</sup>

Thus, the static inertia detection is complete.

---

**Note:** Make sure that the servomotor completes at least 6 full revolutions in the CCW direction before detection.

---

## 5.2.10 Absolute Encoder Multiturn Data and Alarm Reset

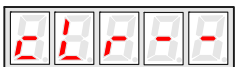
1. Press the MODE key to select the utility function mode.
2. Press the INC or DEC key to select the utility function number Fn010.



3. Press the ENTER key, the display will be shown as below.



4. Press the MODE key to reset the absolute encoder multiturn data and alarm.



5. Thus the absolute encoder multiturn data and alarm reset is complete.

---

**Important:**

This function will clear the absolute position of the encoder; the mechanical safety must be noted.

When the multiturn data is cleared, other encoder alarms will be reset at the same time.

---

## 5.2.11 Absolute Encoder Related Alarms Reset

1. Press the MODE key to select the utility function mode.
2. Press the INC or DEC key to select the utility function number Fn011.



3. Press the ENTER key, the display will be shown as below.



4. Press the MODE key to clear the alarms.



5. Thus the absolute encoder related alarms reset is complete.



# Chapter 6

## MODBUS Communication

### 6.1 RS-485 Communication Wiring

EHD series servo drives provide the MODBUS communication function with RS-485 interface, which can be used to easily set parameters or to perform monitoring operations and so on.

The definitions of the servo drive communication connector terminals are as follows.

CN3:

| Terminal No. | Name    | Function                      |
|--------------|---------|-------------------------------|
| 1            | —       | Reserved                      |
| 2            | —       |                               |
| 3            | 485+    | RS-485 communication terminal |
| 4            | ISO_GND | Isolated ground               |
| 5            | ISO_GND |                               |
| 6            | 485-    | RS-485 communication terminal |
| 7            | CANH    | CAN communication terminal    |
| 8            | CANL    | CAN communication terminal    |

Note: Do not short terminal 1 and 2 of CN3.

CN4:

| Terminal No. | Name    | Function                      |
|--------------|---------|-------------------------------|
| 1            | —       | Reserved                      |
| 2            | —       | Reserved                      |
| 3            | 485+    | RS-485 communication terminal |
| 4            | ISO_GND | Isolated ground               |
| 5            | ISO_GND |                               |
| 6            | 485-    | RS-485 communication terminal |
| 7            | CANH    | CAN communication terminal    |
| 8            | CANL    | CAN communication terminal    |

Note:

1. The length of the cable should be less than 100 meters and in a environment with minimal electrical disturbance/interference. However, if the transmission speed is above 9600bps, please use the communication cable within 15 meters to ensure transmission accuracy..
2. A maximum of 31 servo drives can be connected when RS485 is used. Terminating resistances are used at both ends of the 485 network. If more devices are wanted to connect, use the repeaters to expand.
3. CN3 of servo drive is always used as communication cable input terminal, and CN4 is always used as communication cable output terminal (If still need to connect slave stations, the communication cable is connected from CN4 terminal to the next slave station; if need not, add balance resistor in CN4 terminal.). It is prohibited to connect CN3 of any two servo drives directly when multiple EHD series servo drives are connected.

**Example:**

When a RS-485 network is composed of a PLC and three servo drives (A, B, and C), the cable wiring is shown as follows:  
 PLC→CN3 of A, CN4 of A→CN3 of B, CN4 of B→CN3 of C, CN4 of C→120Ω terminating resistance.

## 6.2 MODBUS Communication Related Parameters

| Parameter No. | Description  | Setting Validation | Control Mode | Meaning  |
|---------------|--------------|--------------------|--------------|--|
| Pn700         | Hex          | After restart      | ALL          | Pn700.0 MODBUS baud rate<br>[0] 4800bps<br>[1] 9600bps<br>[2] 19200bps<br>Pn700.1 Communication protocol selection<br>[0] 7, N, 2 (MODBUS,ASCII)<br>[1] 7, E, 1 (MODBUS,ASCII)<br>[2] 7, O, 1 (MODBUS,ASCII)<br>[3] 8, N, 2 (MODBUS,ASCII)<br>[4] 8, E, 1 (MODBUS,ASCII)<br>[5] 8, O, 1 (MODBUS,ASCII)<br>[6] 8, N, 2 (MODBUS,RTU)<br>[7] 8, E, 1 (MODBUS,RTU)<br>[8] 8, O, 1 (MODBUS,RTU)<br>Pn700.2 Communication protocol selection<br>[0] SCI communication with no protocol<br>[1] MODBUS SCI communication<br>Pn700.3 Reserved |
| Pn701         | Axis address | After restart      | ALL          | Axis address of MODBUS protocol communication  |

## 6.3 MODBUS Communication Protocol

MODBUS communication protocol is only used when Pn700.2 is set to 1. There are two modes for MODBUS communication: ASCII (American Standard Code for information interchange) mode and RTU (Remote Terminal Unit) mode.

The next section describes the two communication modes.

### 6.3.1 Code Meaning

**ASCII Mode:**

Every 8-bit data is consisted by two ASCII characters. For example: One 1-byte data 64 H (Hexadecimal expression) is expressed as ASCII code '64', which contains '6' as ASCII code 36<sub>H</sub> and '4' as ASCII code 34<sub>H</sub>.

ASCII code for number 0 to 9, character A to F are as follows:

|            |                 |                 |                 |                 |                 |                 |                 |                 |
|------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| Character  | '0'             | '1'             | '2'             | '3'             | '4'             | '5'             | '6'             | '7'             |
| ASCII Code | 30 <sub>H</sub> | 31 <sub>H</sub> | 32 <sub>H</sub> | 33 <sub>H</sub> | 34 <sub>H</sub> | 35 <sub>H</sub> | 36 <sub>H</sub> | 37 <sub>H</sub> |
| Character  | '8'             | '9'             | 'A'             | 'B'             | 'C'             | 'D'             | 'E'             | 'F'             |
| ASCII Code | 38 <sub>H</sub> | 39 <sub>H</sub> | 41 <sub>H</sub> | 42 <sub>H</sub> | 43 <sub>H</sub> | 44 <sub>H</sub> | 45 <sub>H</sub> | 46 <sub>H</sub> |

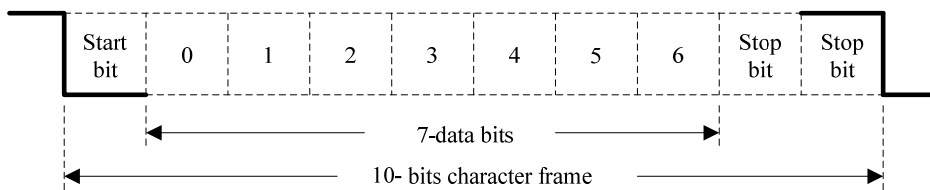
**RTU Mode:**

Every 8-bit data is consisted by two 4-bit hexadecimal data, that is to say, a normal hexadecimal data. For example: decimal data 100 can be expressed as 64<sub>H</sub> by 1-byte RTU data.

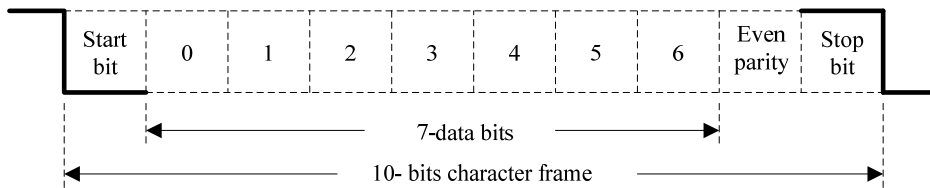
**Data Structure:**

10-bit character form (7-bit data)

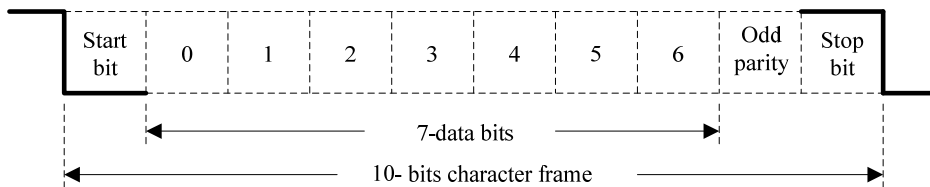
Pn700.1=0: 7, N, 2 (Modbus, ASCII)



Pn700.1=1: 7, E, 1 (Modbus, ASCII)

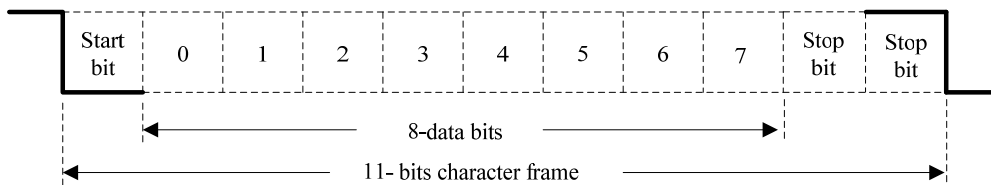


Pn700.1=2: 7, O, 1 (Modbus, ASCII)

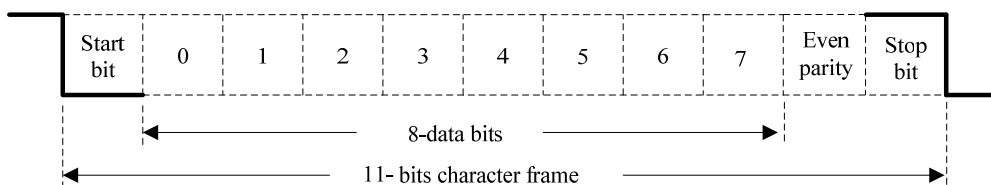


11-bit character form (8-bit data)

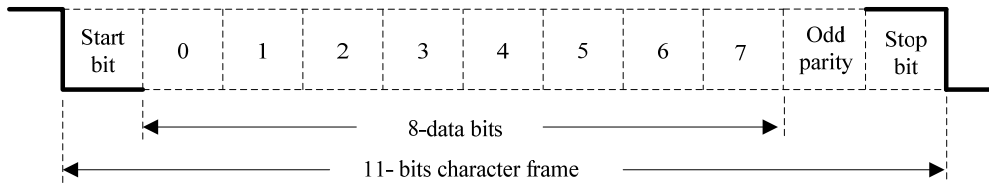
8, N, 2 (Modbus, ASCII/RTU)



8, E, 1 (Modbus, ASCII/RTU)



8, O, 1 (Modbus, ASCII/RTU)



Communication protocol structure:

Data format of communication protocol:

**ASCII Mode:**

|           |   |
|-----------|---|
| STX       | Start character: ' => (3A <sub>H</sub> )                      |
| ADR       | Communication address => 1-byte contains two ASCII codes      |
| CMD       | Reference code => 1-byte contains two ASCII codes             |
| DATA(n-1) | Data content => n-word=2n-byte contain 4n ASCII codes, n ≤ 12 |
| .....     |   |
| DATA(0)   |   |
| LRC       | Checking code => 1-byte contains two ASCII codes              |
| End 1     | End code 1 => (0D <sub>H</sub> ) (CR)                         |
| End 0     | End code 0 => (0A <sub>H</sub> ) (LF)                         |

**RTU Mode:**

|           |   |
|-----------|---|
| STX       | Sleep interval of at least 4 bytes transmission time. |
| ADR       | Communication address => 1-byte                       |
| CMD       | Reference code => 1-byte                              |
| DATA(n-1) | Data content => n-word=2n-byte, n ≤ 12                |
| .....     |   |
| DATA(0)   |   |
| CRC       | CRC checking code => 1-byte                           |
| End 1     | Sleep interval of at least 4 bytes transmission time. |

Communication protocol data format instructions are as follows:

**STX (communication start)**

ASCII mode: ':' character

RTU mode: Sleep interval of at least 4 bytes transmission time (automatically changed according to different communication speed).

**ADR (communication address)**

Valid communication address: 1 to 254

For example: communicate with the servo drive which address is 32 (20 in hex):

ASCII mode: ADR='2', '0'=>'2'=32<sub>H</sub>, '0'=30<sub>H</sub>

RTU mode: ADR=20H

**CMD (command reference) and DATA (data)**

Data structure is determined by command code. Regular command code is shown as follows:

Command code: 03H, read N words(word), N ≤ 20.

For example: read 2 words starting from 0200<sub>H</sub> from the servo drivewhichaddress is 01 H.

**ASCII mode:**

Reference information:

Response information:

|     |     |
|-----|-----|
| STX | “:” |
|-----|-----|

|                                |                        |
|--------------------------------|------------------------|
| ADR                            | '0'                    |
|                                | '1'                    |
| CMD                            | '0'                    |
|                                | '3'                    |
| Data start address             | '0'                    |
|                                | '2'                    |
|                                | '0'                    |
|                                | '0'                    |
| Data number<br>(count as word) | '0'                    |
|                                | '0'                    |
|                                | '0'                    |
|                                | '2'                    |
| LRC checking                   | 'F'                    |
|                                | '8'                    |
| End 1                          | (0D <sub>H</sub> )(CR) |
| End 0                          | (0A <sub>H</sub> )(LF) |

|   |                        |
|---|------------------------|
| STX   | “: ”                   |
| ADR   | '0'                    |
|   | '1'                    |
| CMD   | '0'                    |
|   | '3'                    |
| Data number<br>(count as byte)                      | '0'                    |
|   | '4'                    |
| Content of data start<br>address 0200 <sub>H</sub>  | '0'                    |
|   | '0'                    |
|   | 'B'                    |
|   | '1'                    |
| Content of second data<br>address 0201 <sub>H</sub> | '1'                    |
|   | 'F'                    |
|   | '4'                    |
|   | '0'                    |
| LRC checking  | 'E'                    |
|   | '8'                    |
| End 1   | (0D <sub>H</sub> )(CR) |
| End 0   | (0A <sub>H</sub> )(LF) |

RTU mode:

Reference information: Response information:

|                                |                            |
|--------------------------------|----------------------------|
| ADR                            | 01 <sub>H</sub>            |
| CMD                            | 03 <sub>H</sub>            |
| Data start address             | 02 <sub>H</sub> (high-bit) |
|                                | 00 <sub>H</sub> (low-bit)  |
| Data number<br>(count as word) | 00 <sub>H</sub>            |
|                                | 02 <sub>H</sub>            |
| CRC checking                   | C5 <sub>H</sub> (low-bit)  |
| CRC checking                   | B3 <sub>H</sub> (high-bit) |

|   |                            |
|---|----------------------------|
| ADR   | 01 <sub>H</sub>            |
| CMD   | 03 <sub>H</sub>            |
| Data number<br>(count as byte)                      | 04 <sub>H</sub>            |
| Content of data start<br>address 0200 <sub>H</sub>  | 00 <sub>H</sub> (high-bit) |
|   | B1 <sub>H</sub> (low-bit)  |
| Content of second data<br>address 0201 <sub>H</sub> | 1F <sub>H</sub> (high-bit) |
|   | 40 <sub>H</sub> (low-bit)  |
| CRC checking  | A3 <sub>H</sub> (low-bit)  |
| CRC checking  | D3 <sub>H</sub> (high-bit) |

Reference code: 06<sub>H</sub>, write in one word

For example: write 100 (0064<sub>H</sub>) into 01<sub>H</sub> servo address 0200<sub>H</sub>.

