Wise Servo Drive Users' Manual (Mechatrolink-Ⅱ Bus Communication)

Version: 2021.04.28 1st Version
Author: Product Testing Department

Contents

1 Precautions

Precautions can be divided into the following types according to the degree of loss or injury in case of negligence or omission:

Warning: Precautions requiring special attention. Negligence or omission may result in physical injury, or even death, machine damage or other losses.

Caution: Precautions mainly for informing, such as supplementary instructions and using limitations. Negligence or omission may result in failure of activating a function, and even physical injury or machine damage in some circumstances.

1.1 Warning

- Precautions Related to Storage and Transportation
  - Please properly transport the products in terms of the weight.
  - Please do not stack an excess of specified quantity of products.
  - Please do not climb, stand or place heavy loads on the products.
  - Please do not drag or carry the products via cables or devices connected to them.
  - Please keep away from moisture in storage and transportation
- Precautions Related to Installation
  - Please install the servo drive in the qualified electronic cabinet whose construction must reach IP54 grade of protection. Otherwise, the equipment cannot be used.
  - Please paste sealing strips on the joint of the cabinet to seal all the cracks.
  - Please seal cable entry which should be easy-to-open on the spot.
  - Please adopt a fan or heat exchanger for the heat dissipation and air convection of the cabinet.
  - Please adopt a fan for the heat dissipation and an air strainer in the air inlet or air outlet.
  - Please pay attention to the surroundings and air flow direction of the air vent to make sure that the outflow gas is towards pollution source. Because dust or cutting fluids may access to the servo drive via the tiny cracks and tuyere.
  - Please reserve 100mm space between the front of the serve drive and the door of the electronic cabinet for plugging cables connected with the servo drive and the ventilation and heat dissipation in the cabinet.
  - Please reserve space between the servo drive and other devices according to the requirements.
  - Please firmly install the product without vibration. During installing, please do not cast, knock, and strike the product, and do not impose a load on the product.
  - Please install the servo drive at a position easy to do debugging and maintenance.

- Precautions Related to Installation
  - Please make sure people participating in the wiring and checking are qualified.
  - Please reliably ground the servo drive with grounding resistance less than 4Ω, and do not replace the neutral line with the earth wire. Otherwise, the servo drive may not work normally.
  - Please do wiring firmly and steadily to avoid misoperation.
  - Please make sure voltage values and positive & negative polarity of any connection plugs are in accordance with specifications. Otherwise it may result in breakdowns such as short circuit and permanent damage to the servo drive.
  - To guard against damage to electric shock or servo drive, please keep fingers dry before plugging or touching switch.
  - Please do not plug or open the chassis of servo drive when power on.
- Precautions Related to Running & Debugging
  - Please check parameters settings before running, since wrong setting may lead to accidental movements.
  - Please make sure modification to parameters should be within the allowable range. Otherwise such breakdowns as unsteady running and machine damage will occur.
- Precautions in Use
  - Before powering on, please make sure that the switch is on blackout to avoid occasional start-up.
  - Please check the electromagnetic compatibility during electrical design in order to avoid or reduce electromagnetic interference to the servo drive, and employ a low pass filter to reduce electromagnetic interference if there are other electrical devices nearby.
  - Please do not frequently power on and power off. It is recommended to power on the servo drive again at least one 1min later after power failure or blackout.

1.2 Caution

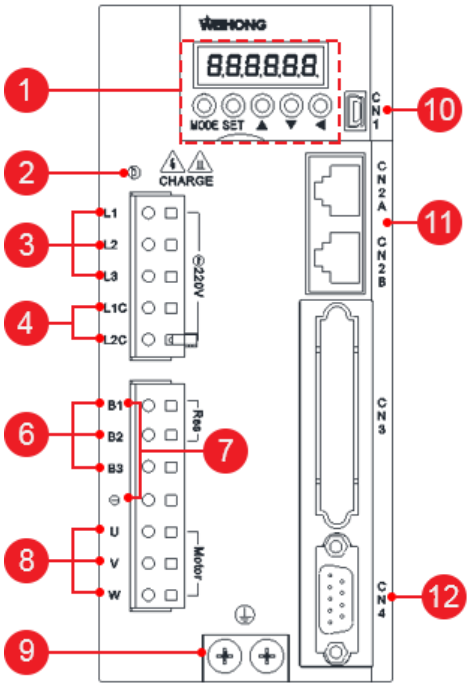
- Please make sure whether the products are what you have ordered.
- Please check if the products are damaged in transit.
- Check if the components and accessories are damaged or missing in terms of the detailed list.
- Please contact us promptly if product discrepancy, accessory missing or transit damage occurs.

2 Basic Information

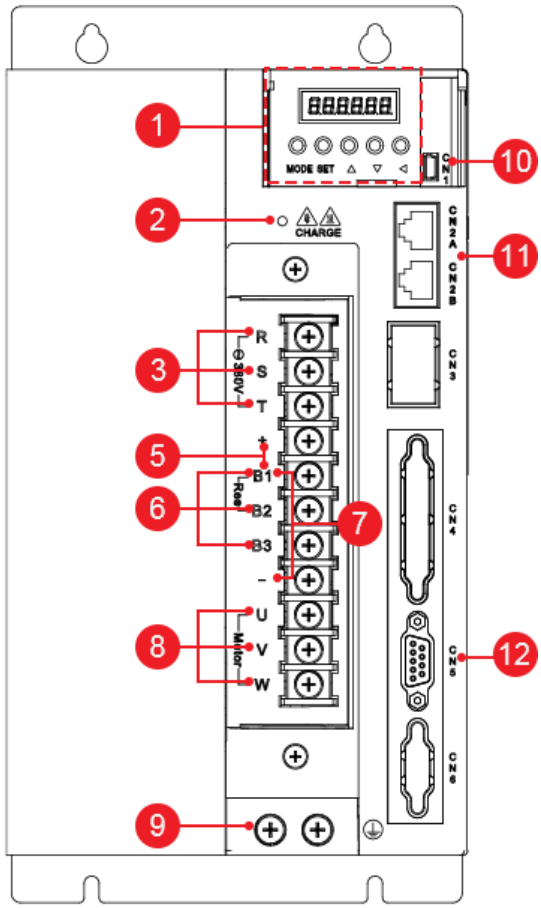
2.1 Front Panel

The structure of the front panel is as follows:

0.1kW ~ 2.5kW



≥ 3.0kW

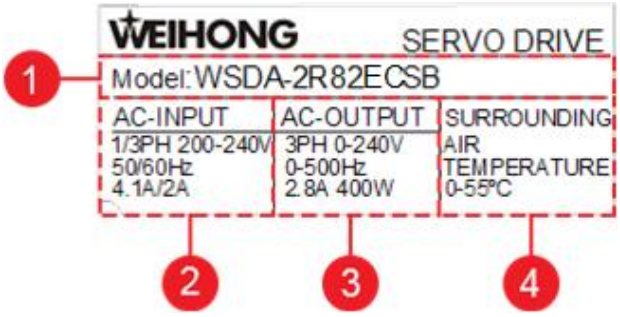


1. Operation panel: consist of one display and five operation buttons. See Operation Panel for details.
2. Power indicator light: show whether the power is ON.
3. Main circuit power input terminal: see Wiring of Main Circuit for details.
4. Control power input terminal: see Wiring of Main Circuit for details.
5. Terminals connecting with DC reactor: see Wiring of Main Circuit for details.
6. External regenerative resistor connection terminal: see Wiring of Main Circuit for details.
7. Servo DC busbar terminal: see Wiring of Main Circuit for details.
8. Terminals connecting with the motor: see Wiring of Main Circuit for details.
9. Grounding terminal: see Wiring of Main Circuit for details.
10. USB interface (CN1): connect with the computer and communicate with iMotion software. See Wiring of CN1-USB Communication Interface for details.
11. M-II bus communication interface(CN2A/B): connect with the device corresponding to the bus system. See Wiring of CN2A/B-M-II Bus Communication Interface for details.

12. Motor encoder interface(CN4): including 9 pins and 15 pins. The above picture takes 9 pins as an example. See Wiring of CN4-Motor Encoder Interface for details.
    - Servo drive with power from 0.1kW to 2.5kW: the interface is **CN4**.
    - Servo drive with power greater than or equal to 3.0kW: the interface is **CN5**.

2.2 Nameplate

The schematic diagram is as follows:



1. Model

WSDA	2R8	2	EC	S	B
①	②	③	④	⑤	⑥

①Product series

Symbol	Spec.
WSDA	A series
WSDS	S seires
WSLM	Multi-axis series

②Capacity symbol

Symbol	Spec.(kW)
1R2	0.1
2R8	0.4
5R0	0.75
6R8	1.0
110	1.5
140	2.5
120	3.0
170	5.0

③Voltage specification

Symbol	Spec.(V)
2	200
4	400

④Interface type

Symbol	Spec.
0P	Pulse train command
AP	Analog·pulse train command
M2	MECHATROLINK-II bus communication command
EC	EtherCAT communication command

⑤Encoder feedback type

Symbol	Spec.
P	Parallel incremental encoder
S	Serial communication encoder
M	Parallel incremental encoder and serial communication encoder

⑥Motor type

Symbol	Spec.
B	Rotary motor
L	Linear motor

2. Specification of input power
3. Specification of output power
4. Ambient temperature

2.3 Control Modes

Control modes include position mode, velocity mode and torque mode.

Servo drives with M-II communication type uses position mode. Thus, please set parameter **Pr001 Control mode setup** to **1**. Modification to parameter **Pr001** takes effect after re-power on the servo drive.

At this time, the drive receives the position / velocity / torque command and makes the motor rotate to the target position / velocity / torque. Position / velocity / torque command of M-II bus-type drive is input through M-II movement instruction.

2.4 Specifications and Functions

This part introduces basic specifications, basic functions and protection functions of the servo drive.

2.4.1 Basic specifications

Basic specifications of the servo drive include the following:

- Main circuit power supply
  - WSDA-1R2, WSDA-2R8, WSDA-5R0, WSDA-6R8: single phase/3-phase 200V~240V$^{+10\%}_{-15\%}$, 50/60Hz
  - WSDA-110, WSDA-140: 3-phase 200V~240V$^{+10\%}_{-15\%}$, 50/60Hz
  - WSDA-120, WSDA-170: 3-phase 380V~240V$^{+10\%}_{-15\%}$, 50/60Hz
- Control circuit power supply
  - WSDA-1R2, WSDA-2R8, WSDA-5R0, WSDA-6R8, WSDA-110, WSDA-140: single phase 200V~240V$^{+10\%}_{-15\%}$, 50/60Hz
  - WSDA-120, WSDA-170: no control circuit power supply
- Insulation resistance
  - WSDA-1R2, WSDA-2R8, WSDA-5R0, WSDA-6R8, WSDA-110, WSDA-140: AC 1500V or DC 2100V, withstand the voltage for 1min, current leak 10mA max
  - WSDA-120, WSDA-170: AC 2500V or DC 2750V, withstand the voltage for 1min, current leak 10mA max
- Ambient temperature (Working)
  - WSDA-1R2, WSDA-2R8, WSDA-5R0, WSDA-6R8, WSDA-110, WSDA-140: 0℃~+55℃ (No condensation and freezing)
  - WSDA-120, WSDA-170: －10℃~55℃. 40℃~55℃ derating with temperature increasing 1℃, the rated output current decreases by 1.5%
- Ambient temperature (Storage): -20℃~+65℃ (Max temperature guarantee: ≤80℃ for 72 hours; humidity: ≤17%RH)
- Protection level/cleanliness
  - Protection level: IP20
  - Cleanliness: 2
  - Placing environment requirements
    - No corrosive gas or inflammable gas
    - No splashing of water, oil or powder
    - Low degree of dust, powder, salt and iron powder
- Ambient humidity: ≤ 90%RH (No freezing and condensation)

- Control mode: SVPWM control
- Encoder feedback
  - 17-bit (resolution 131072) 7-wire serial absolute encoder
  - 20-bit (resolution 1048576) 5-wire serial absolute encoder
  - 23-bit (resolution 8388608) 7-wire serial absolute encoder
  - 24-bit (resolution 16777216) 7-wire serial absolute encoder
  - ABZ incremental encoder
- Pulse direction input signal: M-II bus type
- Pulse output: feedback digital signal by bus command; output encoder pulse via bus output port (A/B/Z-phrase)
- Communication: connect with iMotion software on PC via USB interface.
- Control input: seven physical inputs for general purpose are SI1~SI7. The inputs that can be allocated are as follows:
  - Positive direction over-travel inhibition (POT)
  - Negative direction over-travel inhibition (NOT)
  - Servo-on (SRV-ON)
  - Alarm clear (A-CLR)
  - Gain switching (GAIN)
  - Deviation counter clear (CL)
  - Command pulse inhibition (INH)
  - Torque limit selection (TL-SEL)
  - Command dividing gradual increase switching (DIV1, DIV2)
  - Internal command velocity selection signal (INTSPD1, INTSPD2 and INTSPD3)
  - Zero-speed clamp (ZEROSPD)
  - Velocity command sign (VC-SIGN)
  - Torque command sign (TC-SIGN)
  - Forced alarm (E-STOP)
  - Absolute data request signal (SEN)
  - General input (GP)
  - (Homing) deceleration limit switch input (DEC)
  - External lock input signal (EXT1, EXT2, and EXT3)
- Control output: four physical inputs for general purpose are SO1~SO4. And among them, alarm output **ALM** is fixed allocated to S01. The remaining outputs that can be allocated are as follows:
  - Servo ready output (S-RDY)
  - External brake release (BRK-OFF)
  - Positioning complete (INP)
  - Speed arrival (AT-SPEED)
  - Torque limiting (TLC)
  - Zero-speed clamp detection (ZSP)
  - Velocity coincidence (V-COIN)
  - Warning (WARN1, WARN2)
  - Position command ON/OFF (P-CMD)
  - Positioning complete (INP2)
  - Velocity limiting (V-LIMIT)
  - Alarm attribute (ALM-ATB)
  - Velocity command (V-CMD)
- Front panel: five buttons and six LED indicators

- Regenerative resistor
  - WSDA-1R2, WSDA-2R8: having no internal regenerative resistor, they can only be connected to the external regenerative resistor
  - WSDA-5R0, WSDA-6R8, WSDA-110, WSDA-140, WSDA-120, WSDA-170: having the internal regenerative resistor, they can be connected to the external one as well
- Dynamic brake: built-in dynamic brake
- Control mode: including position control, velocity control, and torque control

2.4.2 Basic Functions

According to control modes, basic functions can be divided into the following:

- Position control
  - Command input
    - Command input method: bus command input
    - Electronic gear ratio: used within range of 0.001~32000
    - Filter: command smooth filter, FIR filter, hysteresis filter
  - Pulse output
    - A/B/Z-phase: linear drive output
    - Division pulse counts: 1 ~ one fourth of encoder resolution
- Velocity control: command input method: bus command input
- Torque control
  - Command input method: bus command input
  - Velocity limit: set it through parameter
  - Torque command filter: one torque command delay filter, one two-stage torque filter and four notch filters

2.4.3 Protection Functions

Protection functions of the servo drive include the following:

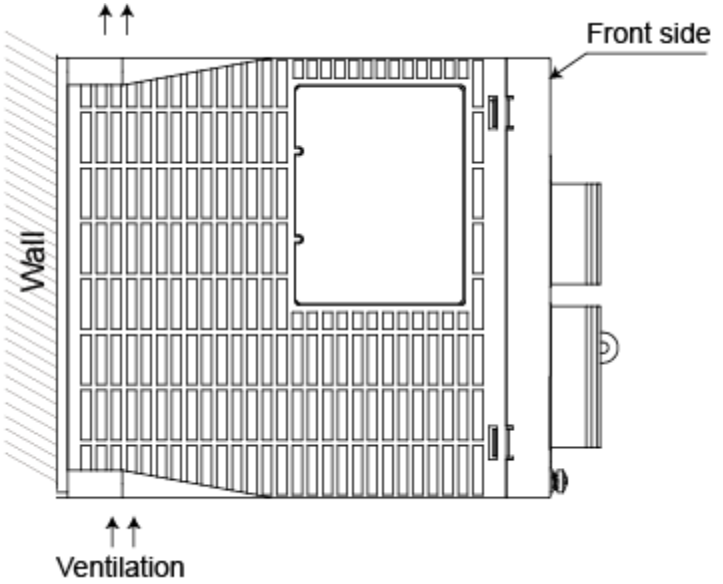
- Hardware protection: over-voltage, under-voltage, phrase loss (exclusive for servo drives with power greater than or equal to 3.0kW), over-current, over-heat of the drive, encoder error, etc.
- Software protection: register error, initialization error, I/O allocation error, over-speed, over-load, brake resistor over-load, positional deviation excess, etc.
- Error protection history: error records, including the latest three errors can be traced

2.5 Mounting

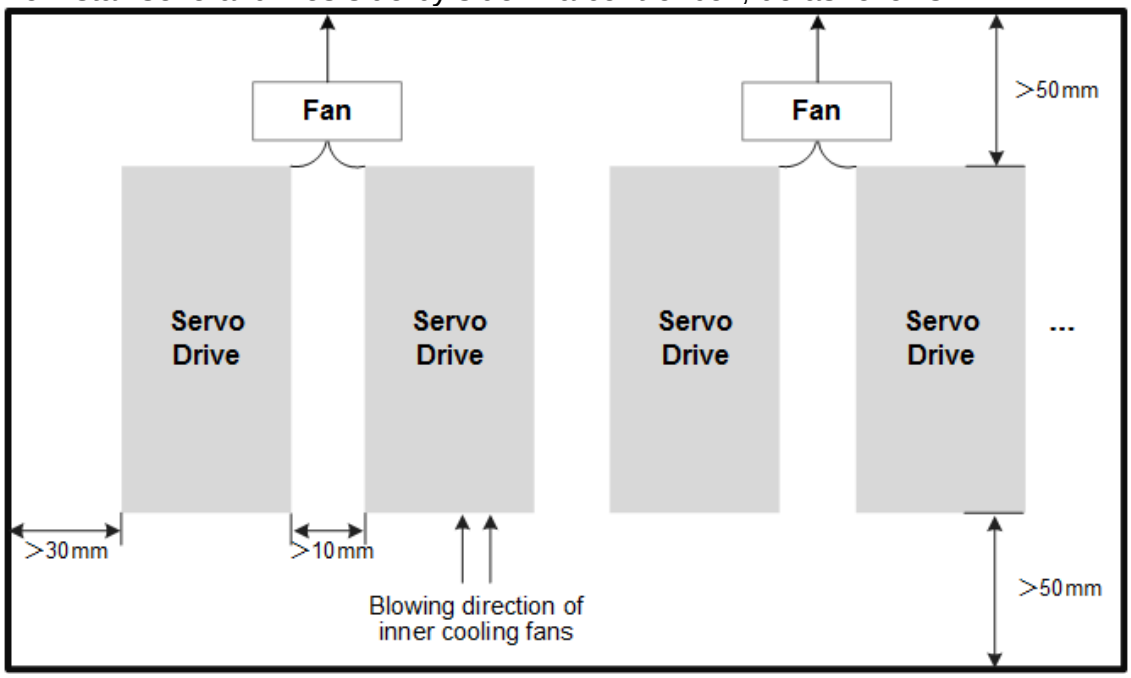
This part introduces how to install the servo drives.

To install the servo drives, do the following:

1. Keep the front panel face to you and install the servo drive perpendicularly to the wall:



2. Secure the drive firmly on the wall via mounting holes, and cool it by cooling fans or nature convection.
3. To install several drives side by side in a control box, do as follows:

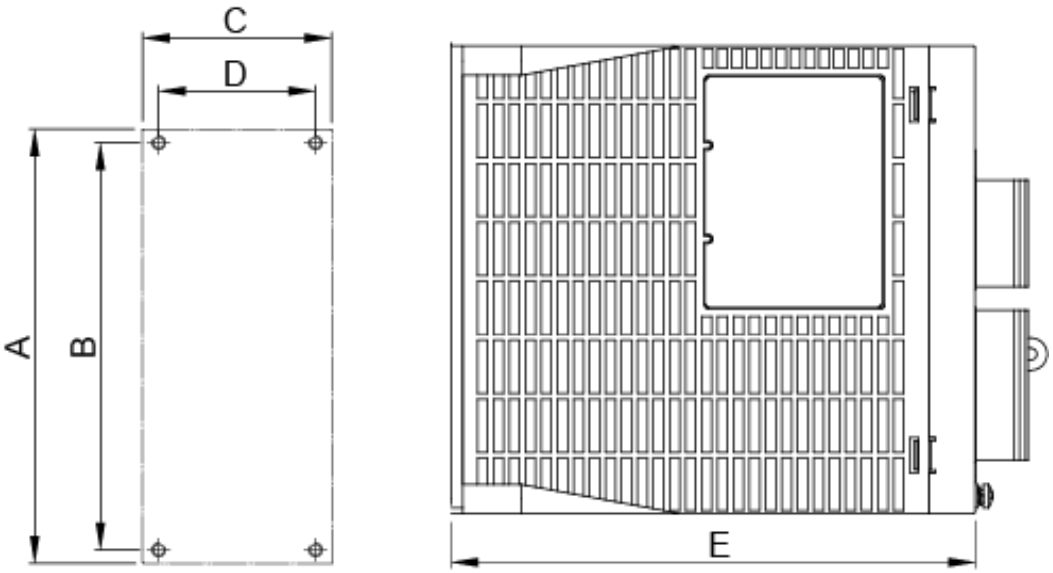


To cool servo drives in this situation, make sure the following:

- Strictly meet the space requirements, and install cooling fans above servo drives:
  - Space between servo drives: ＞10mm
  - Space between upper end and lower end of the servo drive: ＞50mm
- Strictly meet the following environment requirements to avoid high ambient temperature at part, and maintain even temperature inside the control panel:
  - Ambient temperature
    - Servo drive with power from 0.1kW to 2.5kW: 0℃~+55℃
    - Servo drives with power greater than or equal to 3.0kW: -10℃ ~+55℃
  - Humidity: ≤90%RH (no freezing or frost)
  - Ambient temperature for long-term - Servo drive with power from 0.1kW to 2.5kW: ≤ 45℃
  - Servo drives with power greater than or equal to 3.0kW: ≤ 40℃

Installation Dimension

The installation dimension is as follows:



Drive Model	A(mm)	B(mm)	C(mm)	D(mm)	E(mm)	Screw Size	Screw No.
WSDA-1R2	160	150	40	30.5	170	M4	2
WSDA-2R8	160	150	40	30.5	170	M4	2
WSDA-5R0	160	150	70	58	180	M4	3
WSDA-6R8	160	150	70	58	180	M4	3
WSDA-110	160	150	80	70	190	M4	4
WSDA-140	160	150	80	70	190	M4	4
WSDA-120	283.5	269.5	116.5	90	204	M4	4
WSDA-170	283.5	269.5	146.2	90	203.5	M4	4

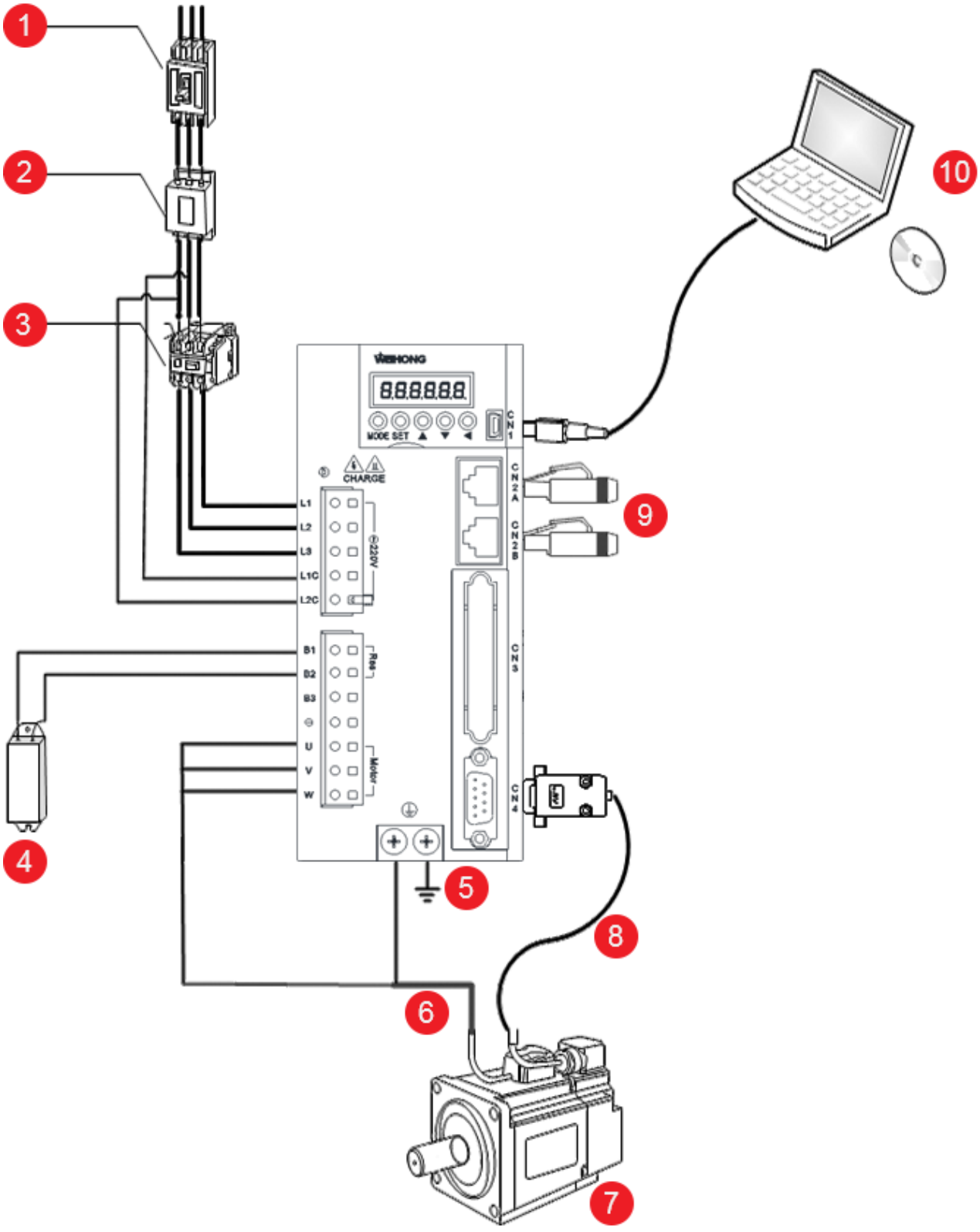
2.6 CNC System Wiring

This part introduces how to connect the WISE servo drive with the CNC system.

The corresponding relationship of terminals for servo drives with different power is as follows:

0.1kW~2.5kW	≥3.0kW
L1、L2、L3	R、S、T
L1C、L2C	-
B1、B2、B3	B1、B2、B3
U、V、W	U、V、W
CN1	CN1
CN2A/B	CN2A/B
CN4	CN5

The wiring of the corresponding terminals is the same. Taking serve drive with power from 0.1kW to 2.5kW as an example, the wiring is as follows:



1. Circuit breaker: protect the power line by shutting the circuit OFF when over-current is detected.
2. Noise filter: eliminate external noise from the power line and noise disturbance form the servo drive.

3. Magnetic contactor: turn the servo drive on and off. Please install a surge suppressor on the magnetic contactor.
   Note: Starting and stopping the servo motor with this magnetic contactor is prohibited.
4. Regenerative resistor
   - When an internal regenerative resistor is used, please keep short-circuit wiring between B2-B3 terminals.
   - When an external regenerative resistor is used, please break the short-circuit wiring between B2-B3 terminals, externally connect regenerative resistor to B1-B2 terminals and set parameter **Pr016 External regenerative resistor setup** to **1**.

   Warning:
   - Please mount the regenerative resistor on incombustible substances such as metal.
   - Please set over-temperature protection when external regenerative resistor is used.
   - Over-temperature protection fuse and thermostat is built in the regenerative resistor. Once fuse action occurs, it cannot restore to the previous state.
5. Ground
6. Motor main circuit cable
7. Motor
8. Encoder cable
9. Fieldbus controller / fieldbus control system / fieldbus type servo drive / terminal resistor
10. PC: supporting iMotion software

3 Wiring

3.1 Wiring of Main Circuit

This section introduces the wiring of main circuit.

It introduces the wiring of main circuit from the following aspects:

- Terminals
- Cables
- Specifications

3.1.1 Terminals

Terminals of main circuit are as follows:

Name	Symbol (0.1kW~2.5kW)	Symbol (≥3.0kW)	Description
Main circuit power input terminal	L1，L2，L3	R，S，T	Please do wiring based on the voltage specification of AC-INPUT item on the nameplate.
Control power input terminal	L1C，L2C	-	Connected to single phase voltage, 200~240V$^{+10\%}_{-15\%}$, 50/60Hz.
Terminals connecting with DC reactor	-	+，B1	Short-circuit copper bar when leaving factory is used, and reactor connection point is externally equipped.
External regenerative resistor connection terminal	B1，B2，B3	B1，B2, B3	B1-B2 is short-circuited by default when an internal regenerative resistor is used. When handling capacity of regenerative power is inadequate, you can connect an external regenerative resistor between B2-B2, and make circuit between B2 and B3 open by removing the wire between them.
Servo DC busbar terminal	B1、⊖	B1、⊖	To share the voltage of the busbar, connect the servo DC busbar terminals of multi-drives when they are connected in parallel.
Connection terminal for the motor	U, V, W	U, V, W	Used to connect with the motor.
Grounding terminal (2)	⏚	⏚	Used as the grounding point of AC and motor power line.

3.1.2 Cables

The specification of communication connecting wire is shielded twisted-pair cable CAT5e. This part introduces the cables of the main circuit from the following aspects:

- Precautions
- Types of cables
- Specifications

3.1.2.1 Precautions

Precautions are as follows:

- Allowable temperature: 40℃, which is the specification for rated current flowing through 3 lines.
- Please use electrical wire of 600V or more withstand voltage for main circuit.
- Please take the attenuation coefficient of allowable current into consideration when binding wires and putting them into PVC tube or metal tube.
- Thermal aging of PVC line is relatively quick, that is, PVC line cannot be used any longer in a short time. Please use heat resistant wire when ambient temperature is very high.

3.1.2.2 Types of Cables

Types of cables are as follows:

- IV
  - Name: 600V PVC wire
  - Allowable temperature of conductor: 60℃
- HIV
  - Name: Special heat-resistant PVC wire
  - Allowable temperature of conductor: 75℃

Relationship between wire diameter and allowable current when three wires are used is shown in table below (Values in the table are the reference specifications of 600V special heat-resistant PVC wire and the maximum specifications in real practice):

AWG Specification	Nominal Cross Sectional Area (mm²)	Constitution (wires/mm²)	Resistance of Conductor (Ω/Km)	30℃ Allowed Current (A)	40℃ Allowed Current (A)	50℃ Allowed Current (A)
20	0.5	19/0.18	39.5	6.6	5.6	4.5
19	0.75	30/0.18	26.0	8.8	7.0	5.5
18	0.9	37/0.18	24.4	9.0	7.7	6.0
16	1.25	50/0.18	15.6	12.0	11.0	8.5
14	2.0	7/0.6	9.53	23.0	20.0	16
12	3.5	7/0.8	5.41	33.0	29.0	24
10	5.5	7/1.0	3.47	43.0	38.0	31
8	8.0	7/1.2	2.41	55.0	49.0	40
6	14.0	7/1.6	1.35	79.0	70.0	57

3.1.2.3 Specifications

Cable specifications of all terminals when the main circuit power input terminals are connected with 3-phase / single phase voltage are as follows:

Terminal	1R2	2R8	5R0	6R8	110	140	120	170
Main circuit power input terminal	0.5 (AWG 20)	0.5 (AWG 20)	0.75 (AWG 19)	1.25 (AWG 16)	2.0 (AWG 14)	2.0 (AWG 14)	2.0 (AWG 14)	2.0 (AWG 14)
Control power input terminal	1.25 (AWG 16)	1.25 (AWG 16)	1.25 (AWG 16)	1.25 (AWG 16)	1.25 (AWG 16)	1.25 (AWG 16)	-	-
Terminals connecting with the motor	0.5 (AWG 20)	0.5 (AWG 20)	0.75 (AWG 19)	1.25 (AWG 16)	2.0 (AWG 14)	2.0 (AWG 14)	2.0 (AWG 14)	2.0 (AWG 14)
External regenerative resistor connection terminal	1.25 (AWG 16)	1.25 (AWG 16)	1.25 (AWG 16)	1.25 (AWG 16)	1.25 (AWG 16)	1.25 (AWG 16)	2.0 (AWG 14)	2.0 (AWG 14)
Grounding terminal	> 2.0 (AWG 14)	> 2.0 (AWG 14)	> 2.0 (AWG 14)	> 2.0 (AWG 14)	> 2.0 (AWG 14)	> 2.0 (AWG 14)	> 2.0 (AWG 14)	> 2.0 (AWG 14)

3.1.3 Specifications

During wiring, note the following:

- If the servo drive is directly connected with business power without insulation by transformer, please use circuit breaker (QF) or fuse to prevent the drive from mis-contact with peripheral components.
- No internal grounding protection circuit is enabled for the servo drive. To build up a safe system, please equip the servo drive with an electric leakage circuit breaker with over-load and short protection, or together with wiring circuit breaker, and install a short protection electric leakage circuit breaker.
- Please do not turn on/off the power frequently. Relatively large amount of charging current occurs when power is on because the power component has capacitor. Thus, frequent turning on/off power leads to decreased performance of main circuit components.
- When designing or arranging the system, please shorten the cable as short as possible.
- In main circuit wiring, note the following:
    - Please use twisted-pair shield wire or standard shield wire for I/O signal cable or encoder cable.
    - Maximum length for I/O signal cable is 3m, and maximum length for encoder cable is 20m.

- In ground connection, note the following:
  - Use bold wire (> 2.0mm²) as you can for ground connection.
  - It is recommended to use ground cable with 100Ω below resistance.
  - It MUST be single point grounding.
  - If the servo motor is insulated from mechanical parts, please ground connecting the motor.
- Please do not bend or pull the cable too tight.
- During setting power-control input, note the following:
  - Please set power-control input: after **Servo alarm** signal feeds out, turn power of main circuit off.
  - Please make sure power specification of used parts match with the input power specification.

Note: When connecting control power and main circuit power, please turn on main circuit power after control power on for 1s, or turn on two kinds of power at the same time. Similarly, please cut off two powers at the same time or cut off main circuit power after control power off.

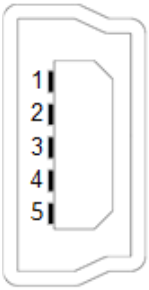
3.2 Wiring of CN1 USB Interface

CN1 is used to connect the servo drive and the PC which installs iMotion software via a USB wire. After connection, you can do monitoring, edit parameter edit, acquire waveform and check alarms/pins on PC.

To get iMotion software, you can contact us or download it from Weihong official website.

3.2.1 Terminal Definitions

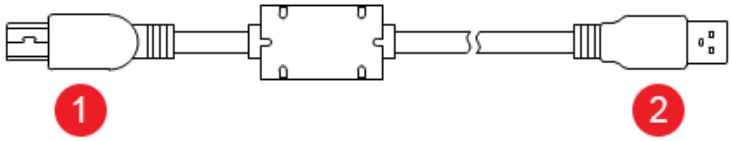
The terminals of CN1 are as follows:



1. GND: Ground connection
2. Undefined
3. Data+: data +
4. Data -: Data -
5. +5V: Power supply +5V

3.2.2 Cables

The cable of CN1 is as follows:



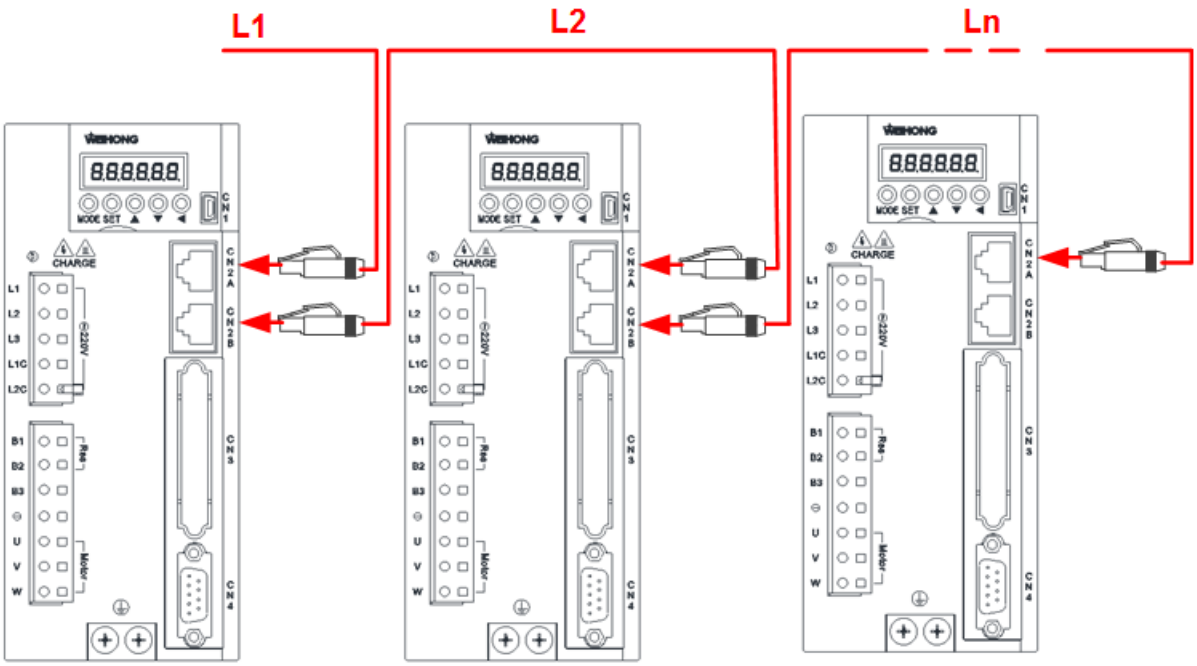
1. Drive side
2. PC side

3.3 Wiring of CN2A/B M-II Bus Communication Interface

CN2A/B, used as the connector for fieldbus, is used to connect the fieldbus with terminal resistor, so as to establish the communication between the servo drive and the control system.