ASCII mode:

Reference information: response information:

|     |      |
|-----|------|
| STX | “: ” |
| ADR | '0'  |
|     | '1'  |

|                    |                        |
|--------------------|------------------------|
| CMD                | '0'                    |
|                    | '6'                    |
| Data start address | '0'                    |
|                    | '2'                    |
|                    | '0'                    |
| Data content       | '0'                    |
|                    | '0'                    |
|                    | '6'                    |
| LRC checking       | '9'                    |
|                    | '3'                    |
| End 1              | (0D <sub>H</sub> )(CR) |
| End 0              | (0A <sub>H</sub> )(LF) |

|   |                        |
|---|------------------------|
| STX   | “ : ”                  |
| ADR   | '1'                    |
| CMD   | '0'                    |
|   | '6'                    |
| Data start address                              | '0'                    |
|   | '2'                    |
|   | '0'                    |
| Content of data start address 0200 <sub>H</sub> | '0'                    |
|   | '0'                    |
|   | '6'                    |
| LRC checking                                    | '9'                    |
|   | '3'                    |
| End 1   | (0D <sub>H</sub> )(CR) |
| End 0   | (0A <sub>H</sub> )(LF) |

RTU mode:

Reference information: Response information:

|                    |                            |
|--------------------|----------------------------|
| ADR                | 01 <sub>H</sub>            |
| CMD                | 06 <sub>H</sub>            |
| Data start address | 02 <sub>H</sub> (high-bit) |
|                    | 00 <sub>H</sub> (low-bit)  |
| Data content       | 00 <sub>H</sub> (high-bit) |
|                    | 64 <sub>H</sub> (low-bit)  |
| CRC checking       | 89 <sub>H</sub> (low-bit)  |
| CRC checking       | 99 <sub>H</sub> (high-bit) |

|                    |                            |
|--------------------|----------------------------|
| ADR                | 01 <sub>H</sub>            |
| CMD                | 06 <sub>H</sub>            |
| Data start address | 02 <sub>H</sub> (high-bit) |
|                    | 00 <sub>H</sub> (low-bit)  |
| Data content       | 00 <sub>H</sub> (high-bit) |
|                    | 64 <sub>H</sub> (low-bit)  |
| CRC checking       | 89 <sub>H</sub> (low-bit)  |
| CRC checking       | 99 <sub>H</sub> (high-bit) |

LRC (ASCII mode) and CRC (RTU mode) error detection value calculation:

LRC calculation in ASCII mode:

ASCII mode uses LRC (Longitudinal Redundancy Check) error detection value. The exceeded parts (e.g. the total value is 128<sub>H</sub> of hex, then take 28<sub>H</sub> only) is taken off by the unit of 256 in the total value from ADR to the last information, then calculate and compensate, the final result is LRC error detection value.

For example: read 1 word from 01<sub>H</sub> servo address 0201<sub>H</sub>

|                                |       |
|--------------------------------|-------|
| STX                            | “ : ” |
| ADR                            | '0'   |
|                                | '1'   |
| CMD                            | '0'   |
|                                | '3'   |
| Data start address             | '0'   |
|                                | '2'   |
|                                | '0'   |
| Data number<br>(count as word) | '1'   |
|                                | '0'   |

|              |                        |
|--------------|------------------------|
|              | '0'                    |
|              | '1'                    |
| LRC checking | 'F'                    |
|              | '8'                    |
| End 1        | (0D <sub>H</sub> )(CR) |
| End 0        | (0A <sub>H</sub> )(LF) |

Add from ADR data to the last data.

01<sub>H</sub> + 03<sub>H</sub> + 02<sub>H</sub> + 01<sub>H</sub> + 00<sub>H</sub> + 01<sub>H</sub> = 08<sub>H</sub>

The compensate value is F8<sub>H</sub> when 2 is used to compensate 08<sub>H</sub>, so LRC is "F", "8".

CRC calculation of RTU mode:

RTU mode uses CRC (Cyclical Redundancy Check) error detection value.

The process of CRC error detection value calculation is shown as follows:

Step 1: Load in a 16-bit register of FFFF<sub>H</sub>, named "CRC" register.

Step 2: Run XOR calculation between the first bit (bit 0) of instruction information and 16-bit CRC register's low bit (LSB), and the result is saved to CRC register.

Step 3: Check the lowest bit (LSB) of CRC register, if it is 0, CRC register moves one bit to right; if it is 1, CRC register moves one bit to right, then run XOR calculation with A001<sub>H</sub>;

Step 4: Go to step 5 till the third step has been executed for 8 times, otherwise return to step 3.

Step 5: Repeat the steps from 2 to 4 for the next bit of instruction information, the content of CRC register is the CRC error detection value while all the bits have been executed by the same way.

Note: After calculating out the CRC error detection value, the CRC low bit should be filled first in instruction information, and then fill the high bit of CRC.

Please refer to the following example:

Read 2 words from the 0101<sub>H</sub> address of 01<sub>H</sub> servo. The final CRC register content calculated from ADR to the last bit of data is 3794<sub>H</sub>, and then the instruction information is shown as follows,

Please be sure that 94<sub>H</sub> is transmitted before 37<sub>H</sub>.

|                                |                            |
|--------------------------------|----------------------------|
| ADR                            | 01 <sub>H</sub>            |
| CMD                            | 03 <sub>H</sub>            |
| Data start address             | 01 <sub>H</sub> (high-bit) |
|                                | 01 <sub>H</sub> (low-bit)  |
| Data number<br>(count as word) | 00 <sub>H</sub> (high-bit) |
|                                | 02 <sub>H</sub> (low-bit)  |
| CRC checking                   | 94 <sub>H</sub> (low-bit)  |
| CRC checking                   | 37 <sub>H</sub> (high-bit) |

End1、End0 (Communication is complete.)

ASCII mode:

Communication is ended with (0DH) - [carriage return] and (0AH) - [new line].

RTU mode:

When the time exceeds the sleep interval by at least 4 bytes transmission time while in the current communication speed, it means the communication is finished.

Example:

The following example uses C language to generate CRC value. The function needs two parameters.

unsigned char \* data;

unsigned char length;

The function will return unsigned integer type CRC value.

```

unsigned int crc_chk(unsigned char * data,unsigned char length){
    int i,j;
    unsigned int crc_reg=0xFFFF;
    While(length- -){
        crc_reg ^=*data++;
        for(j=0;j<8;j++){
            If(crc_reg & 0x01){
                crc_reg=( crc_reg >>1)^0xA001;
            }else{
                crc_reg=crc_reg >>1;
            }
        }
    }
    return crc_reg;
}

```

### 6.3.2 Communication Error Disposal

Problems that occur during communication are a result of the following:

- Data address is incorrect while reading/writing parameters.
- The data is not within the parameter setting range while writing.
- Data transmission fault or checking code fault when communication is disturbed.

When the first and second communication faults occur, the servo drive is running normally, and will feed back an error frame. When the third communication fault occurs, transmission data will be recognized as invalid to give up, and no error frame is returned.

The format of error frame:

**Host controller data frame:**

| start | Slave station address | Command | Data address,content | Checking |
|-------|-----------------------|---------|----------------------|----------|
|       |                       | command |                      |          |

**Servo drive feeds back error frame:**

| start | Slave station address | Response code             | Error code | Checking |
|-------|-----------------------|---------------------------|------------|----------|
|       |                       | command + 80 <sub>H</sub> |            |          |

Error frame responses code=command+80<sub>H</sub>

Error code=00<sub>H</sub>: Normal communication

=01<sub>H</sub>: Servo drive cannot identify the required functions

=02<sub>H</sub>: The required data address does not exist in the servo drive

=03<sub>H</sub>: The required data in servo drive is not allowed. (Beyond the maximum or minimum value of the parameter)

=04<sub>H</sub>: Servo drive starts to perform the requirement, but cannot achieve it.



**For example:** Servo drive axis number is 03<sub>H</sub>, write data 06<sub>H</sub> into parameter Pn100 is not allowed, because the range of parameter Pn100 is 0~0x0036. The servo drive will feedback an error frame, the error code is 03<sub>H</sub> (Beyond the parameter's maximum value or minimum value).

**Host controller data frame:**

| start | Slave station address | Command         | Data address, content               | Checking |
|-------|-----------------------|-----------------|-------------------------------------|----------|
|       | 03 <sub>H</sub>       | 06 <sub>H</sub> | 0002 <sub>H</sub> 0006 <sub>H</sub> |          |

**Servo drive feedback error frame:**

| start | Slave station address | Response code   | Error code      | Checking |
|-------|-----------------------|-----------------|-----------------|----------|
|       | 03 <sub>H</sub>       | 86 <sub>H</sub> | 03 <sub>H</sub> |          |

Besides, if the data frame sent from host controller slave station address is 00<sub>H</sub>, it determines the data to be broadcast data. The servo drives will not feed back any frames.

### 6.3.3 Data Communication Address of Servo State

The communication parameter addresses are shown in the following table:

| Communication data address<br>Hex | Meaning  | Description                                | Operation  |
|-----------------------------------|--|--|------------|
| 0000 ~ 02FD                       | Parameter area                                   | Corresponding parameters in parameter list | Read/write |
| 07F1 ~ 07FA                       | Alarm information memory area                    | Ten alarms historical record               | Read only  |
| 07FB                              | Speed reference zero offset                      |  | Read/write |
| 07FC                              | Torque reference zero offset                     |  | Read/write |
| 07FD                              | Iu zero offset                                   |  | Read only  |
| 07FE                              | Iv zero offset                                   |  | Read only  |
| 0806 ~ 0817                       | Monitor data (corresponding with displayed data) |  |            |
| 0806                              | Speed feedback                                   | Unit:rpm                                   | Read only  |
| 0807                              | Input speed reference value                      | Unit:rpm                                   | Read only  |
| 0808                              | Input torque reference percentage                | Relative rated torque                      | Read only  |
| 0809                              | Internal torque reference percentage             | Relative rated torque                      | Read only  |
| 080A                              | Number of encoder rotation pulses                |  | Read only  |
| 080B                              | Input signal state                               |  | Read only  |
| 080C                              | Encoder signal state                             |  | Read only  |
| 080D                              | Output signal state                              |  | Read only  |
| 080E                              | Pulse setting                                    |  | Read only  |
| 080F                              | Low bits of present location                     | Unit:1 reference pulse                     | Read only  |

|      |  |                                |  |
|------|--|--------------------------------|--|
| 0810 | High bits of present location  | Unit:10000<br>reference pulses | Read only  |
| 0811 | Error pulse counter low 16 bits                                      |                                | Read only  |
| 0812 | Error pulse counter high 16 bits                                     |                                | Read only  |
| 0813 | Setting pulse counter low bits                                       | Unit:1 reference pulse         | Read only  |
| 0814 | Setting pulse counter high bits                                      | Unit:10000 reference pulses    | Read only  |
| 0815 | Load inertia percentage  | %                              | Read only  |
| 0816 | Servomotor overloading proportion                                    | %                              | Read only  |
| 0817 | Current alarm  |                                | Read only  |
|      |  |                                |  |
| 0900 | MODBUScommunication IO signal  | Donot save when<br>power off.  | Read/write   |
| 090E | DSP version  | Version is expressed by digit. | Read only  |
| 090F | CPLD version   | Version is expressed by digit. | Read only  |
| 1010 | 17-bit encoder multi-turn<br>information                             | Unit:1 revolution              | Read only.<br>Only for 17-bit<br>Encoder.<br>Multi-turn:16 bits<br>Single-turn:17 bits |
| 1011 | 17-bit encoder single-turn<br>information                            | Unit:1 pulse                   |  |
| 1012 | 17-bit encoder single-turn<br>information high bits                  |                                |  |
| 1021 | Clear historical alarms  | 01:Clear                       | Write only   |
| 1022 | Clear current alarms   | 01:Clear                       | Write only   |
| 1023 | JOG servo enabled  | 01:Enable<br>00:Disable        | Write only   |
| 1024 | JOG forward rotation   | 01:Forward rotation<br>00:Stop | Write only   |
| 1025 | JOG reverse rotation   | 01:Reverse rotation<br>00:Stop | Write only   |
| 1026 | JOG forward rotation at node<br>position( start signal has been set) | 01:Forward rotation<br>00:Stop |  |
| 1027 | JOG reverse rotation at node<br>position(start signal has been set)  | 01:Reverse rotation<br>00:Stop |  |
| 1028 | Pause at node position   | 01:Pause<br>00:Cancel pause    |  |
|      |  |                                |  |
| 1040 | Clear encoder alarm  | 01:Clear                       | Write only   |
| 1041 | Clear encoder multi-turn data  | 01:Clear                       | Only 17-bit encoder  |

**Note:**

1. Parameter area (communication address 0000~00DE<sub>H</sub>)

Parameter address is relevant to the parameters in the parameter list.

For example, parameter Pn000 is relevant to communication address 0000<sub>H</sub>; parameter Pn101 is relevant to communication address 0065<sub>H</sub>. Read/write operation to address 0000<sub>H</sub> is the read/write operation to Pn000. If the communication input data is not within the parameter range, the data will be aborted, and servo drive will return an operation unsuccessful signal.

2. Alarm information storage area (07F1~07FA<sub>H</sub>)

| Historical alarm number | Description                              | Communication address                 |
|-------------------------|--|---------------------------------------|
| 0                       | Historical alarm 1<br>(the latest alarm) | 07F1 <sub>H</sub>                     |
| 1 ~ 8                   | Historical alarm 2 ~ 9                   | 07F2 <sub>H</sub> ~ 07F9 <sub>H</sub> |
| 9                       | Historical alarm 10 (the furthest alarm) | 07FA <sub>H</sub>                     |

 3. Monitor data area (0806~0816<sub>H</sub>)

The monitor data is corresponding to servo drive panel displays Un000~Un016.

For example: the corresponding data of communication address 0807<sub>H</sub> (speed setting) is FB16<sub>H</sub>.

Therefore, the speed setting is -1258r/m.