3.3.1 Wiring Diagram

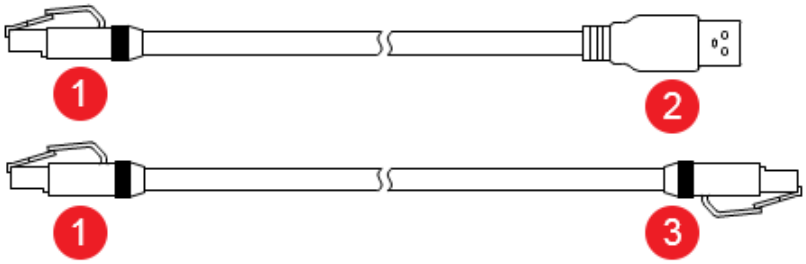
The wiring diagram of CN2A/B is as follows:



L1、L2……Ln are communication lines, and the last servo drive connects to the terminal resistance.

3.3.2 Cables

The cable of CN2A/B is as follows:



1. Drive side
2. Fieldbus
3. Drive side / to terminating resistor

3.4 Wiring of CN4 Motor Encoder Interface

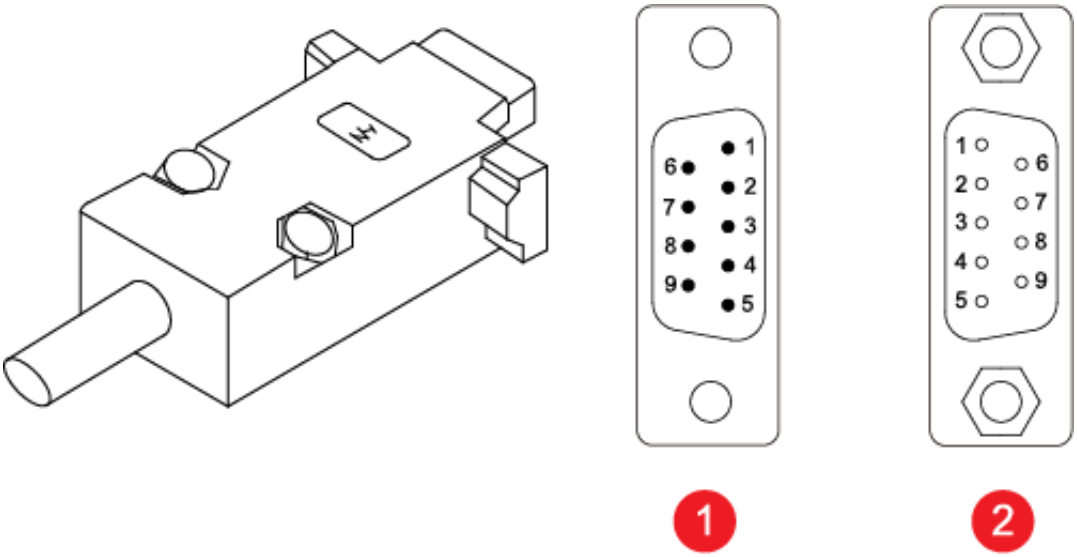
CN4 is used as the interface for motor encoder. And WSDA series servo drives support the encoder with serial 17-bit, 23-bit, 20-bit and 24-bit communication and A/B/Z-phrase incremental encoder.

Note: For servo drives with power from 0.1kW to 2.5kW, the interface is CN4; for servo drives with power above 3.0kW, the interface is CN5.

3.4.1 Terminal Definitions

The terminals of CN4 are as follows:

- Serial communication encoder

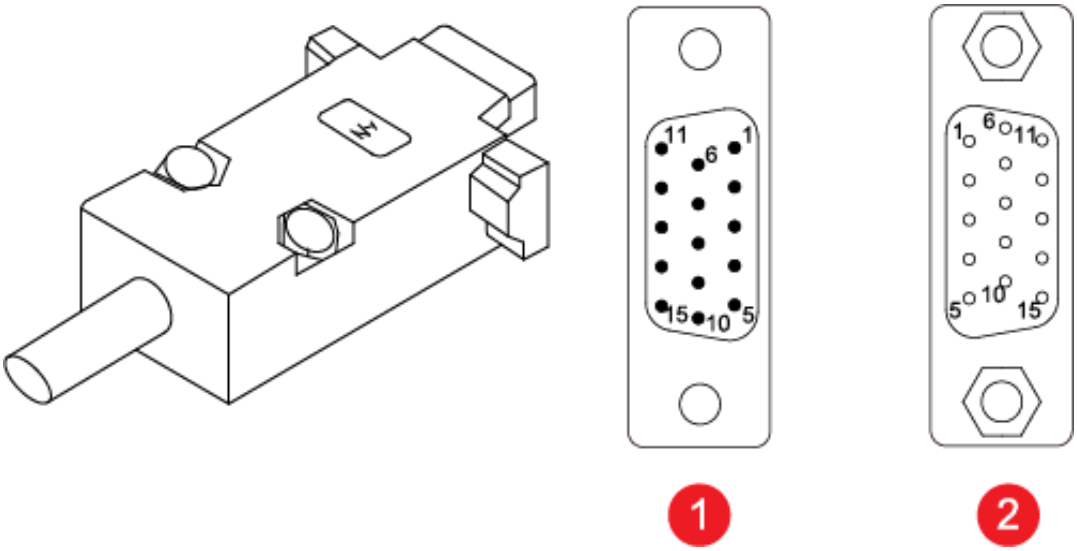


1. Pin
2. Hole

The definitions of pins/holes are as follows:

1. PS: Signal +
2. /PS: Signal -
3. BAT+: Battery +
4. BAT-: Battery -
5. -(BRK-OFF): Undefined
6. Undefined
7. +5V: Power supply +5V
8. GND: Ground
9. +(BRK-OFF): Undefined

- A/B/Z-phrase incremental encoder



1. Pin
2. Hole

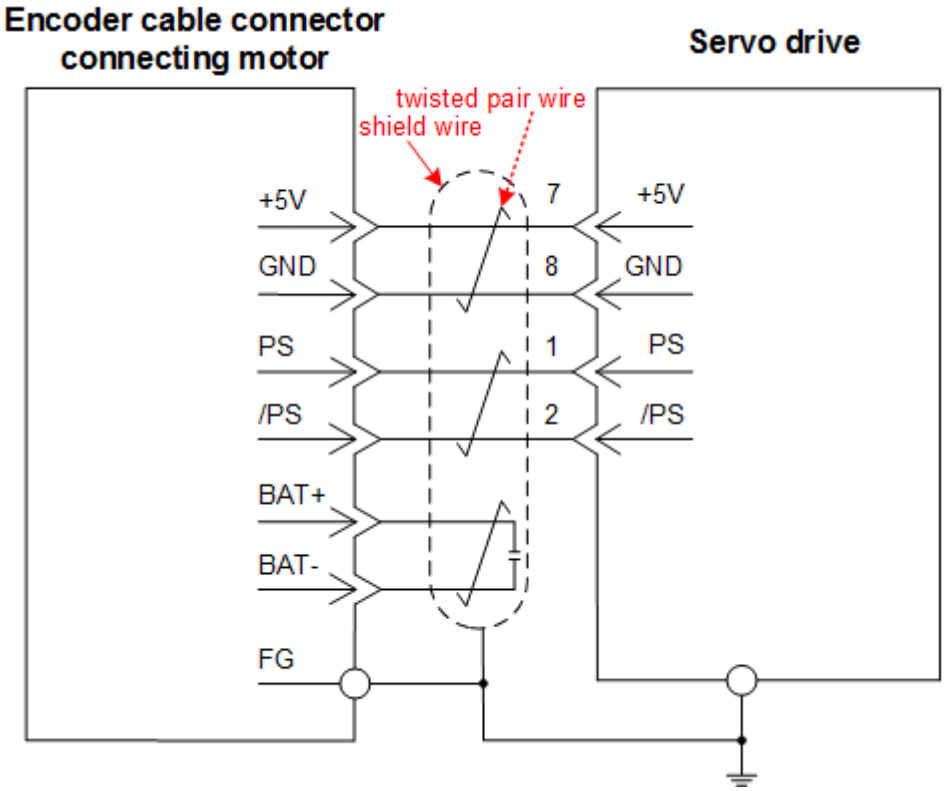
The definitions of pins/holes are as follows:

1. A: A-phrase signal +
2. B: B-phrase signal +
3. Z: Z-phrase signal +
4. U: Magnetic pole position signal U+
5. +5V: Power supply +5V
6. /A: A-phrase signal -
7. /B: B-phrase signal -
8. /Z: Z-phrase signal -
9. /U: Magnetic pole position signal U-
10. Undefined
11. /V: Magnetic pole position signal V-
12. V: Magnetic pole position signal V+
13. /W: Magnetic pole position signal W-
14. W: Magnetic pole position signal W+
15. GND: Ground

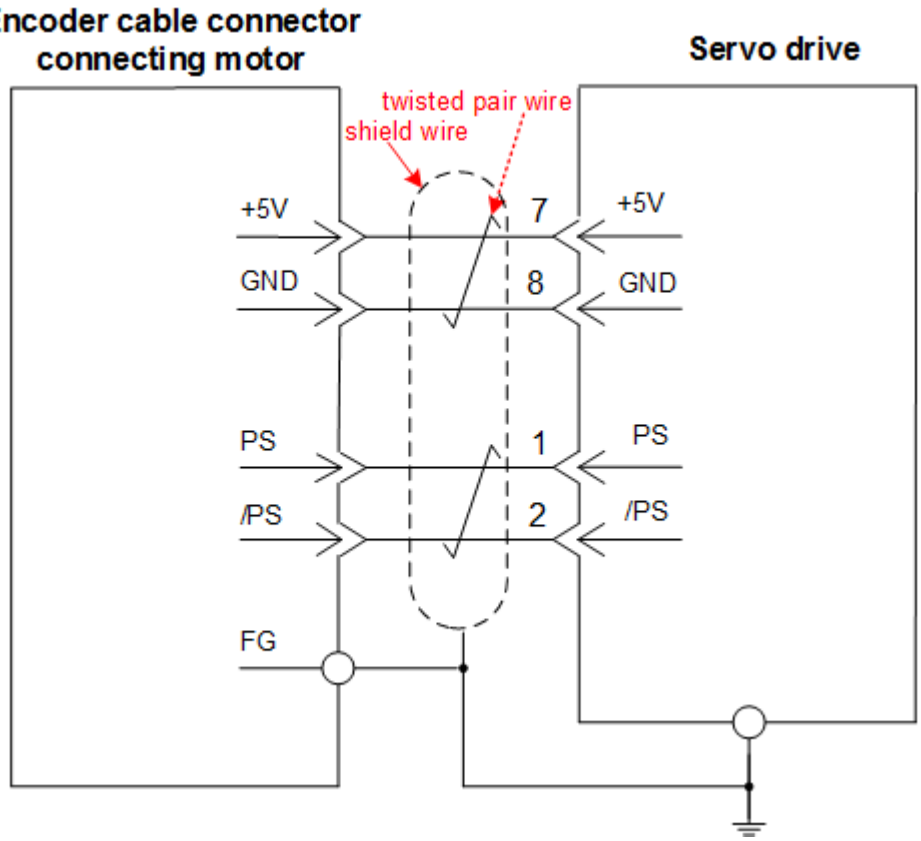
3.4.1.1 Specifications

Specifications are as follows:

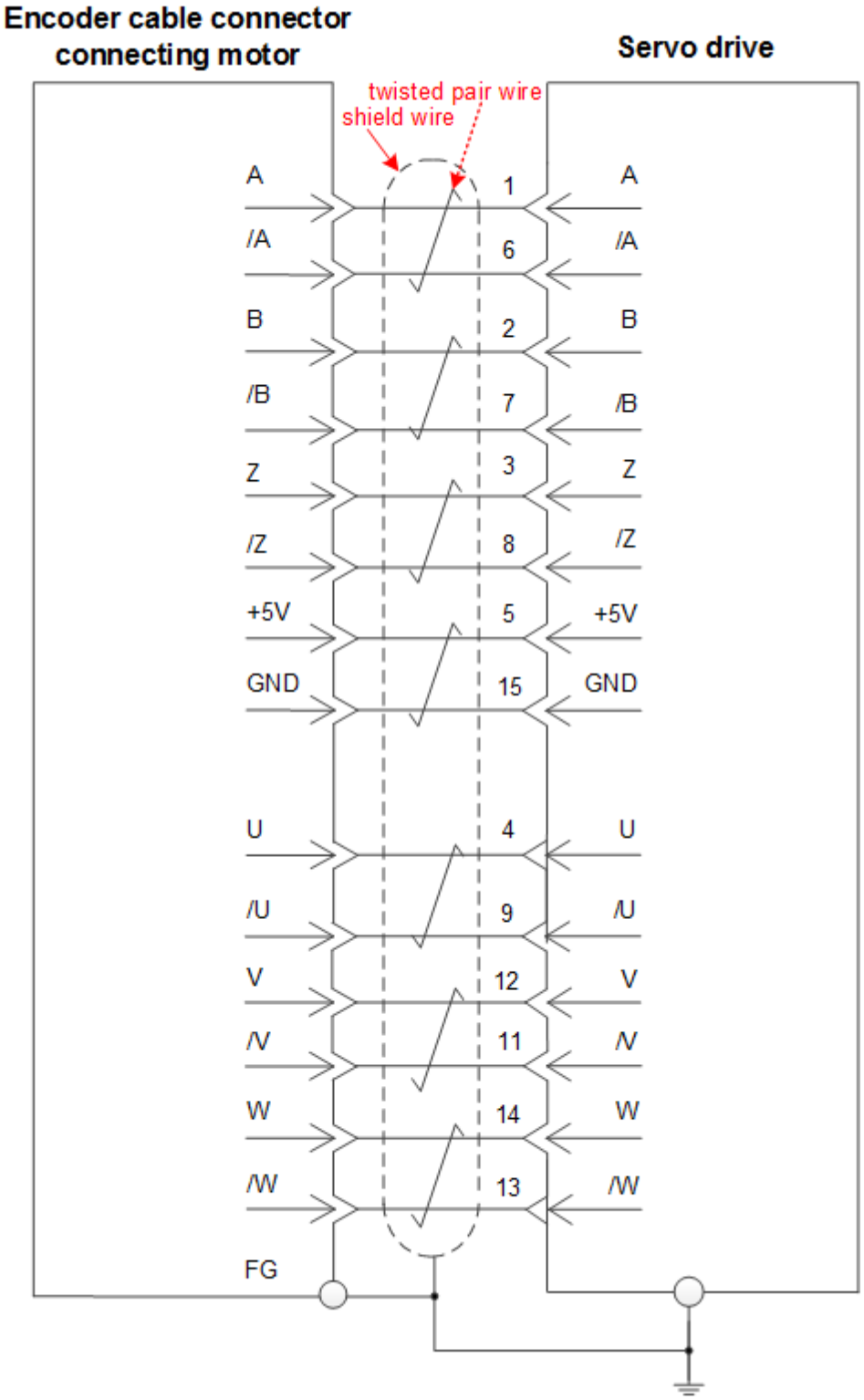
- Serial absolute encoder



- Serial incremental encoder



- A/B/Z-phrase incremental encoder



Note: When A/B/Z-phrase wire-saving encoder is used, U, /U, V, /V, W and /W signals connect to nothing.

3.4.2 Cables

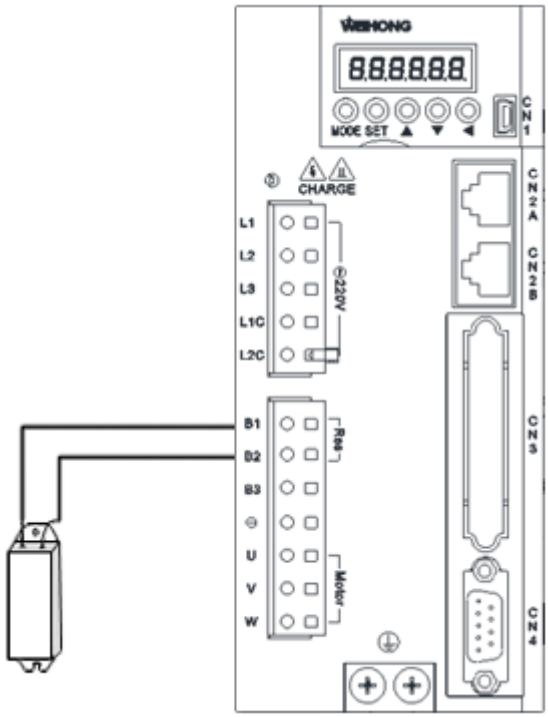
Wiring of encoder cables differs in the types of motors. See the corresponding model selection document for details.

3.5 Wiring of Regenerative Resistor

When the torque direction and rotating direction of the servo motor are opposite to each other, the motor state changes from rotating to regenerating. Regenerative energy is fed back to DC circuit after being rectified by free-wheeling diode. Since the energy in DC circuit cannot be fed back to power grid by rectifier bridge, and can only be absorbed by the capacitor of the servo drive, the charge in capacitor will accumulate into pump voltage and the DC voltage will rise. In this case, the energy can be consumed by regenerative resistor. Otherwise, the parts of servo drive will be damaged due to the high DC voltage.

When the built-in regenerative resistor cannot meet the demand, you can set parameter **Pr016 External regenerative resistor setup** to **1** to use the external regenerative resistor.

When an external regenerative resistor is used, please break the short-circuit wiring between B2-B3 terminals, and externally connect regenerative resistor to B1-B2 terminals.



Warning: Please make sure the wiring of the regenerative resistor is correct. Otherwise, the servo drive may be damaged and fire may occur.

Related Content

- Specifications of regenerative brake resistor
  - Specifications of internal regenerative brake resistor

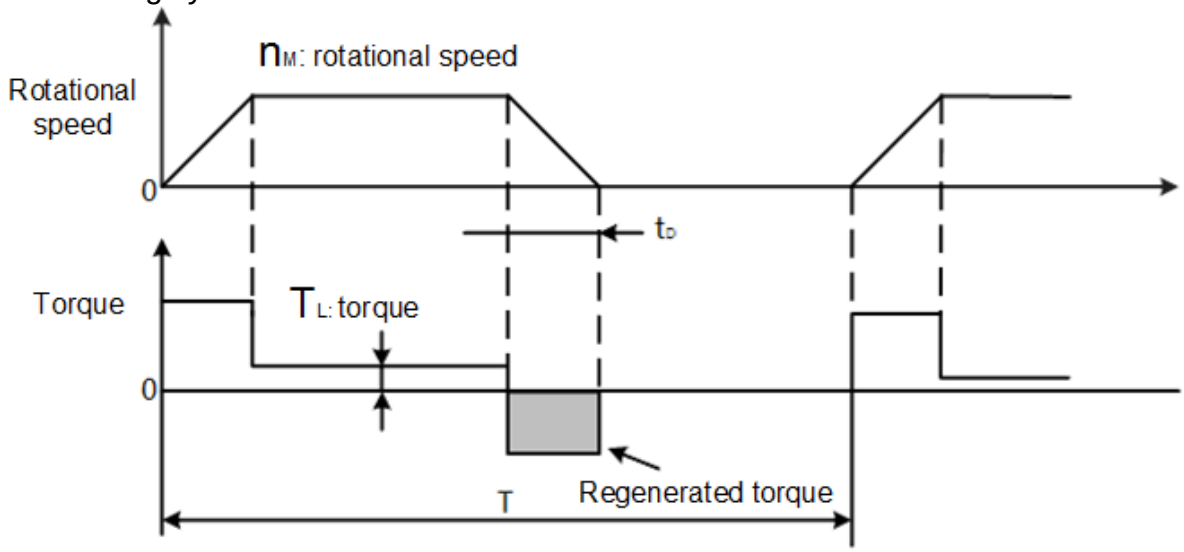
Model	Resistance (Ω)	Power(W)
WSDA-1R2-	—	—
WSDA-2R8-	—	—
WSDA-5R0-	50	40
WSDA-6R8-	50	40
WSDA-110-	20	50
WSDA-140-	20	50
WSDA-120-	40	100
WSDA-170-	40	100

  - Specifications of external regenerative brake resistor

Model	Min Resistance (Ω)	Min Power (W)
WSDA-1R2-	40	80
WSDA-2R8-	40	80
WSDA-5R0-	30	150
WSDA-6R8-	30	200
WSDA-110-	20	300
WSDA-140-	20	500
WSDA-120-	40	300
WSDA-170-	40	500

According to the actual condition, set specification of resistance by parameter **Pr017 Load factor of external regenerative resistor selection**, **Pr018 Regenerative resistor capacity** and **Pr019 Regenerative resistor resistance**.

- Capacity calculation of regenerative resistor
  The running cycle of motor is as follows:



When the motor accelerates or decelerates according to the cycle shown above, please calculate the capacity of regenerative resistor as follows:

a. Calculate rotation energy of the servo system (E_S).
   $E_S = (1/2) * J * w^2 = (1/2) * J * [Spd * (\pi / 30)]^2 = J * Spd^2 / 182(J)$
   $J = J_M + J_L$
   Among them:
   - J_M: rotational inertia of servo motor ($kg \cdot m^2$)
   - J_M: rotational inertia of motor axis load ($kg \cdot m^2$)
   - w: angular speed of servo motor (rad/s)
   - Spd: rotational speed of servo motor (r/min)

b. Calculate energy consumed by load system during deceleration (E_L).
   $E_L = (\pi / 60) * Spd * T_L * t_D$
   Among them:
   - T_L: load torque (N·m)
   - t_D: deceleration stop time (s)

c. Calculate energy consumed by coil resistor of servo motor (E_M).
   Neglected

d. Calculate absorbable energy by servo drive (Ec).
   Energy handled by single internal capacity is as follows:

Model	Power Level (W)	Absorbable Regenerated Energy (J)
WSDA-1R2-	100	9
WSDA-2R8-	400	18
WSDA-5R0-	750	27
WSDA-6R8-	1000	36
WSDA-110-	1500	59
WSDA-140-	2500	59
WSDA-120-	3000	48
WSDA-170-	5000	71

e. Calculate energy consumed by regenerative resistor (E_k).
   $E_k = E_s - (E_L + E_M + E_c)$
f. Calculate capacity of regenerative resistor (W_k).
   $W_k = E_k / (0.3 * T)$
   Among them:
   - W_k: necessary capacity of regenerative resistor (W)
   - T: repeated cycles of servo motor (s)
   - 0.3: 30%, the load ratio of regenerative resistor

Note: In actual calculation, you can neglect the energy consumed by load system, and only calculate the rotation energy Es.

Example 1

Taking servo drives with power from 0.1kW to 2.5kW as an example, to calculate the capacity of regenerative resistor when the load ratio is 400%, do the following:

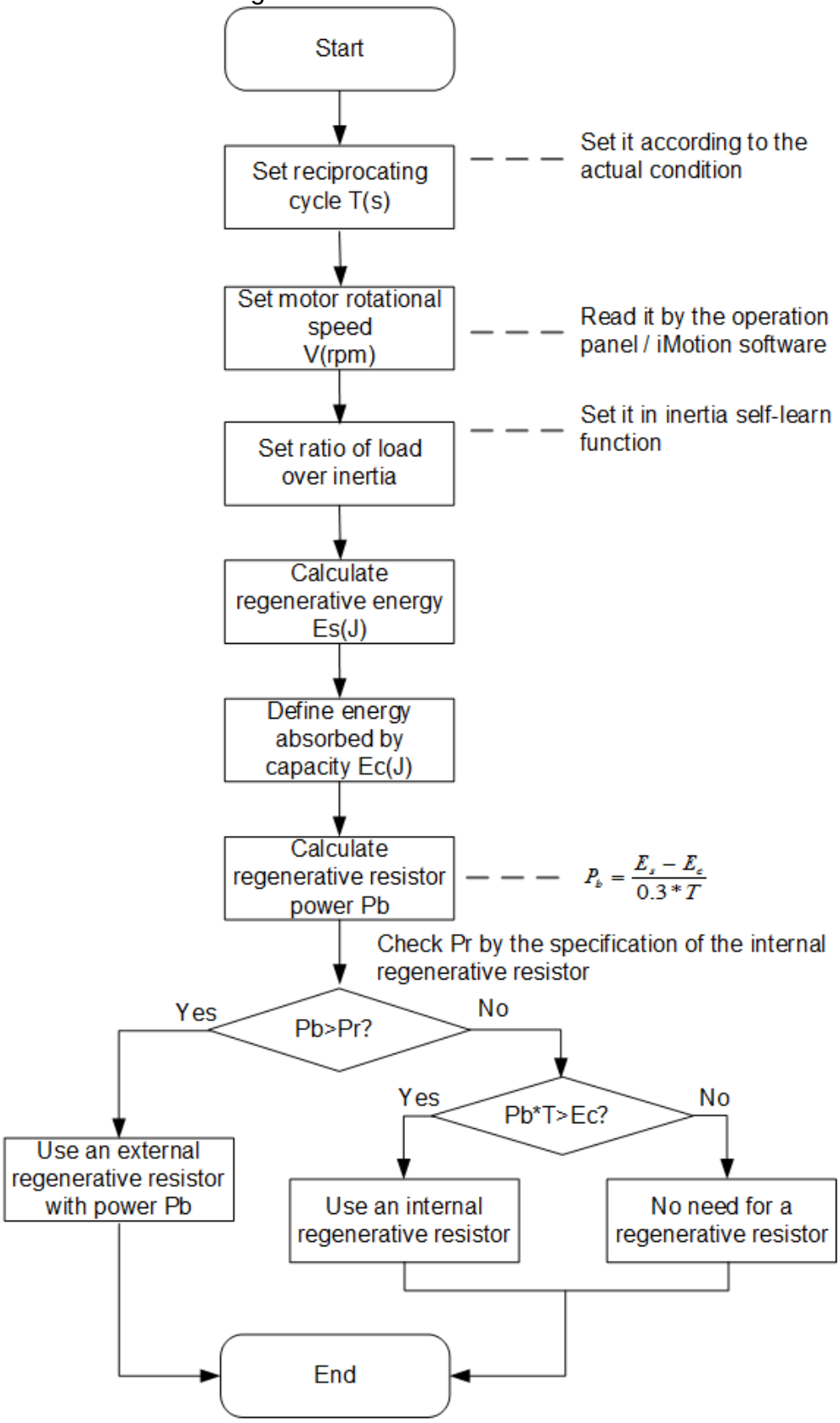
a. Calculate the rotational energy with rated rotational speed:
   $E_S = J * Spd^2 / 182 = 5 * 1.51 * 10^{-4} * 3000^2 / 182 = 37J$
b. Calculate energy consumed by regenerative resistor:
   Energy absorbed by internal capacitor is about 36J. Therefore, the capacitor cannot absorb all the energy. And the remaining energy needs to be consumed by external resistor. Energy needing to be consumed by regenerative resistor is: 37-36=1J
c. Assuming that the acceleration and deceleration cycle of motor is 1s, calculate the capacity of regenerative resistor:
   $W_k = E_k / (0.3 * T) = 1/0.3 = 3W$

W_k is less than 40W, the capacity of internal brake resistor. Therefore, using an internal brake resistor is enough.

Example 2

If the inertia ratio is changed from 400% to 800%, and other conditions do not change, the capacity of regenerative resistor is:
$W_k = E_k / (0.3 * T) = 103W$
W_k is greater than 40W, the capacity of internal brake resistor. Therefore, an external brake resistor is needed.
It is suggested to use an external regenerative resistor with power 103W.

- Model selection of regenerative resistor

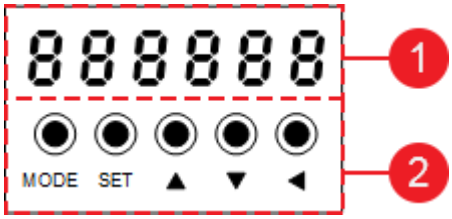


4 Operation Panel

4.1 Overview

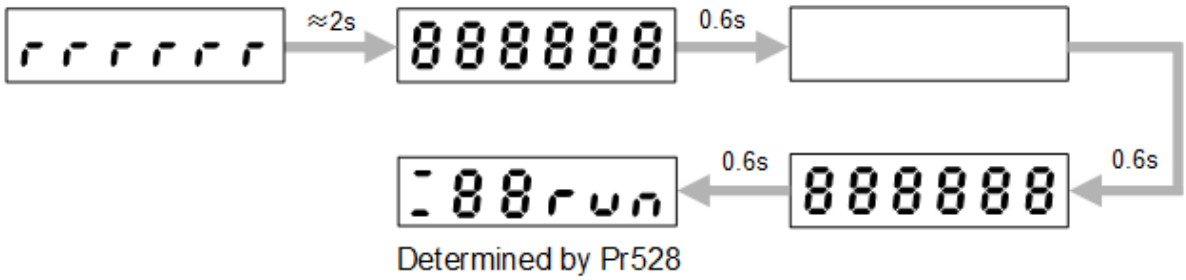
You can use the operation panel to finish operations on the servo drive.

The schematic diagram of the operation panel is as follows:

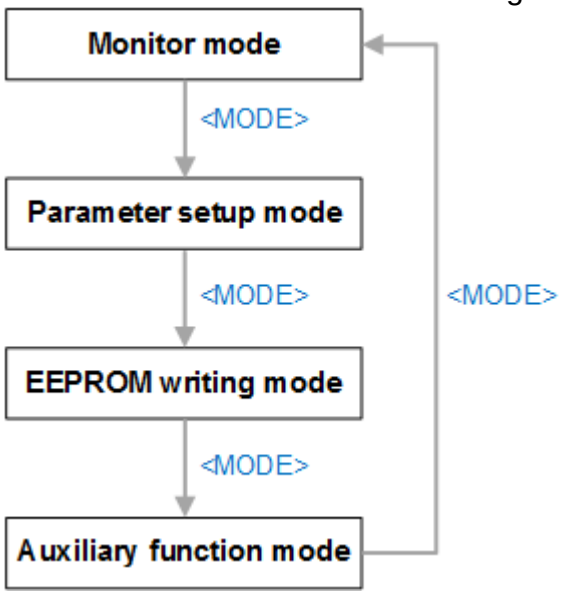


1. LED display (6-digit)
   - Show the current mode, parameter value, etc.
   - Switch to error display screen when an error occurs, with LED flashing at the frequency about 2Hz.

   After the power is ON, the display shows as follows:

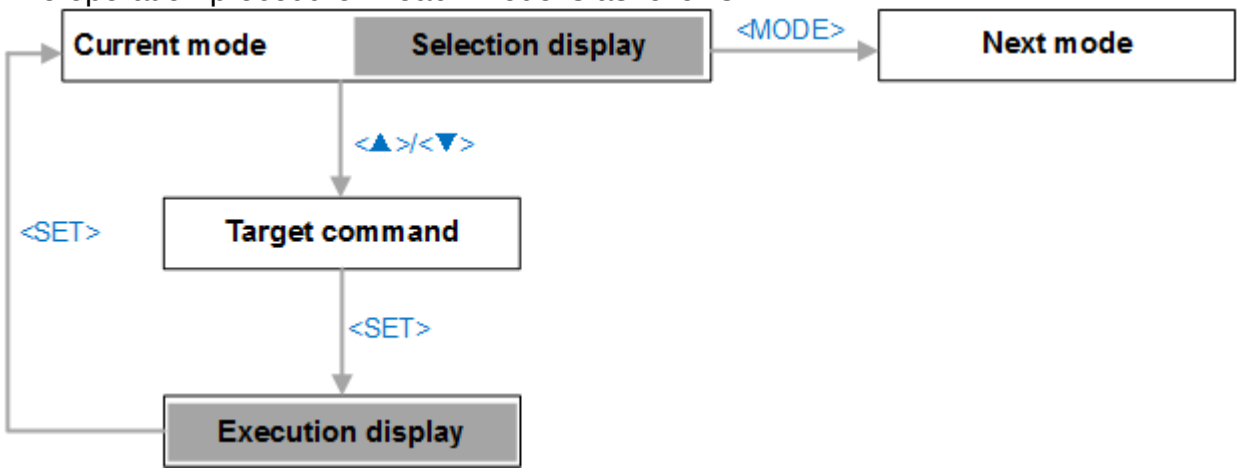


2. Operation buttons
   - **MODE** button: switch to the following modes:



   - **SET** button: change between **Selection** and **Execution** display, save the modification and enter its submenu.
   - ▲ / ▼ button: change display and data, select parameters, execute actions, and increase / decrease a value.
   - ◄ button: change the digit of debugging data.

The operation procedure in each mode is as follows:



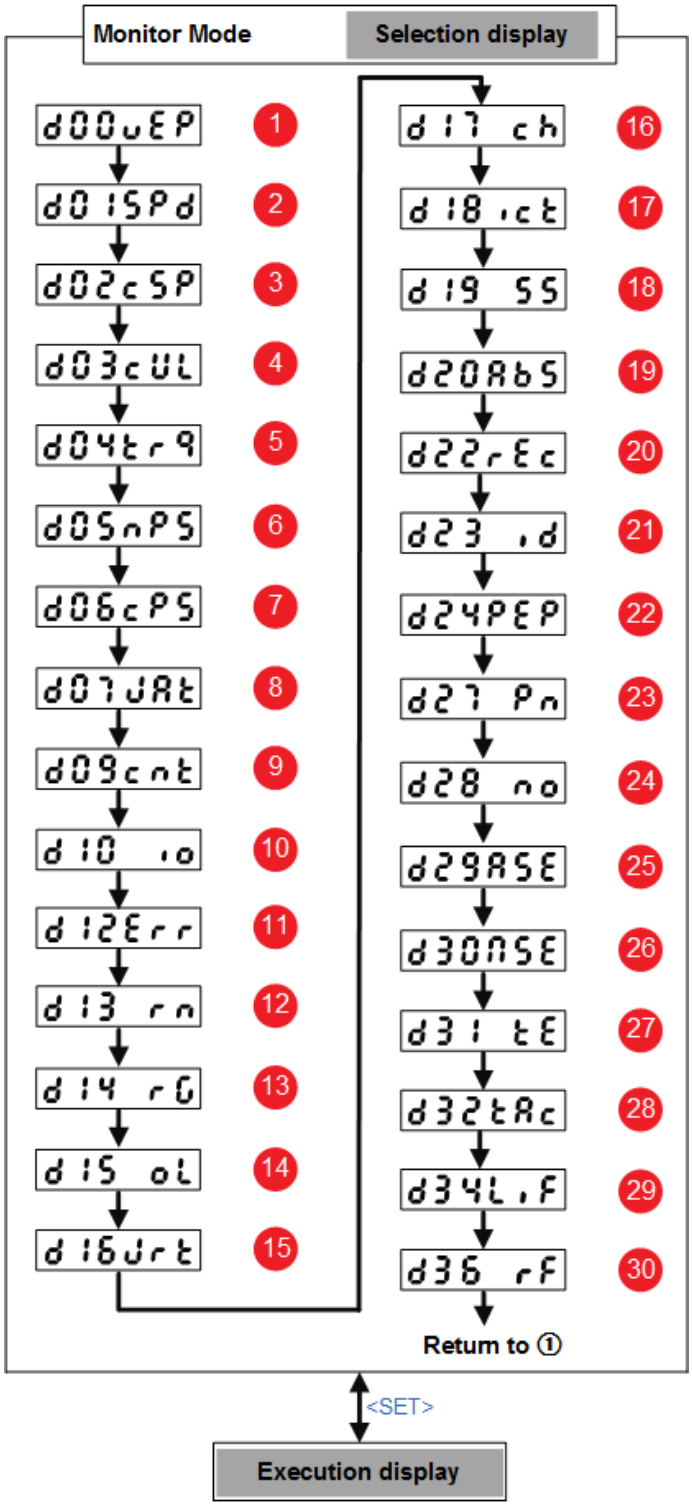
4.2 Operation Mode

4.2.1 Monitor Mode

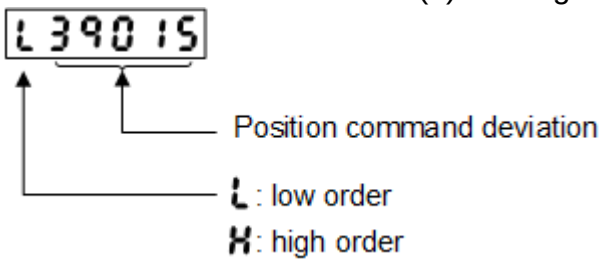
This mode is used to monitor the running status of the servo drive

The procedure of operation in monitor mode is as follows:

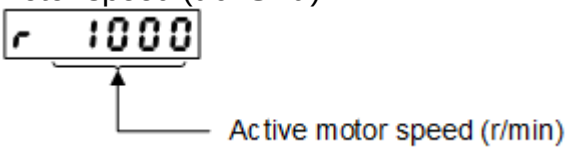
Note: Press ▼ to select the target command towards the arrowed direction, and press ▲ to select the command towards to the reverse direction.