## 4. MODBUS communication IO signal

Use communication to control digital IO signal. This data will not be saved after power off.

It is operated with Pn512 and Pn513 as the communication input IO signal. That is to say, when the parameters setting in Pn512 and Pn513 enable the IO bit, the IO can be controlled by communication.

 5. Software version (090F<sub>H</sub>)

Use digit to represent servo drive software version. For example, if the read out data is D201<sub>H</sub>, it means the software version is D-2.01.

# Chapter 7

## Specifications and Characters

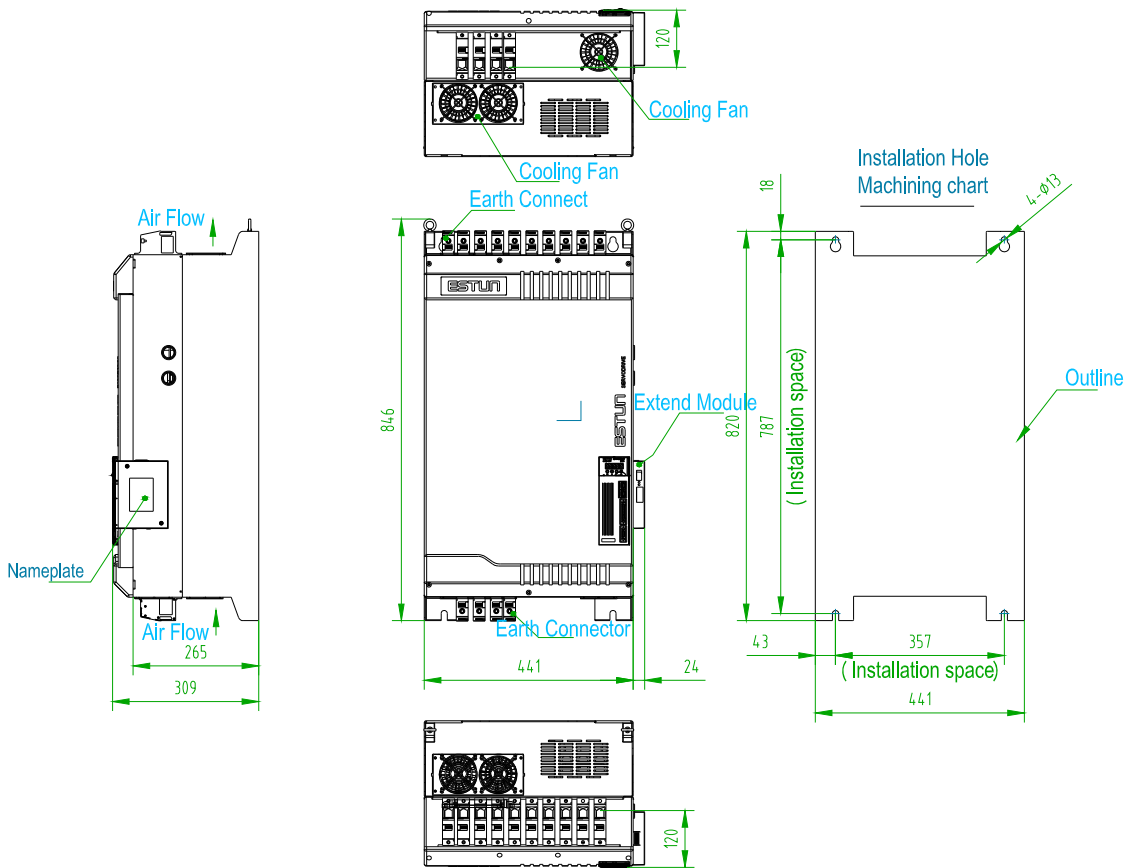
### 7.1 Servo drive Specifications and Models

| Servo drive Model:                |  | EHD-  | 3ED  | 5ZD□B    |         |                 |
|-----------------------------------|--|---|--|----------|---------|-----------------|
| Applicable Servomotor Model:      |  | 035D  | —  | 050DRA□□ | 053DRA□ | —               |
| Applicable Servomotor Model EMT2- |  | —   | 200GW-LAVA 3O-001                            | —        | —       | 200HW-LAVA3O-□□ |
| Continuous Output Current [Arms]  |  | 72  | 87   | 105      | 105     | 130             |
| Max. Output Current [Arms]        |  | 288   | 261  | 420      | 420     | 390             |
| Input Power Supply                | Main Circuit                           | Three-phase 380~440VAC <sup>+10%</sup> / <sub>-15%</sub> (50Hz)                       |  |          |         |                 |
|                                   | Control Circuit                        | Single-Phase 380~440VAC <sup>+10%</sup> / <sub>-15%</sub> (50Hz)                      |  |          |         |                 |
|                                   | Main Input Power Supply Capacity [kVA] | 125   |  |          |         |                 |
| Control Method                    |  | SVPWM Control   |  |          |         |                 |
| Feedback                          |  | Resolver: 32768P/R (max)  |  |          |         |                 |
| Operating Conditions              | Ambient/Storage Temperature            | Ambient temperature: 0~+55°C,<br>Storage temperature: -20~+85°C                       |  |          |         |                 |
|                                   | Ambient/Storage                        | 90% RH (with no condensation)   |  |          |         |                 |
|                                   | Elevation                              | 1000m or less   |  |          |         |                 |
|                                   | Vibration/Shock Resis                  | Vibration Resistance: 4.9m/s <sup>2</sup> , Impact Resistance: 19.6m/s <sup>2</sup>   |  |          |         |                 |
| Configuration                     |  | Base-mounted  |  |          |         |                 |
| Performance                       | Speed Control Range                    |   | 1:5000                                       |          |         |                 |
|                                   | Speed Regulation                       | Load Regulation   | 0~100% load: ±0.01% or less (at rated speed) |          |         |                 |
|                                   |  | Voltage Regulation  | Rated voltage ±10%: 0% (at rated speed)      |          |         |                 |
|                                   |  | Temperature Regulation  | 25±25°C: ±0.1% or less (at rated speed)      |          |         |                 |
| Reference Control                 | Analog Reference Voltage               | ±10VDC at rated torque (Variable setting range: ±0~10VDC)<br>Max. input voltage: ±12V |  |          |         |                 |

| Servo drive Model:                |                                | EHD-  | 3ED   | 5ZD□B    |         |                 |
|-----------------------------------|--------------------------------|---|---|----------|---------|-----------------|
| Applicable Servomotor Model:      |                                | 035D  | —   | 050DRA□□ | 053DRA□ | —               |
| Applicable Servomotor Model EMT2- |                                | —   | 200GW-LAVA 3O-001   | —        | —       | 200HW-LAVA3O-□□ |
|                                   | ce Input                       | Input Impedan   | About 10MΩ or above   |          |         |                 |
|                                   |                                | Circuit   | 10μs  |          |         |                 |
| Speed Control                     | Analog Input Reference         | Reference Voltage   | ±10VDC at rated speed (Variable setting range:±0~10VDC)<br>Max. input voltage: ±12V   |          |         |                 |
|                                   |                                | Input   | About 10MΩ or above   |          |         |                 |
|                                   |                                | Circuit   | 10μs  |          |         |                 |
|                                   | Speed Selection                | Rotation Direction Selection                                      | With /P-CON signal  |          |         |                 |
|                                   |                                | Speed   | Speed 1 to 7  |          |         |                 |
| Function                          | Soft start Setting             | 0~10s (Can be set individually for acceleration and deceleration) |   |          |         |                 |
| Position Control                  | Pulse Reference                | Type  | Sign + pulse train; CCW + CW pulse train;<br>90° phase difference 2-phase (phase A + phase B)   |          |         |                 |
|                                   |                                | Form  | Non-insulated line driver (about + 5V), open collector  |          |         |                 |
|                                   |                                | Frequency   | ×1 multiplier: 4Mpps<br>×2 multiplier: 2Mpps<br>×4 multiplier: 1Mpps<br>Open collector: 200Kpps<br>Frequency will begin to decline when the duty ratio error occurs..   |          |         |                 |
| Position Reference Setting        | Position Setting               | 16 position nodes can be set.                                     |   |          |         |                 |
| I/O Signals                       | Encoder Dividing Pulses Output |   | Phase-A, phase-B, phase-C, line driver output<br>Number of dividing pulses: any   |          |         |                 |
|                                   | Sequence Input                 | Number of channels  | 8 channels  |          |         |                 |
|                                   |                                | Function  | Signal allocations and positive/negative logic modifications:<br>Servo ON (/S-ON), P control (/P-CON), alarm reset (/ALM-RST), position error clear (/CLR), forward run prohibited (P-OT), reverse run prohibited (N-OT), forward current limit (/P-CL), reverse current limit (/N-CL) and so on. |          |         |                 |
|                                   | Sequence Output                | Number of channels  | 4 channels  |          |         |                 |

| Servo drive Model:                |                             | EHD-  | 3ED   | 5ZD□B    |         |                      |
|-----------------------------------|-----------------------------|---|---|----------|---------|----------------------|
| Applicable Servomotor Model:      |                             | 035D  | —   | 050DRA□□ | 053DRA□ | —                    |
| Applicable Servomotor Model EMT2- |                             | —   | 200GW-LAVA<br>3O-001  | —        | —       | 200HW-LAVA3O-□<br>□□ |
|                                   |                             | Function  | Signal allocations and positive/negative logic modifications:<br>Positioning completion(/COIN), speed coincidence(/V-CMP), servomotor rotation detection(/TGON), servo ready(/S-RDY), torque limit output(/CLT), brake interlock output(/BK), encoder C pulse(/PGC) and Over travel (/OT) . |          |         |                      |
| Internal Function                 | Dynamic Brake (DB) function | Main power is cut、 Servo Alarm、 Servo is disable or overtravell   |   |          |         |                      |
|                                   | Regenerative unctions       | 0.75kW ~ 7.5kW : internal regenerative resistor ; 11kW ~ 22kW : external regenerative resistor  |   |          |         |                      |
|                                   | Protection Functions        | Overcurrent, overvoltage, low voltage, overload, regeneration error, overspeed, etc.  |   |          |         |                      |
|                                   | Utility Function            | Alarm trace back、 JOG operation、 load inertia detection, etc.   |   |          |         |                      |
|                                   | Display Function            | CHARGE (Red) 、 POWER (Green) 、 five 7-segment LEDS (Built-in panel operator)  |   |          |         |                      |
|                                   | Communication Functiion     | RS-485 communication port, MODBUS protocol ; CAN communication port, CANopen protocol;<br>EtherCAT communication module, CiA402 protocol; POWERLINK communication module, CiA402 protocol |   |          |         |                      |

## 7.2 Servo drive Dimensional Drawings

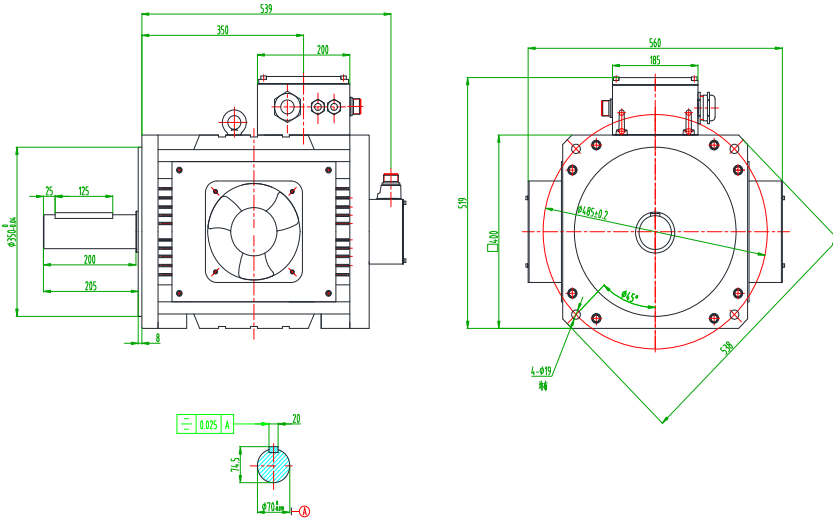


## 7.3 Motor technical spec and model

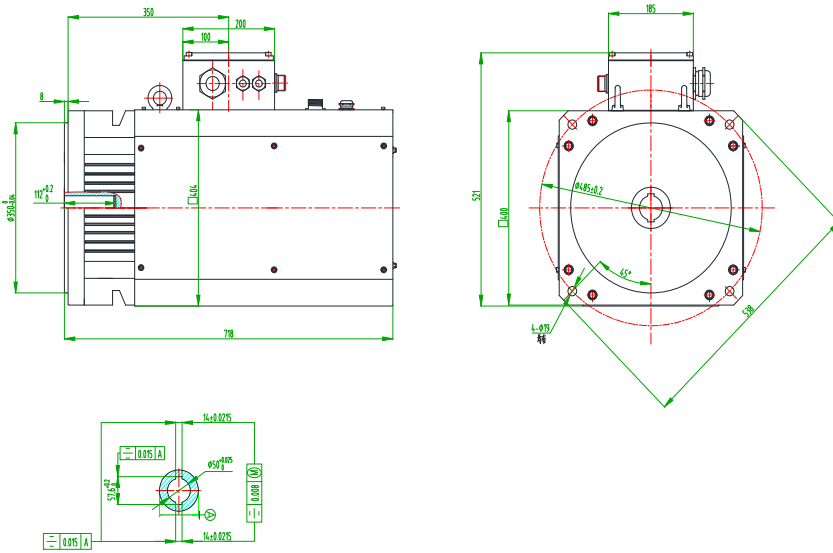
| Servo drive Model:     | EMT-              | 035DRA□□   | —                | 050DRA□□ | 053DRA□□ | —                |
|------------------------|-------------------|--|------------------|----------|----------|------------------|
|                        | EMT2-             | —  | 200GW-LAVA30-001 | —        | —        | 200HW-LAVA30-□□□ |
| Rated Power            | kW                | 35   | 42               | 50       | 53       | 63               |
| Rated Torque           | N·m               | 669  | 800              | 955      | 1000     | 1200             |
| Maximum Torque         | N·m               | 2676   | 2400             | 3820     | 4000     | 3600             |
| Rated Current          | Arms              | 70.5   | 87               | 90       | 105      | 130              |
| Maximum Current        | Arms              | 282  | 261              | 360      | 420      | 390              |
| Rated Speed            | min <sup>-1</sup> | 500  |                  |          |          |                  |
| Maximum Speed          | min <sup>-1</sup> | 600  |                  |          |          |                  |
| Rotormoment of inertia | kg·m <sup>2</sup> | 0.55   | 0.34             | 1.5      | 1.0      | 0.53             |
| OvenproofClass         |                   | F  |                  |          |          |                  |
| Ambien Temperature     |                   | 0 to +40°C ( with no cooling)  |                  |          |          |                  |
| Ambient Humidity       |                   | 20 to 80% RH ( with no condensation )  |                  |          |          |                  |
| Protection mode        |                   | Full closed, cooling by self, IP54(If without oil seal, then eliminateshaft end; Water proof connector, hen eliminate connector) |                  |          |          |                  |