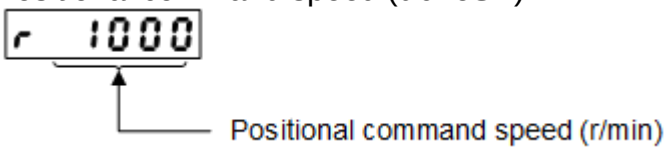
1. Positional command deviation (**d00uEP**)
   To switch between low order (L) and high order (H), press ◄.



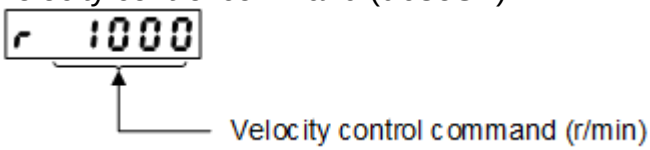
2. Motor speed (**d01SPd**)



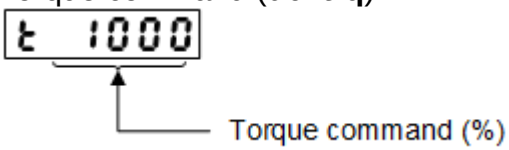
3. Positional command speed (**d02cSP**)



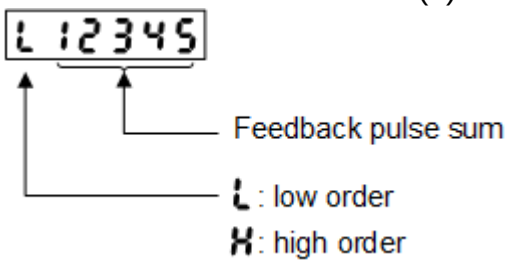
4. Velocity control command (**d03cUL**)



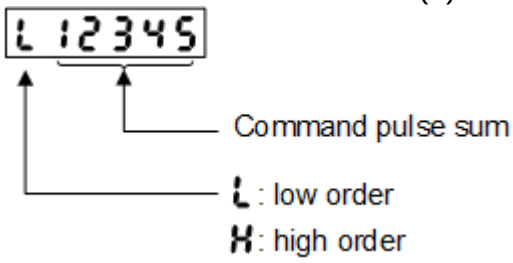
5. Torque command (**d04trq**)



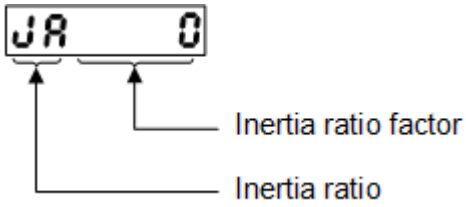
6. Feedback pulse sum (**d05nPS**)
   To switch between low order (L) and high order (H), press ◄.



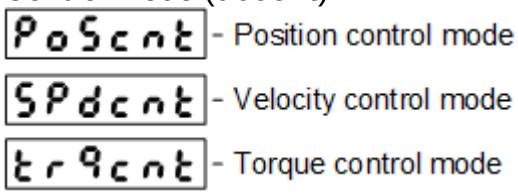
7. Command pulse sum (**d06cPS**)
   To switch between low order (L) and high order (H), press ◄.



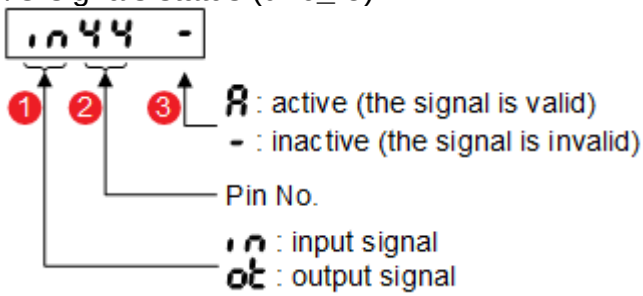
8. Load estimated inertial ratio (**d07JAt**)



9. Control mode (**d09cnt**)

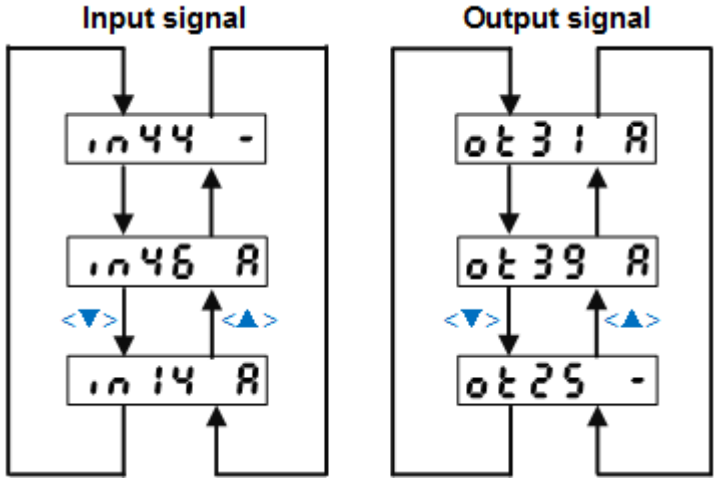


10. I/O signals status (**d10_io**)



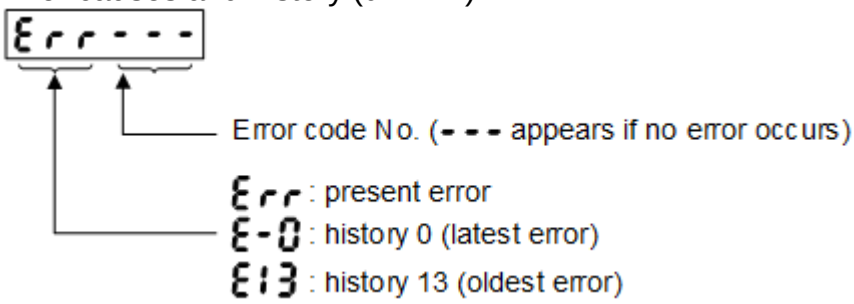
To switch between ① and ②, press ◄:

- ① flashes
  Press ▲ / ▼ to switch between the status **in** and **ot**.

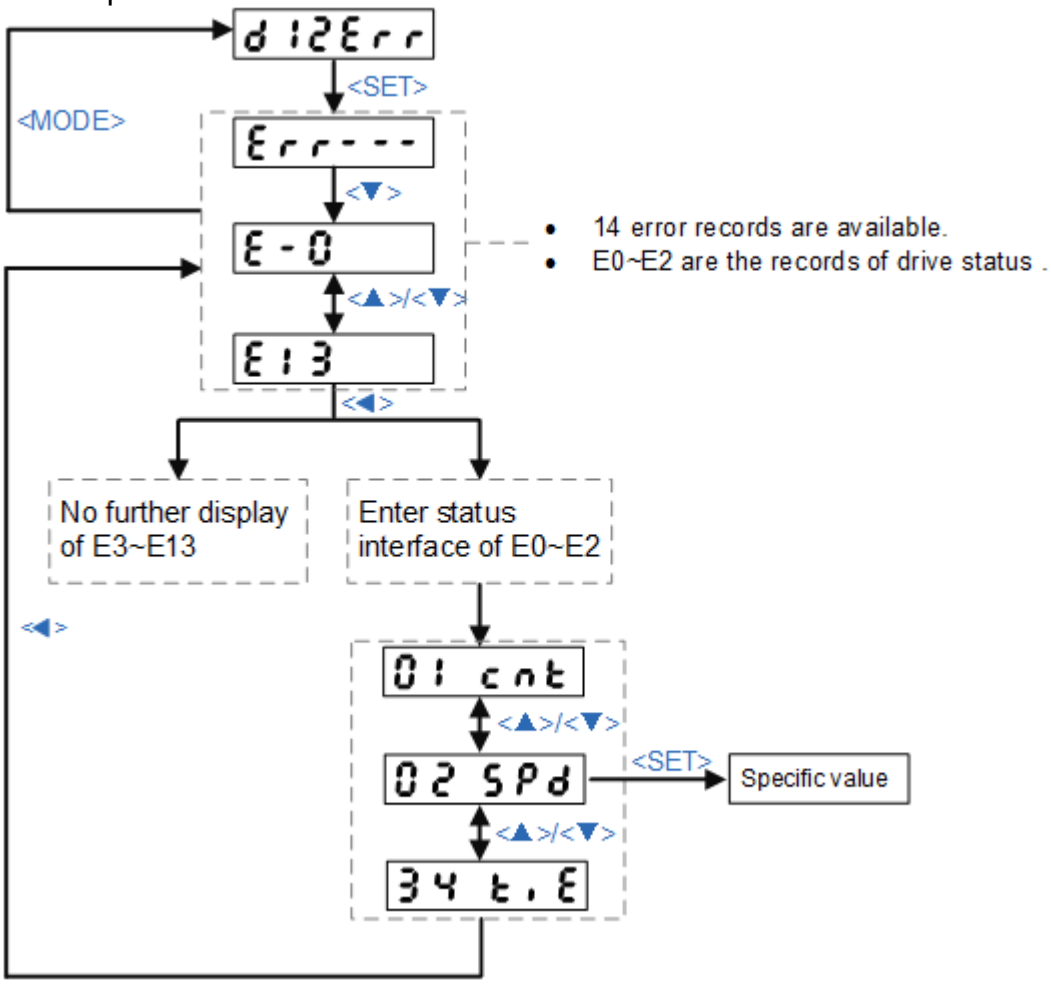


- ② flashes
  Press ▲ / ▼ to switch between the pin number (7 types of input signal and 4 types of output signal.)

11. Error causes and history (**d12Err**)



The steps to check error causes are as follows:



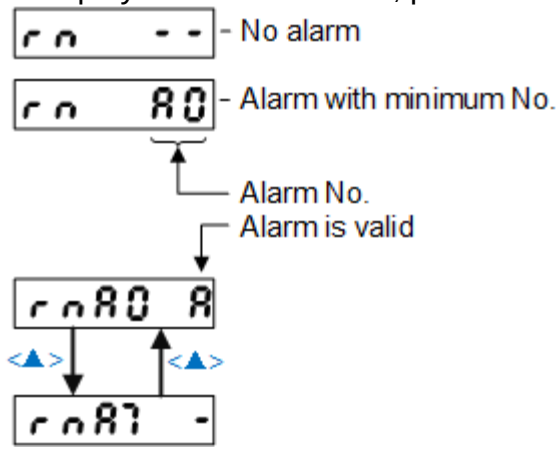
Note: When a history error occurs again, the present one shares the same error code number with history 0.

About error details, see Error and Troubleshooting for details.

Status Information of the Servo Drive When an Alarm Occurs

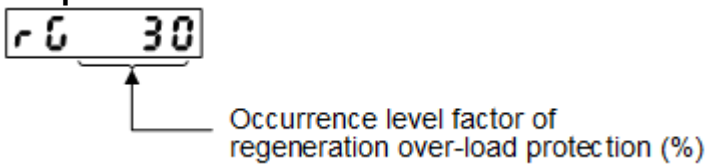
- 01 cnt: control mode
- 02 SPd: motor speed. Unit: rpm
- 03 cSp: position command speed. Unit: rpm
- 04 cUL: speed control command. Unit: rpm
- 05 trq: torque command. Unit: %
- 06 uEP: command position deviation. Unit: command unit
- 07 nPS: motor position. Unit: encoder unit
- 08 Hyb: hybrid deviation. Unit: command unit
- 09 in: logic input port
- 10 oUt: logic output port.
- 11 An1: analog input 1. Unit: 0.01V
- 12 An2: analog input 2. Unit: 0.01V
- 13 An3: analog input 3. Unit: 0.01V
- 14 oL: over-load factor. Unit: %
- 15 rG: regeneration load factor. Unit: %
- 16 Pn: voltage across PN. Unit: 0.01V
- 17 AtH: drive temperature. Unit: ℃
- 18 rn: alarm No.
- 19 Jrt: inertia ratio. Unit: %
- 20 PoG: position loop gain. Unit: 0.1/s
- 21 SPG: speed loop gain. Unit: 0.1Hz
- 22 SiG: time constant of velocity loop integration. Unit: 0.1ms
- 23 EtH: encoder temperature. Unit: ℃
- 24 nF3: 3rd notch frequency. Unit: Hz
- 25 nF4: 4th notch frequency. Unit: Hz
- 26 rSd: absolute encoder multi-turn data
- 27 iU: detected U-phase current value. Unit: AD value
- 28 iE: detected W-phase current value. Unit: AD value
- 29 rSd: M-II communication level.
- 30 ii: M-Ⅱ communication command
- 31 ESt: single revolution data of encoder. Unit: encoder unit
- 32 rEc: occurring times of encoder communication error.
- 33 PEc: occurring times of grating scale connection error.
- 34 tiE: alarm time. Unit: 0.1h

12. Alarm number (**d13_rn**)
    To display alarm occurrence, press ▲ / ▼.

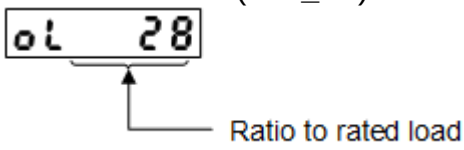


    Note: - represents that the alarm is not occurring.

13. Regenerative load factor (**d14_rG**)
    It is enabled when the value of parameter **Pr016 External regenerative resistor setup** is set to **0** / **1**.

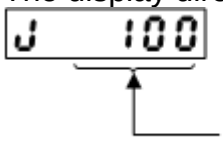


14. Over-load factor (**d15_oL**)

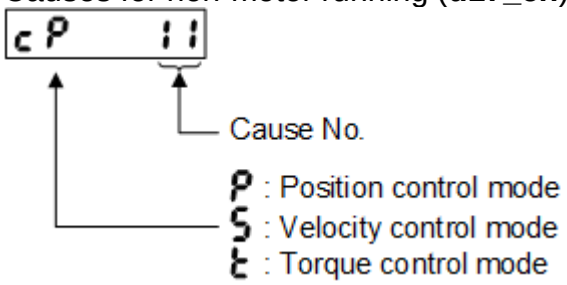


    See Error and Troubleshooting for details.

15. Inertia ratio (**d16Jrt**)
    The display directly displays the value of **Pr004 Inertia ratio**.

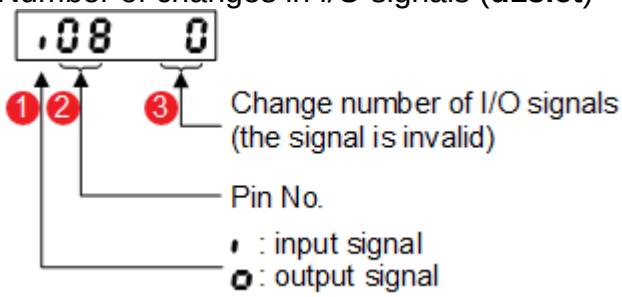


16. Causes for non-motor running (**d17_ch**)



    See Error and Troubleshooting for details.

17. Number of changes in I/O signals (**d18ict**)

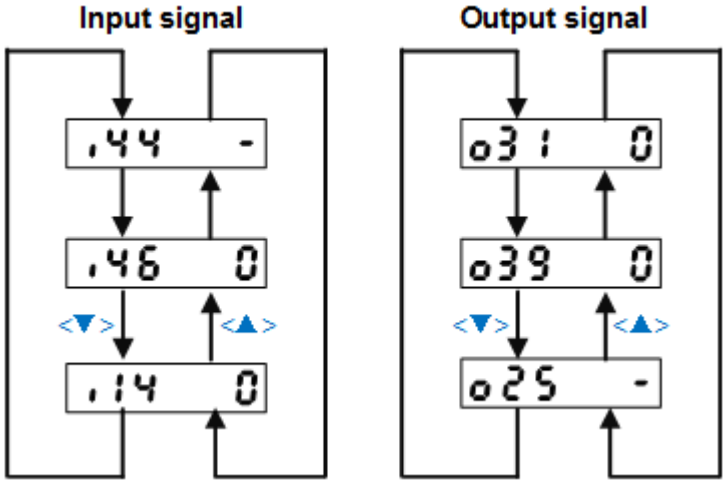


To switch between ① and ②, press ◄:

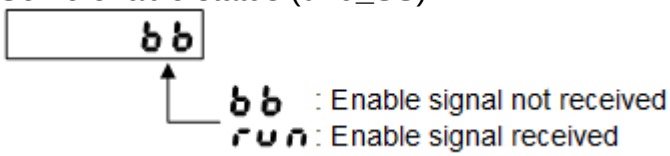
- ① flashes
  Press ▲ / ▼ to switch between the status **i** and **o**.
- ② flashes
  Press ▲ / ▼ to switch between the pin number (7 types of input signal and 4 types of output signal.)

To switch the pin number whose number of changes need to be displayed, press ▲ / ▼.

Example

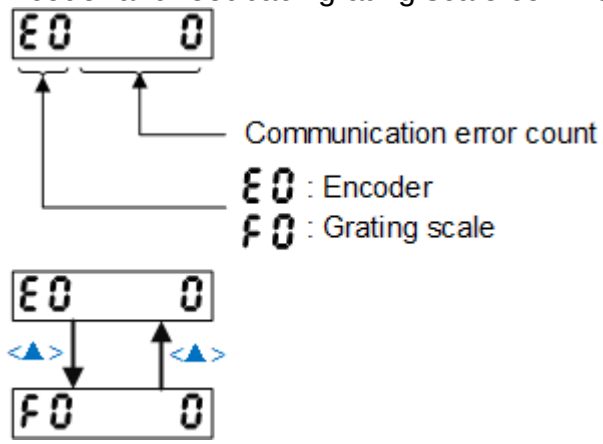


18. Servo enable status (**d19_SS**)

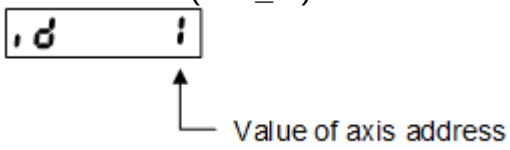


19. Absolute encoder data (**d20AbS**)

20. Encoder and feedback grating scale communication error count monitor (**d22rEc**)

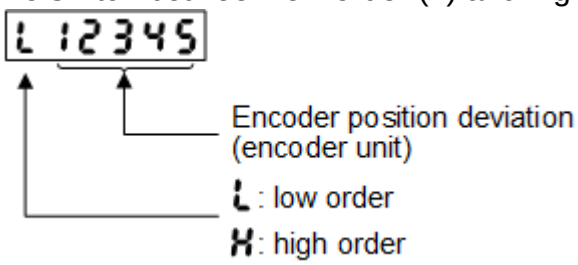


21. Axis address (**d23_id**)



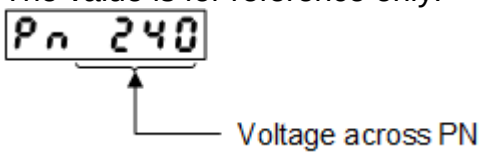
22. Encoder positional deviation (**d24PEP**)

To switch between low order (L) and high order (H), press ◄.



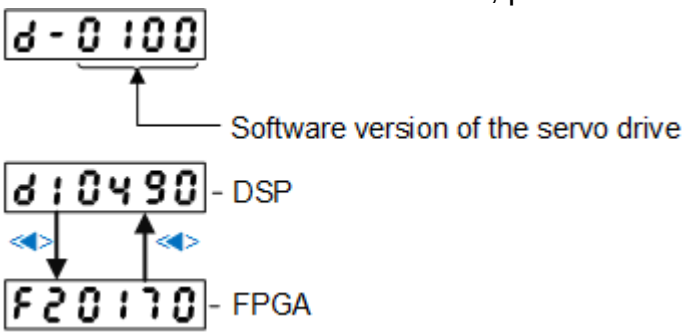
23. Voltage across PN (**d27_Pn**)

The value is for reference only.

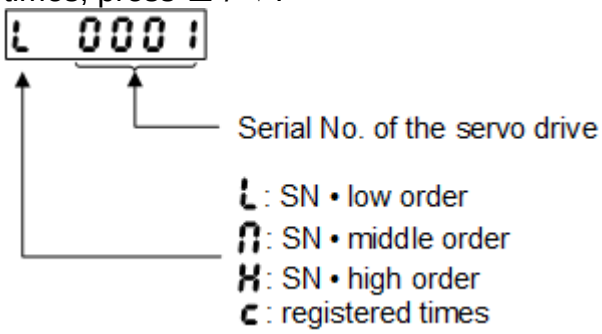


24. Software version (**d28_no**)

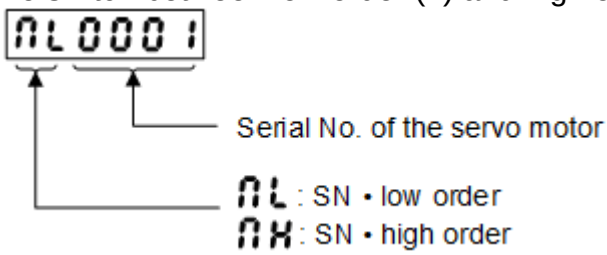
To switch between DSP and FPGA, press ◄:



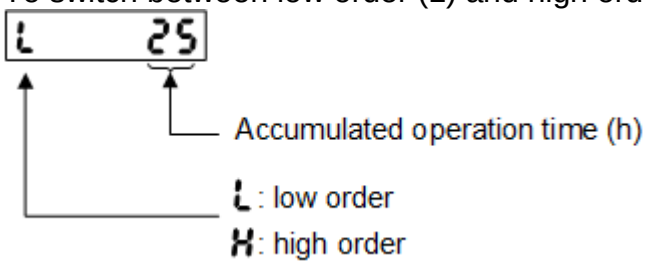
25. Serial number of the drive (**d29ASE**)
    To switch among the high order (H), middle order (N), low order (L) and registered times, press ▲ / ▼.



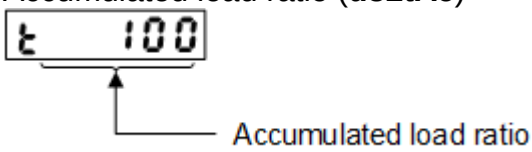
26. Serial number of the motor (**d30NSE**)
    To switch between low order (L) and high order (H), press ▲ / ▼.



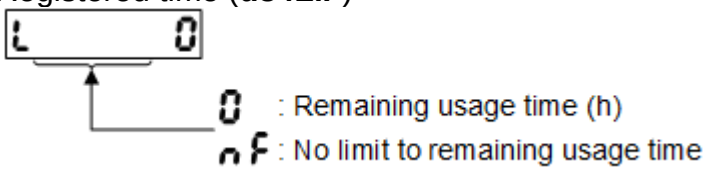
27. Accumulated operation time (**d31_tE**)
    To switch between low order (L) and high order (H), press ▲ / ▼.



28. Accumulated load ratio (**d32tAc**)



29. Registered time (**d34LiF**)

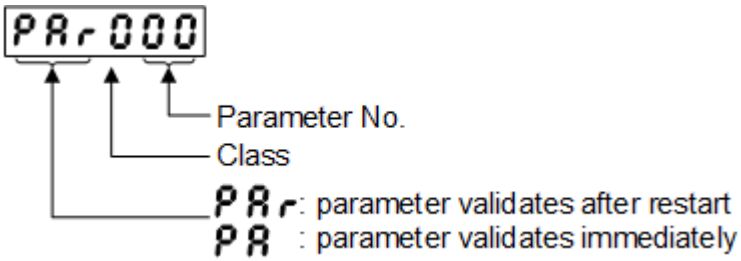


30. Real-time resonance frequency (**d36_rF**)

4.2.2 Parameter Setup Mode

This mode is used to set the parameters of the serve drive.

The meaning of the characters on the display is as follows:



If you set the parameter for the first time or after the power is on, the display shows **PAr000** by default. Otherwise, the display will show the parameter you selected before.

Example

Taking switch parameter **PAr000** to **PA004** as an example, to set drive parameters, do the following:

1. Select **PAr000** and press **SET** to enter the execution display.
2. Select the last digit, and press ▲ / ▼ to increase/decrease the value. The selected digit flashes.
3. To select the digit at the higher order position, press ◄.
4. Press ▲ / ▼ to increase/decrease the value of the selected digit.
5. Repeat steps 3~4 until all desired digits have been modified.
6. To confirm the modification, press **SET** for a while.

Parameters starting with **PA** take effective immediately (after restarting the servo drive, values of these parameters will recover to the previous values.)

To save parameters starting with **PAr** and permanently save parameters starting with **PA**, press **Mode** to enter EEPROM writing mode.

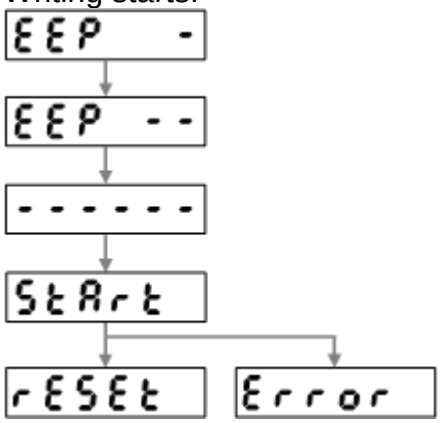
Note: To modify parameters which have great effects on the motor movement (especially the velocity loop and the position loop gains), please do not extremely modify them to a large value at one time.

4.2.3 EEPROM Writing Mode

This mode is used to make settings of parameters effective.

To write the parameter into EEPROM writing mode, do the following:

1. To enter execution display, press **SET**.
2. Press ▲ for about 5s. Sign **-** keeps increasing.
3. Keep pressing ▲ until the display changes to **Start**. > **Note: Start** may not be observed since it lasts for a very short time.
   Writing starts:

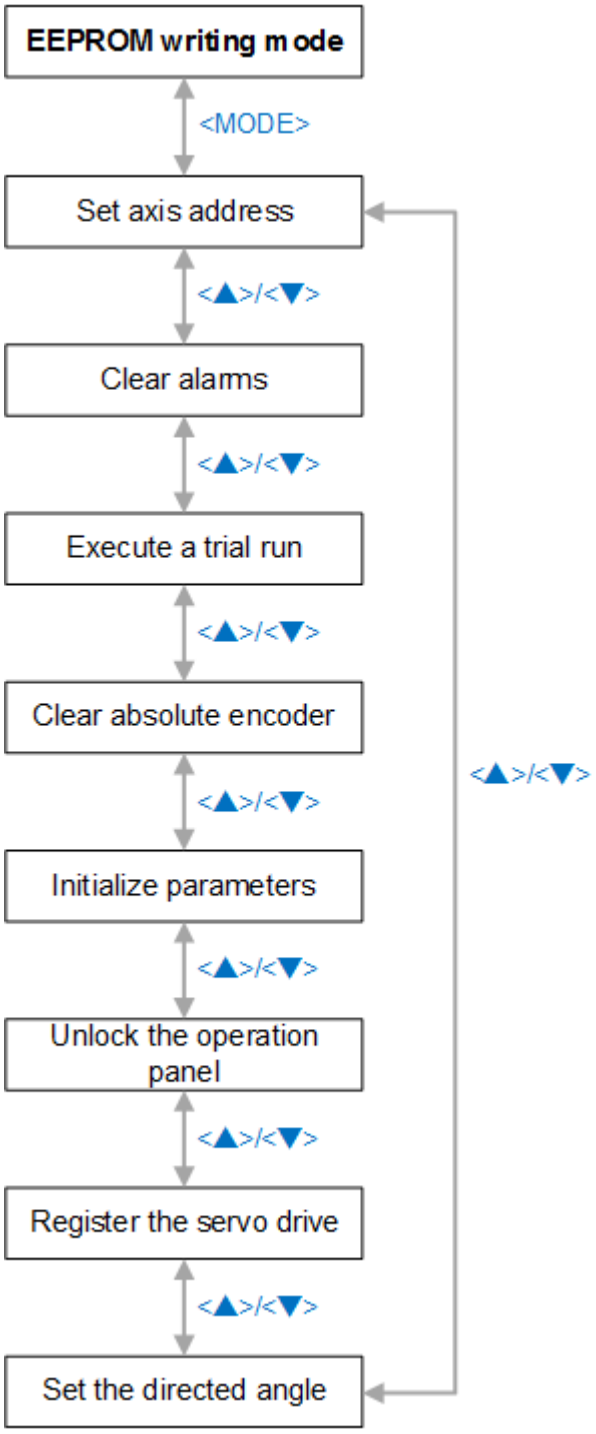


   - If **reset** shows, writing the parameter into EEPROM writing mode is successful.
     Restart the power to make the parameter effective.
   - If **Error** shows, writing the parameter into EEPROM writing mode fails.
     If **Err11.0 Control power supply under-voltage protection** or EEPROM parameter error protection (**Err36.0**, **Err36.1**, **Err36.2**) occurs, the drive system cannot initialize parameters, and **Error** shows.

4.2.4 Auxiliary Function Mode

4.2.4.1 Overview

To switch among each auxiliary mode, do as follows:

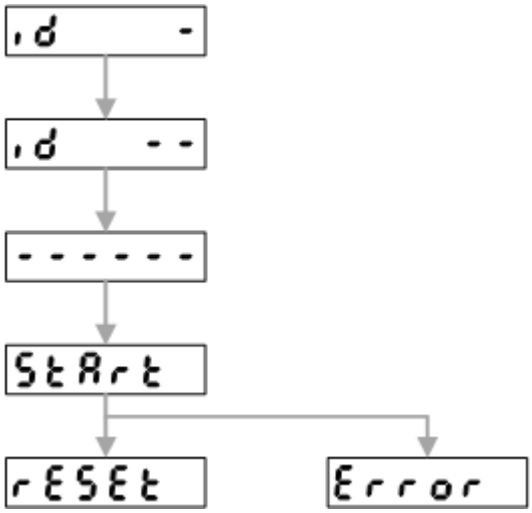


Note: Start may not be observed since it lasts for a very short time.

4.2.4.2 Setting Axis Address

To set axis address, do the following:

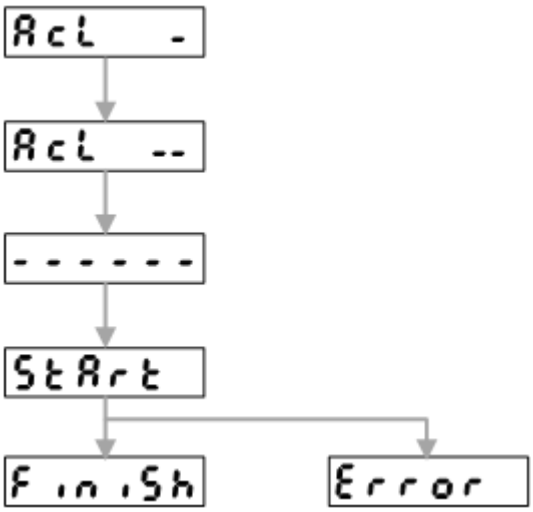
1. To enter axis address setup display, in the auxiliary mode, find **AF_Adr**, and press **SET**.
2. To select the target axis address, press ▲ / ▼.
3. Keep pressing ◄ until the display shows **Start**: The servo drive starts to set axis address:



   - If **reset** shows, setting axis address succeeds. Restart the power to make the parameter effective.
   - If **Error** shows, setting axis address fails.

4.2.4.3 Clearing Alarms

To clear alarms, in the auxiliary mode, find **AF_AcL**, and keep pressing ▲ until the display changes to **Start**. The servo drive starts to clear alarms:

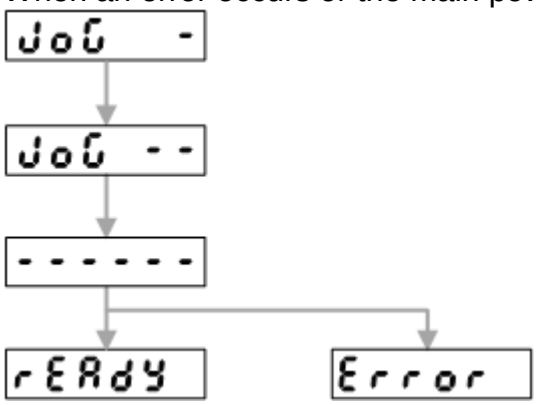


- If **Finish** show, clearing alarms succeeds.
- If **Error** shows, clearing alarms fails.

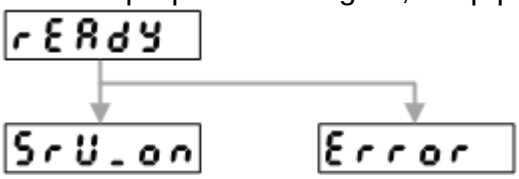
4.2.4.4 Executing a Trial Run

To execute a trial run, do the following:

1. To enter preparation stage 1, in the auxiliary mode, find **AF_JoG**, and keep pressing ▲ until the display changes to **ready**.
   When an error occurs or the main power supply is disconnected, **Error** shows.



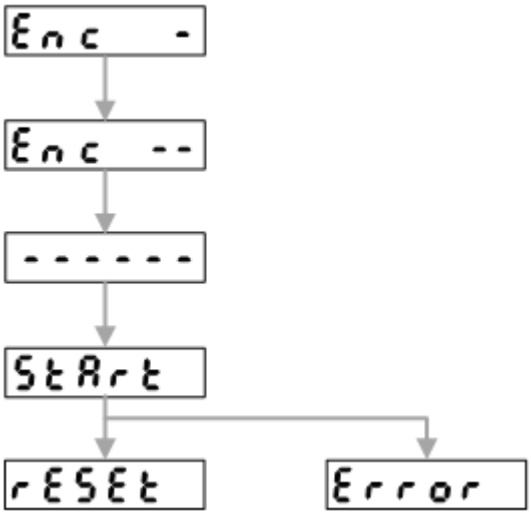
2. To enter preparation stage 2, keep pressing ◂ until the display changes to **SRV-ON**.



   When SRV-ON signal input or non-servo preparation status exists, **Error** shows.
   In preparation stage 2, press ▲ / ▼ to make the motor rotate in CCW direction or in CW direction separately, at speed set by parameter **Pr604 JOG speed**.

4.2.4.5 Clearing the Absolute Encoder

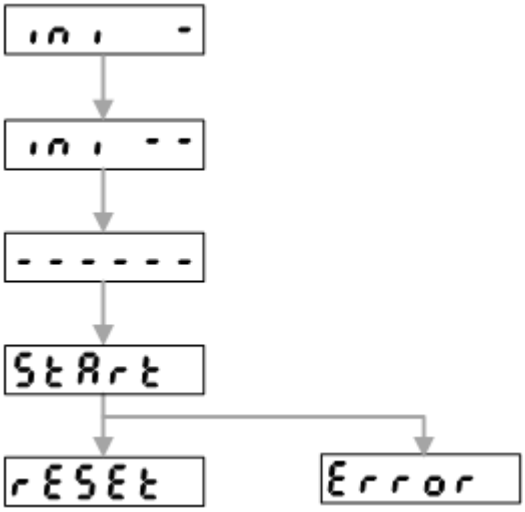
To clear the absolute encoder, in the auxiliary mode, find **AF_Enc**, and keep pressing ▲ until the display changes to **Start**. The servo drive starts to absolute encoder:



- If **reset** shows, clearing absolute encoder succeeds.
- If **Error** shows, clearing absolute encoder fails.
  Causes:
  - The used encoder is not supported.
  - The servo motor is enabled.
  - Parameter **Pr015 Absolute encoder setup** is set to **1**.