## 7.4 Motor Installation Dimension

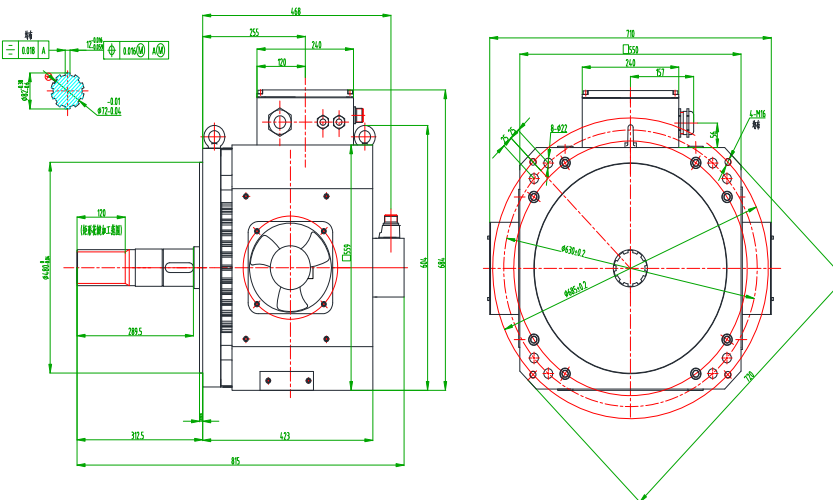
EMT-035DRA



EMT-035DRB



EMT-050DRA



EMT-053DRA







A.1 Parameter List

| Parameter No. | Name   | Unit | Setting Range | Factory Setting | Setting Invalidation |
|---------------|--|------|---------------|-----------------|----------------------|
| Pn000         | Binary<br>Pn000.0: Servo ON<br>Pn000.1: Forward rotation input signal prohibited (P-OT)<br>Pn000.2: Reverse rotation input signal prohibited (N-OT)<br>Pn000.3: Alarm output when instantaneous power loss                     | —    | 0~1111        | 0               | After restart        |
| Pn001         | Binary<br>Pn001.0: CCW,CW selection<br>Pn001.1: Analog speed limit enabled<br>Pn001.2: Analog torque limit enabled<br>Pn001.3: 2nd electronic gear enabled   | —    | 0~1111        | 0               | After restart        |
| Pn002         | Binary<br>Pn002.0: Electronic gear switching mode<br>Pn002.1: Reserved<br>Pn002.2: Absolute encoder selection<br>Pn002.3: Reserved   | —    | 0~0111        | 0010            | After restart        |
| Pn003         | Binary<br>Pn003.0: Reserved<br>Pn003.1: Reserved<br>Pn003.2: Low speed compensation<br>Pn003.3: Overload enhancement   | —    | 0~1111        | 0               | After restart        |
| Pn004         | Hex<br>Pn004.0: Stop mode<br>Pn004.1: Error counter clear mode<br>Pn004.2: Reference pulse form<br>Pn004.3: Inverses pulse   | —    | 0~0x3425      | 0               | After restart        |
| Pn005         | Hex<br>Pn005.0: Torque feedforward mode<br>Pn005.1: Control mode<br>[0] Speed control(analog reference)<br>[1] Position control(pulse train)<br>[2] Torque control(analog reference)<br>[3] Speed control(contact reference)←→ | —    | 0~0x33E3      | 0               | After restart        |

| Parameter No. | Name   | Unit  | Setting Range     | Factory Setting | Setting Invalidation |
|---------------|--|-------|-------------------|-----------------|----------------------|
|               | speed control(zero reference)<br>[4] Speed control(contact reference)←→<br>speed control(analog reference)<br>[5] Speed control(contact reference)←→<br>position control(pulse train)<br>[6] Speed control(contact reference)←→<br>torque control(analog reference)<br>[7] Position control(pulse train)←→<br>speed control(analog reference)<br>[8] Position control(pulse train)←→<br>torque control(analog reference)<br>[9] Torque control(analog reference)←→<br>speed control(analog reference)<br>[A] Speed control(analog reference)←→<br>zero clamp<br>[B] Position control(pulse train)←→<br>position control(inhibit)<br>[C] Position control(contact reference)<br>[D] Speed control(parameter reference)<br>[E] Special control<br>Pn005.2:Out-of-tolerance alarm selection<br>Pn005.3:Servomotor model |       |                   |                 |                      |
| Pn006         | Hex<br>Pn006.0:Bus mode<br>Pn006.1:Reserved<br>Pn006.2:Reserved<br>Pn006.3:Reference input filter for open collector signal  | —     | 0~0x1033          | 0x0020          | After restart        |
| Pn008         | Hex<br>Pn008.0: wider the width of C pulse or not<br>Pn008.1: Reserved   | kHz   | 0x0004<br>~0x0035 | 0x0015          | After restart        |
| Pn100         | Online autotuningsetting<br>Pn100.0 Load inertia setting<br>[0] Manual setting<br>[1,2,3] Normal mode<br>[4,5,6] Vertical load<br>[1,4] Load inertia without variation<br>[2,5] Load inertia with little variation<br>[3,6] Load inertia with great variation  | —     | 0~6               | 0               | After restart        |
| Pn101         | Machine rigidity setting   | —     | 0~15              | 5               | Immediately          |
| Pn102         | Speed loop gain  | Hz    | 1~4000            | 160             | Immediately          |
| Pn103         | Speed loop integral time constant  | 0.1ms | 1~4096            | 200             | Immediately          |
| Pn104         | Position loop gain   | 1/s   | 0~1000            | 40              | Immediately          |

| Parameter No. | Name  | Unit            | Setting Range | Factory Setting | Setting Invalidation |
|---------------|---|-----------------|---------------|-----------------|----------------------|
| Pn105         | Torque reference filter time constant   | 0.1ms           | 0~250         | 4               | Immediately          |
| Pn106         | Load inertia percentage   | —               | 0~20000       | 0               | Immediately          |
| Pn107         | 2nd speed loop gain   | Hz              | 1~4000        | 40              | Immediately          |
| Pn108         | 2nd speed loop integral time constant   | 0.1ms           | 1~4096        | 200             | Immediately          |
| Pn109         | 2nd position loop gain  | Hz              | 0~1000        | 40              | Immediately          |
| Pn110         | 2nd torque reference filter time constant   | 0.1ms           | 0~250         | 4               | Immediately          |
| Pn111         | Speed bias  | rpm             | 0~300         | 0               | Immediately          |
| Pn112         | Feedforward   | %               | 0~100         | 0               | Immediately          |
| Pn113         | Feedforward filter  | 0.1ms           | 0~640         | 0               | Immediately          |
| Pn114         | Torque feedforward  | %               | 0~100         | 0               | Immediately          |
| Pn115         | Torque feedforward filter   | 0.1ms           | 0~640         | 0               | Immediately          |
| Pn116         | P/PI switching condition<br>0:Torque reference percentage<br>1:Value of offset counter<br>2:Value of acceleration speed setting<br>3:Value of speed setting<br>4:Fixed PI   | —               | 0~4           | 0               | After restart        |
| Pn117         | Torque switching threshold  | %               | 0~300         | 200             | Immediately          |
| Pn118         | Offset counter switching threshold  | reference pulse | 0~10000       | 0               | Immediately          |
| Pn119         | Setting acceleration speed switching threshold  | 10rpm/s         | 0~3000        | 0               | Immediately          |
| Pn120         | Setting speed switching threshold   | rpm             | 0~10000       | 0               | Immediately          |
| Pn121         | Gain switching condition<br>0:Fix to 1st group gain<br>1:External switch gain switching<br>2:Torque percentage<br>3:Value of offset counter<br>4:Value of acceleration speed setting<br>5:Value of speed setting<br>6:Speed reference input | —               | 0~6           | 0               | After start          |
| Pn122         | Switching delay time  | 0.1ms           | 0~20000       | 0               | Immediately          |
| Pn123         | Threshold switching level   |                 | 0~20000       | 0               | Immediately          |
| Pn124         | Reserved  | —               | —             | —               | —                    |
| Pn125         | Position gain switching time  | 0.1ms           | 0~20000       | 0               | Immediately          |
| Pn126         | Hysteresis switching  | —               | 0~20000       | 0               | Immediately          |
| Pn127         | Low speed detection filter  | 0.1ms           | 0~100         | 10              | Immediately          |
| Pn128         | Speed gain acceleration relationship during online autotuning   | —               | 0~3           | 3               | Immediately          |
| Pn129         | Low speed correction coefficient  | —               | 0~30000       | 0               | Immediately          |
| Pn130         | Friction load   | 0.1%            | 0~3000        | 0               | Immediately          |
| Pn131         | Friction compensation speed hysteresis area   | rpm             | 0~100         | 0               | Immediately          |
| Pn132         | Sticking friction load  | 0.1%/1000rp     | 0~1000        | 0               | Immediately          |

| Parameter No. | Name   | Unit     | Setting Range | Factory Setting | Setting Invalidation |
|---------------|--|----------|---------------|-----------------|----------------------|
|               |  | m        |               |                 |                      |
| Pn133         | Pressure circle proportion coefficient   | —        | 1~2000        | 700             | Immediately          |
| Pn134         | Pressure circleintegral time   | 0.1ms    | 1~20000       | 600             | Immediately          |
| Pn135         | Maximum reverse speed in stress mode(when setting,note that if pump can be reversed)                                   | rpm      | 0~500         | 50              | Immediately          |
| Pn136         | Pressure feedbackoffsetadjustion   | —        | -1024~1024    | 0               | Immediately          |
| Pn137         | Pressure feedbackfilter time constant  | 0.1ms    | 0~1000        | 10              | Immediately          |
| Pn138         | Pressure given filter time constant  | 0.1ms    | 0~1000        | 10              | Immediately          |
| Pn200         | PG divided ratio   | Puls     | 16~16384      | 16384           | After restart        |
| Pn201         | 1st electronic gear numerator  | —        | 1~65535       | 1               | After restart        |
| Pn202         | Electronic gear denominator  | —        | 1~65535       | 1               | After restart        |
| Pn203         | 2nd electronic gear numerator  | —        | 1~65535       | 1               | After restart        |
| Pn204         | Position reference Acceleration /deceleration time constant  | 0.1ms    | 0~32767       | 0               | Immediately          |
| Pn205         | Position reference filter form selection   | —        | 0~1           | 0               | After restart        |
| Pn300         | Speed reference input gain   | rpm/v    | 0~3000        | 50              | Immediately          |
| Pn301         | Analog speed given zero bias   | 10mv     | -1000~1000    | 0               | Immediately          |
| Pn302         | Reserved   | —        | —             | —               | —                    |
| Pn303         | Reserved   | —        | —             | —               | —                    |
| Pn304         | Parameter speed  | rpm      | 0~6000        | 50              | Immediately          |
| Pn305         | JOG speed  | rpm      | 0~6000        | 50              | Immediately          |
| Pn306         | Soft start acceleration time   | ms       | 0~10000       | 0               | Immediately          |
| Pn307         | Soft start deceleration time   | ms       | 0~10000       | 0               | Immediately          |
| Pn308         | Speed filter time constant   | ms       | 0~10000       | 0               | Immediately          |
| Pn309         | S curve risetime   | ms       | 0~10000       | 0               | Immediately          |
| Pn310         | Speed reference curve form<br>0:Slope<br>1:S curve<br>2:1 <sup>st</sup> order filter<br>3:2 <sup>nd</sup> order filter | —        | 0~3           | 0               | After restart        |
| Pn311         | S form selection   | —        | 0~3           | 0               | Immediately          |
| Pn312         | DP communication JOG speed   | rpm      | -6000~6000    | 500             | Immediately          |
| Pn313         | Pressure Slope time (100bar rise time)   | 0.1ms    | 0~10000       | 0               | Immediately          |
| Pn314         | Pressure feedback value  | 0.1bar/v | 0~10000       | 250             | Immediately          |
| Pn315         | Pressure given value   | 0.1bar/v | 0~10000       | 140             | Immediately          |
| Pn316         | Internal speed 1   | rpm      | -6000~6000    | 30              | Immediately          |
| Pn317         | Internal speed 2   | rpm      | -6000~6000    | 50              | Immediately          |
| Pn318         | Internal speed 3   | rpm      | -6000~6000    | 100             | Immediately          |
| Pn319         | Internal speed 4   | rpm      | -6000~6000    | -30             | Immediately          |
| Pn320         | Internal speed 5   | rpm      | -6000~6000    | -50             | Immediately          |
| Pn321         | Internal speed 6   | rpm      | -6000~6000    | -100            | Immediately          |
| Pn322         | Internal speed 7   | rpm      | -6000~6000    | 200             | Immediately          |