4.2.4.6 Initializing Parameters

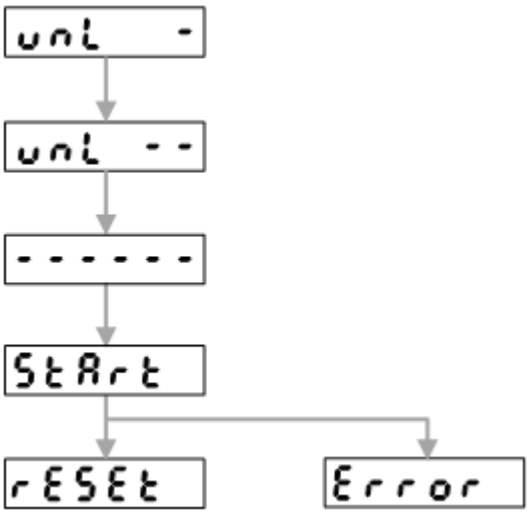
To initialize parameters, in the auxiliary mode, find **AF_ini**, and keep pressing ▲ until the display changes to **Start**. The servo drive starts to initialize parameter:



- If **reset** shows, initializing parameters succeeds.
- If **Error** shows, initializing parameters fails.
  When **Err11.0 Control power supply under-voltage protection** or EEPROM related errors (**Err36.0**, **Err36.1**, **Err36.2**) occur, parameter initialization fails, and **Error** shows.

4.2.4.7 Unlocking the Operation Panel

To unlock the operation panel, in the auxiliary mode, find **AF_unL**, and keep pressing ▲ until **Start** shows. The servo drive starts to unlock the operation panel:

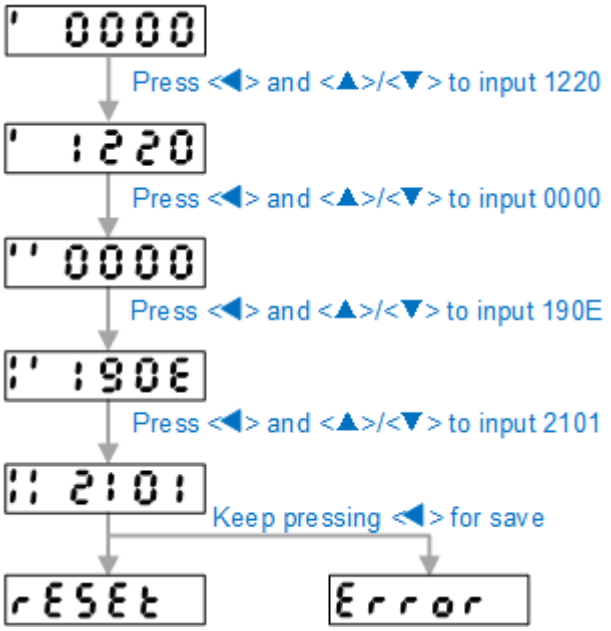


- If **reset** shows, unlocking the operation panel succeeds.
- If **Error** shows, unlocking the operation panel fails.

4.2.4.8 Registering the Servo Drive

To register the servo drive, in the auxiliary mode, find **AF_rEG** and press **SET**. The registering display shows and the servo drive starts to register the servo drive.

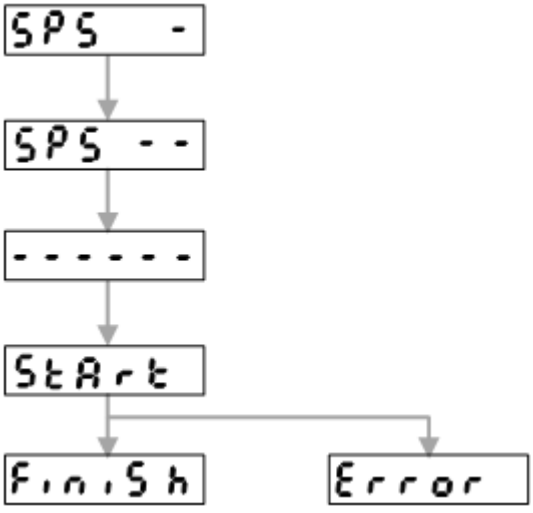
Taking the registration code 1220-0000-190E-2101 as an example:



- If **reset** shows, registering the servo drive succeeds.
- If **Error** shows, registering the servo drive fails.

4.2.4.9 Setting the Directed Angle

To set the directed angle, in the auxiliary mode, find **AF_SPS**, and keep pressing ▲ until the display changes to **Start**. The servo drive starts to set the directed angle:



- If **Finish** shows, setting the directed angle succeeds.
- If **Error** shows, setting the directed angle fails.

4.3 Locking of the Operation Panel

It is used to avoid inappropriate operations such as a wrong modification to parameters.

Limits with the operation panel locked differ in operation modes:

- Monitor mode: no limit and able to check all monitor data.
- Parameter setup mode: unable to modify parameters but able to check their values.
- EEPROM writing mode: no display and unable to write.
- Auxiliary function mode: no display and unable to execute all auxiliary functions except **Unlocking the Operation Panel**.

To lock the operation panel, do the following on the operation panel or with iMotion software:

1. Set the value of parameter **Pr535 Lock setup of front panel** to **1**, and write it into EEPROM.
   When the value of parameter **Pr535** is set to **0**, the operation panel is unlocked.
2. Restart the servo drive.

If you need to unlock the operation panel, do the following:

1. Do one of the following:
   - On the operation panel of the servo drive, execute unlocking the operation panel in the auxiliary function mode.
   - With iMotion software, set the value of parameter **Pr535** to **0**, and write it into EEPROM.
2. Restart the servo drive.

5 Motor Trial Run

5.1 Checking before Running

It is used to offer checking items before running the motor, to make sure the safety of running.

Before running the motor, make sure the following:

- The wiring is correct, especially the power input and the motor output.
- There is no grounded short circuit.
- All connections are sound and stable.
- The power supply is within rated voltage.
- The motor is stable.

5.2 Commissioning

Before running the motor, basic commissioning is required.

The process of basic commissioning is as follows:

1. Turn the servo motor on.
2. Select the rotational direction.
3. **Optional:** Set the overload level.
4. **Optional:** Enable the brake.
5. **Optional:** Stop the servo motor at servo off or alarm.

5.2.1 Turning the Servo Motor on

It is used to control the power on/off status of the servo motor.

Note: There are two ways to turn the servo motor on. After one method is enabled, the other is invalid.

To turn the servo motor on, do one of the following:

- Connect the bus. After connecting the bus, the motor is enabled automatically.
- Execute a trial run. It can only be used during a trial run.
  Note: When external SRV-ON signal input is active, trial run function is unavailable.

5.2.2 Selecting the Rotational Direction

In this way, you can obtain the same command polarity and rotational direction without changing the sign of interpolation position.

To select the rotational direction, set the value of parameter **Pr000 Rotational direction setup**.

5.2.3 Setting the Overload Level

It is used to set overload level of the servo motor by modifying overload error **Err16.0 Over-load protection** and the detected time of overload alarm.

To set the overload level, set the value of parameter **Pr512 Over-load level setup**.

Note: This operation cannot change the characteristics of overload.

5.2.4 Enabling the Brake

It is used to maintain the position when the servo drive is turned off, preventing moving parts of the machine from additional movement caused by self-mass or external force.

Brake is embedded in the servo motor with the built-in brake, and it is a kind of special and exclusive brake without magnetic excitation, and cannot be used for braking purpose. Please enable it only when the motor stops.

5.2.5 Stopping the Servo Motor at Servo off or Alarm

It is used to stop the servo motor when the servo is turned off or an alarm occurs.

To stop the servo motor at servo off or alarm, do the following:

- Set status in deceleration and after stopping at servo off by setting parameter **Pr506 Sequence at servo-off**.
- Set status in deceleration and after stopping at alarm by setting parameter **Pr510 Sequence at alarm**.

5.3 Trial Run

It is used to execute a trial run of the servo motor, to check the working condition of the servo motor.

Before executing a trial run, do the following:

1. See **CNC System Wiring** to connect the main power, control power, motor cable and encoder cable.
2. Remove the brake.
   Note: Please do not connect the brake to the machine.

During conducting a trial run, pay attention to the following:

- Please disconnect the communication with the control system during the trial running.
- Please restore parameters especially **Pr004 Inertia ratio**, **Pr101 1st gain of velocity loop** ~ **Pr104 1st time constant of torque filter** to the default before using them.
- To avoid oscillation and other unexpected accidents during trial run, please set the parameters related to gain to appropriate values.
  Note: Please set **Pr104 1st time constant of torque filter** to **0** when unloading loads.
- Please set the parameters based on velocity control mode, because the motor is running in velocity control mode during trial running.
- Please press **SET** or **MODE** button to exit **JOG** mode and switch to normal status once **Error** displays when SRV-ON is valid during a trial run.
- The motor will be out of control for at most 1s when the cable is disconnected or connectors fall off during a trial run. Please be careful during operating.

To execute a trial run, do one of the following:

- Execute a trial run by the operation panel.
- Execute a trial run by iMotion software.

5.3.1 Executing a Trial Run by the Operation Panel

To execute a trial run by operation panel, see Execute Trial Run for details.

After executing a trial run by the operation panel, press **SET** to exit the trial run mode.

During the trial run:

- The motor speed is decided by parameter **Pr604 JOG Speed**.
- Time to accelerate and decelerate remains 1(r/min)/ms all the time.

5.3.2 Executing a Trial Run by iMotion Software

Before executing a trial run by iMotion software, do the following:

1. Install iMotion software on your computer.
2. Connect the computer with the servo drive through the USB wire.

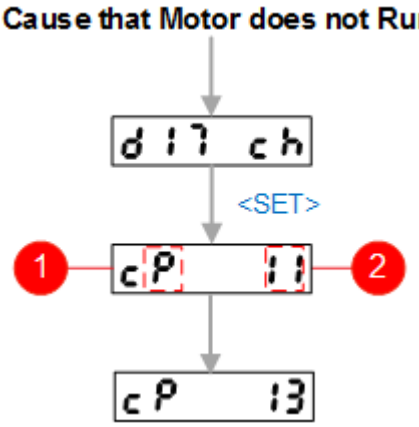
To execute a trial run by iMotion software, do the following:

1. Power on the drive, and launch iMotion software.
2. Click **Trial Run** in the function menu on iMotion software.
   See Trial Run by iMotion Software for details.

5.4 Troubleshooting

When the motor does not run, you can find the cause through the operation panel, and troubleshoot it.

To find causes that the motor does not run through the operation panel, do as follows:



1. The current control mode
   - i: idle
   - P: position control
   - S: velocity control
   - T: torque control
2. The number of cause
   When several causes occur at the same time, the operation panel only displays the cause with the minimum number and the LED is flashing. Only when the cause is solved, the next one can be displayed.

No.	Error name	Description	P	S	T
Flash	Errors or alarms	Errors or alarms occurred.	●	●	●
00	No cause	Cannot find causes for non-motor running.	●	●	●
01	Main power cutoff	Main power supply to the servo drive is not connected or turned ON.	●	●	●
02	No SRV-ON input	No SRV-ON input was connected to **COM-**.	●	●	●
03	Drive inhibit input is valid	When parameter **Pr504** is equal to **0** (drive inhibit input is valid), speed command is in positive direction when positive direction over-travel inhibition input (POT) is valid, and speed command is in negative direction when negative direction over-travel inhibition input (NOT) is valid.	●	●	●
04	Torque limit is too small	The valid torque setup of **Pr013** (1st) or **Pr522** (2nd) is set to a value lower than 5% of the rated value.	●	●	●
06	INH input is valid	**Pr518** is set to **0** (command pulse inhibit input is valid), and INH is in open circuit.	●		

No.	Error name	Description	P	S	T
07	The frequency of command pulse wave input is too low	The causes that command pulse is not input correctly or input forms for parameter **Pr006** and **Pr007** are different will lead to less than one pulse position command in each control cycle.	●		
08	CL input is valid	Deviation counter reset input (CL) is connected to **COM-**.	●		
09	ZEROSPD input is valid	Parameter **Pr315** is set to **1** (zero clamp) and ZEROSPD is in open circuit.		●	●
11	Internal speed command is 0	When internal speed command is selected, the speed is set below 30 r/min.		●	
12	Torque command is too small	The input value of torque command is 5% lower than the rated value.			●
13	Speed limit is too small	When parameter **Pr317** is set to **0**, the value of **Pr321** is too small; when parameter **Pr317** is set to **2**, the value of parameter **Pr321** or **Pr322** is too small.			●
14	Others	Besides cause 1~13, the rotational speed of the motor is still below 20 r/min. At this time, causes the speed command is too small, the motor is overloaded, the motor is being locked or collided, or an error occurred in the drive or motor have occurred.	●	●	●

6 Connection of the Control System

6.1 Selecting the Control System

This operation takes **NK300CX Integrated CNC Control System** (hereinafter referred to as **NK300CX**) as an example.

The type of control system is set by parameter **N50000 Control System Type** in **NK300CX**.

- 0: non-bus control system. Please use Lambda 5E.
- 0: bus control system. Please use Lambda 5M.

To select the control system, set parameter **N50000 Control System Type** in **NK300CX** to **1**.

6.2 Setting Related Parameters

This part includes setting system parameters in the CNC control system and set WISE drive parameters.

6.2.1 Setting System Parameters in the CNC Control System

This operation takes **NK300CX** as an example.

To set system parameters in the CNC control system, set the following parameters:

- **N16000 Drive Station Address**
  It should match with toggle switch setting of the drive station address.
  The number of each drive station address should be unique, such as X-axis is set 1, Y-axis is set to 2, and Z-axis is set to 3… 0 is invalid.
- **N16020 Encoder Digit**: the encoder digit of a servo motor.
- **N16030/N16040 Electronic Gear Ratio**: its setting should match with the value of drive parameter **Electronic Gear Ratio**. It is set to 1:1 by default.
- **N74130/N74140 Mechanical Reducer Ratio**: please set it based on the actual situation. It is set to 1:1 by default.
- **N74100 Screw Pitch**: the axial distance or degree between the corresponding points of two adjacent teeth on the threads.

6.2.2 Setting WISE Drive Parameters

Before setting WISE drive parameters, ensure drive parameter **Pr001 Control mode setup** is set to**1**.

To set WISE drive parameters, set the following drive parameters:

- **Pr009 1st numerator of electronic gear**
- **Pr010 Denominator of electronic gear**

6.3 Setting Axis Address

When the axis address is set to **0**, communication function is disabled. It is suggested to set axis address in order, for example: X-axis: 1; Y-axis: 2; Z-axis: 3...

In the same control system, the number of each drive axis address should be unique.

To set axis address, do one of the following:

- Operation panel.
- iMotion software (3.0.0 version or above)

Restart the power to make the setting effective.

6.4 Setting Datum or Executing Returning to the Machine Origin

This operation takes **NK300CX** as an example.

6.4.1 Setting Datum

If an absolute encoder is used, please set datum.

Before setting datum, make sure the following:

- In **NC300CX**, the value of parameter **N11001 Encoder Type** is set to **1**, and the value of parameter **Encoder Feedback** is set to **Yes**.
- The drive parameter **Absolute encoder setup** is set to **0**.

To set datum, see Set Datum with an Absolute Encoder for details.

6.4.2 Executing Returning to the Machine Origin

If an incremental encoder is used, please execute returning to the machine origin.

Before executing returning to the machine origin, make sure the following:

- In **NC300CX**, the value of parameter **N11001 Encoder Type** is set to **0**, and the value of parameter **Encoder Feedback** is set to **No**.
- The drive parameter **Absolute encoder setup** is set to **1**.

To execute returning to the machine origin, see Return to the Machine Origin with an Incremental Encoder for details.

6.5 Making the Servo Motor Running

To make the servo motor running, start the servo motor after correctly doing wiring for the system, and set the control system, servo drive and servo motor.

7 Absolute System

7.1 Installing and Replacing a Battery

This part introduces how to install a battery to the absolute encoder for the first time and replace it when a battery alarm occurs.

It is recommended to replace the battery every two years. If the electrolyte inside the battery leaks out, it will corrode the surrounding parts and result in short circuit.

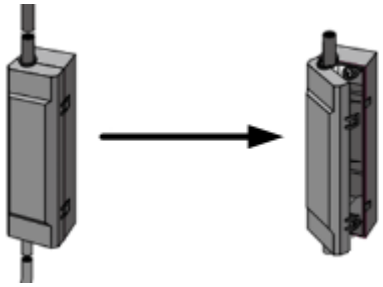
The process of replacing a battery is the same with that of installing it.

Before installing/replacing a battery to the absolute encoder, make sure the following:

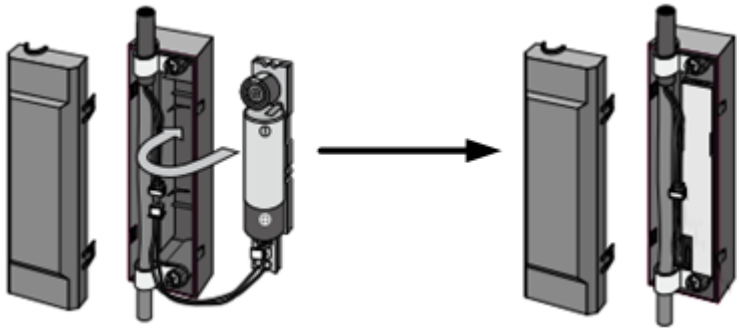
- The specification of the battery is 3.6V, 2000mAh.
- The power of the servo drive is on. Otherwise, data stored in the encoder will be lost.

To install a battery to the absolute encoder, do the following:

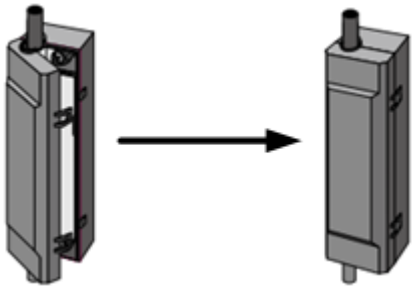
1. Raise the latch and take off the cover of the battery box:



2. To install the battery to the battery box, place the battery with **+** electrode facing downward, and connect it to the connector.



3. Close the cover of the battery box.



Note: Please do not pinch the connector cable.

When starting the machine tool for the first time after installing the battery, do the following:

1. To clear the encoder data (multi-turn data) to **0**, select one of the following:
   - Operation panel
   - iMotion software
2. **Optional:** For the non-bus type servo drives, after replacing the battery, to clear the battery alarms, do one of the following:
   - Operation panel.
   - iMotion software

   For bus type servo drives, connect the bus type drive with the master station. The system automatically clears the alarm.
3. Restart the servo drive.

After installing/replacing a battery to the absolute encoder, place the battery in the following environments:

- Indoors where the products are free from rain or direct sun beam.
- Places where the products are not subjected to corrosive atmosphere such as hydrogen sulfide, sulfurous acid, chlorine, ammonia, chloric gas, sulfuric gas, acid, alkaline and salt and so on, and are free from splash of inflammable gas, grinding oil, oil mist, iron powder or chips, etc.
- Places where are well-ventilated and humid and dust-free.
- Vibration-free places.

7.2 Making Your Own Cable for an Absolute Encoder

You can make your cable by yourself for an absolute encoder.

Before making your own cable for an absolute encoder, do the following:

- Prepare the connector for the battery of the absolute encoder.
- Securely install and fix the battery.
  Otherwise, the wire breakdown or damage to the battery may occur.
  See *Instruction Manual of the Battery* for the battery handling.

To make your own cable for an absolute encoder, see the corresponding model selection document.

7.3 Enabling the Absolute Function

The absolute function can help to read the actual position of the motor again after abnormal status is removed, such as power off, alarm clearance (except for **Err44.0 Absolute single turn counter error protection**, so as to make sure the coordinates in the software is the same with the actual coordinates.

Before enabling the absolute function, make sure the used encoder is the absolute encoder.

To enable the absolute function, set parameter **Pr015 Absolute encoder setup** to **1**.

7.4 Setting the Upper Limit of Absolute Multi-turn Data

It is used to set the upper limit of multi-turn data for any absolute encoders.

To set the upper limit of absolute multi-turn data, do the following:

1. To enter unlimited rotation in the absolute mode, set the value of parameter **Pr015 Absolute encoder setup** to **4**.
2. Restart the servo drive.
3. Set the value of parameter **Pr629 Absolute multi-turn data upper limit** according to the actual upper limit of multi-turn data of the used absolute encoder.
   If the value does not match with the actual one, **Err74.0 Multi-turn data upper limit mismatch error protection** occurs.

8 Gain Tuning

8.1 Preparing for Tuning the Gain

It is used to make the servo drive ready to adjust the gain.

To prepare for adjusting the gain, do the following according to the actual situation:

- Setting torque limit.
- Setting over-speed protection.
- Setting positional deviation excess protection.
- Setting the working range of the servo motor.

8.1.1 Setting Torque Limit

It is used to limit the maximum torque of the servo motor, so as to reduce the damage to machine caused by errors such as clutch or collision.

To set torque limit, do the following:

1. Set the value of parameter **Pr013 1st torque limit**.
   Note: If the torque is limited below actually required level, over-speed protection and positional deviation protection may be triggered due to overshoot command and command reception delay.
2. **Optional:** To externally detect the torque limit status, allocate **Torque in-limit signal output (TLC)** with **CN3** interface specification to output signal.
   Note: For servo drives with power above 3.0kW, the interface is **CN4**.

8.1.2 Setting Over-speed Protection

It is used to set over-speed protection, so that **Err26.0 Over-speed protection** occurs when the motor speed becomes extremely high, that is when the speed exceeds the value of parameter **Pr513 Over-speed level setup**.

The motor speed is as 1.2 times of the maximum of the applicable motor by default.

To set over-speed protection, do the following:

1. Calculate the value of parameter **Pr513** according to the following formula:
   Pr513 = Vmax * (1.2~1.5)
   Among them:
   - Vmax: the maximum speed (r/min) of the servo motor during running.
   - 1.2~1.5: the safety coefficient to avoid the frequent occurrence of over-speed.
2. Set the calculated value to parameter **Pr513**.

Note: You can run the motor at a low speed at the primary adjustment phase, or add safety coefficient to the speed, in order to trigger protection when oscillation occurs.

8.1.3 Setting Positional Deviation Excess Protection

It is used to set positional deviation excess protection in the position mode, so that **Err24.0 Positional deviation excess protection** occurs once the difference between positional command and motor position is large.

The positional deviation in normal operation varies with the setting of active speed and gain.

To set positional deviation excess protection, do the following:

1. To calculate the value of parameter **Pr014 Position deviation excess setup**, select one of the following formula according to the actual condition:
   - When parameter **Pr520 Position setup unit selection** is set to **0** (with command position deviation detection):
     Pr014= Vc/Kp * (1.2~2.0)
     When position command filter is enabled, plus the value of **Vc * time constant of filter (s)**.
   - When parameter **Pr520** is set to **1** (with encoder positional deviation detection):
     Pr014= Ve/Kp * (1.2~2.0)
     The setting of positional command filter will not affect the setting of parameter **Pr014**.
     Among them:
     - Vc: the maximum frequency (pulse/s) of positional command pulse.
     - Ve: the maximum pulse (pulse/s) of encoder unit.
     - Kp: the position loop gain (1/s). When switching Kp, please use the minimum value to calculate.
     - 1.2~2.0: the safety coefficient to avoid the frequent occurrence of over-speed.
2. Set the calculated value to parameter **Pr014**.

8.1.4 Setting the Working Range of the Servo Motor

It is used to set the working range of the motor in the position mode, so that **Err34.0 Motor movable range protection** occurs once the range of the current position command exceeds the value of parameter **Pr514 Motor working range setup**.

To set the motor working range, set the value of parameter **Pr514**.

8.2 Estimating the Inertia Ratio

It is used to estimate the ratio of the load inertia against the rotor (of the servo motor) inertia, so as to accurately know the load inertia.

The conditions for inertia ratio estimation:

- Load inertia: load is too small or large compared to the rotor inertia; the load inertia changes too quickly.
- Load: the machine stiffness is extremely low; there is a nonlinear characteristic, such as backlash.
- Action requirements: speed should be greater than 100rpm (generally, it is set to 300rpm); acceleration should be greater than 80r/s^2.
  When you use iMotion software for testing, speed should set to 500rpm and acceleration time should set to 100r/s^2.

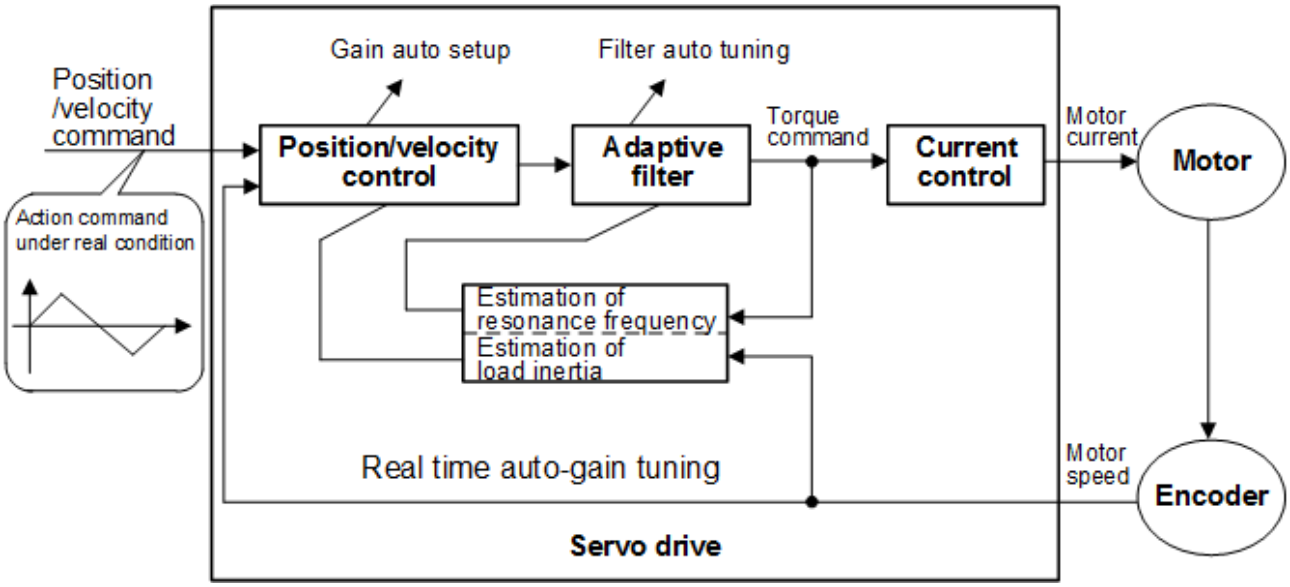
To estimate the inertia ratio, do the following:

1. Set parameter **Pr002 Real-time auto-gain tuning setup** to **5**.
2. Run the servo motor according to the action requirements. The value of parameter **Pr004 Inertia ratio** keeps a relatively stable value.
3. Set parameter **Pr002** to **0** to disable the real time auto-tuning.

8.3 Setting the Adaptive Filter

It is used to estimate the resonance frequency according to the vibration component in the motor speed, and automatically set the notch filter coefficient and remove the resonance component in the torque command, so as to reduce the resonance vibration.

The principle is as follows:



8.3.1 Operation

Before setting the adaptive filter, make sure the following:

- The control mode is in position or velocity mode.
- The servo is turned on.
- Parameters, such as deviation counter clear, command inhibit and torque limit, are appropriately set.
- The servo motor can run normally.

To set the adaptive filter, set the value of parameter **Pr200 Adaptive filter mode setup**.

Note: When it is set to **0**, adaptive filter is disabled.

If the resonance point affects the motor speed, the following parameters of 3rd and 4th notch filters are automatically set according to the number of adaptive filters:

- **Pr207 3rd notch frequency**
- **Pr208 3rd notch width selection**
- **Pr209 3rd notch depth selection**
- **Pr210 4th notch frequency**
- **Pr211 4th notch width selection**
- **Pr212 4th notch depth selection**

Note: If power is turned off within 30min after the end of tuning process, the result of the real-time auto-tuning is not saved. In this case, please manually write parameters to EEPROM and then turn off the power.

8.3.2 Troubleshooting

Phenomenon 1

After the servo drive is turned on at the first time, or after increasing the value of parameter **Pr003 Selection of machine stiffness at real-time auto-gain tuning**, the adaptive filter does not enter into stable status. And abnormal sound or oscillation lasts or repeats for 3 or more reciprocating operations.

Solution

1. Write the value of parameters in stable status into EEPROM.
2. Decrease the value of parameter **Pr003**.
3. To disable the adaptive filter, set the value of **Pr200 Adaptive filter mode setup** to **0**.
4. Manually set the notch filter.

Phenomenon 2

After abnormal sound or oscillation, the set values of 3rd and 4th notch filters may turn to extreme values.

Solution

1. To disable the adaptive filter, set the value of **Pr200 Adaptive filter mode setup** to **0**.
2. Set parameter **207 3rd notch frequency** and **Pr210 4th notch frequency** to **5000**(disabled status).
3. Enable the adaptive filter again.

8.3.3 Conditions That Obstruct the Action of Adaptive Filter

Under the following conditions, the servo drive may not work normally. In this case, please manually set the notch filter to prevent resonance:

- Resonance point:
  - The resonance frequency is less than 3 times of velocity loop band width.
  - Resonance peak is low, or control gain is low where the motor speed is not affected.
  - Several points of resonance exist.
- Load: motor speed variation with high harmonic component is generated due to non-linear factors such as backlash.
- Command mode: acceleration/deceleration is rapid, such as 30000r/min per 1s.

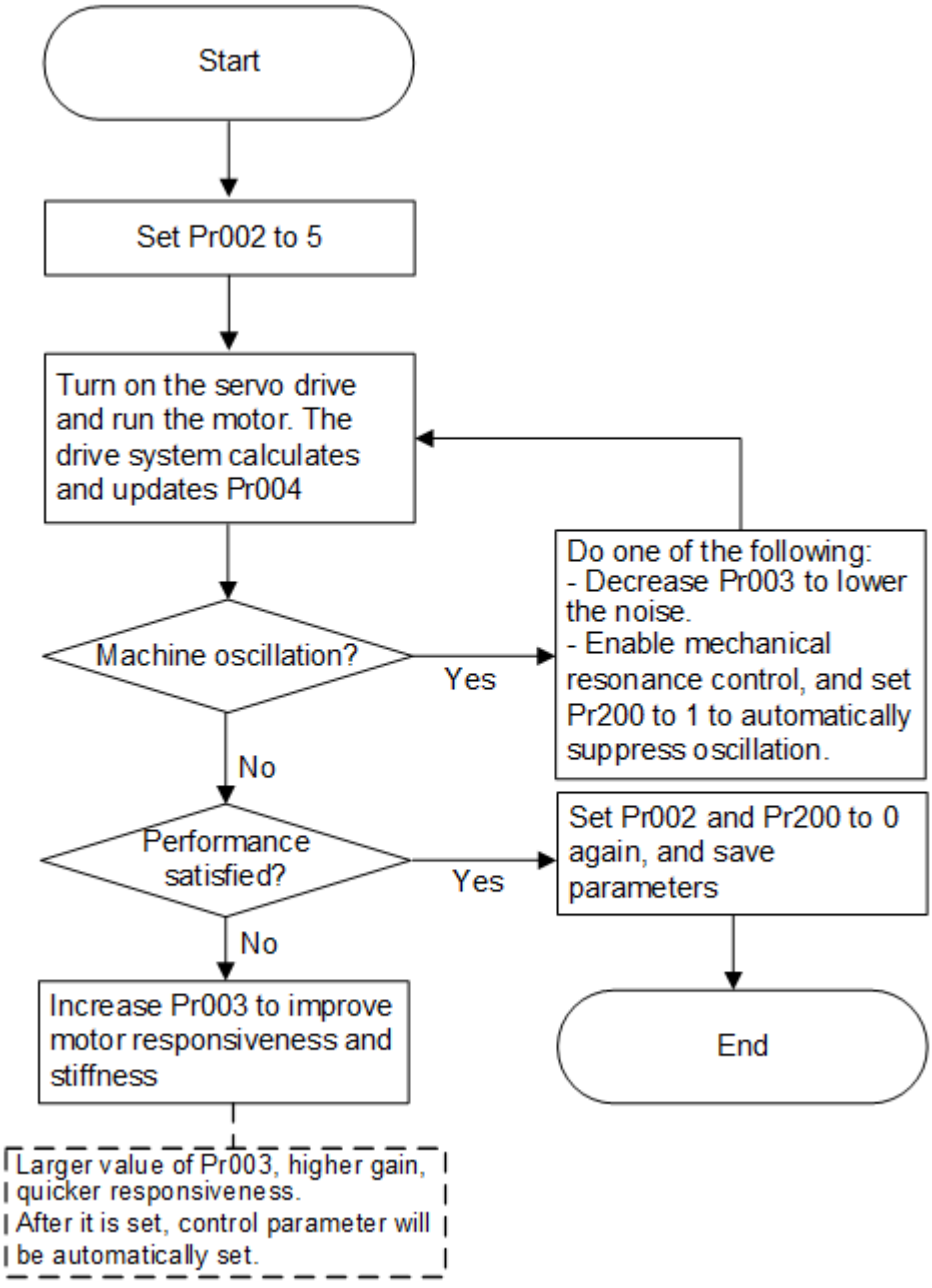
8.4 Setting Automatic Gain Tuning

Before setting automatic gain tuning, make sure the following:

- The servo is turned on.
- Input signals such as **Deviation counter clear** and **Command input inhibition**, and other parameters except for controls such as **Torque limit setup**, are correctly set.
- The servo motor can run normally.
- Parameter **Pr002 Real time auto-tuning gain setup** is not set to 0.
  When it is set to **0**, real time auto-tuning is disabled.

8.4.1 Operation

To set automatic gain tuning, do the following:



During the real time auto-tuning process, the values of parameters **Pr004 Inertia ratio**, **Pr607 Torque command additional value**, **Pr608 Positive direction torque compensation value** and **Pr609 Negative direction torque compensation value** will be written into EEPROM every 30 minutes. When you turn on the servo drive again, the servo drive will take these values as initial data to execute automatic tuning.

Note: If power is turned off within 30 minutes after the end of tuning process, the result of the real-time auto-tuning is not saved. In this case, please manually write parameters to EEPROM and then turn off the power.

For how to suppress oscillation, see Suppressing the Machine Resonance and Setting the Adaptive Filter for details.

8.4.2 Troubleshooting

Phenomenon 1

After the servo drive is turned on at the first time, or after increasing the value of parameter **Pr003 Real time auto-tuning stiffness setup**, the load characteristics estimation does not enter into stable status immediately or gradually, and abnormal sound or oscillation lasts or repeats for 3 or more reciprocating operations.

Solution

1. Decrease the value of parameter **Pr003**.
2. Set parameter **Pr002** to **0** to disable the real time auto-tuning.
3. Set parameter **Pr004** to the value calculated by the equipment and set parameters **Pr607**, **Pr608** and **Pr609** to **0**.

Phenomenon 2

When abnormal sound or oscillation occurs, parameters **Pr004**, **Pr607**, **Pr608** and **Pr609** may turn to extreme values.

Solution

Take the measures mentioned above to solve this problem.

Phenomenon 3

Parameter **Pr004** becomes obviously abnormal.

Solution

- Use the general mode to carry out automatic tuning.
- Manually set parameter **Pr004** to an appropriate value based on the calculation.

8.4.3 Related Information

How to Enhance the Machine Stiffness

1. Well mount the machine tool on the ground base and secure no vibration.
2. Use the servo couplings with high stiffness.
3. Use wide synchronization belt.
   The tensile force of the belt should be set within the over-load range of motor axial load during installation.
4. Use gear with small backlash.
   The inherent vibration (resonance frequency) of mechanical system will greatly affect gain tuning of the servo machine. Therefore, for machines with low resonance frequency (low machine stiffness), response setup of the servo machine cannot be set too high.

Parameter Setting Table for Basic Gain

The involved parameters include:

- **Pr100 1st gain of position loop**
- **Pr101 1st gain of velocity loop**
- **Pr102 1st time constant of velocity loop integration**
- **Pr104 1st time constant of torque filter**
- **Pr105 2nd gain of position loop**
- **Pr106 2nd gain of velocity loop**
- **Pr107 2nd time constant of velocity loop integration**
- **Pr109 2nd time constant of torque filter**

Stiffness	Pr100 (0.1/s)	Pr101 (0.1Hz)	Pr102 (0.1ms)	Pr104 (0.01ms)	Pr105 (0.1/s)	Pr106 (0.1Hz)	Pr107 (0.1ms)	Pr109 (0.01ms)
0	20	15	3700	1500	25	15	10000	1500
1	25	20	2800	1100	30	20	10000	1100
2	30	25	2200	900	40	25	10000	900
3	40	30	1900	800	45	30	10000	800
4	45	35	1600	600	55	35	10000	600
5	55	45	1200	500	70	45	10000	500
6	75	60	900	400	95	60	10000	400
7	95	75	700	300	120	75	10000	300
8	115	90	600	300	140	90	10000	300
9	140	110	500	200	175	110	10000	200
10	175	140	400	200	220	140	10000	200
11	320	180	310	126	380	180	10000	126
12	390	220	250	103	460	220	10000	103
13	480	270	210	84	570	270	10000	84
14	630	350	160	65	730	350	10000	65

Stiffness	Pr100 (0.1/s)	Pr101 (0.1Hz)	Pr102 (0.1ms)	Pr104 (0.01ms)	Pr105 (0.1/s)	Pr106 (0.1Hz)	Pr107 (0.1ms)	Pr109 (0.01ms)
15	720	400	140	57	840	400	10000	57
16	900	500	120	45	1050	500	10000	45
17	1080	600	110	38	1260	600	10000	38
18	1350	750	90	30	1570	750	10000	30
19	1620	900	80	25	1880	900	10000	25
20	2060	1150	70	20	2410	1150	10000	20
21	2510	1400	60	16	2930	1400	10000	16
22	3050	1700	50	13	3560	1700	10000	13
23	3770	2100	40	11	4400	2100	10000	11
24	4490	2500	40	9	5240	2500	10000	9
25	5000	2800	35	8	5900	2800	10000	8
26	5600	3100	30	7	6500	3100	10000	7
27	6100	3400	30	7	7100	3400	10000	7
28	6600	3700	25	6	7700	3700	10000	6
29	7200	4000	25	6	8400	4000	10000	6
30	8100	4500	20	5	9400	4500	10000	5
31	9000	5000	20	5	10500	5000	10000	5

8.5 Setting Manual Gain Tuning

It is required when the best gain cannot be obtained due to the limits of load condition, or the best response and stability are required at each load.

When oscillation occurs in the servo system or its control performance is not good, you can manually adjust the gain by adjusting parameters related to velocity loop or position loop, in order to enhance the system performance or remove oscillation.

To set manual gain tuning, do the following:

1. Doing basic adjustment.
2. **Optional:** Switching the gain.
3. **Optional:** Suppressing the machine resonance.
4. **Optional:** Setting two-stage torque filter.
   It is available only when suppressing the machine resonance is required.

8.5.1 Doing Basic Adjustment

The involved parameters include **Pr101 1st gain of velocity loop**, **Pr102 1st time constant of velocity loop integration**, **Pr104 1st time constant of torque filter** and **Pr100 1st gain of position loop**.

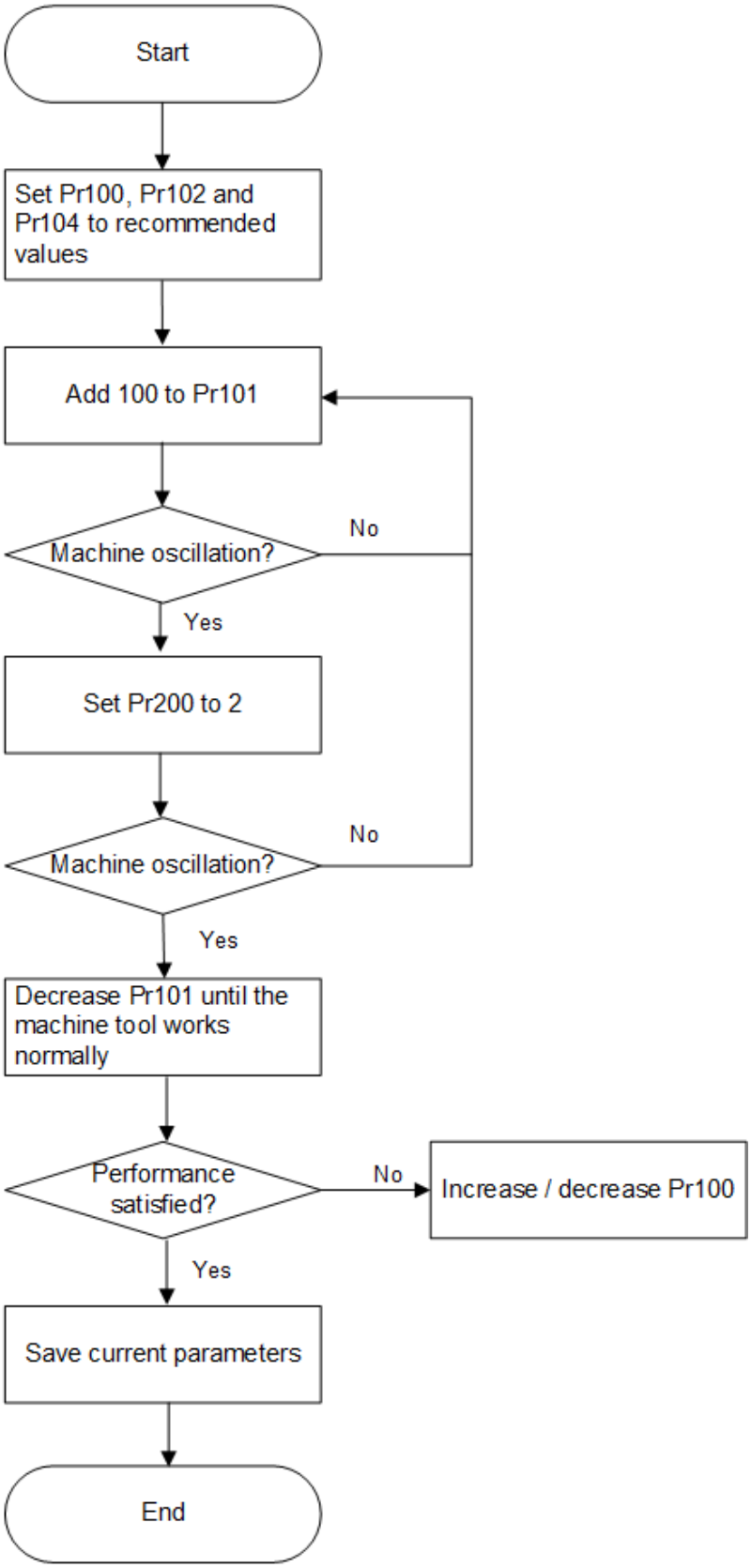
Recommended values of these parameters are as follows:

Industry	Pr100	Pr102	Pr104
Woodwork	300~600	150	30
Aluminum Engraving	500~800	120	30
Metalwork	1000~1600	90	30
3C	1000~1600	90	30
Laser cutting	1500~2800	100	30
Waterjet cutting	400~600	100	30

These parameters are inter-restricted. Increase of gain of position loop may result in the instability of position loop output command, finally causing instability of the whole servo system.

Before doing basic adjustment, estimate the inertia ratio.

To do basic adjustment, do the following:



Note: Generally, velocity loop gain is larger than position loop gain. When position loop gain exceeds velocity loop gain largely, tuning may be out of range, caused by filter signal, which will severely destroy the system performance.

The motor speed is in accordance with the positional command, velocity is within the allowable range and positioning time is short, if these parameters are set properly.

After doing basic adjustment, set the value of parameter **Pr200 Adaptive filter mode setup** to **0**.

If you are not satisfied with the result, contact us for help.

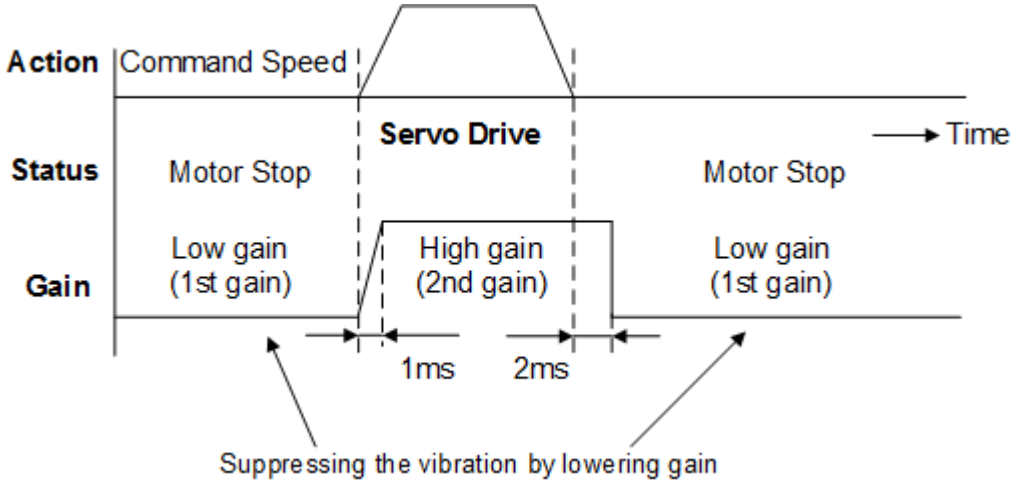
8.5.2 Switching the Gain

It is used to switch between the first gain and the second gain.

By switching proper gain based on the internal data or external signal, the following effects can be obtained:

- Decrease the gain when motor stops (servo lock) to reduce vibration.
- Increase the gain when motor stops (servo stable) to shorten the stable time.
- Increase the gain during operation to improve command compliance.
- Based on the condition of the machine tool, change the gain with the external signal.

The principle of gain switching is as follows:



To switch the gain, see **Gain Switching Condition Setting** for details.

Example

To reduce the noise when the servo motor stops by switching to the lower gain, do the following:

1. Manually adjust the gain without switching the gain.
2. Set the values of 2nd gain related parameters to the values of 1st gain related parameters:
    - Set parameter **Pr105 2nd gain of position loop** to the same value as parameter **Pr100 1st gain of position loop**.
    - Set parameter **Pr106 2nd gain of velocity loop** to the same value as parameter **Pr101 1st gain of velocity loop**.
    - Set parameter **Pr107 2nd time constant of velocity loop integration** to the same value as parameter **Pr102 1st time constant of velocity loop integration**.
    - Set parameter **Pr108 2nd filter of speed detection** to the same value as parameter **Pr103 1st filter of speed detection**.
    - Set parameter **Pr109 2nd time constant of torque filter** to the same value as parameter **Pr104 1st time constant of torque filter**.

3. To set the condition for gain switching, set the following parameters:
   - **Pr114 2nd gain setup**
   - **Pr115 Mode of position control switching**
   - **Pr116 Delay time of position control switching**
   - **Pr117 Level of position control switching**
   - **Pr118 Hysteresis at position control switching**
   - **Pr119 Position gain switching time**
4. Adjust parameters of 1st gain **Pr101** and **Pr104** when the motor stops.

Parameter	Step 1	Step 2	Step 3	Step 4
Pr100	630	-	-	-
Pr101	350	-	-	270
Pr102	160	-	-	-
Pr103	0	-	-	-
Pr104	65	-	-	84
Pr110	300	-	-	-
Pr111	50	-	-	-
Pr105	-	630	-	-
Pr106	-	350	-	-
Pr107	-	160	-	-
Pr108	-	0	-	-
Pr109	-	65	-	-
Pr114	-	-	1	-
Pr115	-	-	7	-
Pr116	-	-	30	-
Pr117	-	-	0	-
Pr118	-	-	0	-
Pr119	-	-	0	-
Pr004	It depends	-	-	-

Gain Switching Condition Setting

Gain switching condition differs in the control mode.

In the following three tables, ● represents **Valid**, while - represents **Invalid**.

- Position control

Pr115	Condition to Switch to 2nd Gain	Figure *5	Delay Time *1 (Pr116)	Level (Pr117)	Hysteresis*2 (Pr118)
0	Fixed to 1st gain		–	–	–
1	Fixed to 2nd gain		–	–	–
2	Gain switching input		–	–	–
3	Torque command	A	●	● (%)	● (%)
4	Invalid (Fixed to 1st gain)		–	–	–
5	Velocity command	C	●	● (r/min)	● (r/min)
6	Position deviation	D	●	●* 3(pulse)	● * 3(pulse)
7	Position command exists	E	●	–	–
8	Positioning does not end	F	●	–	–
9	Actual speed	C	●	● (r/min)	● (r/min)
10	Positional command + actual speed	C	●	● (r/min)	● (r/min)

- Velocity control mode

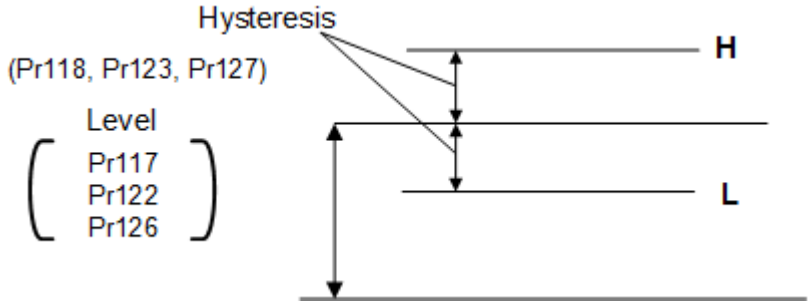
Pr120	Condition to Switch to 2nd Gain	Figure *5	Delay Time *1(Pr121)	Level (Pr122)	Hysteresis*2 (Pr123)
0	Fixed to 1st gain		–	–	–
1	Fixed to 2nd gain		–	–	–
2	Gain switching input		–	–	–
3	Torque command	A	●	● (%)	● (%)
4	Velocity command variation	B	–	●*4 (10r/min)/s)	●*4 (10r/min)/s)
5	Velocity command	C	●	● (r/min)	● (r/min)

- Torque control mode

Pr124	Condition to Switch to 2nd Gain	Figure*5	Delay Time*1 (Pr125)	Level (Pr126)	Hysteresis *2(Pr127)
0	Fixed to 1st gain		–	–	–
1	Fixed to 2nd gain		–	–	–
2	Gain switching input, GAIN ON		–	–	–
3	Torque command	A	●	● (%)	● (%)

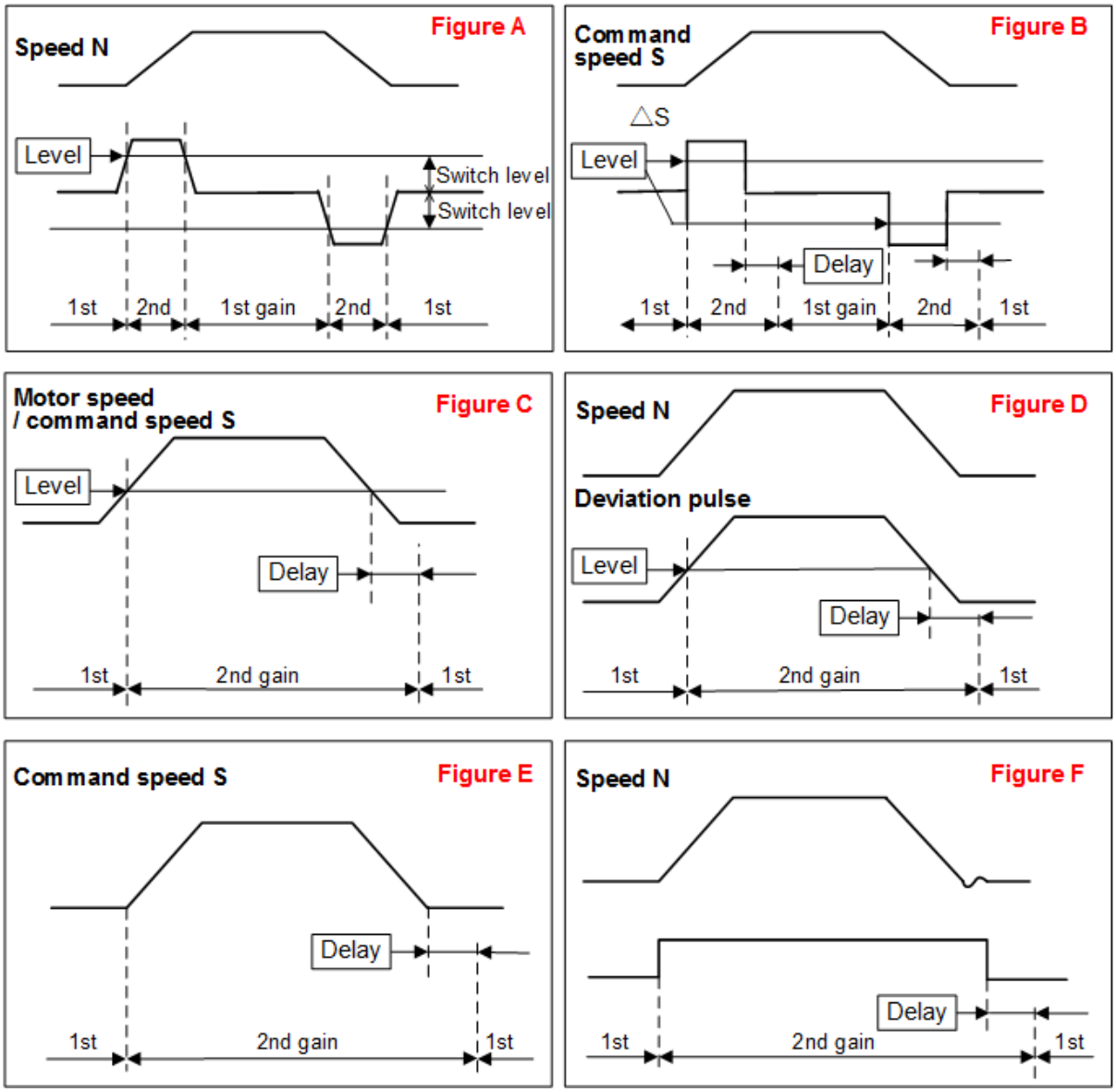
Notes:

- *1: delay time (**Pr116**, **Pr121** and **Pr125**) will be valid only during returning from 2nd gain to 1st gain.
- *2: hysteresis **Pr118 Hysteresis at position control switching**, **Pr123 Hysteresis at velocity control switching** and **Pr127 Hysteresis at torque control switching** is defined as follows:



- *3: define the encoder resolution through the control mode.
- *4：when there is a speed variation of 10r/min in 1s, please set the value to **1**.

- *5：the time sequences of gain switching in these three control modes are as follows:



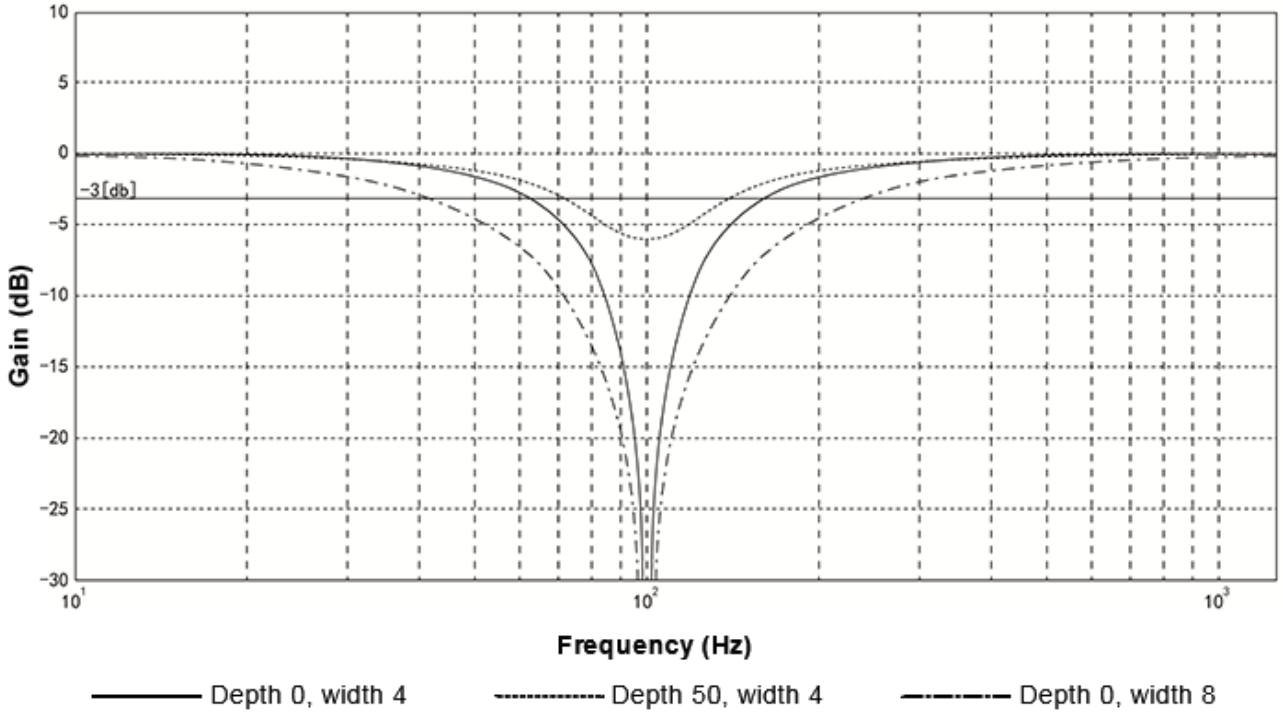
Note: The figure of time sequences does not reflect a timing lag of gain switching due to hysteresis (**Pr118**, **Pr123**, and **Pr127**).

8.5.3 Suppressing the Machine Resonance

In the case of low machine stiffness, you cannot set a higher gain because vibration and noise will occur due to resonance caused by axis distortion. This operation is used to suppress the resonance peal at the notch filter, so as to get a higher gain or reduce the level of vibration.

Generally, the servo drive is equipped with four notch filters.

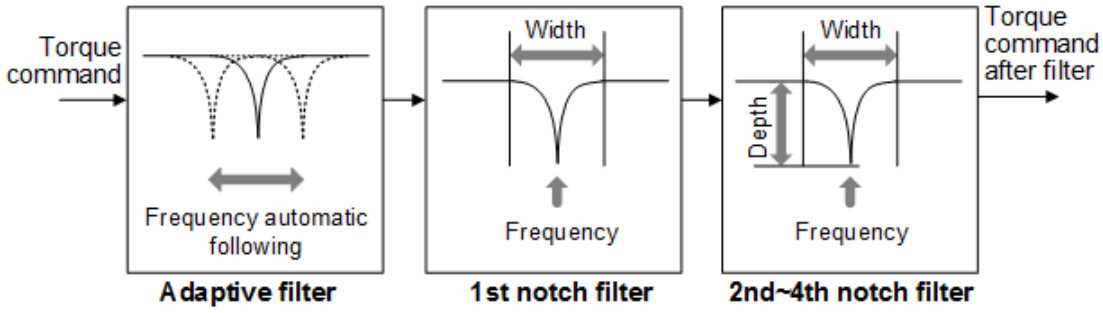
The frequency characteristics of notch filter are as follows:



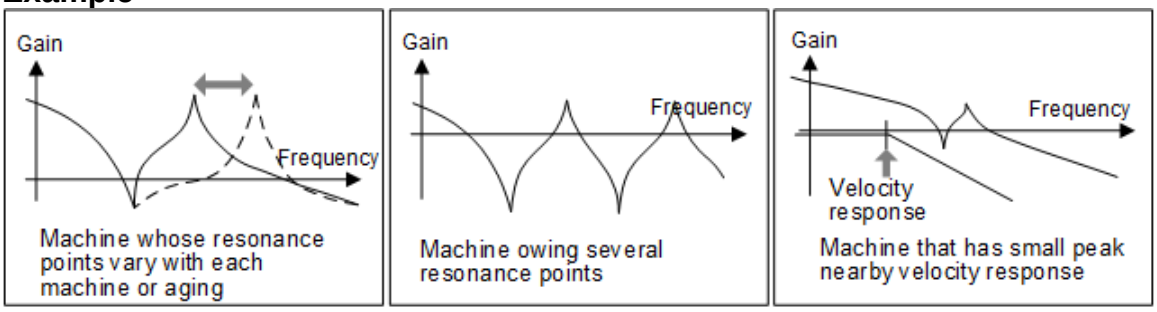
To suppress the machine resonance, do the following:

1. To reduce the level of vibration at vicinity of resonance frequency, set parameter **Pr104 1st time constant of torque filter** and **Pr109 2nd time constant of torque filter**.
   You can obtain the cut off frequency of the torque command filter according to the following formula:
   Cut off frequency (Hz)fc = 1/ (2 * Pr104(or Pr109) * 0.00001)
2. To adjust the notch filter, set the following parameters:
   - **Pr201 1st notch frequency**
   - **Pr202 1st notch width selection**
   - **Pr203 1st notch width selection**
   - **Pr204 2nd notch frequency**
   - **Pr205 2nd notch width selection**
   - **Pr206 2nd notch depth selection**
   - **Pr207 3rd notch frequency**
   - **Pr208 3rd notch width selection**
   - **Pr209 3rd notch depth selection**
   - **Pr210 4th notch frequency**
   - **Pr211 4th notch width selection**
   - **Pr212 4th notch depth selection**

After setting the above parameters, the frequency, width and depth of the notch filter are adjusted as follows:



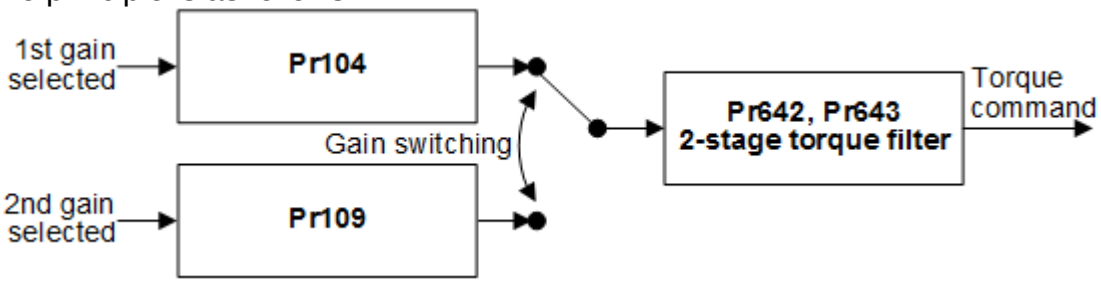
Example



8.5.4 Setting Two-stage Torque Filter

It is used to set the 3rd torque filter, namely, the two-stage torque filter, so as to effectively suppress oscillating component in high frequency range.

The principle is as follows:



You can set two-stage torque filter in any control modes.

Before setting two-stage torque filter, make sure the following:

- The servo drive is turned on.

Factors other than control parameters such as torque limit are properly set.

- The servo motor can run normally.

To set two-stage torque filter, do the following:

1. Set the value of parameter **Pr643 Two-stage torque filter attenuation term**** to **1000** (i.e.ζ=1).
2. Gradually increase the value of parameter **Pr642 Two-stage torque filter time constant**.
   Minimum: 5.

8.6 Tuning the Gain with the CNC Bus Control System

It is used to adjust the gain with the CNC bus control system.

To adjust the gain with the bus control system, do the following:

1. To well connect each component, see CNC System Wiring for details.
2. Enter **Servo Parameter** interface, and set related parameters including control system mode, drive type in the control system.
3. Enter **Auto adjustment** interface in the control system.
4. Set 1st limit, 2nd limit, initial mode, and initial stiffness.
5. Click **Start Estimation**. The motor runs, and the CNC control system automatically estimate inertia ratio, friction, and variable loads.
6. Click **Next** to enter **Gain Adjustment** interface, and do as follows:

Restart the servo drive to validate the adjustment result.

9 Application

9.1 Exact Stop for Positioning

It is used to make the servo drive and the motor to the target position for positioning at the target speed.

To execute the exact stop for positioning, do one of the following:

- Set the angle for the exact stop of spindle by the communication command of the host.
  The servo drive does the orientation according to the positioning angle specified by the host after it finishes latching.
  Please see the document of the host to set the target position, target speed, and latching signal type.
- Set the angle for the exact stop of spindle by related parameters:
  a. Set the following parameters:
     - **Pr450 Function selection application switch 2**
     - **Pr442 Linear acceleration constant in standard position mode**
     - **Pr443 Linear deceleration constant in standard position mode**
     - **Pr444 Command pulse count per revolution of machine**
     - **Pr445 Oriented angle setup**

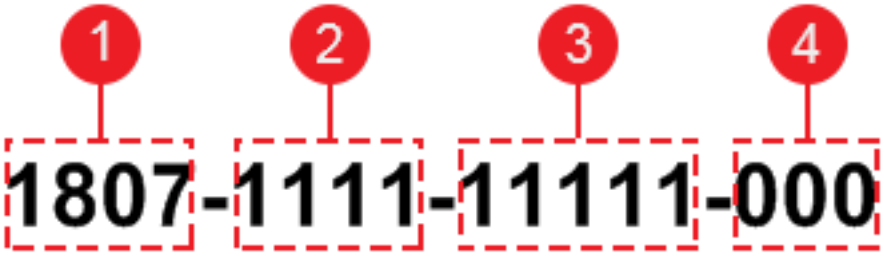
  b. Manually move the spindle to the position of exact stop after the spindle stops.

  To automatically save the current position to the value of parameter **Pr445**, set the directed angle by the operation panel.

10 Drive Registration

10.1 Getting the Serial Number

The serial number of the servo drive consists of the following:



1. High (4 digits): year and month
2. Middle (4 digits): production order
3. Low (5 digits): running number
4. Lowest (3 digits): registered times

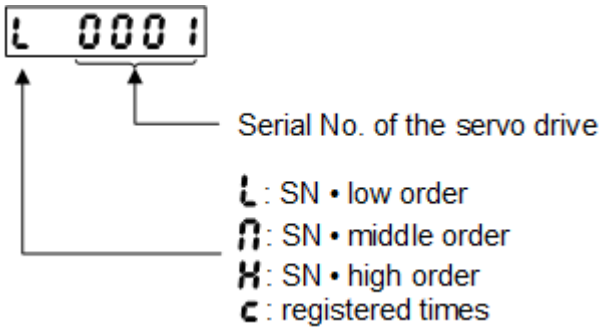
To get the serial number, do one of the following:

- Get the serial number by the operation panel.
- Get the serial number by iMotion software.

10.1.1 Getting the Serial Number by the Operation Panel

To get the serial number by the operation panel, do the following:

1. In monitor mode, switch to **d29ASE**.
2. Press **SET**:



3. To check order of the serial number, and check the drive manufacturing number, press ▲ / ▼.
4. Organize the serial number order and manufacturing number in the rule.

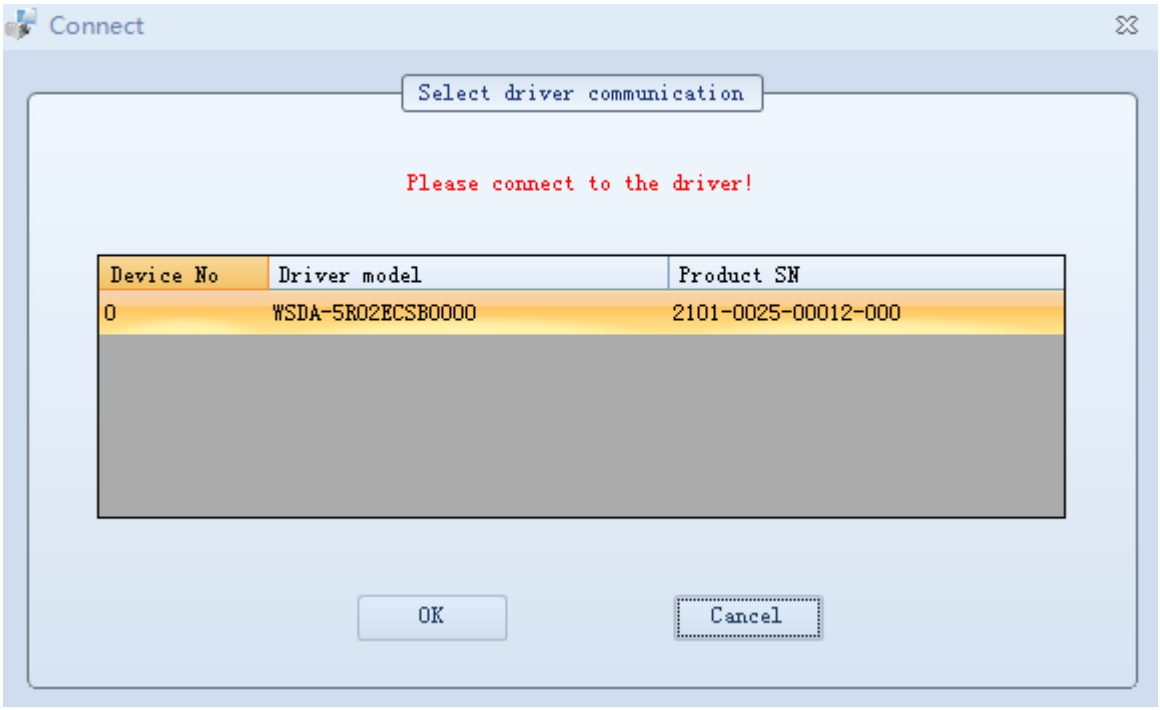
10.1.2 Getting the Serial Number by iMotion Software

Before getting the serial number by iMotion software, make sure the following ;

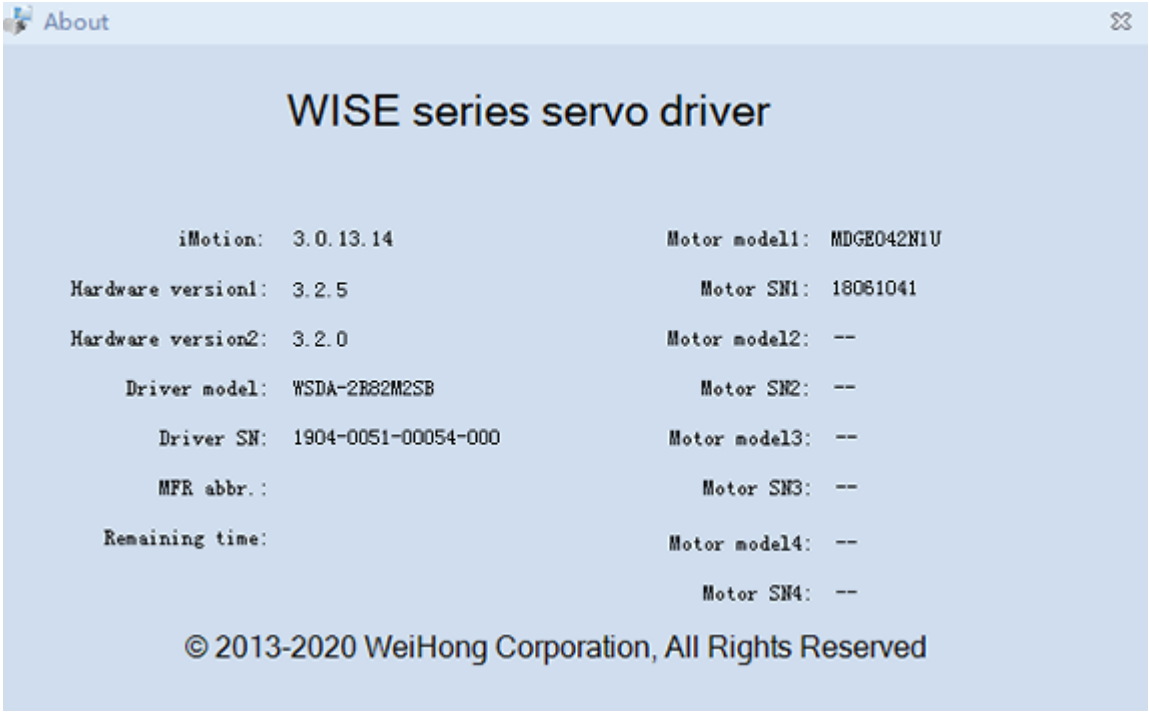
- The version of iMotion software is above 3.0.0.
- The servo drive is successfully connected with PC.

To get the serial number by iMotion software, do one of the following:

- To open **Connect** dialog box, open iMotion software. **Driver SN** column is the serial number:



- To open **About** dialog box, open iMotion software, and select **Other** → **About iMotion** in the function menu bar. **Driver SN** is the serial number:



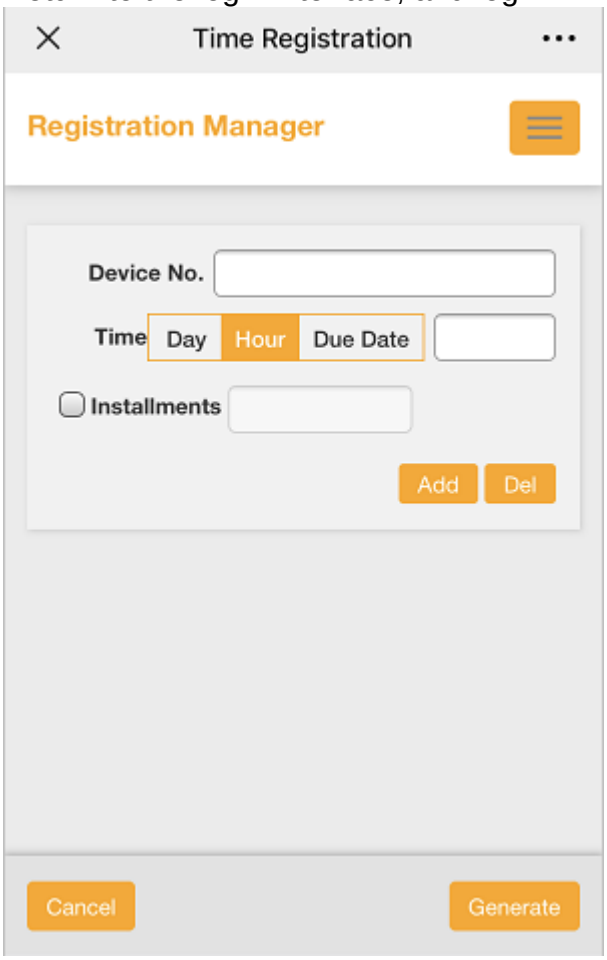
10.2 Getting the Registration Code

Before getting the registration code, do the following:

1. To get an account, contact the local sales, sales assistant or dial customer service phone 400-882-9188.
2. To put on records, fill in *Registration Confirmation Letter*, seal and send it to Weihong company. Weihong company records the information in the confirmation letter you have returned.