| Parameter No. | Name  | Unit      | Setting Range | Factory Setting | Setting Invalidation |
|---------------|---|-----------|---------------|-----------------|----------------------|
| Pn400         | Torque reference gain   | 0.1V/100% | 10~100        | 33              | Immediately          |
| Pn401         | Forward torque internal limit①  | %         | 0~300         | 400             | Immediately          |
| Pn402         | Reverse torque internal limit①  | %         | 0~300         | 400             | Immediately          |
| Pn403         | Forward external torque limit①  | %         | 0~300         | 100             | Immediately          |
| Pn404         | Reverse external torque limit①  | %         | 0~300         | 100             | Immediately          |
| Pn405         | Plug braking torque limit   | %         | 0~300         | 300             | Immediately          |
| Pn406         | Speed limit during torque control   | rpm       | 0~6000        | 200             | Immediately          |
| Pn407         | Notch filter 1 frequency  | Hz        | 50~5000       | 5000            | Immediately          |
| Pn408         | Notch filter 1 depth  | —         | 0~11          | 1               | Immediately          |
| Pn409         | Notch filter 2 frequency  | Hz        | 50~5000       | 5000            | Immediately          |
| Pn410         | Notch filter 2 depth  | —         | 0~11          | 1               | Immediately          |
| Pn411         | Reserve   | —         | —             | —               | —                    |
| Pn412         | Reserve   | —         | —             | —               | —                    |
| Pn413         | Torque control delay time   | 0.1ms     | 1~2000        | 100             | Immediately          |
| Pn414         | Torque control speed hysteresis   | rpm       | 10~1000       | 50              | Immediately          |
| Pn415         | Analog torque given zero bias   | 10mv      | -1000~1000    | 0               | Immediately          |
| Pn500         | Positioning error   | Puls      | 0~5000        | 100             | Immediately          |
| Pn501         | Coincidence difference  | rpm       | 0~100         | 10              | Immediately          |
| Pn502         | Zero clamp speed  | rpm       | 0~3000        | 10              | Immediately          |
| Pn503         | Rotation detection speed TGON   | rpm       | 0~3000        | 20              | Immediately          |
| Pn504         | Offset counter overflow alarm   | 256Puls   | 1~32767       | 1024            | Immediately          |
| Pn505         | Servo ON waiting time   | ms        | -2000~2000    | 0               | Immediately          |
| Pn506         | Basic waiting flow  | 10ms      | 0~500         | 0               | Immediately          |
| Pn507         | Brake waiting speed   | rpm       | 10~100        | 100             | Immediately          |
| Pn508         | Brake waiting time  | 10ms      | 10~100        | 50              | Immediately          |
| Pn509         | Allocate input signal to terminal   | —         | 0~0xCCCC      | 0x3210          | After restart        |
| Pn510         | Allocate input signal to terminal   | —         | 0~0xCCCC      | 0x7654          | After restart        |
| Pn511         | Allocate outputsignal to terminal   | —         | 0~0x0777      | 0x0210          | After restart        |
| Pn512         | Bus control input node low-bit enable   | —         | 0~1111        | 0               | Immediately          |
| Pn513         | Bus control input node low-bit enable   | —         | 0~1111        | 0               | Immediately          |
| Pn514         | Input port filter   | 0.2ms     | 0~1000        | 1               | Immediately          |
| Pn515         | Alarm port filter   | 0.2ms     | 0~3           | 1               | Immediately          |
| Pn516         | Input port signal inversion   | —         | 0~1111        | 0               | Immediately          |
| Pn517         | Input port signal inversion   | —         | 0~1111        | 0               | Immediately          |
| Pn518         | Dynamic brake time  | ms        | 50~2000       | 125             | Immediately          |
| Pn519         | Serial encoder error time   | 0.1ms     | 0~10000       | 3               | Immediately          |
| Pn520         | Position complete time  | 0.1ms     | 0~60000       | 500             | Immediately          |
| Pn521         | Main Power Alarm enable parameter<br>Pn521.0: detectbleeder resistor<br>Shattered Alarm<br>Pn521.1: detectundervoltagealarm<br>Pn521.2: detect Overvoltagealarm<br>Pn521.3: detect Power line phase | —         | 0~1111        | 1               | Immediately          |

| Parameter No. | Name  | Unit   | Setting Range | Factory Setting | Setting Invalidation |
|---------------|---|--------|---------------|-----------------|----------------------|
|               | <p>shortagealarm</p> <p>If connect externally regenerative resistor</p> <p>0: connect externally regenerative resistor between B1 and B2</p> <p>1: dose not connect externally regenerative resistor, relay on internal capacitance</p> <p>( This parameter is in effect only on EHD-02/04 /EHD-E-02/04 )</p> |        |               |                 |                      |
| Pn522         | <p>Binary</p> <p>Pn522.0: Voltage abnormity detect mode</p> <p>Pn522.1: Reserve</p> <p>Pn522.2: Reserve</p> <p>Pn522.3: Reserve</p>   | —      | 0~1111        | 0               | Immediately          |
| Pn523         | <p>Binary</p> <p>Pn523.0: IGBT superheat alarmenable</p> <p>Pn523.1: Motor uperheat alarmenable</p> <p>Pn523.2: Reserve</p> <p>Pn523.3: Reserve</p>   | —      | 0~1111        | 0010            | Immediately          |
| Pn524         | Overload allowed time increase  | —      | 1~100         | 40              | Immediately          |
| Pn525         | Overload alarm threshold  | %      | 100~150       | 100             | Immediately          |
| Pn526         | <p>Temperature threshold of motor overheat alarm</p> <p>( Only enabled in EHD-75/1A/1E/2B )</p>   | ℃      | 50~180        | 110             | Immediately          |
| Pn527         | Actual detect value of Power 5v   | 10mV   | 480~520       | 500             | Immediately          |
| Pn528         | Current overload alarm threshold  | A      | 0~800         | 750             | Immediately          |
| Pn600         | Position pulse in point to point control  | 10000P | -9999~9999    | 0               | Immediately          |
| Pn601         | Position pulse in point to point control  | 1P     | -9999~9999    | 0               | Immediately          |
|               | .....   |        |               |                 |                      |
| Pn630         | Position pulse in point to point control  | 10000P | -9999~9999    | 0               | Immediately          |
| Pn631         | Position pulse in point to point control  | 1P     | -9999~9999    | 0               | Immediately          |
| Pn632         | Point to point speed control  | rpm    | 0~3000        | 500             | Immediately          |
|               | .....   |        |               |                 |                      |
| Pn647         | Point to point speed control  | rpm    | 0~3000        | 500             | Immediately          |
| Pn648         | Point to point1st order filter  | 0.1ms  | 0~32767       | 0               | Immediately          |
|               | .....   |        |               |                 |                      |
| Pn663         | Point to point1st order filter  | 0.1ms  | 0~32767       | 0               | Immediately          |
| Pn664         | Stop time   | 50ms   | 0~300         | 10              | Immediately          |
|               | .....   |        |               |                 |                      |
| Pn679         | Stop time   | 50ms   | 0~300         | 10              | Immediately          |
| Pn680         | Reserved  | —      | —             | —               | —                    |
| Pn681         | <p>Hex</p> <p>Pn681.0:Single/cyclic, start/reference point selection</p>  | —      | 0~0x0133      | 0x0000          | Immediately          |



| Parameter No. | Name   | Unit       | Setting Range     | Factory Setting | Setting Invalidation |
|---------------|--|------------|-------------------|-----------------|----------------------|
|               | Pn681.1:Change step and start mode<br>Pn681.2:Change step input signal mode<br>Pn681.3:Reserved  |            |                   |                 |                      |
| Pn682         | Programme mode   | —          | 0~1               | 0               | Immediately          |
| Pn683         | Programme start step   | —          | 0~15              | 0               | Immediately          |
| Pn684         | Programme stop step  | —          | 0~15              | 1               | Immediately          |
| Pn685         | Search travel speed in position control (contact reference); Speed of finding reference point (hitting the origin signal ORG) in position homing control.      | rpm        | 0~500             | 200             | Immediately          |
| Pn686         | Leave travel switch speed in position control(contact reference); Speed of finding reference point (leaving the origin signal ORG) in position homing control. | rpm        | 0~500             | 30              | Immediately          |
| Pn687         | Position teaching pulse  | 10000P     | -9999~9999        | 0               | Immediately          |
| Pn688         | Position teaching pulse  | 1P         | -9999~9999        | 0               | Immediately          |
| Pn689         | Homing Mode Setting  | —          | 0~0111            | 0               | After restart        |
| Pn690         | Number of error pulses during homing   | 10000pulse | 0~9999            | 0               | Immediately          |
| Pn691         | Number of error pulses during homing   | 1pulse     | 0~9999            | 0               | Immediately          |
| Pn700         | Hex<br>Pn700.0:MODBUS communication baud rate<br>Pn700.1:MODBUS protocol selection<br>Pn700.2:Communication protocol selection<br>Pn700.3:Reserved             | —          | 0~0x0182          | 0x0151          | After restart        |
| Pn701         | MODBUS axis address  | —          | 1~247             | 1               | After restart        |
| Pn702         | Reserved   | —          | —                 | —               | —                    |
| Pn703         | CANcommunication speed   | —          | 0x0005            | 0x0004          | After restart        |
| Pn704         | CAN communication contact  | —          | 1~127             | 1               | After restart        |
| Pn840         | Hex<br>Pn840.0: Encoder model selection<br>Pn840.1: Motor designing sequence<br>Pn840.2: Reserved<br>Pn840.3: Reserved   | —          | 0x0C03~<br>0x0C05 | 0x0C05          | After restart        |

## A.2 Description of Parameter Type

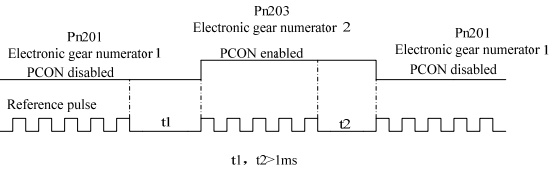
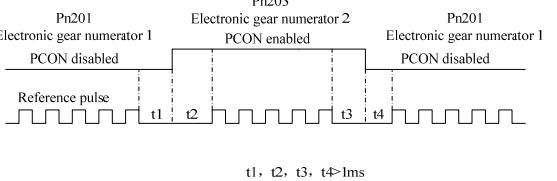
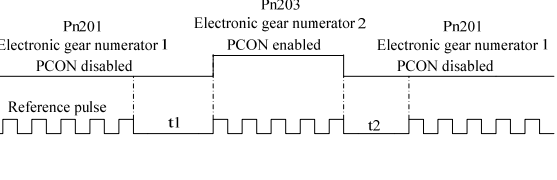
| Type                        | Parameter No. | Description   |
|-----------------------------|---------------|---|
| Function selection switches | Pn000~Pn006   | Control mode, stop mode, and some functions selection |
| Parameters of servo gain    | Pn100~Pn138   | Position gain, speed gain,rigidity,etc.               |

|  |             |   |
|--|-------------|---|
| Position control related parameters                          | Pn200~Pn205 | PG divided ratio, electronic gear, etc.                               |
| Speed control related parameters                             | Pn300~Pn322 | Speed reference input, soft start, etc.                               |
| Torque control related parameters                            | Pn400~Pn415 | Torque limit, etc.  |
| Parameters to control I/O port                               | Pn500~Pn527 | Allocation of I/O port function                                       |
| Point-to-point control and homing control related parameters | Pn600~Pn688 | Internal point-to-point control and homing control related parameters |
| Communication parameters                                     | Pn700~Pn704 | Setting of communication parameters                                   |

### A.3 Parameters in detail

| Parameter No. | Description | Setting Validation | Control Mode | Function and Meaning   |
|---------------|-------------|--------------------|--------------|--|
| Pn000         | Binary      | After restart      | ALL          | Pn000.0 Servo ON<br>[0] External S-ON enabled.<br>[1] External S-ON disabled. Servomotor excitation signal is turned ON automatically after S-RDY is output. |

| Parameter No. | Description | Setting Validation | Control Mode  | Function and Meaning   |
|---------------|-------------|--------------------|---|--|
|               |             |                    |   | <p>Pn000.1 Forward rotation input signal prohibited (P-OT)</p> <p>[0] External P-OT enabled. Operate in the time sequence setting in Pn004.0 when travel limit occurs.<br/>[1] External P-OT disabled.</p> <p>Pn000.2 Reverse rotation input signal prohibited (N-OT)</p> <p>[0] External N-OT enabled. Operate in the time sequence setting in Pn004.0 when travel limit occurs.<br/>[1] External N-OT disabled.</p> <p>Pn000.3 Alarm output when instantaneous power loss</p> <p>[0] Instantaneous power loss for one period with no alarm output<br/>[1] Instantaneous power loss for one period with alarm output</p>  |
| Pn001         | Binary      | After restart      | Pn001.0<br>ALL<br>Pn001.1<br>T<br>Pn001.2<br>P, S<br>Pn001.3<br>P | <p>Pn001.0 CCW, CW selection</p> <p>[0] Sets CCW as forward direction<br/>[1] Sets CW as forward direction</p> <p>Pn001.1 Analog speed limit enabled</p> <p>[0] Sets the value of Pn406 as the speed limit value during torque control.<br/>[1] Use the lower speed between V-REF and Pn406 as an external speed limit input.</p> <p>Pn001.2 Analog torque limit enabled</p> <p>[0] Sets Pn401~Pn404 as torque limit.<br/>[1] Sets the value corresponding to Vref input analog voltage as torque limit.</p> <p>Pn001.3 2nd electronic gear enabled</p> <p>[0] Without 2nd electronic gear, PCON signal is used to switch P/PI<br/>[1] 2nd electronic gear is enabled, PCON signal is only used as 2nd electronic gear when Pn005.3 is set to 1.</p> |
| Pn002         | Binary      | After restart      | ALL   | <p>Pn002.0 Electronic gear switching mode</p> <p>[0] Corresponding time sequence</p> <p style="text-align: center;">t1, t2 &gt; 1ms</p> <p>[1] Corresponding time sequence</p>   |

| Parameter No. | Description | Setting Validation | Control Mode   | Function and Meaning  |
|---------------|-------------|--------------------|--|---|
|               |             |                    |  |  <p><b>Time sequence when Pn002.0=0 or 1</b></p>  <p><b>Error time sequence</b></p>  <p><b>Pn002.1 Reserved</b><br/> <b>Pn002.2 Absolute encoder selection</b><br/>         [0] Use absolute encoder as an absolute encoder<br/>         [1] Use absolute encoder as an incremental encoder<br/> <b>Pn002.3 Reserved</b></p>            |
| Pn003         | Binary      | After restart      | ALL  | <p>Pn003.0 Reserved<br/>         Pn003.1 Reserved<br/>         Pn003.2 Low speed compensation<br/>         [0] Without low speed correction<br/>         [1] With low speed correction to avoid servomotor creeping, but the degree of correction is determined by the setting in Pn219.<br/>         Pn003.3 Overload enhancement<br/>         [0] Without overload enhancement function<br/>         [1] With overload enhancement function, which can enhance the overload capacity when servomotor exceeds the 2 times rated overload. It is used in frequent power ON/OFF occasions.</p> |
| Pn004         | Hex         | After restart      | Pn004.0<br>ALL<br>Pn004.1<br>P<br>Pn004.2<br>P<br>Pn004.3<br>P | <p>Pn004.0 Stop Mode<br/>         [0] Stops the servomotor by applying DB and then releases DB.<br/>         [1] Coast to a stop.<br/>         [2] Stops the servomotor by DB when servo OFF, stops the servomotor by plug braking when overtravel, then places it into coast (power OFF) mode.<br/>         [3] Makes the servomotor coast to a stop state when</p>  |