To get the registration code, do the following:

1. Search and follow official account **WEIHONG** on WeChat.
2. To obtain a temporary login password, click **Service** → **Registration** → **Activate Account**, and input your telephone number.
3. Return to the login interface, and log in:



4. Input the serial number.
5. Input the registration time.
   Unit: hour (h).
   Note: After the servo drive powers off, the remaining time will not be calculated.
6. **Optional:** To register several servo drives at the same time, click **Add**.
7. To generate the registration code, click **Generate** if you are sure the above information is correct.

10.3 Registering the Servo Drive

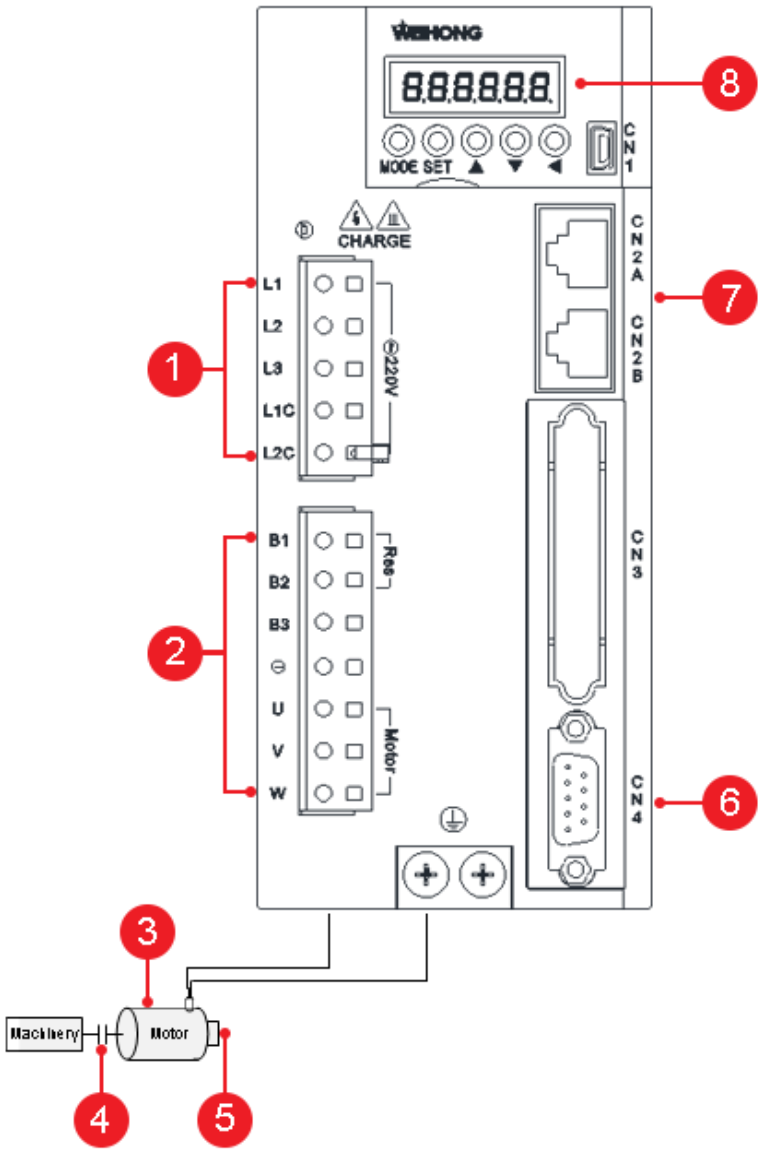
To register the servo drive, do one of the following:

- Register the servo drive by the operation panel
- Register the servo drive by iMotion software
- Register the servo drive through Weihong products.
  At present, parts of Weihong products, including NcStudio software, and NK300CX integrated CNC control system, support direct registration.
  Please contact us for details.

11 Alarms, Error Codes and Troubleshooting

11.1 Common Troubleshooting

When an exception occurs in communication of the servo drive, motor and system, troubleshoot it as follows:



1. Make sure the following:
   - The supply voltage is normal.
   - The power is normal.
   - No connection is loose.
2. Make sure the following:
   - Connection parts are not pulled off, disconnected, or contacted.
   - The wiring is correct. See **CNC System Wiring** for details.
   - The connector is not pulled off.
   - The short wire is not pulled off.
3. Make sure no abnormal noise generated from the motor.
4. Make sure no connection is loose.
5. Make sure the electromagnetic brake works normally.
6. Make sure the wiring of the encoder is correct or wire is not pulled off. See **CNC System Wiring** for details.
7. Make sure the following:
   - The wiring of the bus control system is stable.
   - The last servo drive connects to the terminating resistor.
8. Make sure the following:
   - No error code No. is displayed.
   - Parameter settings are correct.

11.2 Alarms

When an alarm occurs in the servo drive, the operation panel displays according to the following cycle every 0.8s / 0.3s:

11.2.1 How to Find Alarms

To find alarms, see **alarm number (d13_rn)** and **list of alarms** for details.

11.2.2 List of Alarms

Detailed information of alarms is as follows:

A0

- Name: Overload protection
- Cause: Load factor is 85% or more than the protection level.
- Latch time: 1s~10s or ∞

A1

- Name: Over-regeneration alarm
- Cause: Regenerative load factor is 85% or more the protection level.
- Latch time: 1s~10s or ∞

A2

- Name: Battery alarm
- Cause: Battery voltage is 3.2V or lower.
- Latch time: ∞

A3

- Name: Fan alarm
- Cause: Fan has stopped for 1s.
- Latch time: 1s~10s or ∞

A4

- Name: Encoder communication alarm
- Cause: The number of successive encoder communication errors exceeds the specified value.
- Latch time: 1s~10s or ∞

A5

- Name: Encoder overheat alarm
- Cause: The encoder overheat is detected.
- Latch time: 1s~10s or ∞

A6

- Name: Vibration detection alarm
- Cause: The motor vibration is detected.
- Latch time: 1s~10s or ∞

A7

- Name: Lifetime detection alarm
- Cause: The life expectancy of registration becomes shorter than the specified time.
- Latch time: ∞

A8

- Name: External scale error alarm
- Cause: The alarm of feedback scale is detected.
- Latch time: 1s~10s or ∞

A9

- Name: External scale communication alarm
- Cause: The number of successive feedback scale communication errors exceeds the specified value.
- Latch time: 1s~10s or ∞

A10

- Name: Over-load of servo drive
- Cause: Load factor is 85% or more than the protection level.
- Latch time: 1s~10s or ∞

A11

- Name: MECHATROLINK data setup alarm
- Cause: Parameter No., data range and parameter value exceed the specified values.
- Latch time: 1s~10s or ∞

A12

- Name: MECHATROLINK unsupported command alarm
- Cause: Unsupported commands are received.
- Latch time: 1s~10s or ∞

A13

- Name: MECHATROLINK command executing condition not met alarm
- Cause: Command is run in unsupported layer and does not meet the command executing conditions.
- Latch time: 1s~10s or ∞

11.3 List of Error Codes

The error codes, displayed as ErrXXY on the front panel will be written in the format of Err XX.Y (XX: main code; Y: sub code) hereinafter.

To remove the related error, please power off troubleshoot the problem, and then power on.

To clear clearable errors, see Error Status Clearing for details.

The list of error codes is as follows:

Error Code	Name	History	Clearable	Stop Immediately
Err11.0	Control power under-voltage protection	-	●	-
Err12.0	Over-voltage protection	●	●	-
Err13.0	Main power supply under-voltage protection (between P and N)	-	●	-
Err13.1	Main power supply under-voltage protection (AC interception detection)	-	●	●
Err14.0	Over-current protection	●	-	-
Err14.1	IPM error protection	●	-	-
Err15.0	Over-heat protection	●	-	●
Err16.0	Over-load protection	●	●	●
Err18.0	Regeneration over-load protection	●	-	●
Err18.1	Regenerative transistor error protection	●	-	-
Err19.0	DB (dynamic brake) over-load protection	●	-	-
Err21.0	Encoder communication disconnect error protection	●	-	-
Err21.1	Encoder communication error protection	●	-	-
Err23.0	Encoder communication data error protection	●	-	-

Error Code	Name	History	Clearable	Stop Immediately
Err24.0	Positional deviation excess protection	●	●	●
Err24.1	Velocity deviation excess protection	●	●	●
Err26.0	Over-speed protection	●	●	●
Err26.1	2nd over-speed protection	●	●	-
Err27.1	Command pulse division/multiplication error protection	●	●	●
Err28.0	Pulse regeneration limit protection	●	●	●
Err29.0	Deviation count overflow protection	●	●	-
Err33.0	I/F duplicated allocation error 1	●	-	-
Err33.2	I/F input function number error 1	●	-	-
Err33.3	I/F input function number error 2	●	-	-
Err33.4	I/F output function number error 1	●	-	-
Err34.0	Software limit protection	●	●	●
Err36.0~Err36.3	EEPROM parameter error protection	-	-	-
Err37.0~Err37.2	EEPROM code error protection	-	-	-
Err38.0	Driver inhibited input protection	-	●	●
Err40.0	Absolute encoder system down error protection	●	-	-
Err41.0	Absolute count overflow error protection	●	-	-
Err42.0	Absolute encoder over-speed error protection	●	●	-
Err43.0	Encoder initialization error protection	●	-	-
Err44.0	Absolute encoder single turn count error protection	●	-	-
Err45.0	Absolute encoder multi-turn count error protection	●	-	-
Err46.0	Absolute encoder overheat protection	●	-	-
Err47.0	Absolute status error protection	●	-	-
Err48.0	Encoder Z-phase error protection	●	-	-

Error Code	Name	History	Clearable	Stop Immediately
Err49.0	Encoder CS signal error protection	●	-	-
Err52.0	Mismatch of regenerative resistor parameter	●	-	-
Err55.0	A / B-phase connection error protection	●	-	-
Err55.1	CS connection error protection	●	-	-
Err55.2	Z-phase connection error protection	●	-	-
Err55.3	CS signal logic error protection	●	-	-
Err55.4	AB-phase missing error protection	●	-	-
Err56.0	ABZ incremental encoder over-speed error protection	●	-	-
Err56.1	ABZ incremental encoder UVW error protection	●	-	-
Err56.2	ABZ incremental encoder ABZ error protection	●	-	-
Err57.0	Current sampling offset excess protection	●	-	-
Err57.1	Current gain diagnosis error protection	●	-	-
Err58.0	Chip working error protection	●	-	-
Err59.0	Registered time expired	-	-	-
Err59.1	Mismatching software version	●	-	-
Err60.0	M-II communication ASIC fault 1	●	-	●
Err61.0	M-II communication ASIC fault 2	●	-	●
Err62.0	M-II internal synchronous error 1	●	●	●
Err63.0	M-II transmission cycle setup error	●	●	●
Err64.0	M-II synchronous error	-	●	●
Err64.1	M-II synchronous failure	●	●	●
Err65.0	M-II communication fault (receipt error)	-	●	●
Err65.1	M-II transmission cycle error (synchronous interval error)	●	●	●
Err70.0	Motor setting error protection	-	-	-

Error Code	Name	History	Clearable	Stop Immediately
Err70.1	Motor combination error 1 protection	-	-	-
Err70.2	Motor combination error 2 protection	-	-	-
Err70.3	Motor automatic setting error protection	●	●	-
Err71.0	Magnet pole position estimation error 1 protection	●	●	-
Err71.1	Magnet pole position estimation error 2 protection	●	●	-
Err71.2	Magnet pole position estimation error 3 protection	-	-	-
Err73.0	Mismatch of regenerative resistor parameter	-	-	-
Err74.0	Multi-turn data upper limit value disagreement error protection	●	-	-
Err76.0	Motor stall over-temperature protection	-	-	-
Err77.0	Runaway protection	-	-	-
Err87.0	Forced alarm input protection	-	●	●
Err95.1	Motor automatic recognition error	-	-	-
Err95.2	Motor automatic recognition error	-	-	-
Err95.3	Motor automatic recognition error	-	-	-
Err95.4	Motor automatic recognition error	-	-	-
Other	Other error protection	●	-	-

11.4 Details of Error Codes

11.4.1 Err10 Series

11.4.1.1 Err11.0

11.4.1.1.1 Error Code

Err11.0: Control power under-voltage protection

11.4.1.1.2 Cause

Voltage between P and N of the converter portion of the control power supply is less than the specified value:

1. Supply voltage is low.
2. Instantaneous power failure occurs.
3. Supply voltage falls due to inrush current at the main power-on.
4. Failure of the servo drive (failure of the circuit).

11.4.1.1.3 Solution

Measure the voltage between lines of connector and terminal block, and troubleshoot as follows:

1. Increase the supply voltage.
2. Change the power supply.
3. Increase the power capacity.
4. Replace the servo drive with a new one.

11.4.1.2 Err12.0

11.4.1.2.1 Error Code

Err12.0: Over-voltage protection

11.4.1.2.2 Cause

Voltage between P and N of the converter portion of the control power supply exceeds the specified value:

1. Supply voltage exceeds the permissible input voltage, and voltage surge due to the phase-advancing capacitor or UPS (uninterruptible power supply) occurs.
2. Disconnection of the regeneration discharge resistor.
3. External regeneration discharge resistor is not appropriate.
4. There is a switch in zero lines or resistance is too large, which lead to deviation of the neutral point, and high voltage in a single phrase or two phrases.
5. Failure of the servo drive (failure of the circuit).

11.4.1.2.3 Solution

Measure the voltage between lines of connector (L1(R), L2(S), L3(T)), and troubleshoot as follows:

1. Input correct voltage, remove a phase-advancing capacitor, and measure resistance of the external resistor for P-B of the servo drive.
   Note: Too high voltage may lead to damages to the servo drive. If such a situation occurs, please power off immediately.
2. Replace the external regenerative resistor.
3. Decrease the resistance of the external regenerative resistor, and increase power. The resistance of the external regenerative resistor should be less than that of the internal regenerative resistor, and greater than or equal to the allowable minimum, and power should be greater than the power of the resistor.
4. Make sure the screws in zero lines of the machine tool and power distribution cabinet are not loose and there is no switch in zero lines.
5. Replace the servo drive with a new one.

11.4.1.3 Err13.0~Err13.1

11.4.1.3.1 Error Code

Err13.0: Main power supply under-voltage protection (between P and N)

Err13.1: Main power supply under-voltage protection (AC interception detection)

11.4.1.3.2 Cause

When the value of parameter **Pr508 LV trip selection at the main power-OFF** is set to **1**, the time for instantaneous power failure between R, S and T is greater than the value of parameter **Pr509 Detection time at main power-OFF. And the voltage between P and N of the converter portion of the main power supply is less than the specified value during Servo-On:

1. Supply voltage is low.
2. Instantaneous power failure occurs.
3. Supply voltage falls down due to inrush current at the main power-on.
4. Lack of phase (3-phase input servo drive is operated with single phase input.
5. Failure of the servo drive (failure of the circuit).

11.4.1.3.3 Solution

Measure the voltage between lines of connector (L1(R), L2(S), L3(T)), and troubleshoot as follows:

1. Increase the supply voltage, rule out the causes of the shutdown of the magnetic contactor of the main power supply, and re-power on.
2. Change the power supply, set the value of parameter **Pr509** to a larger value, and correctly set each phase (R, S, T) of the power supply.
3. Increase the power capacity.
4. Correctly set each phase (R, S, T) of the power supply
   - 3-phrase: use three terminals.
   - Single phrase: use any two of the three terminals.
5. Replace the servo drive with a new one.

11.4.1.4 Err14.0

11.4.1.4.1 Error Code

Err14.0: Over-current protection

11.4.1.4.2 Cause

Current through the converter portion exceeds the specified value:

1. Failure of the servo drive (failure of the circuit, IGBT or other components).
2. Short circuit of the motor wire (U, V and W).
3. Earth fault of the motor wire.
4. Burnout of the motor.
5. Poor contact of the motor wire.
6. Welding of relay contact for dynamic braking due to frequent servo ON/OFF operations.
7. The motor and servo drive does not match.
8. Timing of pulse input is same as or earlier than Servo-ON.
9. The circuit of the dynamic brake is too heat, which leads to the blowing of the temperature fuse.

11.4.1.4.3 Solution

Check if the motor wire is short-circuited:

1. If the error occurs immediately, replace the servo drive with a new one. Otherwise, turn Servo-On, while disconnecting the motor.
2. Make a correct wiring connection of the motor wire.
3. Check if insulation resistance between motor wires, U, V, W and earth wire.
   In case of poor insulation, replace the motor with a new one.
4. Check the balance of resistor between each motor wire.
   if unbalance is found, replace the motor with a new one.
5. Check the loose connectors.
   If they are loose or pulled out, fix connectors securely.
6. Replace the servo drive with a new one.
7. Replace the motor with one that can match with the servo drive.
8. Enter the pulses 100ms or longer after servo-on.
9. Set the stop time of dynamic brake during running at high speed to about 3min, and do not frequently turn on or turn off the servo drive.

11.4.1.5 Err14.1

11.4.1.5.1 Error Code

Err14.1: IPM error protection

11.4.1.5.2 Cause

Current through the converter portion exceeds the specified value:

1. Failure of the servo drive (failure of the circuit, IGBT or other components).
2. Short circuit of the motor wire (U, V and W).
3. Earth fault of the motor wire.
4. Burnout of the motor.
5. Poor contact of the motor wire.
6. Welding of relay contact for dynamic braking due to frequent servo ON/OFF operations.
7. The motor and servo drive does not match.
8. Timing of pulse input is same as or earlier than Servo-ON.
9. The circuit of the dynamic brake is too heat, which leads to the blowing of the temperature fuse.

11.4.1.5.3 Solution

Check if the motor wire is short-circuited:

1. If the error occurs immediately, replace the servo drive with a new one. Otherwise, turn Servo-On, while disconnecting the motor.
2. Make a correct wiring connection of the motor wire.
3. Check if insulation resistance between motor wires, U, V, W and earth wire.
   In case of poor insulation, replace the motor with a new one.
4. Check the balance of resistor between each motor wire.
   If unbalance is found, replace the motor with a new one.
5. Check the loose connectors.
   If they are loose or pulled out, fix connectors securely.
6. Replace the servo drive with a new one.
7. Replace the motor with one that can match with the servo drive.
8. Enter the pulses 100ms or longer after servo-on.
9. Set the stop time of dynamic brake during running at high speed to about 3min, and do not frequently turn on or turn off the servo drive.

11.4.1.6 Err15.0

11.4.1.6.1 Error Code

Err15.0: Over-heat protection

11.4.1.6.2 Cause

The temperature of the heat sink and power device exceeds the specified temperature:

1. Ambient temperature of the servo drive exceeds the specified temperature.
2. Over-load of the servo drive.

11.4.1.6.3 Solution

Troubleshoot as follows, and check the status of the servo drive and motor:

1. Improve the ambient temperature and cooling condition.
2. Increase the capacity of the servo drive and motor and the acceleration/deceleration time of the motor, and lower the load of the motor.

11.4.1.7 Err16.0

11.4.1.7.1 Error Code

Err16.0: Over-load protection

11.4.1.7.2 Cause

The value of torque command exceeds the over-load level set by parameter **Pr512 Setup of over-load level**, and overload protection according to the time characteristics is enabled:

1. Load is heavy: the actual torque exceeds the rated torque and the motor keeps running for a long time.
2. Oscillation and hunching action due to poor adjustment, and the value of parameter **Pr004 Inertia ratio** is incorrect.
3. Wrong wiring of the motor, or disconnection of the motor.
4. The machine tool collides or the load suddenly turns heavy, and the machine tool is distorted.
5. Electromagnetic brake is kept engaged.
6. While wiring multiple axes, the motor cable is connected to the incorrect axis.
7. The value of parameter **Pr512 Torque limit selection** is incorrect.

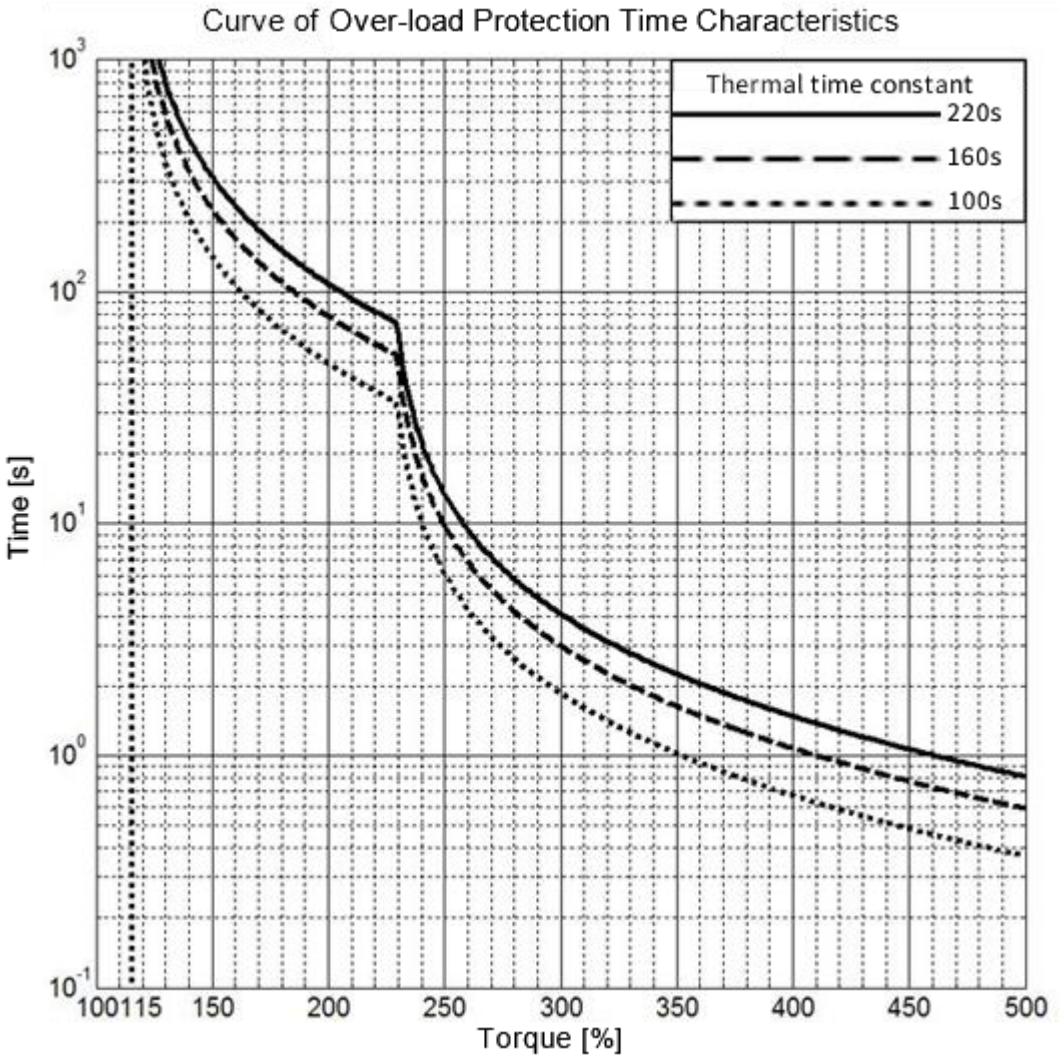
11.4.1.7.3 Solution

With iMotion software, check if the wave of the torque (current) oscillates or fluctuates up and down very much, and check the over-load alarm display and load factor:

1. Increase the capacity of the servo drive and motor and the acceleration/deceleration time of the motor, and lower the load of the motor.
2. Make a gain tuning again.
3. Wire correctly as the wiring diagram, or replace the cables.
4. Remove the cause of distortion, and lower the load.
5. Release the brake, and measure the voltage between brake terminals.
   If the voltage exception occurs, replace the brake with a new one.
6. Make a correct wiring by matching the correct motor and encoder wires.
7. Set the value of parameter **Pr512** to **0** (that is 1.2 times of the maximum motor revolution).

11.4.1.7.4 Over-load Protection Time Characteristics

Please use over-load protection in torque range shown in the figure below:



Thermal time constant corresponding to power is as follows:

- P < 100W: 110s
- 100W < P < 400W: 160s
- 400W < P < 1kW: 200s
- 1kW < P < 5kW: 220s

11.4.1.8 Err18.0

11.4.1.8.1 Error Code

Err18.0: Regeneration over-load protection

11.4.1.8.2 Cause

Regenerative energy exceeds the capacity of regenerative resistor:

1. Due to the regenerative energy during deceleration caused by a large load mass, converter voltage rises.
   The voltage is raised further due to the lack of capacity of absorbing this energy of the regeneration resistor.
2. Regenerative energy is not absorbed in the specified time due to a high motor speed.
3. The value of external regenerative resistor parameter is incorrect.
4. The supply voltage exceeds the specified value.

11.4.1.8.3 Solution

Check the load factor of the regenerative resistor from the front panel or via Lambda. And do not use in the continuous regenerative brake application.

1. Check the running pattern (speed monitor). Check the load factor of the regenerative resistor and over-regeneration warning display. Increase the capacity of the servo drive and motor, and loosen the deceleration time. Lower the motor speed. Use an external regenerative resistor.
2. Check the value of parameter **Pr018 Regenerative over-load protection** and **Pr019 Regenerative resistor setup**.
3. Make sure the supply voltage is set within the specified range.
   Warning: Please install an external protection such as thermal fuse when parameter **Pr016** is set to **2**. Otherwise, regenerative resistor loses the protection and it may be heated up extremely and may burn out.

11.4.1.9 Err18.1

11.4.1.9.1 Error Code

Err18.1: Regenerative transistor error protection

11.4.1.9.2 Cause

1. Disconnection of the regeneration resistor, and incorrect connection between B2 and B3 terminals.
2. The value of the parameter **Pr016 External regenerative resistor setup** is incorrect.
3. Failure of the regenerative transistor.

11.4.1.9.3 Solution

1. Check the wiring of the regenerative resistor, and make sure correct connection between B2 and B3 terminals and no regenerative resistor between B2 and B3 terminals.
2. Make sure the value of parameter **Pr016** is correct.
3. Replace the servo drive with a new one.

11.4.1.10 Err19.0

11.4.1.10.1 Error Code

Err19.0: DB (dynamic brake) over-load protection

11.4.1.10.2 Cause

1. The motor is driven by external power.
2. Rotating energy when DB is stopping exceeds the resistor capacity of DB.
3. Failure of the servo drive.

11.4.1.10.3 Solution

1. Do not drive the motor with external power or force.
2. Decrease the command velocity of the servo drive, decrease load inertia ratio, and reduce times of DB stalling.
3. Replace the servo drive with a new one.

11.4.2 Err20 Series

11.4.2.1 Err21.0

11.4.2.1.1 Error Code

Err21.1: Encoder communication error protection

11.4.2.1.2 Cause

Communication between the encoder and the servo drive is interrupted after certain times, and disconnection detecting function is triggered.

11.4.2.1.3 Solution

1. Check if signal SD+ and SD- of encoder cable are twisted pairs.
2. Make sure shielding layers for the two ends of the encoder cable are well connected.
3. Make a wiring connection of the encoder as the wiring diagram.

11.4.2.2 Err21.1

11.4.2.2.1 Error Code

Err21.1: Encoder communication error protection

11.4.2.2.2 Cause

Noise leads to communication data error.

11.4.2.2.3 Solution

1. Make sure the supply voltage of the encoder is DC $5V^{+5\%}_{-5\%}$(4.75V~5.25V). Please pay special attention when the encoder cables are long.
2. Check if signal SD+ and SD- of encoder cable are twisted pairs.
3. Separate the encoder cable and the motor cable if they are bound together.
4. Connect the shield to FG.

11.4.2.3 Err23.0

11.4.2.3.1 Error Code

Err23.0: Encoder communication data error protection

11.4.2.3.2 Cause

1. Data communication between the encoder is normal, but contents of data are not correct.
2. It is caused by noise.

11.4.2.3.3 Solution

1. Make sure the supply voltage of the encoder is DC $5V^{+5\%}_{-5\%}$(4.75V~5.25V). Please pay special attention when the encoder cables are long.
2. Check if signal SD+ and SD- of encoder cable are twisted pairs.
3. Separate the encoder cable and the motor cable if they are bound together.
4. Connect the shield to FG.

11.4.2.4 Err24.0

11.4.2.4.1 Error Code

Err24.0: Positional deviation excess protection

11.4.2.4.2 Cause

The positional deviation pulse exceeds the value of parameter **Pr014 Position deviation excess setup**:

1. The movement of the motor does not follow the command.
2. The value of parameter **Pr014** is too small.

11.4.2.4.3 Solution

1. Check if the motor follows to the positional command pulses:
    a. Check if the motor follows the position command pulses. If not, proceed to the next step.
    b. Check if the output torque saturates in torque monitor. If not, proceed to the next step.
    c. Make a gain tuning, and set the values of parameter **Pr013 1st torque limit** and **Pr522 2nd torque limit** to the maximum.
    d. Make a wiring connection of the encoder as the wiring diagram.
    e. Increase the acceleration/deceleration time, and lower the load and speed of the motor.
2. Increase the value of parameter **Pr014**.

11.4.2.5 Err24.1

11.4.2.5.1 Error Code

Err24.1: Velocity deviation excess protection

11.4.2.5.2 Cause

The difference between the internal positional command speed and actual speed (speed deviation) exceeds the value of parameter **Pr602 Velocity deviation excess setup**.

11.4.2.5.3 Solution

1. Increase the acceleration/deceleration time of internal positional command speed, or improve the follow-up characteristic by adjusting the gain.
2. Increase the set value of parameter **Pr602**.
3. To disable the error, set the value of parameter **Pr602** to **0**, that is to disable the excess speed deviation detection.

Note: If the internal positional command speed is forcibly set to 0 due to instantaneous stop caused by the command pulse inhibit input (INH) or CW / CCW over-travel inhibition input, the speed deviation rapidly increases at this moment. The speed deviation also largely increases on the rising edge of the internal positional command speed. Therefore, please set the value of parameter **Pr602** large enough.

11.4.2.6 Err26.0

11.4.2.6.1 Error Code

Err26.0: Over-speed protection

11.4.2.6.2 Cause

The rotational speed of the motor exceeds the value of parameter **Pr513 Over-speed level setup**.

11.4.2.6.3 Solution

1. Reasonably set the speed command.
2. Check the input frequency, division, multiplication ratio of command pulse.
3. Make a gain tuning when an overshoot occurs due to a poor gain tuning.
4. Make a wiring connection of the encoder as the wiring diagram.
5. Set the value of parameter **Pr513** to **0** (that is 1.2 times of the maximum motor revolution).

11.4.2.7 Err26.1

11.4.2.7.1 Error Code

Err26.1: 2nd over-speed protection

11.4.2.7.2 Cause

The motor rotational speed exceeds the value of parameter **Pr615 2nd over-speed level setup**.

11.4.2.7.3 Solution

1. Reasonably set the speed command.
2. Check the input frequency, division, multiplication ratio of command pulse.
3. Make a gain tuning when an overshoot occurs due to a poor gain tuning.
4. Make a wiring connection of the encoder as the wiring diagram.
5. Correctly set the value of parameter **Pr615**.

11.4.2.8 Err27.1

11.4.2.8.1 Error Code

Err27.1: Command pulse division/multiplication error protection

11.4.2.8.2 Cause

The ratio of the electronic gear is incorrect:

- It exceeds range 0.001~32000.
- The numerator/denominator of the electronic gear is greater than 64bit in the process of calculation.
- The final result of the numerator/denominator of the electronic gear is greater than 32bit.

11.4.2.8.3 Solution

Correctly set the ratio of the electronic gear.

11.4.2.9 Err28.0

11.4.2.9.1 Error Code

Err28.0: Pulse regeneration limit protection

11.4.2.9.2 Cause

The output frequency of pulse regeneration exceeds the maximum.

11.4.2.9.3 Solution

1. Check the values of parameters **Pr011 Output pulse counts per one motor revolution** and **Pr503 Denominator of pulse output division**.
2. To disable the detection, set the value of parameter **Pr533 Pulse regenerative output limit setup** to **0**.

11.4.2.10 Err29.0

11.4.2.10.1 Error Code

Err29.0: Deviation count overflow protection

11.4.2.10.2 Cause

Positional deviation of encoder pulse reference or full loop deviation of grating scale exceeds 2^{29}(536870912).

11.4.2.10.3 Solution

Check if the motor follows the position command pulses.

11.4.3 Err30 Series

11.4.3.1 Err33 Series

11.4.3.1.1 Error Code

Err33.0: I/F input duplicated allocation error 1

Err33.2: I/F input function number error 1

Err33.3: I/F input function number error 2

Err33.4: I/F output function number error 1

11.4.3.1.2 Cause

Err33.0: Input signals (SI1, SI2, SI3, SI4, SI5, SI6, SI7) are assigned with two functions.

Err33.2: Input signals (SI1, SI2, SI3, SI4, SI5, SI6, SI7) are assigned with undefined number.

Err33.3: Input signal SI1 is assigned as other function when communicating with Lambda terminal board.

Err33.4: Output signals (SO1, SO2, SO3, SO4) are assigned with undefined number.

11.4.3.1.3 Solution

1. Allocate correct function to each connector pin.
2. Check if registration function is enabled:
    - Yes: Allocate signal **ALM_CLR Alarm Clear Input** to the connector pin except SI1.
    - No: Set the value of parameter **Pr639 Lambda communication ON/OFF signal** to **0**, and allocate signal **ALM_CLR Alarm Clear Input** to SI1 signal.

11.4.3.2 Err34.0

It is used to set the working range of the motor in the position mode, so that **Err34.0 Motor movable range protection** occurs once the range of the current position command exceeds the value of parameter **Pr514 Motor working range setup**. With this function, you can prevent the work from colliding with the end of the machine tool caused by motor oscillation.

11.4.3.2.1 Error Code

Err34.0: Software limit protection

This error code occurs in the following conditions:

- Position control.
- Servo is on.
- Input signals such as the deviation counter clear and command input inhibit, and parameters except for controls such as torque limit setup are set correctly.
- The servo motor can run normally.

11.4.3.2.2 Cause

The motor operates outside its working range specified in parameter **Pr514**:

1. A poor gain tuning.
2. The value of parameter **Pr514** is too small.

11.4.3.2.3 Solution

Make sure the motor runs normally:

1. Check the gain (balance between position gain and speed gain) and inertia ratio.
2. Increase the value of parameter **Pr514**, or set it to **0** to disable the protective function.

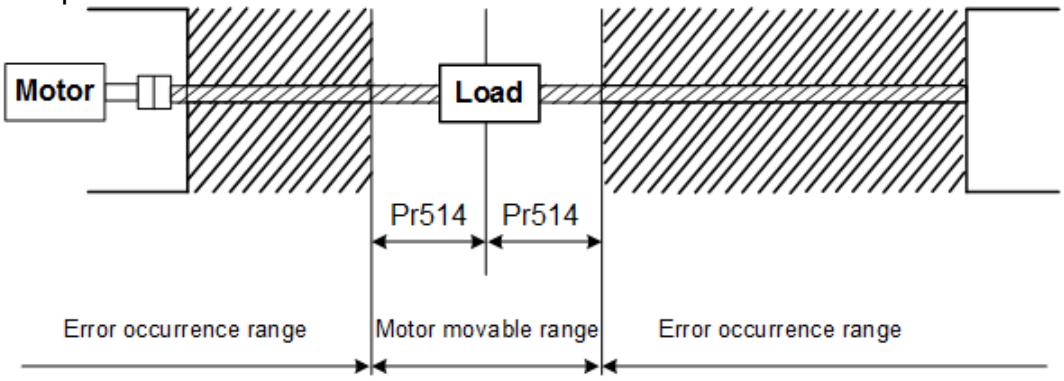
During troubleshooting, please note the following:

- **Err34.0** is not a protection against the abnormal positional command.
- When **Err34.0** is activated, the motor will decelerate and stop according to parameter **Pr510 Sequence at alarm**.
  The work (load) may collide to the end of the machine tool and be damaged depending on the load during this deceleration. Thus, please take deceleration movement into consideration when you set up parameter **Pr514**.

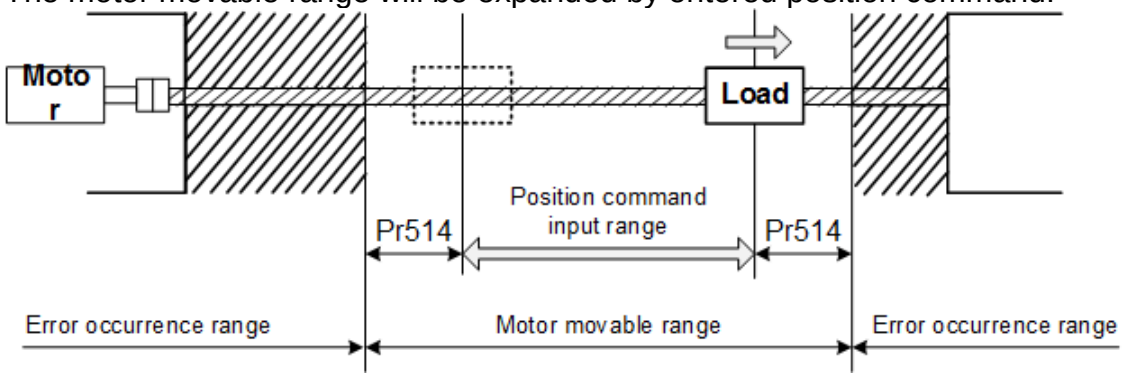
11.4.3.2.4 Example of Movement

Make sure the servo is on:

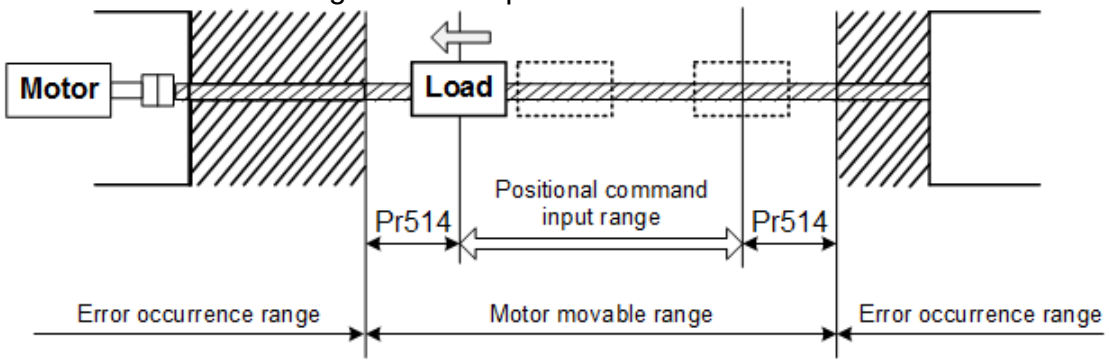
- With no position command
  The working range of the servo motor: It refers to the travel range which is set at both sides of the motor with parameter **Pr514**.
  When the load can trigger **Err34.0** (oblique line range) due to oscillation, software limit protection will be activated.



- With no position command
  - Right action
    The motor movable range will be expanded by entered position command.



  - Left action
    The motor movable range will be expanded further.



11.4.3.3 Err36 Series

11.4.3.3.1 Error Code

Err36.0 / Err36.1 / Err36.2: EEPROM parameter error protection

11.4.3.3.2 Cause

Data in parameter storage area is damaged when reading the data from EEPPOM at power-on.

11.4.3.3.3 Solution

Power off, and re-power on.

If the error still exists, replace the servo drive with a new one, and send the old one to us for repair.

11.4.3.4 Err37 Series

11.4.3.4.1 Error Code

Err37.0 / Err37.1 / Err37.2: EEPROM code error protection

11.4.3.4.2 Cause

Operating EEPROM fails when reading the data from EEPROM at power-on.

11.4.3.4.3 Solution

1. Initialize parameters.
2. If the error still exists, replace the servo drive with a new one, and send the old one to us for repair.

11.4.3.5 Err38.0

11.4.3.5.1 Error Code

Err38.0: Driver inhibited input protection

11.4.3.5.2 Cause

1. When the value of parameter **Pr504 Over-travel inhibition input** is set to **0**, both positive and negative over-travel inhibit inputs are ON.
2. When the value of parameter **Pr504** is set to **2**, positive or negative over-travel inhibit inputs is turned ON.

11.4.3.5.3 Solution

1. Make sure there are not any errors in switches, wires or power supply which are connected to positive / negative direction over-travel inhibit input.
2. Make sure the control power supply (DC12~24V) is powered on normally.

11.4.4 Err40 Series

11.4.4.1 Err40.0

11.4.4.1.1 Error Code

Err40.0: Absolute encoder system down error protection

11.4.4.1.2 Cause

The voltage of the built-in capacitor falls below the specified value because the power supply or battery for the absolute encoder is down.

11.4.4.1.3 Solution

1. After connecting the power supply for the battery, clear the absolute encoder.
2. Check the battery cable.

11.4.4.2 Err41.0

11.4.4.2.1 Error Code

Err41.0: Absolute count overflow error protection

11.4.4.2.2 Cause

Multi-turn count of the absolute encoder exceeds the specified value.

11.4.4.2.3 Solution

1. To ignore the multi-turn count overflow, set the value of parameter **Pr015 Absolute encoder setup** to **2**.
2. Limit the travel from machine origin with **32767** revolutions.

11.4.4.3 Err42.0

11.4.4.3.1 Error Code

Err42.0: Absolute encoder over-speed error protection

11.4.4.3.2 Cause

The motor speed exceeds the specified value when the battery offers the power during the power failure.

11.4.4.3.3 Solution

1. Make sure the supply voltage of the encoder is DC $5V^{+5\%}_{-5\%}$(4.75V~5.25V).
2. Check the connecting condition of the encoder connector.

11.4.4.4 Err43.0

11.4.4.4.1 Error Code
Err43.0: Encoder initialization error protection

11.4.4.4.2 Cause
An error is detected during initializing the encoder.

11.4.4.4.3 Solution
Replace the motor with a new one.

11.4.4.5 Err44.0

11.4.4.5.1 Error Code
Err44.0: Absolute encoder single turn count error protection

11.4.4.5.2 Cause
Single turn count error protection of the absolute encoder is detected.

11.4.4.5.3 Solution
Replace the motor with a new one.

11.4.4.6 Err45.0

11.4.4.6.1 Error Code
Err45.0: Absolute encoder multi-turn count error protection

11.4.4.6.2 Cause
Multi-turn count error protection of the absolute encoder is detected.

11.4.4.6.3 Solution
Replace the motor with a new one.

11.4.4.7 Err46.0

11.4.4.7.1 Error Code
Err46.0: Absolute encoder overheat protection

11.4.4.7.2 Cause
Encoder temperature is too high.

11.4.4.7.3 Solution
Cool down the environment temperature of the motor.

11.4.4.8 Err47.0

11.4.4.8.1 Error Code
Err47.0: Absolute status error protection

11.4.4.8.2 Cause
The running speed of the Encoder is greater than the specified value at power-on.

11.4.4.8.3 Solution
Avoid the motor to rotate at power-on.

11.4.4.9 Err48.0

11.4.4.9.1 Error Code

Err48.0: Encoder Z-phase error protection

11.4.4.9.2 Cause

1. Missing pulses of Z-phase serial incremental encoder is detected.
2. Encoder failure.

11.4.4.9.3 Solution

Replace the motor with a new one.

11.4.4.10 Err49.0

11.4.4.10.1 Error Code

Err49.0: Encoder CS signal error protection

11.4.4.10.2 Cause

1. CS signal logic error of the serial incremental encoder is detected.
2. Encoder failure.

11.4.4.10.3 Solution

Replace the motor with a new one.

11.4.5 Err50 Series

11.4.5.1 Err52.0

11.4.5.1.1 Error Code

Err52.0: Incorrect regenerative resistor parameter

11.4.5.1.2 Cause

The value of parameter **Pr019 Resistance of external regenerative resistor** is less than the minimum resistance.

11.4.5.1.3 Solution

Replace the regenerative resistor.

11.4.5.2 Err55.0

11.4.5.2.1 Error Code

Err55.0: A / B-phase connection error protection

11.4.5.2.2 Cause

A/B-phase wiring in the feedback encoder is defective, e.g. discontinued.

11.4.5.2.3 Solution

Check the A/B-phase wiring connection in the feedback encoder.

11.4.5.3 Err55.1

11.4.5.3.1 Error Code

Err55.1: CS connection error protection

11.4.5.3.2 Cause

CS signal wiring is defective, e.g. discontinued.

11.4.5.3.3 Solution

Check the CS signal wiring connection.

11.4.5.4 Err55.2

11.4.5.4.1 Error Code
Err55.2: Z-phase connection error protection

11.4.5.4.2 Cause
Z-phase wiring in the feedback encoder is defective, e.g. discontinued.

11.4.5.4.3 Solution
Check the Z-phase wiring connection in the feedback encoder.

11.4.5.5 Err55.3

11.4.5.5.1 Error Code
Err55.3: CS signal logic error protection

11.4.5.5.2 Cause
There is an error in CS signal logic (All of CS signals 1, 2 and 3 are high or low).

11.4.5.5.3 Solution
Check the CS signal wiring connection.

11.4.5.6 Err55.4

11.4.5.6.1 Error Code
Err55.4: AB-phase missing error protection

11.4.5.6.2 Cause
There are extremely few AB-phase pulses between CS signal changes.

11.4.5.6.3 Solution
Check the CS signal, A-phrase, and B-phrase wiring connections.

11.4.5.7 Err56.0

11.4.5.7.1 Error Code
Err56.0: ABZ incremental encoder over-speed error protection

11.4.5.7.2 Cause
The motor speed exceeds the specified value.

11.4.5.7.3 Solution
Power off, restart the servo drive, and avoid the motor runs at extreme speed.

11.4.5.8 Err56.1

11.4.5.8.1 Error Code
Err56.1: ABZ incremental encoder UVW error protection

11.4.5.8.2 Cause
1. U, V, W signal logic error of the serial incremental encoder is detected.
2. Encoder failure.

11.4.5.8.3 Solution
1. Check the wiring of U, V, W signals of the encoder.
2. Make sure there is no strong disturbance source in the vicinity of the encoder.

11.4.5.9 Err56.2

11.4.5.9.1 Error Code

Err56.2: ABZ incremental encoder ABZ error protection

11.4.5.9.2 Cause

1. Missing pulses of A-phrase, B-phrase, and Z-phase serial incremental encoder is detected.
2. Encoder failure.

11.4.5.9.3 Solution

1. Check the wiring of A-phrase, B-phrase, and Z-phase of the encoder.
2. Make sure there is no strong disturbance source in the vicinity of the encoder.

11.4.5.10 Err57.0

11.4.5.10.1 Error Code

Err57.0: Current sampling offset excess protection

11.4.5.10.2 Cause

Error is detected in current sampling chip circuit.

11.4.5.10.3 Solution

Power off, and re-power on. If the error still exists, replace the servo drive with a new one, and send the old one to us for repair.

11.4.5.11 Err57.1

11.4.5.11.1 Error Code

Err57.1: Current gain diagnosis error protection

11.4.5.11.2 Cause

1. Power circuit error.
2. Disconnection of the motor wire (U, V and W).

11.4.5.11.3 Solution

1. Power off, and re-power on. If the error still exists, replace the servo drive and motor with new ones, and send the old ones to us for repair.
2. Check the wiring of U, V, W.

11.4.5.12 Err58.0

11.4.5.12.1 Error Code

Err58.0: Chip working error protection

11.4.5.12.2 Cause

It may be caused by the power supply of the chip or noise.

11.4.5.12.3 Solution

Power off, and re-power on. If the error still exists, replace the servo drive and motor with new ones, and send the old ones to us for repair.

11.4.5.13 Err59.0

11.4.5.13.1 Error Code
Err59.0: Registered time expired

11.4.5.13.2 Cause
Remaining usage time is insufficient.

11.4.5.13.3 Solution
Check the remaining usage time, contact with the distributors and manufacturers, and register again.

11.4.5.14 Err59.1

11.4.5.14.1 Error Code
Err59.1: Mismatching software version

11.4.5.14.2 Cause
The software version does not match with the actual one.

11.4.5.14.3 Solution
Check the software version, and contact with the distributors and manufacturers.

11.4.6 Err60 Series

11.4.6.1 Err60.0

11.4.6.1.1 Error Code
Err60.0: M-II communication ASIC fault 1

11.4.6.1.2 Cause
Failure of the MECHATROLINK communication component of the servo drive.

11.4.6.1.3 Solution
Power off, and re-power on. If the error still exists, replace the servo drive with a new one, and send the old one to us for repair.

11.4.6.2 Err61.0

11.4.6.2.1 Error Code
Err61.0: M-II communication ASIC fault 2

11.4.6.2.2 Cause
The setting of MECHATROLINK communication parameter exceeds the specified range.

11.4.6.2.3 Solution
Modify the setting of MECHATROLINK communication parameter.

11.4.6.3 Err62.0

11.4.6.3.1 Error Code
Err62.0: M-II internal synchronous error 1

11.4.6.3.2 Cause
1. MECHATROLINK transmission cycle changes.
2. Failure of the servo drive.

11.4.6.3.3 Solution
1. Eliminate the causes which makes the transmission cycle of host computer changed.
2. Power off, and re-power on. If the error still exists, replace the servo drive with a new one, and send the old one to us for repair.

11.4.6.4 Err63.0

11.4.6.4.1 Error Code

Err63.0: M-II transmission cycle setup error

11.4.6.4.2 Cause

The setting of MECHATROLINK transmission cycle exceeds the specified range.

11.4.6.4.3 Solution

Modify the setting of MECHATROLINK communication parameter.

11.4.6.5 Err64.0

11.4.6.5.1 Error Code

Err64.0: M-II synchronous error

11.4.6.5.2 Cause

1. Error in connection of the communication cable and terminal resistor.
2. An error occurs during updating WDT data of the host computer.
3. Failure of the servo drive.

11.4.6.5.3 Solution

1. Check the connection of the communication cable and terminal resistor.
2. Correctly update WDT data.
3. Power off, and re-power on. If the error still exists, replace the servo drive with a new one, and send the old one to us for repair.

11.4.6.6 Err64.1

11.4.6.6.1 Error Code

Err64.1: M-II synchronous failure

11.4.6.6.2 Cause

1. Error in connection of the communication cable and terminal resistor.
2. When synchronous communication starts, an error occurs during updating WDT data of the host computer.
3. Failure of the servo drive.

11.4.6.6.3 Solution

1. Correctly connect MECHATROLINK communication cables and terminal resistors.
2. Correctly update WDT data.
3. Power off, and re-power on. If the error still exists, replace the servo drive with a new one, and send the old one to us for repair.

11.4.6.7 Err65.0

11.4.6.7.1 Error Code

Err65.0: M-II communication fault (receipt error)

11.4.6.7.2 Cause

1. The wiring of MECHATROLINK is wrong.
2. The communication address of servo drive is not same with that of the host computer.
3. Failure of the servo drive.

11.4.6.7.3 Solution

1. Correctly connect MECHATROLINK communication cables and terminal resistors.
2. Check the setting of servo drive communication address.
3. Power off, and re-power on. If the error still exists, replace the servo drive with a new one, and send the old one to us for repair.

11.4.6.8 Err65.1

11.4.6.8.1 Error Code

Err65.1: M-II transmission cycle error (synchronous interval error)

11.4.6.8.2 Cause

1. MECHATROLINK transmission cycle changes.
2. Failure of the servo drive.

11.4.6.8.3 Solution

1. Eliminate the causes which makes the transmission cycle of host computer changed.
2. Power off, and re-power on. If the error still exists, replace the servo drive with a new one, and send the old one to us for repair.

11.4.7 Err70 Series

11.4.7.1 Err70.0

11.4.7.1.1 Error Code

Err70.0: Motor setting error protection

11.4.7.1.2 Cause

1. Parameter **Pr700 Motor type selection** is set to **0**.
2. The value of parameter **Pr713 Feedback encoder resolution/number of scale pulse per rotation** is out of range.
3. When setting parameter **Pr700** to **1** (Linear type), parameter **Pr714 Magnet pole pitch** and **Pr734 Number of pulses per magnet pole** are set at the same time.
4. When parameter **Pr700** is set to **1** (Linear type), the value of parameter **Pr734 Number of pulses per magnet pole** is out of range.
5. When parameter **Pr700** is set to **2** (Rotary type), the value of parameter **Pr705 Number of pole pairs of motor** is set to **0**.
6. When parameter **Pr700** is set to **2** (Rotary type), and **Pr323 Encoder type selection** is set to **3** ~ **9**, the value of parameter **Pr711 Encoder digit per revolution** is set to **0**.
7. Parameter **Pr701 Rated effective motor current** ~ **Pr704 Maximum motor speed**, **Pr706 Linear back EMF constant** ~ Pr710 Motor inertia**, **Pr715**, and **Pr724** are set to **0**.
8. When parameter **Pr700** is set to **1** (Linear type), the value of parameter **Pr323 Encoder type selection** is set to **3~9**.

11.4.7.1.3 Solution

1. Check the value of parameter **Pr700 Motor type selection**.
2. Check the value of parameter **Pr713 Feedback encoder resolution / number of scale pulse per rotation**.
3. Check the value of parameter **Pr700 Motor type selection**, **Pr714 Magnet pole pitch** and **Pr734 Number of pulses per magnet pole**.
4. Check the value of parameter **Pr700 Motor type selection** and **Pr734 Number of pulses per magnet pole**.
5. Check the value of parameter **Pr700 Motor type selection** and **Pr705 Number of pole pairs of motor**.
6. Check the value of parameter **Pr700 Motor type selection**, **Pr323 Encoder type selection** and **Pr711 Encoder digit per revolution**.
7. Check the value of parameter **Pr701 Rated effective motor current**, **Pr702 Rated motor torque**, **Pr704 Maximum motor speed**, **Pr706 Linear back EMF constant**, **Pr707 Motor phase resistance**, **Pr709 Motor phase inductance**, **Pr710 Motor inertia**, **Pr715 Maximum instantaneous motor current** and **Pr724 Magnet pole detection scheme selection**.
8. Check the value of parameter **Pr700 Motor type selection** and **Pr323 Encoder type selection**.
   When linear motor is used, rotary encoder cannot be used.

11.4.7.2 Err70.1

11.4.7.2.1 Error Code

Err70.1: Motor combination error 1 protection

11.4.7.2.2 Cause

1. The value of parameter **Pr701 Rated effective motor current** is greater than the allowable rated current for the servo drive.
2. The value of parameter **Pr715 Maximum instantaneous motor current** is greater than the allowable current for the servo drive.

11.4.7.2.3 Solution

1. Check the value of parameter **Pr701** (Unit: 0.1Arms).
2. Check the value of parameter **Pr715** (Unit: 0.1Arms).

If the parameter is set correctly, replace the servo drive with larger power.

11.4.7.3 Err70.2

11.4.7.3.1 Error Code

Err70.2: Motor combination error 2 protection

11.4.7.3.2 Cause

1. The rated motor current is too small against the rated drive current.
2. The percentage of the maximum current to the rated motor current is larger than 500%.

11.4.7.3.3 Solution

1. Check the value of parameter **Pr701 Rated effective motor current** (Unit: 0.1Arms).
   If the parameter is set correctly, replace the servo drive with smaller power.
2. Check the value of parameter **Pr701 Rated effective motor current** and **Pr715 Maximum instantaneous motor current**.

11.4.7.4 Err70.3

11.4.7.4.1 Error Code

Err70.3: Motor automatic setting error protection

11.4.7.4.2 Cause

An error occurs during automatic setting of the motor.

11.4.7.4.3 Solution

Check the wiring of the motor and the feedback type.

11.4.7.5 Err71.0

11.4.7.5.1 Error Code

Err71.0: Magnet pole position estimation error 1 protection

11.4.7.5.2 Cause

1. Magnet pole position estimation is not finished correctly.
2. The setting of the motor phase sequence is incorrect.
3. Shortage of torque command / command time at the time of magnet pole position estimation.
4. A vertical axis exists.
5. An unbalanced load and a large friction.

11.4.7.5.3 Solution

1. Check the phase sequence of the motor.
2. Increase the value of parameter **Pr726 Torque command time for magnet pole position estimation** and **Pr727 Command torque for magnet pole position estimation**
3. Disable magnet pole position estimation function for the vertical axis and an axis with an unbalanced load and a large friction.

11.4.7.6 Err71.1

11.4.7.6.1 Error Code

Err71.1: Magnet pole position estimation error 2 protection

11.4.7.6.2 Cause

The motor does not stop after the set time of parameter **Pr731 Motor stop control time for magnet pole position estimation**.

11.4.7.6.3 Solution

1. Increase the value of parameter **Pr731**.
2. Check for unbalanced loads (the motor does not run when torque command is **0**).

11.4.7.7 Err71.2

11.4.7.7.1 Error Code

Err71.2: Magnet pole position estimation error 3 protection

11.4.7.7.2 Cause

1. The value of parameter **Pr724 Magnet pole detection scheme selection** is set to **3** when magnet pole position estimation is not executed.
2. The value of parameter **Pr724** is set to **3** when the encoder is not the absolute type.

11.4.7.7.3 Solution

1. Set parameter the value of parameter **Pr724** to **2**, perform magnet pole position estimation once, and set the value of parameter **Pr724** to **3**.
2. Make sure the encoder is absolute type.

11.4.7.8 Err73.0

11.4.7.8.1 Error Code

Err73.0: Mismatch of regenerative resistor parameter

11.4.7.8.2 Cause

The value of parameter **Capacity of regenerative resistor*** is less than the minimum capacity, or the value of parameter **Pr019 Resistance of regenerative resistor** is less than the minimum resistance.

11.4.7.8.3 Solution

Replace the regenerative resistor, and set the value of parameter **Pr018** or **Pr019**.

11.4.7.9 Err74.0

11.4.7.9.1 Error Code

Err74.0: Multi-turn data upper limit value disagreement error protection

11.4.7.9.2 Cause

In the unlimited rotary absolute mode, the upper limit of multi-turn date differs in encoder type.

11.4.7.9.3 Solution

1. Make sure the value of parameter **Pr629 Absolute multi-turn data upper limit** is set within the specified range.
2. If the error occurs after the control power supply is on, power off and re-power on.

11.4.7.10 Err76.0

11.4.7.10.1 Error Code

Err76.0: Motor stall over-temperature protection

11.4.7.10.2 Cause

The actual motor speed is less than 10rpm, but the torque command reaches the maximum and lasting time reaches the value of parameter **Pr661 Time window of motor stall over temperature protection**.

1. UVW phase loss, or disconnection. Or their phase sequence is incorrect.
2. The value of the parameter is incorrect.
3. External causes.

11.4.7.10.3 Solution

1. Connect the UVW cables in the correct way, or replace cables.
2. Modify the values of motor parameters, including **Pr705 Number of pole pairs of motor** and **Pr445 Oriented angle setup**.
3. Make sure the running command is the same with the actual speed.

Note: After troubleshooting, please power off for 30s before motor running.

11.4.7.11 Err77.0

11.4.7.11.1 Error Code

Err77.0: Runaway protection

11.4.7.11.2 Cause

1. The UVW phase sequence is incorrect.
2. The interference signal causes an error in the initial phase detection of the motor rotor at power-on.
3. The encoder model is wrong or the wiring is incorrect.
4. The encoder cable is aging or corroded, or the encoder connector is loose.
5. The gravity load in vertical axis applications is too heavy.
6. Incorrect parameter setting lead to too large servo vibration.

11.4.7.11.3 Solution

1. Connect the UVW cables in the correct phase sequence.
2. If UVW phase sequence is correct, but the error still occurs, power off and re-power on.
3. Check if the servo drive matches with the motor.
   If not, replace the motor with one that can match with the servo drive.
4. Turn the servo off and manually rotate the motor shaft, to check if D01 in the monitor mode changes as the motor shaft rotates. If not, re-weld, tighten or replace the encoder cable. 5. Lighten the load of the vertical axis, increase the stiffness level, or hide the error without affecting safety and use.
5. Check if the rigidity level is too high, which leads to vibration during motor running. If it is, adjust the value of parameter **Pr003 Selection of machine stiffness at real-time auto-gain tuning** to avoid too large vibration.

11.4.8 Err80 Series

11.4.8.1 Err87.0

11.4.8.1.1 Error Code

Err87.0: Forced alarm input protection

11.4.8.1.2 Cause

Forced alarm input (E-STOP) is applied.

11.4.8.1.3 Solution

Check the wiring of forced alarm input (E-STOP).

11.4.9 Err90 Series

11.4.9.1 Err95.0

11.4.9.1.1 Error Code

Err95.0: Motor automatic recognition error protection

11.4.9.1.2 Cause

The motor and the voltage specification of the servo drive does not match.

11.4.9.1.3 Solution

Replace the motor with one that can match with the servo drive.

11.4.9.2 Err95.1

11.4.9.2.1 Error Code

Err95.1: Motor automatic recognition error protection

11.4.9.2.2 Cause

The motor and encoder connector of the servo drive does not match.

11.4.9.2.3 Solution

Replace the motor with one that can match with the servo drive.

11.4.9.3 Err95.2

11.4.9.3.1 Error Code

Err95.2: Motor automatic recognition error protection

11.4.9.3.2 Cause

The motor and the power rate of the servo drive does not match.

11.4.9.3.3 Solution

1. Replace the motor with one that can match with the servo drive.
2. Check the value of parameter **Pr024 Motor Number**.

11.4.9.4 Err95.3

11.4.9.4.1 Error Code

Err95.3: Motor automatic recognition error protection

11.4.9.4.2 Cause

The encoder type does not match with the setting of the servo drive.

11.4.9.4.3 Solution

Make sure the encoder type match with the value of parameter **Pr015 Absolute encoder setup**.

11.4.9.5 Err95.4

11.4.9.5.1 Error Code

Err95.4: Motor automatic recognition error protection

11.4.9.5.2 Cause

Error in reading from encoder EEPROM.

11.4.9.5.3 Solution

Contact us, and do the following:

- Power off, and re-power on.
- Check the nameplate of the motor, and make sure the motor model matches with the value of parameter **Pr024 Motor Number**.

If the error still exists, replace the servo drive and motor with new ones, and send the old ones to us for repair.

11.4.10 Other Error Codes

11.4.10.1 Other Error Code

11.4.10.1.1 Error Code

Other error

11.4.10.1.2 Cause

1. Control circuit malfunctions due to too much noise or other causes.
2. Self-diagnosis function of the servo drive is triggered due to some error inside of the drive.

11.4.10.1.3 Solution

Power off, and re-power on. If the error still exists, replace the servo drive and motor with new ones, and send the old ones to us for repair.

11.5 Error Status Clearing

During error status, error code (Err.) will be displayed on the front panel LED and the servo cannot be enabled.

To see if the error status can be cleared, please check the clearable attribute in List of Error Code for details.

For error codes that cannot be cleared, troubleshoot it, power off and re-power on.

Note: Please clear the error status when the motor stops and safety can be guaranteed.

To clear the error status for clearable error codes, do one of the following:

- Clear the error status by the operation panel.
- Clear the error status by iMotion software

12 Parameters

12.1 Overview

Before checking the drive parameters, please pay attention to the following:

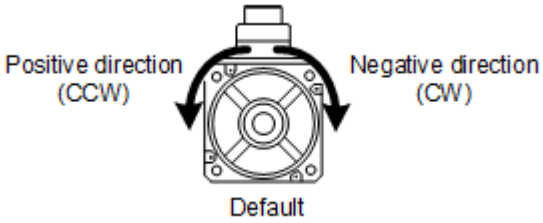
Related mode

- P: Position control
- S: Velocity control
- T: Torque control
- ALL: P S T

12.2 [Class 0] Basic Setting

12.2.1 Pr000

- Name: Rotational direction setup
- Unit: -
- Range: 0~1
- Default value: 1
- Effective time: After restart
- Related mode: ALL
- Description: Specify the relationship between the direction of command and direction of motor rotation.



  - 0
    - Positive command: The motor turns CW (viewed from load side shaft end), and positive direction drive inhibit input is valid.
    - Negative command: The motor turns CCW (viewed from load side shaft end), and negative direction drive inhibit input is valid.
  - 1
    - Positive command: The motor turns CCW (viewed from load side shaft end), and positive direction drive inhibit input is valid.
    - Negative command: The motor turns CW (viewed from load side shaft end), and positive direction drive inhibit input is valid.

12.2.2 Pr001

- Name: Control mode setup
- Unit: -
- Range: 0~3
- Default value: 1
- Effective time: After restart
- Related mode: ALL
- Description: Specify the control mode.
  - 0: idle mode.
  - 1: position control mode
  - 2: velocity control mode
  - 3: torque control mode

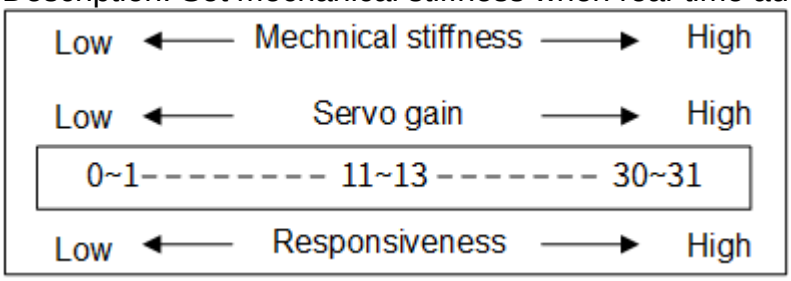
12.2.3 Pr002

- Name: Real-time auto-gain tuning setup
- Unit: -
- Range: 0~7
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the action mode of the real-time auto-gain tuning.
  - 0: invalid
    Real-time auto-gain tuning function is disabled.
  - 1: standard
    It is the basic mode (focusing on stability), not using unbalanced load and friction compensation, gain switching, and inertia estimation.
  - 2: positioning
    In position control mode, it focuses on positioning, not using unbalanced load for horizontal axis. And it is suggested to use this mode on the machine with ball screw driving with low friction.
    Velocity and torque control modes are the same as in the standard mode.
  - 3: vertical axis
    In position and velocity control mode, with additional features of the positioning mode, it compensates unbalanced load for vertical axes, so as to minimize variations in the setting time.
    Torque control modes are the same as in the standard mode.
  - 4: friction compensation
    In position control mode, with additional features of the vertical axis mode, it reduces positioning setting time with the belt driving axis with high friction.
    Velocity control mode is the same as in the vertical axis mode, and torque control mode is the same as in the standard mode.
  - 5: load characteristic learning
    It learns load characteristics and synchronously updates the estimation valve of inertia. You can use these features with its supported software.

- 6: customize
  It combines with parameter **Pr632 Real time auto tuning custom setup** to achieve real-time auto tuning functions.
  Some functions may be unavailable in some control modes.
- 7: load characteristic measurement
  It only estimates the load characteristics without changing the settings of current parameters. You can use these features with its supported software.
  Some functions may be unavailable in some control modes.

12.2.4 Pr003

- Name: Setup of machine stiffness at real-time auto-gain tuning
- Unit: -
- Range: 0~31
- Default value: 13
- Effective time: Immediately
- Related mode: ALL
- Description: Set mechanical stiffness when real-time auto-gain tuning is enabled.



Note: The greater the set value, the higher the servo stiffness and response. However, oscillation or vibration will occur. Therefore, please check the machine actions when improving servo stiffness and response.

12.2.5 Pr004

- Name: Inertia ratio
- Unit: %
- Range: 0~10000
- Default value: 250
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the ratio of the load inertia against the rotor (of the servo motor) inertia.

$$Pr004 = \frac{\text{Load inertia}}{\text{Rotor inertia}} * 100\%$$

When parameter **Pr002 Real-time auto-gain tuning setup** is valid (set to a value except 0), the inertia ratio will be estimated.

12.2.6 Pr008~Pr010

Including parameters **Pr008 Command pulse counts per one motor revolution**, **Pr009 1st numerator of electronic gear**, and **Pr010 Denominator of electronic gear**.

12.2.6.1 Pr008

- Name: Command pulse counts per one motor revolution
- Unit: pulse
- Range: 0~16777216
- Default value: 0.
- Effective time: After restart
- Related mode: P
- Description: Specify the command pulse that causes single turn of the motor shaft.
  When the parameter is set to **0**, parameter **Pr009 1st numerator of electronic gear** and **Pr010 Denominator of electronic gear** become valid.

12.2.6.2 Pr009

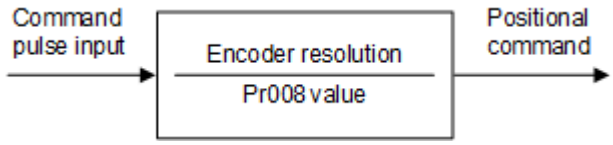
- Name: 1st numerator of electronic gear
- Unit: -
- Range: 0~1073741824
- Default value: 1
- Effective time: Immediately
- Related mode: P
- Description: Specify the numerator of division/multiplication operation made according to the command pulse input.
  When is it set to **0**, the value of parameter **Pr008 Command pulse counts per one motor revolution** turns to **0**.

12.2.6.3 Pr010

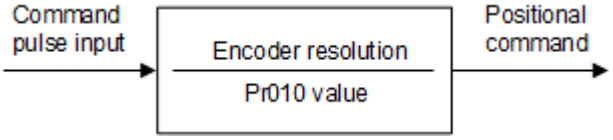
- Name: Denominator of electronic gear
- Unit: -
- Range: 1~1073741824
- Default value: 1
- Effective time: Immediately
- Related mode: P
- Description: Specify the denominator of division/multiplication operation made according to the command pulse input.
  This parameter is valid when **Pr008 Command pulse counts per one motor revolution** is set to **0**.

12.2.6.4 Relationship among Pr008, Pr009 and Pr010

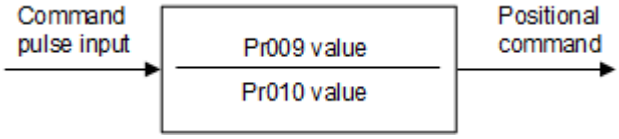
- When parameter **Pr008** is set to **1~2^{20}** and parameters **Pr009** and **Pr010** have no effect on command pulse counts per one motor revolution, command pulse counts per one motor revolution is processed according to parameter **Pr008**:



- When parameters **Pr008** and **Pr009** are set to **0** and parameter **Pr010** is set to **1~2^{30}**, command pulse counts per one motor revolution is processed according to parameter **Pr010**:



- When parameters **Pr008** is set to **0** and parameters **Pr009** and **Pr010** are set to **1~2^{30}**, command pulse counts per one motor revolution is processed according to parameter **Pr009** and **Pr010**:



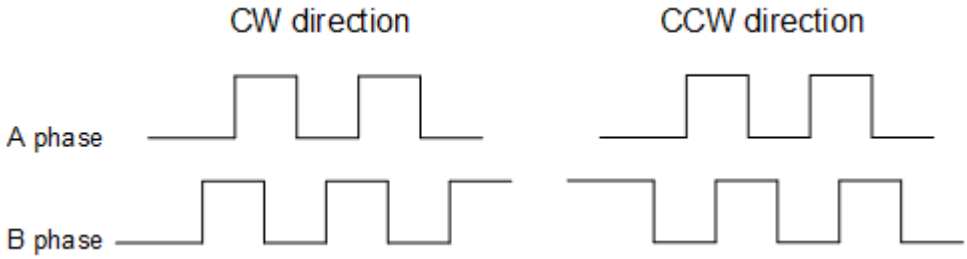
12.2.7 Pr011

- Name: Output pulse counts per one motor revolution
- Unit: pulse
- Range: 1~4194304
- Default value: 2500
- Effective time: After restart
- Related mode: ALL
- Description: Specify the output pulse counts per one motor revolution for each OA-axis and OB-axis as the output pulse counts.
  4 times of output pulse counts will be:

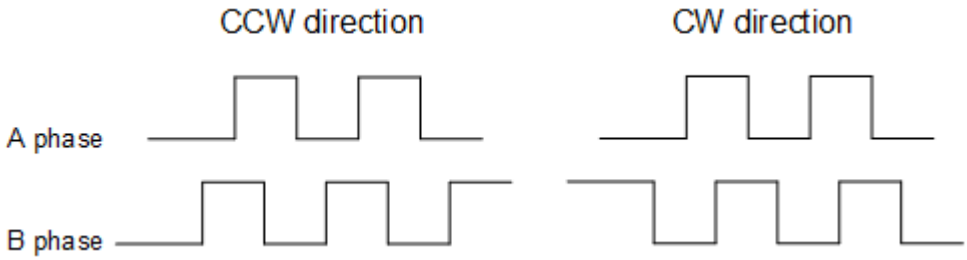
$$\text{Output pulse counts per one motor revolustion} = Pr011 * 4$$

12.2.8 Pr012

- Name: Reversal of pulse output logic
- Unit: -
- Range: 0~1
- Default value: 0.
- Effective time: After restart
- Related mode: ALL
- Description: Reverse the phase relation between the A-phase and B-phase pulse by reversing the B-phase logic:
  - 0: Encoder. B-phase logic is non-reversal.



  - 0: Encoder. B-phase logic is reversal.