| Parameter No. | Description | Setting Validation | Control Mode  | Function and Meaning   |
|---------------|-------------|--------------------|---|--|
|               |             |                    |   | <p>servo OFF, stops the servomotor by plug braking when overtravel, then places it into coast (power OFF) mode.</p> <p>[4]Stops the servomotor by DB when servo OFF, stops the servomotor by plug braking when overtravel, then places it into zero clamp mode.</p> <p>[5]Makes the servomotor coast to a stop state when servo OFF, stops the servomotor by plug braking when overtravel, then places it into zero clamp mode.</p> <p>Pn004.1 Error counter clear mode</p> <p>[0]Clear error pulse when S-OFF, donot when overtravel.</p> <p>[1]Do not clear error pulse.</p> <p>[2]Clear error pulse when S-OFF orovertravel (excep for zero clamp)</p> <p>Pn004.2 Reference pulse form</p> <p>[0]Sign + Pulse</p> <p>[1]CW+CCW CW + CCW</p> <p>[2]A + B (×1)</p> <p>[3]A + B (×2)</p> <p>[4]A + B (×4)</p> <p>Pn004.3 Inverses pulse</p> <p>[0]Do not inverse PULS reference and SIGN reference.</p> <p>[1]Do not inverse PULS reference; Inverses SIGN reference.</p> <p>[2]Inverse PULS reference;Do not inverse SIGN reference.</p> <p>[3]Inverse PULS reference and SIGN reference.</p> |
| Pn005         | Hex         | After restart      | <p>Pn005.0<br/>P, S</p> <p>Pn005.1<br/>ALL</p> <p>Pn005.2<br/>P</p> | <p>Pn005.0 Torque feedforward form</p> <p>[0]Use general torque feedforward, external analog(Tref) feedforward input is invalid.</p> <p>[1]Use general torque feedforward, external analog(Tref) feedforward input is valid.</p> <p>[2]Use high-speed torque feedforward, external analog(Tref) feedforward input is invalid.</p> <p>[3]Use high-speed torque feedforward, external Analog(Tref)feedforward input is valid.</p> <p>Pn005.1 Control mode</p> <p>[0]Speed control(analog reference)<br/>PCON: OFF, PI control; ON, P control</p> <p>[1]Position control(pulse train reference)<br/>PCON: OFF, PI control; ON, P control</p> <p>[2]Torque control(analog reference)</p>   |

| Parameter No. | Description | Setting Validation | Control Mode | Function and Meaning  |
|---------------|-------------|--------------------|--------------|---|
|               |             |                    |              | <p>PCON is invalid.</p> <p>[3]Speed control(contact reference)←→speed Control(zero reference)<br/>PCON , PCL , NCL : OFF Switches to position control(zero reference)</p> <p>[4]Speed control(contact reference)←→speed control(analog reference)<br/>PCON , PCL , NCL : OFF Switches to position control(analog reference)</p> <p>[5]Speed control(contact reference)←→position control(pulse train reference)<br/>PCON , PCL , NCL : OFF Switches to position control(pulse train reference)</p> <p>[6]Speed control(contact reference)←→torque Control(analog reference)<br/>PCON , PCL , NCL : OFF Switches to position control(analog reference)</p> <p>[7]Position control(pulse train reference)←→speed Control(analog reference)<br/>PCON: OFF position control(pulse train reference); ON speed control(analog reference)</p> <p>[8]Position control(pulse train reference)←→Torque Control(analog reference)<br/>PCON: OFF position control(pulse train reference); ON torque control(analog reference)</p> <p>[9]Torque control(analog reference)←→speed Control(analog reference)<br/>PCON: OFF Torque control(analog reference); ON Speed control(analog reference)</p> <p>[A]Speed control(analog reference)←→zero clamp Control<br/>PCON: OFF Speed control(analog reference); ON zero clamp control</p> <p>[B]Positin control(pulse train reference)←→position control(INHIBIT)<br/>PCON: OFF Position control(pulse train reference); ON position control(INHIBIT)</p> <p>[C]Position control(contact reference)<br/>PCON: Used to change step<br/>PCL, NCL: Used to search reference point or start</p> <p>[D]Speed control(parameter reference)<br/>PCON, PCL, NCL invalid</p> <p>[E ]Special control<br/>PCON invalid</p> |

| Parameter No. | Description               | Setting Validation | Control Mode | Function and Meaning  |
|---------------|---------------------------|--------------------|--------------|---|
|               |                           |                    |              | <p>Pn005.2 Out-of-tolerance alarm selection</p> <p>[0] Out-of-tolerance alarm disabled</p> <p>[1] Out-of-tolerance alarm enabled. Outputs alarm when the value of error counter exceeds Pn504 setting value.</p> <p>[2] Reserved</p> <p>[3] Reserved</p> <p>Pn005.3 Servomotor model selection①</p> <p>[0] EMT-050D</p> <p>[1] EMT-035D</p> <p>[2] EMT-053D</p> <p>[3] EMT2-200GW-LAVA3O-001</p> <p>[4] EMT2-200HW-LAVA3O-XXX</p>   |
| Pn006         | Hex                       | After restart      |              | <p>Pn006.0 Bus type selection</p> <p>[0] No bus</p> <p>[1] PROFIBUS-DP V0/V1</p> <p>[2] PROFIBUS-DP V2</p> <p>Pn006.1 Reserved</p> <p>Pn006.2 Reserved</p> <p>Pn006.3 Reference input filter for open collector signal</p> <p>[0] When pulse is difference input, the max value of servo receiving pulse frequency <math>\leq 400K</math></p> <p>[1] When pulse is difference input, the max value of servo receiving pulse frequency <math>\leq 4M</math></p>  |
| Pn008         | Hex                       | After restart      |              | <p>Pn008.0 Switch ratio selection (unit: kHz)</p> <p>Pn008.1 A24 alarm filter number selection</p> <p>[n] When occur +1 alarms, spring A24 alarm</p>  |
| Pn100         | Online autotuning setting | After restart      | P, S         | <p>Pn100.0 Load inertia setting</p> <p>[0] Manual setting</p> <p>[1,2,3] Normal mode</p> <p>[4,5,6] Vertical load</p> <p>[1,4] Load inertia without variation</p> <p>[2,5] Load inertia with little variation</p> <p>[3,6] Load inertia with great variation</p> <p>Pn100.1 Online autotuning setting</p> <p>[0] Manual setting</p> <p>[1] Standard</p> <p>[2] Steadily</p> <p>[3] High precision</p> <p>Note:</p> <p>1. Autotuning is invalid when servomotor max. speed is less than 100rpm. Manual gain adjustment is used.</p> <p>2. Autotuning is invalid when servomotor acceleration / deceleration speed is less than 5000rpm/s. Manual</p> |

| Parameter No. | Description                               | Setting Validation | Control Mode | Function and Meaning   |
|---------------|---|--------------------|--------------|--|
|               |   |                    |              | gain adjustment is used.<br>3. Autotuning is invalid when mechanical clearance is too big during operation. Manual gain adjustment is used.<br>4. Autotuning is invalid when the difference of different speed load is too great. Manual gain adjustment is used.  |
| Pn101         | Machine rigidity setting                  | Immediately        | P, S         | The response speed of servo system is determined by this parameter. Normally, the rigidity should be set a little larger. However, if it is too large, it would suffer mechanical impact. It should be set a little smaller when large vibration is present. This parameter is only valid in autotuning. |
| Pn102         | Speed loop gain                           | Immediately        | P, S         | This parameter determines speed loop gain.<br>Unit: Hz   |
| Pn103         | Speed loop integral time constant         | Immediately        | P, S         | Decreases the value of this parameter to shorten positioning time and enhance speed response.<br>Unit: 0.1ms   |
| Pn104         | Position loop gain                        | Immediately        | P            | This parameter determines position loop gain. Decreases this value to enhance servo rigidity, but vibration will occur if the value is too large.<br>Unit: 1/s   |
| Pn105         | Torque reference filter time constant     | Immediately        | P, S, T      | Torque reference filter can eliminate or lighten mechanical vibration, but incorrect setting will result to mechanical vibration. Unit: 0.01ms   |
| Pn106         | Load inertia percentage                   | Immediately        | P, S         | Setting value = (load inertia / rotor inertia) × 100<br>Unit: %  |
| Pn107         | 2nd speed loop gain                       | Immediately        | P, S         | The meanings of these parameters are the same as Pn102~Pn105.<br>These parameters are only needed to set when two types of gain function are enabled.  |
| Pn108         | 2nd speed loop integral time constant     | Immediately        | P, S         |  |
| Pn109         | 2nd position loop gain                    | Immediately        | P            |  |
| Pn110         | 2nd torque reference filter time constant | Immediately        | P, S, T      |  |
| Pn111         | Speed bias                                | Immediately        | P            | This parameter setting can shorten positioning time. However, if it is too large or does not cooperate with Pn111 correctly, vibration will occur.<br>The relationship with speed reference, error counter, positioning error is shown in the following chart.   |



| Parameter No. | Description                                    | Setting Validation | Control Mode | Function and Meaning   |
|---------------|--|--------------------|--------------|--|
|               |  |                    |              |  |
| Pn112         | Feedforward                                    | Immediately        | P            | <p>It is used to set position feedforward. The response speed is faster and position error is less when this parameter setting is higher. Vibration will occur if the value is set too large.</p> <p>Unit: %</p> |
| Pn113         | Feedforward filter                             | Immediately        | P            | <p>It is used to ease mechanical vibration due to position feedforward. The feedforward lag will be enlarged and result to vibration if the value is set too large.</p> <p>Unit: 0.1ms</p>                       |
| Pn114         | Torque feedforward                             | Immediately        | P, S         | <p>It is used to set torque feedforward, and enhance response speed.</p> <p>Set the load inertia percentage(Pn106) correctly to enable this function in manual gain adjustment mode.</p> <p>Unit: %</p>          |
| Pn115         | Torque feedforward filter                      | Immediately        | P, S         | <p>It is used to ease mechanical vibration due to torque feedforward.</p> <p>Unit: 0.1ms</p>   |
| Pn116         | P/PI switching condition                       | After restart      | P, S         | <p>0: Torque reference percentage<br/>           1: Value of offset counter<br/>           2: Value of acceleration speed setting<br/>           3: Value of speed setting<br/>           4: Fixed PI</p>        |
| Pn117         | Torque switching threshold                     | After restart      | P, S         | <p>Threshold of torque to switch PI control to P control.</p> <p>Unit: %</p>   |
| Pn118         | Offset counter switching threshold             | Immediately        | P            | <p>Threshold of error counter to switch PI control to P control.</p> <p>Unit: pulse</p>  |
| Pn119         | Setting acceleration speed switching threshold | Immediately        | P, S         | <p>Threshold of acceleration speed to switch PI control to P control.</p> <p>Unit: 10rpm/s</p>   |
| Pn120         | Setting speed switching threshold              | Immediately        | P, S         | <p>Threshold of speed to switch PI control to P control.</p> <p>Unit: rpm</p>  |
| Pn121         | Gain switching                                 | After restart      | P, S         | <p>0: Fix to 1st group gain</p>  |

| Parameter No. | Description   | Setting Validation | Control Mode | Function and Meaning   |
|---------------|---|--------------------|--------------|--|
|               | condition   |                    |              | 1:External switch gain switching(G-SEL)<br>2:Torque percentage<br>3:Value of offset counter<br>4:Value of acceleration speed setting ( 10rpm )<br>5:Value of speed setting<br>6:Speed reference input<br>7: actual motor speed |
| Pn122         | Switching delay time  | Immediately        | P, S         | Delay time of switching gain when switching condition is satisfied.  |
| Pn123         | Switch threshold level  | Immediately        | P, S         | Gain switching trigger level   |
| Pn124         | Reserved  | —                  | —            | —  |
| Pn125         | Position gain switching time  | Immediately        | P            | This parameter is used to smooth transition if the change of the two groups of gain is too large.  |
| Pn126         | Hysteresis switching  | Immediately        | P, S         | This parameter is used to set the operation hysteresis of gain switching.  |
| Pn127         | Low speed detection filter  | Immediately        | P, S         | This parameter is used to filter in low speed detection. The speed detection will be lagged if the value is too large.   |
| Pn128         | Speed gain acceleration relationship during online autotuning                         | Immediately        | P, S         | The increasing multiple of speed loop gain is the same rigidity during online autotuning. The speed loop gain is larger when this value is higher.   |
| Pn129         | Low speed correction coefficient  | Immediately        | P, S         | The intensity of anti-friction and anti-creeping at low speed. Vibration will occur if this value is set too large.  |
| Pn130         | Friction Load   | Immediately        | P, S         | Frictin load or fixed load compensation  |
| Pn131         | Friction compensation speed hysteresis area   | Immediately        | P, S         | Threshold of friction compensation start   |
| Pn132         | Sticking friction load  | Immediately        | P, S         | Sticking damp which is in direct proportion to speed.  |
| Pn133         | Pressure circle proportion coefficient  | Immediately        | —            | When control is in the pressure mode , Those parameters is in effect   |
| Pn134         | Pressure circleintegral time  | Immediately        | —            |  |
| Pn135         | Maximum reverse speed in stress mode (when setting,note that if pump can be reversed) | Immediately        | —            |  |
| Pn136         | Pressure feedbackoffsetadjusti on   | Immediately        | —            |  |
| Pn137         | Pressure feedbackfilter time constant   | Immediately        | —            |  |

| Parameter No. | Description   | Setting Validation | Control Mode | Function and Meaning  |
|---------------|---|--------------------|--------------|---|
| Pn138         | Pressure given filter time constant                         | Immediately        | —            |   |
| Pn200         | PG divided ratio  | After restart      | P, S, T      | Analog encoder output orthogonal difference pulses.<br>The meaning of this value is the number of analog encoder output orthogonal difference pulses per one servomotor rotation.   |
| Pn201         | 1st electronic gear numerator                               | After restart      | P            | The electronic gear enables the reference pulse to relate with the servomotor travel distance, so the host controller doesn't change the mechanical deceleration ratio and encoder pulses. In fact, it is the setting of frequency doubling or frequency division to the reference pulses.<br>$\frac{\text{Numerator}(Pn201 \text{ or } Pn203)}{\text{Denominator}(Pn202)}$ |
| Pn202         | Electronic gear denominator                                 | After restart      | P            |   |
| Pn203         | 2nd electronic gear numerator                               | After restart      | P            |   |
| Pn204         | Position reference acceleration /deceleration time constant | Immediately        | P            | This value is used to smooth the input pulses. The effect of smoothness is better when the value is higher, but lag will occur if the value is too large.   |
| Pn205         | Position reference filter form selection                    | After restart      | P            | [0]: 1st order filter<br>[1]: 2nd order filter  |
| Pn300         | Speed reference input gain                                  | Immediately        | S            | The corresponding speed to 1V analog input  |
| Pn301         | Analog speed given zero bias                                | Immediately        | S            | This parameter is used to set zero bias of analog speed given, and it is related with the speed reference input gain (Pn300).<br>Speed reference=(External speed given input analog-Analog speed given zero bias) × Speed reference input gain  |
| Pn302         | Reserved  | —                  | —            | —   |
| Pn303         | Reserved  | —                  | —            | —   |
| Pn304         | Parameter speed   | Immediately        | S            | The parameter can be set to positive or negative. When control mode is set to D, it determines the speed of motor .<br>The servomotor speed is determined by this parameter when Pn005.1=D.   |
| Pn305         | JOG speed   | Immediately        | S            | It is used to set JOG rotation speed, and the direction is determined by the pressing key during JOG operation.   |
| Pn306         | Soft start acceleration time                                | Immediately        | S            | The time for trapeziform acceleration to accelerate to 1000rpm.<br>Unit: ms   |
| Pn307         | Soft start deceleration time                                | Immediately        | S            | The time for trapeziform deceleration to decelerate to 1000rpm.<br>Unit: ms   |

| Parameter No. | Description                            | Setting Validation | Control Mode    | Function and Meaning  |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
|---------------|--|--------------------|-----------------|---|--|--|--|-----------------|--------|-------|-------|--------|------|------|---------------|------|-------|--------|-------|------|--------|-------|-------|--------|-------|------|------|--------|------|-------|--------|-------|------|--------|-------|-------|--------|
| Pn308         | Speed filter time constant             | Immediately        | S               | 1st order filter time constant<br>Unit: ms  |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn309         | S curve risetime                       | Immediately        | S               | The time for transition from one point to another point in S curve.   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn310         | Speed reference curve form             | After restart      | S               | 0:Slope<br>1:S curve<br>2:1 <sup>st</sup> order filter<br>3:2 <sup>nd</sup> order filter  |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn311         | S formselection                        | After restart      | S               | This value determines the transition form of S curve.   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn312         | DP communication JOG speed             | Immediately        | P, S, T         | Communication speed of bus JOG.<br>It can be set to positive or negative.   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn313         | Pressure Slope time (100bar rise time) | Immediately        | —               | —   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn314         | Pressure feedback value                | Immediately        | —               | —   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn315         | Pressuregiven value                    | Immediately        | —               | —   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn316         | Speed internal 1                       | Immediately        | S               | Internal speed is enabled when Pn005.1=3~6<br><table border="1" style="width:100%; border-collapse: collapse;"> <thead> <tr> <th colspan="3">Input signal</th> <th rowspan="2">operating speed</th> </tr> <tr> <th>/P-CON</th> <th>/P-CL</th> <th>/N-CL</th> </tr> </thead> <tbody> <tr> <td rowspan="4">OFF(H)</td> <td>OFF(</td> <td>OFF(</td> <td>Zero speed or</td> </tr> <tr> <td>OFF(</td> <td>ON(L)</td> <td>SPEED1</td> </tr> <tr> <td>ON(L)</td> <td>OFF(</td> <td>SPEED2</td> </tr> <tr> <td>ON(L)</td> <td>ON(L)</td> <td>SPEED3</td> </tr> <tr> <td rowspan="4">ON(L)</td> <td>OFF(</td> <td>OFF(</td> <td>SPEED4</td> </tr> <tr> <td>OFF(</td> <td>ON(L)</td> <td>SPEED5</td> </tr> <tr> <td>ON(L)</td> <td>OFF(</td> <td>SPEED6</td> </tr> <tr> <td>ON(L)</td> <td>ON(L)</td> <td>SPEED7</td> </tr> </tbody> </table> | Input signal                                       |  |  | operating speed | /P-CON | /P-CL | /N-CL | OFF(H) | OFF( | OFF( | Zero speed or | OFF( | ON(L) | SPEED1 | ON(L) | OFF( | SPEED2 | ON(L) | ON(L) | SPEED3 | ON(L) | OFF( | OFF( | SPEED4 | OFF( | ON(L) | SPEED5 | ON(L) | OFF( | SPEED6 | ON(L) | ON(L) | SPEED7 |
| Input signal  |  |                    | operating speed |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| /P-CON        | /P-CL                                  | /N-CL              |                 |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| OFF(H)        | OFF(                                   | OFF(               | Zero speed or   |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
|               | OFF(                                   | ON(L)              | SPEED1          |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
|               | ON(L)                                  | OFF(               | SPEED2          |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
|               | ON(L)                                  | ON(L)              | SPEED3          |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| ON(L)         | OFF(                                   | OFF(               | SPEED4          |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
|               | OFF(                                   | ON(L)              | SPEED5          |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
|               | ON(L)                                  | OFF(               | SPEED6          |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
|               | ON(L)                                  | ON(L)              | SPEED7          |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn317         | Speed internal 2                       | Immediately        | S               |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn318         | Speed internal 3                       | Immediately        | S               |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn319         | Speed internal 4                       | Immediately        | S               |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn320         | Speed internal 5                       | Immediately        | S               |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn321         | Speed internal 6                       | Immediately        | S               |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn322         | Speed internal 7                       | Immediately        | S               |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn400         | Torque reference gain                  | Immediately        | T               | The meaning of this parameter is the needed analog input voltage to reach the rated torque.   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn401         | Forward torque internal limit          | Immediately        | P, S, T         | Servomotor output torque limit value (depending on the actual overload capacity) .  |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn402         | Reverse torque internal limit          | Immediately        | P, S, T         |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn403         | Forward external torque limit          | Immediately        | P, S, T         |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn404         | Reverse external torque limit          | Immediately        | P, S, T         |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn405         | Plug braking torque limit              | Immediately        | P, S, T         |   |  |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |
| Pn406         | Speed limit during                     | Immediately        | T               |   | Servomotor output torque limit value during torque |  |  |                 |        |       |       |        |      |      |               |      |       |        |       |      |        |       |       |        |       |      |      |        |      |       |        |       |      |        |       |       |        |

| Parameter No. | Description                       | Setting Validation | Control Mode | Function and Meaning  |   |
|---------------|-----------------------------------|--------------------|--------------|---|---|
|               | torque control                    |                    |              | control   |   |
| Pn407         | Notch filter 1 frequency          | Immediately        | P, S, T      | Notch filter 1 frequency  | <p>1. In some conditions, vibration will be picked up and response will be lagged after notch filter is set.</p> <p>2. When notch filter frequency is set to 5000, the notch filter is invalid.</p> |
| Pn408         | Notch filter 1 depth              | Immediately        | P, S, T      | Notch filter 1 depth  |   |
| Pn409         | Notch filter 2 frequency          | Immediately        | P, S, T      | Notch filter 2 frequency  |   |
| Pn410         | Notch filter 2 depth              | Immediately        | P, S, T      | Notch filter 2 depth  |   |
| Pn411         | Low frequency vibration frequency | Immediately        | P, S         | Frequency of low frequency vibration with load.   |   |
| Pn412         | Low frequency vibration damp      | Immediately        | P, S         | Attenuation damp of low frequency vibration with load. It does not need to change.  |   |
| Pn413         | Torque control delay time         | Immediately        | T            | These parameters are only enabled in position control mode.   |   |
| Pn414         | Torque control speed hysteresis   | Immediately        | T            |   |   |
| Pn415         | Analog torque given zero bias     | Immediately        | T            | <p>This parameter is used to set zero bias of analog torque given, and it is related with torque reference input gain (Pn400),</p> <p>Torque reference=(External torque given input analog-Analog torque given zero bias) × Torque reference input gain</p> |   |
| Pn500         | Positioning error                 | Immediately        | P            | Outputs /COIN signal when error counter is less than this value.  |   |
| Pn501         | Coincidence difference            | Immediately        | P            | Outputs /VCMP signal when the difference between speed reference value and speed feedback value is less than this value.  |   |
| Pn502         | Zero clamp speed                  | Immediately        | S            | The servomotor is locked in the form of temporary position loop when the speed corresponding to the analog input is less than this value.   |   |
| Pn503         | Rotation detection speed TGON     | Immediately        | P, S, T      | When the servomotor speed exceeds this parameter setting value, it means that the servomotor has already rotated steadily and outputs /TGON signal.   |   |
| Pn504         | Offset counter overflow alarm     | Immediately        | P            | When the value in error counter exceeds this parameter setting value, it means that error counter alarm has occurred and outputs alarm an signal.   |   |
| Pn505         | Servo ON waiting time             | Immediately        | P, S, T      | <p>These parameters are only enabled when the port output parameters are allocated with /BK signal output.</p> <p>These parameters are used to keep braking (prevent</p>  |   |

| Parameter No. | Description   | Setting Validation | Control Mode | Function and Meaning  |
|---------------|---|--------------------|--------------|---|
| Pn506         | Basic waiting flow  | Immediately        | P, S, T      | from gravity glissade or continuous outside force on servomotor) time sequence.<br>Servo ON waiting time:<br>①For the parameter is plus, /BK signal is output firstly when servo-ON signal is input, and then servomotor excitation signal is created after delaying the parameter setting time.  |
| Pn507         | Brake waiting speed   | Immediately        | P, S, T      | ②For the parameter is minus, servomotor excitation signal is output firstly when servo-ON signal is input, and then /BK signal is created after delaying the parameter setting time.<br>Basic waiting flow:<br>Standard setting: /BK output (braking action) and servo-OFF are at the same time.<br>Now, the machine movable part may shift slightly due to gravity according to mechanical configuration and character; it can be eliminated by using the parameters when the servomotor is at stop or at a low speed. |
| Pn508         | Brake waiting time  | Immediately        | P, S, T      | Brake waiting speed:<br>/BK signal is output when the servomotor speed is decreased below the parameter setting value at servo-OFF.<br>Brake waiting time:<br>BK signal is output when the delay time exceeds the parameter setting value after servo-OFF.<br>/BK signal is output as long as either of the brake waiting speed or brake waiting time is satisfied.   |
| Pn509         | Allocate input port to signal, one port with four bits(hex) | After restart      | P, S, T      | Pn509.0 corresponding port CN1_14<br>Pn509.1 corresponding port CN1_15<br>Pn509.2 corresponding port CN1_16<br>Pn509.3 corresponding port CN1_17  |
| Pn510         | Allocate input port to signal, one port with four bits(hex) | After restart      | P, S, T      | Pn510.0 corresponding port CN1_39<br>Pn510.1 corresponding port CN1_40<br>Pn510.2 corresponding port CN1_41<br>Pn510.3 corresponding port CN1_42<br>Terminal PRI : CN1_14< CN1_15< CN1_16< CN1_17< CN1_39< CN1_40< CN1_41< CN1_42<br>Corresponding signal of each data is shown as following:<br>0: S-ON<br>1: P-CON<br>2: P-OT<br>3: N-OT  |

| Parameter No. | Description                            | Setting Validation | Control Mode | Function and Meaning   |
|---------------|--|--------------------|--------------|--|
|               |  |                    |              | 4: ALMRST<br>5: CLR<br>6: P-CL<br>7: N-CL<br>8: G-SEL<br>9: JDPOS-JOG+<br>A: JDPOS-JOG-<br>B: JDPOS-HALT   |
| Pn511         | Output signal allocation               | After restart      | P, S, T      | Pn511.0 corresponding port CN1_11, CN1_12<br>Pn511.1 corresponding port CN1_05, CN1_06<br>Pn511.2 corresponding port CN1_09, CN1_10<br>Corresponding signal of each data is shown as follows:<br>0: /COIN/VCMP<br>1: /TGON<br>2: /S-RDY<br>3: /CLT<br>4: /BK<br>5: /PGC<br>6: OT<br>7: /RD |
| Pn512         | Bus control input node low-bit enabled | Immediately        | P, S, T      | Bus communication input port enabled:<br>[0]: Disabled<br>[1]: Enabled<br>Pn512.0→CN1_14<br>Pn512.1→CN1_15   |
| Pn513         | Bus control input node low-bit enabled | Immediately        | P, S, T      | Pn512.2→CN1_16<br>Pn512.3→CN1_17<br>Pn513.0→CN1_39<br>Pn513.1→CN1_40<br>Pn513.2→CN1_41<br>Pn513.3→CN1_42   |
| Pn514         | Input port filter                      | Immediately        | P, S, T      | It is used to set input port filter time. The signal will be lagged if the parameter setting is too high.  |
| Pn515         | Alarm port filter                      | Immediately        | P, S, T      | Alarm port filter time, setting too long to lag input signal   |
| Pn516         | Input port signal inversion            | Immediately        | P, S, T      | [0]: Do not inverse signal.<br>[1]: Inverse signal<br>Pn516.0→CN1_14 inversion<br>Pn516.1→CN1_15 inversion   |

| Parameter No. | Description                       | Setting Validation | Control Mode | Function and Meaning   |
|---------------|-----------------------------------|--------------------|--------------|--|
| Pn517         | Input port signal inversion       | Immediately        | P, S, T      | Pn516.2→CN1_16 inversion<br>Pn516.3→CN1_17 inversion<br>Pn517.0→CN1_39 inversion<br>Pn517.1→CN1_40 inversion<br>Pn517.2→CN1_41 inversion<br>Pn517.3→CN1_42 inversion   |
| Pn518         | Reserved                          | —                  | —            | —  |
| Pn519         | Reserved                          | —                  | —            | —  |
| Pn520         | Reserved                          | —                  | —            | —  |
| Pn521         | Main Power Alarm enable parameter | Immediately        | P,S,T        | Pn521.0: detectbleeder resistor Shattered Alarm<br>Pn521.1:detectundervoltagealarm<br>Pn521.2:detect Overvoltagealarm<br>Pn521.3:detect Power line phase shortagealarm<br>0: detect alarm<br>1: no detect alarm  |
| Pn522         | Binary                            | Immediately        | P,S,T        | Pn522.0: Voltage abnormality detect mode<br>Pn522.1: Reserve<br>Pn522.2: Reserve<br>Pn522.3: Reserve<br>Pn522.0 直流母线电压异常检测方式<br>[0]: 硬件检测<br>[1]: 软件检测<br>Pn522.1 过载报警 A04 屏蔽位<br>[0]使能 A04 报警检测功能<br>[1]屏蔽 A04 报警检测功能<br>Pn522.2 保留<br>Pn522.3 电流超限报警 A24 屏蔽位<br>[0]使能 A24 报警检测功能<br>[1]屏蔽 A24 报警检测功能 |
| Pn523         | Binary                            | Immediately        | —            | Pn523.0: IGBT superheat alarmentenable A18<br>[0]: 检测 IGBT 过热报警<br>[1]: 不检测 IGBT 过热报警<br>Pn523.1: Motor uperheat alarmentenable A19<br>.1 检测电机过热报警<br>[0]: 检测电机过热过热报警<br>Pn523.2: A23<br>Pn523.3 再生回路异常 A16 报警屏蔽位<br>[0]使能 A16 报警检测功能<br>[1]屏蔽 A16 报警检测功能  |
| Pn524         | Overload allowed time increase    | Immediately        | —            | 增大此值可以延长过载报警的时间，不建议用户随意更改。   |



| Parameter No. | Description   | Setting Validation | Control Mode | Function and Meaning   |
|---------------|---|--------------------|--------------|--|
| Pn525         | Overload alarm threshold  | Immediately        | P, S, T      | When load percentage is larger than overload alarm threshold, A04 will occur soon.<br>Pn525 is recommended to set below 120, otherwise the servo drive and motor will be damaged.  |
| Pn526         | Temperature threshold of motor overheat alarm (Only enabled in EHD-75/1A/1E/2B) | Immediately        | P, S, T      | When servomotor winding temperature exceeds Pn526 setting, A19 will occur. (Only enabled in EHD-75/1A/1E/2B)   |
| Pn527         | Actual detect value of Power 5v   | Immediately        | P, S, T      | 将电源 5V 的实际供电值写入此参数可提高温度检测精度, 单位 10mV。  |
| Pn528         | Current overload alarm threshold  | Immediately        | P, S, T      | 用于设定 A24 电流超限报警的阈值, 单位 A。当模块电流最大值超过设定的阈值的次数超过 Pn008.1+1 时, 产生 A24 报警。  |
| Pn600         | JPOS0 Position pulse in point to point control                                  | Immediately        | P            | The two parameters are used in combination, and the algebraic sum of them is the position JPOS0 needs to reach.(The number of servomotor rotation revolutions is related with the programme mode of point to point control.)<br>Pn600 Unit: 10000P<br>Pn601 Unit: 1P |
| Pn601         | JPOS0 Position pulse in point to point control                                  | Immediately        | P            |  |
|               | .....   |                    |              | The meaning of other point to point control related parameters are the same.   |
| Pn630         | JPOS15 Position pulse in point to point control                                 | Immediately        | P            | The two parameters are used in combination, and the algebraic sum of them is the position of JPOS0 needs to reach.(The number of servomotor rotation revolutions is related with the programme mode of point to point control.)                                      |
| Pn631         | JPOS15 Position pulse in point to point control                                 | Immediately        | P            |  |
| Pn632         | JPOS0 Point to point speed control  | Immediately        | P            | JPOS0 Point to point speed control<br>Unit: rpm  |
|               | .....   |                    |              | The speed of other point to point control  |
| Pn647         | JPOS15 Point to point speed control   | Immediately        | P            | The speed of JPOS15 point to point control<br>Unit: rpm  |
| Pn648         | JPOS0 Point to point 1st order filter   | Immediately        | P            | 1st order filter time of JPOS0 point to point control can stop or start the servomotor mildly.   |
|               | .....   |                    |              | 1st order filter of other point to point control.  |
| Pn663         | JPOS15 Point to point 1st order filter  | Immediately        | P            | 1st order filter time of JPOS15 point to point control can stop or start the servomotor mildly.  |
| Pn664         | JPOS0 point to point control stop time  | Immediately        | P            | JPOS0 point to point control stop time<br>Unit: 50ms   |
|               | .....   |                    |              | Other point to point control stop time   |
| Pn679         | JPOS15 point to   | Immediately        | P            | JPOS15 point to point control stop time  |

| Parameter No. | Description   | Setting Validation | Control Mode | Function and Meaning  |
|---------------|---|--------------------|--------------|---|
|               | point control stop time   |                    |              | Unit: 50ms  |
| Pn680         | Reserved  | —                  | —            | —   |
| Pn681         | Hex   | Immediately        | P            | <p><b>Pn681.0</b> Single/cyclic, start/reference point selection<br/>                     [0] Cyclic operation, PCL start signal, NCL search reference point in forward direction.<br/>                     [1] Single operation, PCL start signal, NCL search reference point in forward direction.<br/>                     [2] Cyclic operation, NCL start operation, PCL search reference point in forward direction.<br/>                     [3] Single operation, NCL start operation, PCL search reference point in forward direction.</p> <p><b>Pn681.1</b> Change step and start mode<br/>                     [0] Delay to change step, no need of start signal, delay to start after S-ON.<br/>                     [1] PCON change step, no need of start signal, PCON delay to start after S-ON, but inside pulse can not stop when PCON off.<br/>                     [2] Delay to change step, need start signal, canceling start signal can immediately stop inside pulse.<br/>                     Return to programmed start point process step when reset.<br/>                     [3] PCON change step, need start signal, canceling start signal can immediately stop inside pulse. Return to programmed start point process step when reset.</p> <p><b>Pn681.2</b> Change step input signal mode<br/>                     [0] Change step input signal electrical level mode<br/>                     [1] Change step input signal pulse mode</p> <p>Pn681.3 Reserved</p> |
| Pn682         | Programme mode  | Immediately        | P            | [0] : Incremental programme<br>[1]: Absolute programme  |
| Pn683         | Programme start step  | Immediately        | P            | Select the start point of the point to point control  |
| Pn684         | Programme stop step   | Immediately        | P            | Select the stop point of the point to point control.  |
| Pn685         | Search travel speed in position control (contact reference)       | Immediately        | P            | Search the servomotor speed in the direction of reference point towards travel switch.  |
| Pn686         | Leave travel switch speed in position control (contact reference) | Immediately        | P            | Search the servomotor speed when the reference point leaves travel switch.  |
| Pn687         | Position teaching   | Immediately        | P            | The two parameters are used in combination, and the   |

| Parameter No. | Description               | Setting Validation | Control Mode | Function and Meaning   |
|---------------|---------------------------|--------------------|--------------|--|
|               | pulse                     |                    |              | algebraic sum of them is the current position of position teaching. When performing the position teaching by utility function, the algebraic sum of the two parameters are given to the current position<br>Pn687 unit: 10000P<br>Pn688 unit: 1P   |
| Pn688         | Position teaching pulse   | Immediately        | P            |  |
| Pn700         | Hex                       | After restart      | ALL          | Pn700.0 MODBUS communication baud rate<br>[0] 4800bps<br>[1] 9600bps<br>[2] 19200bps<br>Pn700.1 MODBUS protocol selection<br>[0] 7, N, 2 (MODBUS,ASCII)<br>[1] 7, E, 1 (MODBUS,ASCII)<br>[2] 7, O, 1 (MODBUS,ASCII)<br>[3] 8, N, 2 (MODBUS,ASCII)<br>[4] 8, E, 1 (MODBUS,ASCII)<br>[5] 8, O, 1 (MODBUS,ASCII)<br>[6] 8, N, 2 (MODBUS,RTU)<br>[7] 8, E, 1 (MODBUS,RTU)<br>[8] 8, O, 1 (MODBUS,RTU)<br>Pn700.2 Communication protocol selection<br>[0] No protocol SCI communication<br>[1] MODBUS SCI communication<br>Pn700.3 Reserved |
| Pn701         | MODBUS Axis address       | After restart      | ALL          | Axis address of MODBUS protocol communication  |
| Pn702         | Reserved                  | —                  | —            | —  |
| Pn703         | CAN communication speed   | After restart      | ALL          | Pn703.0 CAN communication baud rate<br>[0] 50Kbps<br>[1] 100Kbps<br>[2] 125Kbps<br>[3] 250Kbps<br>[4] 500Kbps<br>[5] 1Mbps   |
| Pn704         | CAN communication contact | After restart      | ALL          | CANopen Aix address of communication   |
| Pn840         | Hex                       | After restart      | ALL          | <b>Pn840.0</b> Encoder model selection<br>[0]-[2] Reserved (For factory using)<br>[3] 17-bit absolute encoder<br>[4] 17-bit incremental encoder<br>[5] Resolver<br><b>Pn840.1</b> Reserved<br><b>Pn840.2</b> Reserved (For factory using)<br><b>Pn840.3</b> Reserved (For factory using)   |



Alarm Display

| Alarm Display | Alarm Output | Alarm Name   | Meaning  |
|---------------|--------------|--|--|
| A. 01         | ×            | Parameter breakdown  | The checksum results of parameters are abnormal.   |
| A. 02         | ×            | AD shift channels breakdown  | AD related electrical circuit is faulty  |
| A. 03         | ×            | Overspeed  | The servomotor speed is excessively high and the servomotor is out of control.             |
| A. 04         | ×            | Overload   | The servomotor is operating continuously under a torque largely exceeding ratings.         |
| A. 05         | ×            | Position error counteroverflow   | Internal counter overflow  |
| A. 06         | ×            | Position error pulse overflow  | Position error pulse exceeded parameter (Pn504)  |
| A. 07         | ×            | The setting of electronic gear or given pulse frequency is not reasonable. | The setting of electronic gear is not reasonable or the given pulse frequency is too high. |
| A. 08         | ×            | The 1st channel of current detection is wrong.                             | Something wrong with the inside chip of the 1st channel.                                   |
| A. 09         | ×            | The 2nd channel of current detection is wrong.                             | Something wrong with the inside chip of the 2nd channel.                                   |
| A. 10         | ×            | Incremental Encoder is break off.  | At least one of Incremental Encoder PA,PB,PC is broken off.                                |
| A. 12         | ×            | Overcurrent  | An overcurrent flowed through the IPM.   |
| A. 13         | ×            | Overvoltage  | Main circuit voltage for servomotor rotation is excessively high.                          |
| A. 14         | ×            | Undervoltage   | Main circuit voltage for servomotor rotation is excessively low.                           |
| A. 15         | ×            | Bleeder resistor error   | Bleeder resistor is faulty.  |
| A. 16         | ×            | Regeneration error   | Regenerative circuit error   |
| A. 17         | ×            | Resolver error   | The communication of resolver is abnormal.   |
| A. 18         | ×            | IGBT superheat alarm   | IGBT temperature is too high.  |
| A. 19         | ×            | Motor overheat alarm   | Motor temperature is too high.   |
| A. 20         | ×            | Power line phase shortage  | One phase does not bring into main circuit power supply.                                   |
| A. 21         | ×            | Instantaneous power off alarm  | An power off for more than one period is occurred in AC.                                   |
| A. 22         | ×            | Motor temperature detection sensor is break off.                           | Encoder cable is error.  |

| Alarm Display | Alarm Output | Alarm Name   | Meaning  |
|---------------|--------------|--|--|
| A. 24         | ×            | Brake overcurrent alarm                                      | 模块电流超过 Pn528 设定的阈值一定次数时 Bleeder resistor is too small, or bleeder module is faulty.  |
| A. 41         | ×            | Reserved   | Reserved   |
| A. 42         | ×            | Servomotor type error  | The parameter setting of servo drive does not match the servomotor.  |
| A. 43         | ×            | Servo drive type error                                       | The parameter setting of servo drive does not match the servomotor.  |
| A. 44         | ×            | Reserved   | Reserved   |
| A. 45         | ×            | Absolute encoder multiturn information error                 | Absolute encoder multiturn information is faulty.  |
| A. 46         | ×            | Absolute encoder multiturn information overflow              | Absolute encoder multiturn information overflow.   |
| A. 47         | ×            | Battery voltage below 2.5V                                   | Absolute encoder multiturn information is lost.  |
| A. 48         | ×            | Battery voltage below 3.1V                                   | Battery voltage is too low.  |
| A. 50         | ×            | Serial encoder communication overtime                        | Encoder disconnected; encoder signal disturbed; encoder error or encoder decoding circuit error.   |
| A. 51         | ×            | Absolute encoder overspeed alarm detected                    | Absolute encoder multiturn information may be faulty.<br>Error reasons:<br>1.The battery is not connected or the battery voltage is insufficient.<br>2.The power supply to servo drive is not turned ON when the battery voltage is normal, or the servomotor running acceleration is too high due to external reason. |
| A. 52         | ×            | Absolute state of serial encoder error                       | Encoder or the encoder decoding circuit is faulty.   |
| A. 53         | ×            | Serial encoder caution error                                 | Encoder or the encoder decoding circuit is faulty.   |
| A. 54         | ×            | Parity bit or end bit in serial encoder control domain error | Encoder signal is disturbed or the encoder decoding circuit is faulty.   |
| A. 55         | ×            | Serial encoder communication data checking error             | Encoder signal is disturbed or the encoder decoding circuit is faulty.   |
| A. 56         | ×            | End bit in serial encoder control domain error               | Encoder signal is disturbed or the encoder decoding circuit is faulty.   |
| A. 58         | ×            | Serial encoder data empty                                    | The EEPROM data of serial encoder is empty.  |
| A. 59         | ×            | Serial encoder data format error                             | The EEPROM data format of serial encoder is incorrect.   |
| A. 60         | ×            | Communication module<br>Communication not detected           | module is not plugged in or the communication module is faulty.  |
| A. 61         | ×            | Communication unsuccessful                                   | CPU of communication module operated abnormally.   |

| Alarm Display | Alarm Output | Alarm Name   | Meaning  |
|---------------|--------------|--|--|
| A. 62         | ×            | Servo drive can not receive the period data of communication module. | Receive channel of servo drive data or send channel of communication module is faulty.   |
| A. 63         | ×            | Communication module can not receive the servo drive response data.  | Communication module is faulty.  |
| A. 64         | ×            | Communication module and bus connectionless                          | Bus communication is faulty.   |
| A. 66         | ×            | CAN communication abnormal   | CAN communication is faulty because of abnormal communication connection or disturbance. |
| A. 67         | ×            | Receiving heartbeat timeout  | The master station sends heartbeat time timeout  |
| A. 69         | ×            | Synchronization signal monitoring cycle is longer than setting       | The filling time and the cycle of the synchronous signal does not match.                 |
| A. 00         | ○            | Not an error   | Normal operation status.   |

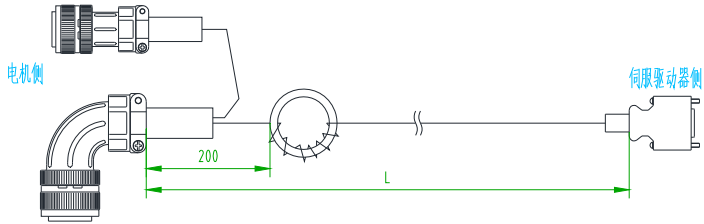
○: Output transistor is ON. ×: Output transistor is OFF.

A.45、A.46、A.47、A.48、A.51 only can be reset when the absolute encoder related alarm is cleared.

The multiturn data should be cleared because of the multiturn information is incorrect.

Encoder Wire

Encoder wire HRP-TS24-XXas follows:







## **ESTUN AUTOMATION TECHNOLOGY CO., LTD**

Address: 16 Shuige Road, Jiangning Development Zone  
Nanjing 211106, P.R.China

Tel: +86-25-58328505/8507

Fax: +86-25-58328504

Web: [www.estun.cn](http://www.estun.cn)



WWW.ESTUN.COM