12.2.9 Pr013

- Name: 1st torque limit
- Unit: %
- Range: 0~500
- Default value: 300
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the limit value of the motor output torque. It is used to limit the maximum torque of the servo motor, so as to reduce the damage to machine caused by errors such as clutch or collision.
  If the torque is limited below actually required level, over-speed protection and positional deviation protection may be triggered due to overshoot command and command reception delay.

12.2.10 Pr014

- Name: Position deviation excess setup
- Unit: command unit
- Range: 0~1073741824
- Default value: 35000000
- Effective time: Immediately
- Related mode: P

- Description: Specify excess range of positional deviation by the command unit (default).
  Parameter unit and calculation mode can be changed by parameter **Pr520 Position setup unit selection**. **Err24.0 Positional deviation excess protection** is invalid when this parameter is set to **0**.

$$Pr014 > \frac{\text{Max motor speed(Rpm)}}{60} * \frac{\text{Encoder revolution}}{Pr100/10} * \text{Electrical gear ratio} * 1.2\sim2$$

  Example
  When parameter **Pr100 1st gain of position loop** is set to **270**, the electronic gear ratio of the servo drive is set **1:1**, the maximum motor speed is 3000r/min, and the encoder revolution is 17Bit, then it is suggested to set this parameter as follows:
  Pr014 > (3000/60) * (2^{17}/(270/10) * 1 * 1.2 = 291271
  The electronic gear ratio converting to turns is 2.22r, and if the motor collides when its speed is 60r/min, then **Err24.0 Positional deviation excess protection** occurs within 3s.

12.2.11 Pr015

- Name: Absolute encoder setup
- Unit: -
- Range: 0~4
- Default value: 2
- Effective time: After restart
- Related mode: ALL
- Description: Specify the using method of absolute encoder.
  - 0: Use as an absolute encoder.
  - 1: Use as an incremental encoder.
  - 2: Use as an absolute encoder, but ignore the multi-turn counter over.
  - 3: Exclusively used by manufacturers (setup is prohibited).
  - 4: Unlimited rotation in absolute mode. It is used in absolute system (absolute mode). There is no limitation for the upper limit of multi-revolution count.

12.2.12 Pr016

- Name: External regenerative resistor setup
- Unit: -
- Range: 0~3
- Default value: Without built-in resistor (≤400W): 3; with built-in resistor (＞400W): 0.
- Effective time: After restart
- Related mode: ALL
- Description: When you need to use the built-in regenerative resistor of the driver, separate this built-in regenerative resistor or externally install the regenerative resistor, please set this parameter.
    - 0: use the built-in regenerative resistor as regenerative resistor. Regenerative processing circuit will be activated and regenerative resistor overload protection will be triggered according to the built-in resistor (about 1% duty).
    - 1: use the external regenerative resistor as regenerative resistor. The drive trips due to **Err18.0 Regeneration over-load protection** occurs when regenerative processing circuit is activated and its active ratio exceeds 10%.
    - 2: use the external regenerative resistor as regenerative resistor. Exclusively used by manufacturers (setup is prohibited).
    - 3: use no regenerative resistor. Both regenerative processing circuit and regenerative protection are not activated, and the built-in capacitor handles all regenerative power.

  Warning:

    - When you use the built-in regenerative resistor, please set this parameter to **0**.
    - Please install an external protection such as thermal fuse when you use the external regenerative resistor. Otherwise, the regenerative resistor might be heated up abnormally and result in burnout, regardless of validation or invalidation of regenerative over-load protection.
    - Please do not touch the external regenerative resistor. Because the external regenerative resistor gets very hot, and might cause burning.

12.2.13 Pr017

- Name: Regenerative resistor heat dissipation coefficient
- Unit: %
- Range: 0~100
- Default value: 30
- Effective time: After restart
- Related mode: ALL
- Description: Specify the heat dissipation coefficient of regenerative resistor according to the cooling condition of resistance:
    - Natural convection cooling: ≤ 30％.
    - Forced air cooling: ≤ 50％.

12.2.14 Pr018~Pr019

Including parameters **Pr018 Regenerative resistor capacity** and **Pr019 Regenerative resistor resistance**.

12.2.14.1 Pr018

- Name: Regenerative resistor capacity
- Unit: W
- Range: 0~65535
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the capacity of regenerative resistor.

12.2.14.2 Pr019

- Name: Regenerative resistor resistance
- Unit: Ω
- Range: 0~65535
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the resistance of regenerative resistor.

12.2.14.3 Relationship between Pr018 and Pr019

When parameters **Pr018** and **Pr019** are set to **0**, please use the recommended capacity and resistance of regenerative resistor. The recommended values are as follows:

Drive Power	Capacity	Resistance
400W	200W	40Ω
750W	400W	40Ω
1000W	500W	30Ω
1500W	800W	20Ω
2500W	1200W	20Ω
3.0kW	1000W	50Ω
5.0kW	1800W	40Ω

Note: When setting values of parameters **Pr018** and **Pr019** are less than the minimum, **Err730 Mismatch of regenerative resistor parameter** occurs.

12.2.15 Pr020

- Name: Brake unit action voltage
- Unit: 0.1V
- Range: 3500~7500
- Default value: 3900
- Effective time: After restart
- Related mode: ALL
- Description: When the busbar voltage reaches the setting value of this parameter, the brake unit is triggered.

12.2.16 Pr024

- Name: Motor number
- Unit: -
- Range: 0~9999999
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the motor number, not affected by factory settings.
  - 0: the motor number is automatically recognized according to the motor nameplate.
  - 1: exclusively used by manufacturers.
  - 2~9999999: please prepare the applicable motor according to the drive nameplate.

  This parameter will be automatically set according to the motor number.
  Please check the value of this parameter at first power-on. Incorrect value may lead to failure of the servo drive and motor. If the value of this parameter is greater than value in **Table of Motor Number**, **Err95.0: Motor automatic recognition error protection** occurs.

12.3 [Class 1] Gain Adjustment

12.3.1 Pr100~Pr104

Including parameters **Pr100 1st gain of position loop**, **Pr101 1st gain of velocity loop** and **Pr102 1st time constant of velocity loop integration**, **Pr103 1st filter of speed detection**, and **Pr104 1st time constant of torque filter**.

12.3.1.1 Pr100

- Name: 1st gain of position loop
- Unit: 0.1/s
- Range: 0~30000
- Default value: 480
- Effective time: Immediately
- Related mode: P
- Description: Specify the response of the positional control system.
  The higher value you set, the faster the positioning time you can obtain. Too great value may cause oscillation.

12.3.1.2 Pr101

- Name: 1st gain of velocity loop
- Unit: 0.1Hz
- Range: 1~32767
- Default value: 270
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the response of the velocity loop.
  The higher the value you set, the faster the response of overall servo system you can obtain. Too great value may cause oscillation.

12.3.1.3 Pr102

- Name: 1st time constant of velocity loop integration
- Unit: 0.1ms
- Range: 1~10000
- Default value: 210
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the integration time constant of velocity loop.
  The smaller the value, the faster the deviation approaching to 0 at stall. The integration will be maintained by setting this parameter to **9999**. The integration effect will be lost by setting it to **10000**.

12.3.1.4 Pr103

- Name: 1st filter of speed detection
- Unit: 0.01ms
- Range: 0~10000
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the time constant of LPF (low-pass filter) after speed detection. The greater the set value, the greater the time constant you can obtain. As a result, you can decrease the motor noise, however, response becomes slow. Generally, it is set to the default value **0**.

12.3.1.5 Pr104

- Name: 1st time constant of torque filter
- Unit: 0.01ms
- Range: 0~2500
- Default value: 84
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the time constant of the 1st delay filter inserted in the torque command. Oscillation caused by distortion resonance can be controlled.

12.3.2 Pr105~Pr109

The function and content of 1st gain is the same with that of 2nd gain, including parameters **Pr105 2nd gain of position loop**, **Pr106 2nd gain of velocity loop** and **Pr107 2nd time constant of velocity loop integration**, **Pr108 2nd filter of speed detection**, and **Pr109 2nd time constant of torque filter**. Generally, 1st gain is used. To adjust gain, you need to manually tune 1st gain.

12.3.2.1 Pr105

- Name: 2nd gain of position loop
- Unit: 0.1/S
- Range: 0~30000
- Default value: 570
- Effective time: Immediately
- Related mode: P
- Description: Specify the response of the positional control system.
  The higher value you set, the faster the positioning time you can obtain. Too great value may cause oscillation.

12.3.2.2 Pr106

- Name: 2nd gain of velocity loop
- Unit: 0.1Hz
- Range: 1~32767
- Default value: 270
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the response of the velocity loop.
  The higher the value you set, the faster the response of overall servo system you can obtain. Too great value may cause oscillation.

12.3.2.3 Pr107

- Name: 2nd time constant of velocity loop integration
- Unit: 0.1ms
- Range: 1~10000
- Default value: 10000
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the integration time constant of velocity loop.
  The smaller the value, the faster the deviation approaching to 0 at stall. The integration will be maintained by setting this parameter to **9999**. The integration effect will be lost by setting it to **10000**.

12.3.2.4 Pr108

- Name: 2nd filter of speed detection
- Unit: 0.01ms
- Range: 0~10000
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: The greater the set value, the greater the time constant you can obtain. As a result, you can decrease the motor noise, however, response becomes slow. Generally, it is set to the default value **0**.

12.3.2.5 Pr109

- Name: 2nd time constant of torque filter
- Unit: 0.01ms
- Range: 0~2500
- Default value: 84
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the time constant of the 1st delay filter inserted in the torque command. Oscillation caused by distortion resonance can be controlled.

12.3.3 Pr110

- Name: Velocity feed forward gain
- Unit: 0.1%
- Range: 0~1000
- Default value: 300
- Effective time: Immediately
- Related mode: P
- Description: Please add the result, multiplying the velocity control command calculated according to the internal positional command by the value of this parameter, to the velocity command resulting from the positional control process.

12.3.4 Pr111

- Name: Velocity feed forward filter
- Unit: 0.01ms
- Range: 0~6400
- Default value: 200
- Effective time: Immediately
- Related mode: P
- Description: Specify the time constant of 1st low-pass filter which affects the input of velocity feed forward.
  The relationship between the positional deviation during operation at a constant velocity and velocity feed forward gain is as follows:

$$\text{Positional deviation (Command unit)} = \frac{\text{Command velocity (Command unit)}}{\text{Position gain (1/S)}} * \frac{\text{100 - Velocity feed forward gain (\%)}}{100}$$

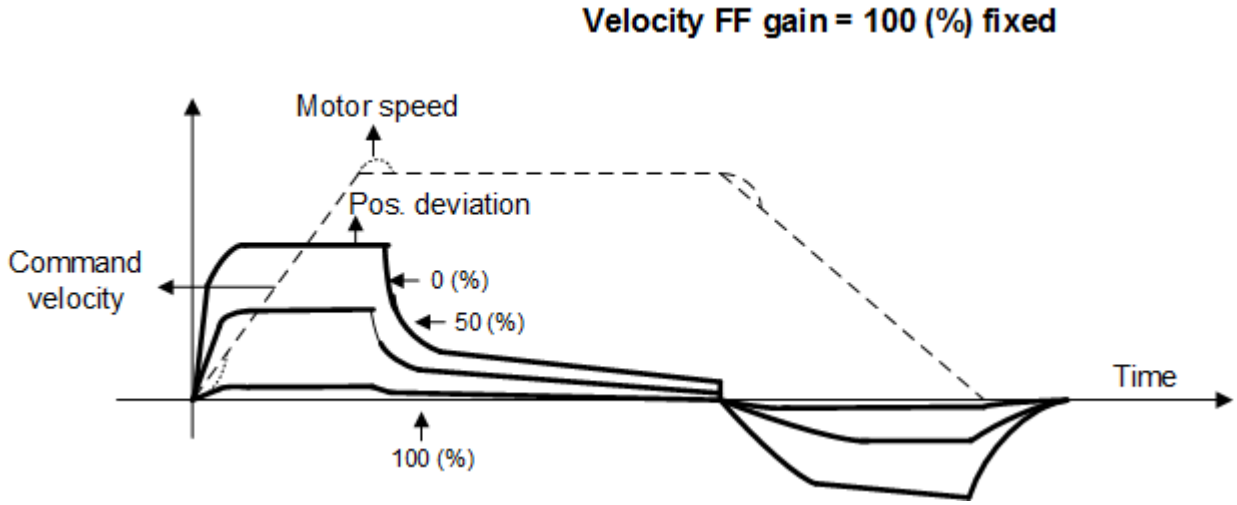
  The velocity feed forward will become effective as the velocity feed forward gain is gradually increased with this parameter is set to **50** (0.5ms).

12.3.5 Pr112

- Name: Torque feed forward gain
- Unit: 0.1%
- Range: 0~1000
- Default value: 0
- Effective time: Immediately
- Related mode: P S
- Description: Please add the result, multiplying the torque control command calculated according to the velocity control command by the value of this parameter, to the torque command resulting from the velocity control process.
  Positional deviation can be minimized close to 0 by increasing the torque forward gain while driving in trapezoidal speed pattern under ideal condition where disturbance torque is not active.

12.3.6 Pr113

- Name: Torque feed forward filter
- Unit: 0.01ms
- Range: 0~6400
- Default value: 0
- Effective time: Immediately
- Related mode: P S
- Description: Specify the time constant of 1st low-pass filter which affects the input of torque feed forward.
  The torque feed forward will become effective as the torque feed forward gain is gradually increased with this parameter is set to **50** (0.5ms). The larger the time constant of torque feed forward filter is, the larger the positional deviation of acceleration change point will be.



Among them:

- To use the torque feed forward, please correctly set the inertia ratio. You can set the value determined at the start of the real time auto tuning, or set the inertia ratio that can be calculated from the machine specification to parameter **Pr004 Inertia ratio**.
- Positional deviation can be minimized close to 0 by increasing the torque forward gain while driving in trapezoidal speed pattern under ideal condition where disturbance torque is not active.

Note: Zero positional deviation is impossible in actual situation because of disturbance toque.

12.3.7 Pr114

- Name: 2nd gain setup
- Unit: -
- Range: 0~1
- Default value: 1
- Effective time: Immediately
- Related mode: ALL
- Description: By using the gain switching function, specify the optimal adjustment.
  - 0: fixed to 1st gain. By using the gain switching input (GAIN), change the velocity loop operation to PI or P. when the logical setting of GAIN input is a-contact:
    - When GAIN input photo coupler is OFF, change the velocity loop operation to PI.
    - When GAIN input photo coupler is ON, change the velocity loop operation to P.

    Note: OFF/ON of photo coupler is reversed when the logical setting of GAIN input is b-contact.
  - 1: enable gain switching of 1st gain (parameter **Pr100 1st gain of position loop**~**Pr104 1st time constant of torque filter**) and 2nd gain (parameter **Pr105 2nd gain of position loop**~**Pr109 2nd time constant of torque filter**).

12.3.8 Pr115

- Name: Mode of position control switching
- Unit: -
- Range: 0~10
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: In position control mode, specify the condition to trigger gain switching.
  - 0: fixed to 1st gain
    Fixed to the first gain parameters, including **Pr100 1st gain of position loop**~**Pr104 1st time constant of torque filter**.
  - 1: fixed to 2nd gain
    Fixed to the second gain parameters, including **Pr105 2nd gain of position loop**~**Pr109 2nd time constant of torque filter**.

- 2: gain switching input
  - 1st gain: when the gain switching input (GAIN) is open.
  - 2nd gain: when the gain switching input (GAIN) is connected to **COM-**.
  - If no input signal is allocated to the gain switching input (GAIN), the 1st gain is fixed.
- 3: torque command is large.
  - 2nd gain: when the absolute value of the torque command is greater than (level + hysteresis) % with the 1st gain.
  - 1st gain: when the absolute value of the torque command is less than or equal to (level - hysteresis) % with the 2nd gain.
- 4: velocity command variation is large. In velocity control mode:
  - 2nd gain: when the absolute value of the velocity command is greater than (level + hysteresis) 10r/min/s with the 1st gain.
  - 1st gain: when the absolute value of the velocity command is less than (level - hysteresis) 10r/min/s, and greater than the delay time with the 2nd gain. In position and torque control mode, the 1st gain is fixed.
- 5: velocity command is large. In position and velocity control mode:
  - 2nd gain: when the absolute value of the velocity command is greater than (level + hysteresis) r/min with the 1st gain.
  - 1st gain: when the absolute value of the velocity command is less than or equal to (level - hysteresis) r/min, and greater than the delay time with the 2nd gain.
- 6: positional deviation is large. In position control mode:
  - 2nd gain: when the absolute value of the positional deviation is greater than (level + hysteresis) pulse with the 1st gain.
  - 1st gain: when the absolute value of the positional deviation is less than (level - hysteresis) pulse, and greater than the delay time with the 2nd gain.

  Unit of level and hysteresis is pulse, and it is set as the encoder resolution in position control mode.
- 7: with position command in position control mode:
  - 2nd gain: when the position command is not 0 with the 1st gain.
  - 1st gain: when the time of position command kept 0 is greater than the delay time with the 2nd gain.
- 8: positioning is not completed. In position control mode:
  - 2nd gain: when the positioning is not completed with the 1st gain.
  - 1st gain: when the time of positioning kept in completed condition is greater than the delay time with the 2nd gain.
- 9: actual speed is large. In position control mode:
  - 2nd gain: when the absolute value of the actual speed is greater than (level + hysteresis) r/min with the 1st gain.
  - 1st gain: when the absolute value of the actual speed is less than (level - hysteresis) r/min, and greater than the delay time with the 2nd gain.
- 10: with position command and actual speed. In position control mode:
  - 2nd gain: when the position command is not 0 with the 1st gain.
  - 1st gain: when the time of position command kept 0 is greater than the delay time, and the absolute value of the actual speed is less than (level - hysteresis) r/min with the 2nd gain.

12.3.9 Pr116

- Name: Delay time of position control switching
- Unit: 0.1ms
- Range: 0~10000
- Default value: 50
- Effective time: Immediately
- Related mode: P
- Description: In position control mode, if parameter **Pr115 Position control switching mode** is set to **3** or **5**~**10**, specify the delay time from triggering detection to the actual switching when switching from the 2nd gain to the 1st gain.

12.3.10 Pr117

- Name: Level of position control switching
- Unit: according to the mode
- Range: 0~20000
- Default value: 50
- Effective time: Immediately
- Related mode: P
- Description: In position control mode, specify triggering level when parameter **Pr115 Position control gain switching mode** is set to **3**, **5**, **6**, **9** and **10**.
  Note: The value of this parameter cannot be less than parameter **Pr118 Hysteresis at position control switching**.

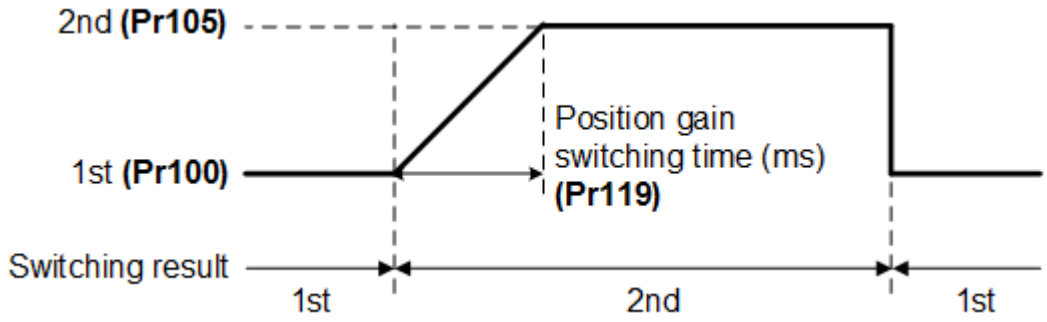
12.3.11 Pr118

- Name: Hysteresis at position control switching
- Unit: according to the mode
- Range: 0~20000
- Default value: 33
- Effective time: Immediately
- Related mode: P
- Description: In position control mode, specify triggering hysteresis when **Pr115 Position control switching mode** is set at **3**, **5**, **6**, **9** and **10**.
  Note: If the value parameter **Pr117 Level of position control switching** is less than this parameter, the value of this parameter will be set the same with parameter **Pr117**.

12.3.12 Pr119

- Name: Position gain switching time
- Unit: 0.1ms
- Range: 0~10000
- Default value: 33
- Effective time: Immediately
- Related mode: P
- Description: In position control mode, if the difference between parameter **Pr100 1st gain of position loop** and **Pr105 2nd gain of position loop** is large, limit the increasing rate of position loop gain, and reduce torque change and vibration. When position loop gain is increased, this parameter can make gain change.

Note: Setting of the parameter does not affect the gain switching time when the gain of position loop is switched to lower level (gain is switched immediately).



12.3.13 Pr120

- Name: Mode of velocity control switching
- Unit: -
- Range: 0~5
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: In velocity control mode, specify the condition to trigger gain switching.
  - 0: Fixed to 1st gain
  - 1: Fixed to 2nd gain
  - 2: Gain switching input
  - 3: Torque command
  - 4: Velocity command variation
  - 5: Speed command is large

12.3.14 Pr121

- Name: Delay time of velocity control switching
- Unit: 0.1ms
- Range: 0~10000
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: In velocity control mode, specify the delay time from triggering detection to the actual switching when switching from the 2nd gain to the 1st gain, when parameter **Pr120 Velocity control switching ode** is set to or **3~5**.

12.3.15 Pr122

- Name: Level of velocity control switching
- Unit: according to the mode
- Range: 0~20000
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: In velocity control mode, specify triggering level when parameter **Pr120 Torque control switching mode** is set at **3~5**.

Note: The value of this parameter cannot be less than parameter **Pr123 Hysteresis at velocity control switching**.

12.3.16 Pr123

- Name: Hysteresis at velocity control switching
- Unit: according to the mode
- Range: 0~20000
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: In velocity control mode, specify triggering hysteresis when parameter **Pr120 Velocity control switching ode** is set at **3**~**5**.
  Note: If the value parameter **Pr122 Level of velocity control switching** is less than this parameter, the value of this parameter will be set the same with parameter **Pr122**.

12.3.17 Pr124

- Name: Mode of torque control switching
- Unit: -
- Range: 0~3
- Default value: 0
- Effective time: Immediately
- Related mode: T
- Description: In torque control mode, specify the condition to trigger gain switching.
  - 0: fixed to 1st gain
  - 1: fixed to 2nd gain
  - 2: gain switching input
  - 3: torque command

12.3.18 Pr125

- Name: Delay time of torque control switching
- Unit: 0.1ms
- Range: 0~10000
- Default value: 0
- Effective time: Immediately
- Related mode: T
- Description: In torque control mode, specify the delay time from triggering detection to the actual switching when switching from the 2nd gain to the 1st gain, when parameter **Pr115 Torque control switching mode** is set to **3**.

12.3.19 Pr126

- Name: Level of torque control switching
- Unit: according to the mode
- Range: 0~20000
- Default value: 0
- Effective time: Immediately
- Related mode: T
- Description: In torque control mode, specify triggering level when parameter **Pr124 Torque control switching mode** is set at **3**.

Note: The value of this parameter cannot be less than parameter **Pr127 Hysteresis at torque control switching**.

12.3.20 Pr127

- Name: Hysteresis at torque control switching
- Unit: according to the mode
- Range: 0~20000
- Default value: 0
- Effective time: Immediately
- Related mode: T
- Description: In torque control mode, specify triggering hysteresis when **Pr124 Torque control switching mode** is set at **3**.
  Note: If the value parameter **Pr126 Level of torque control switching** is less than this parameter, the value of this parameter will be set the same with parameter **Pr126**.

12.4 [Class 2] Damping Control

12.4.1 Pr200

- Name: Adaptive filter mode setup
- Unit: -
- Range: 0~4
- Default value: 0
- Effective time: Immediately
- Related mode: P S
- Description: Specify the resonance frequency to be estimated by the adaptive filter and specify the operation after estimation.
  - 0: adaptive filter is invalid. Parameters related to the 3rd and 4th notch filter keep the current value.
  - 1: 1 adaptive filter is valid. Parameters related to the 3rd notch filter will be updated based on adaptive performance.
  - 2: 2 adaptive filters are valid. Parameters related to the 3rd and 4th notch filter will be updated based on adaptive performance. And parameters related to the 1st and 2nd notch filter are set according to the resonance point read by **FFT Analysis** in iMotion software.
  - 3: resonance frequency measurement mode. The result of measurement can be checked with iMotion software. Parameters related to the 3rd and 4th notch filter keep the current value.
  - 4: clear result of adaptation. Parameters related to the 3rd and 4th notch filter are disabled and results of adaptive operation are cleared.

12.4.2 Pr201~Pr203

Including parameters **Pr201 1st notch frequency**, **Pr202 1st notch width selection** and **Pr203 1st notch depth selection**.

12.4.2.1 Pr201

- Name: 1st notch frequency
- Unit: Hz
- Range: 50~5000
- Default value: 5000
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the frequency of the 1st notch filter. The notch filter function is invalid when this parameter is set to **5000**.

12.4.2.2 Pr202

- Name: 1st notch width selection
- Unit: -
- Range: 0~20
- Default value: 2
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the width of the 1st notch filter. The larger the value, the larger the notch width you can obtain. Generally, it is set to the default value **2**.

12.4.2.3 Pr203

- Name: 1st notch depth selection
- Unit: -
- Range: 0~99
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the depth of the 1st notch filter. The larger the value, the shallower the notch depth and smaller the phase delay you can obtain.

12.4.3 Pr204~Pr206

Including parameters **Pr204 2nd notch frequency**, **Pr202 2nd notch width selection** and **Pr206 2nd notch depth selection**.

12.4.3.1 Pr204

- Name: 2nd notch depth selection
- Unit: Hz
- Range: 50~5000
- Default value: 5000
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the frequency of the 2nd notch filter. The notch filter function is invalid when this parameter is set to **5000**.

12.4.3.2 Pr205

- Name: 2nd notch width selection
- Unit: -
- Range: 0~20
- Default value: 2
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the width of the 2nd notch filter. The larger the value, the larger the notch width you can obtain. Generally, it is set to the default value **2**.

12.4.3.3 Pr206

- Name: 2nd notch depth selection
- Unit: -
- Range: 0~99
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the depth of the 2nd notch filter. The larger the value, the shallower the notch depth and smaller the phase delay you can obtain.

12.4.4 Pr207~Pr209

Including parameters **Pr207 3rd notch frequency**, **Pr211 3rd notch width selection** and **Pr209 3rd notch depth selection**.

12.4.4.1 Pr207

- Name: 3rd notch frequency
- Unit: Hz
- Range: 50~5000
- Default value: 5000
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the frequency of the 3rd notch filter. The notch filter function is invalid when this parameter is set to **5000**.

12.4.4.2 Pr208

- Name: 3rd notch width selection
- Unit: -
- Range: 0~20
- Default value: 2
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the width of the 3rd notch filter. The larger the value, the larger the notch width you can obtain. Generally, it is set to the default value **2**.

12.4.4.3 Pr209

- Name: 3rd notch depth selection
- Unit: -
- Range: 0~99
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the depth of the 3rd notch filter. The larger the value, the shallower the notch depth and smaller the phase delay you can obtain.

12.4.5 Pr210~Pr212

Including parameters **Pr210 4th notch frequency**, **Pr211 4th notch width selection** and **Pr212 4th notch depth selection**.

12.4.5.1 Pr210

- Name: 4th notch frequency
- Unit: Hz
- Range: 50~5000
- Default value: 5000
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the frequency of the 4th notch filter. The notch filter function is invalid when this parameter is set to **5000**.

12.4.5.2 Pr211

- Name: 4th notch width selection
- Unit: -
- Range: 0~20
- Default value: 2
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the width of the 4th notch filter. The larger the value, the larger the notch width you can obtain. Generally, it is set to the default value **2**.

12.4.5.3 Pr212

- Name: 4th notch depth selection
- Unit: -
- Range: 0~99
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the depth of the 4th notch filter. The larger the value, the shallower the notch depth and smaller the phase delay you can obtain.

12.4.6 Pr214~Pr215

Including parameters **Pr214 1st damping frequency** and **Pr215 1st damping ratio**.

12.4.6.1 Pr214

- Name: 1st damping frequency

- Unit: 0.1Hz
- Range: 0~2000
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the 1st damping frequency.

12.4.6.2 Pr215

- Name: 1st damping ratio
- Unit: 0.001
- Range: 0~500
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the 1st damping ratio.

12.4.7 Pr216~Pr217

Including parameters **Pr216 2nd damping frequency** and **Pr217 2nd damping ratio**.

12.4.7.1 Pr216

- Name: 2nd damping frequency
- Unit: 0.1Hz
- Range: 0~2000
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the 2nd damping frequency.

12.4.7.2 Pr217

- Name: 2nd damping ratio
- Unit: 0.001
- Range: 0~500
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the 2nd damping ratio.

12.4.8 Pr218~Pr219

Including parameters **Pr218 3rd damping frequency** and **Pr219 3rd damping ratio**.

12.4.8.1 Pr218

- Name: 3rd damping frequency
- Unit: 0.1Hz
- Range: 0~2000
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the 3rd damping frequency.

12.4.8.2 Pr219

- Name: 3rd damping ratio
- Unit: 0.001
- Range: 0~500
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the 3rd damping ratio.

12.4.9 Pr220~Pr221

Including parameters **Pr220 4th damping frequency** and **Pr221 4th damping ratio**.

12.4.9.1 Pr220

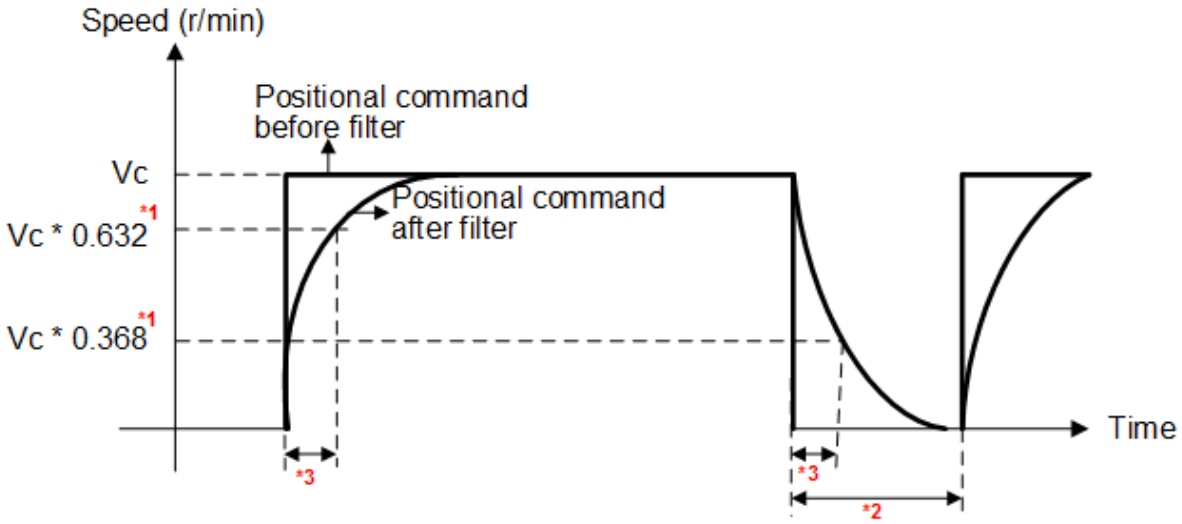
- Name: 4th damping frequency
- Unit: 0.1Hz
- Range: 0~2000
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the 4th damping frequency.

12.4.9.2 Pr221

- Name: 4th damping ratio
- Unit: 0.001
- Range: 0~500
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the 4th damping ratio.

12.4.10 Pr222

- Name: Position command smoothing filter
- Unit: 0.1ms
- Range: 0~32767
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the time constant of 1st low-pass filter, when a square wave command for the target speed Vc is applied.

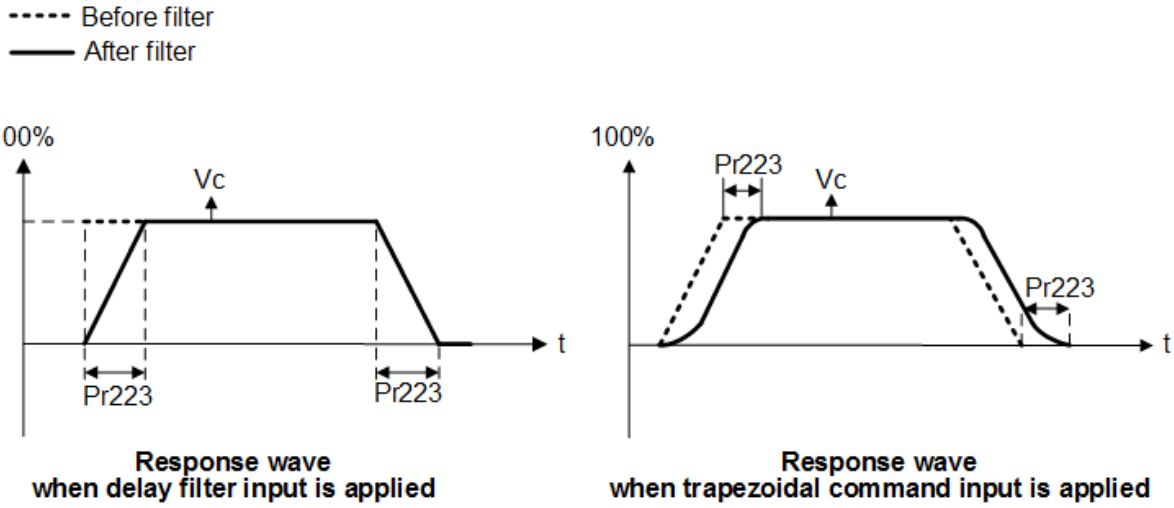


- *1: when the actual filter time constant (the set value * 0.1ms) is less than 100ms, the absolute error is less than or equal to 0.2ms; when it is greater than 20ms, the relative error is less than or equal to 0.1%.
- *2: the command pulse within each control cycle is changed from 0 to a value other than 0 while the positioning complete is being output.
  Note: If the time constant is decreased and positioning range is increased, and many pulses are accumulated in the filter (the area equivalent of “value of position command before filter minus value of position command after filter” integrated over the time), at the time of switching, these pulses are discharged at a higher rate, causing the motor to return to the previous position, and run at a speed higher than the command speed for a short time.

  If the switching as described in *2 occurs during this delay time, the change of this parameter will be suspended without taking effect.
- *3: positional command filter time (ms) (Pr222 * 0.1ms)

12.4.11 Pr223

- Name: Position command FIR filter
- Unit: 0.1ms
- Range: 0~5120
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Set the time constant of the FIR filter in response to the position command.



12.5 [Class 3] Velocity/Torque Control

12.5.1 Pr300

- Name: Speed setup, internal/external switching
- Unit: -
- Range: 0~4
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: Specify the internal or external switching for speed setup.
  - 0: bus communication command.
  - 1: internal speed command. At this time, please set parameter **Pr304 1st speed of speed setup**.
  - 2~3: internal use.

12.5.2 Pr301

- Name: Velocity command direction selection
- Unit: -
- Range: 0~1
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: Specify the method to select positive/negative direction for velocity command.

Set Value	Select Speed Command Sign (1st ~8th Speed)	Speed Command Sign Selection (VC-SIGN)	Speed Command Direction
0	+	No effect	Positive direction
0	-	No effect	Negative direction
1	Sign has no effect	OFF	Positive direction
1	Sign has no effect	ON	Negative direction

12.5.3 Pr303

- Name: Reversal of speed command input
- Unit: -
- Range: 0~1
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: Specify the polarity of non-internal velocity command.
  - 0: non-reversal.
  - 1: reversal.

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

12.5.4 Pr304~Pr311

Including parameters **Pr304 1st speed of speed setup**, **Pr305 2nd speed of speed setup**, **Pr306 3rd speed of speed setup**, **Pr307 4th speed of speed setup**, **Pr308 5th speed of speed setup**, **Pr309 6th speed of speed setup**, **Pr310 7th speed of speed setup**, **Pr311 8th speed of speed setup**.

12.5.4.1 Pr304

- Name: 1st speed of speed setup
- Unit: r/min
- Range: -20000~20000
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: Specify the 1st speed of internal command speeds.

12.5.4.2 Pr305

- Name: 2nd speed of speed setup
- Unit: r/min
- Range: -20000~20000
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: Specify the 2nd speed of internal command speeds.

12.5.4.3 Pr306

- Name: 3rd speed of speed setup
- Unit: r/min
- Range: -20000~20000
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: Specify the 3rd speed of internal command speeds.

12.5.4.4 Pr307

- Name: 4th speed of speed setup
- Unit:
- Range: -20000~20000
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: Specify the 4th speed of internal command speeds.

12.5.4.5 Pr308

- Name: 5th speed of speed setup
- Unit: r/min
- Range: -20000~20000
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: Specify the 5th speed of internal command speeds.

12.5.4.6 Pr309

- Name: 6th speed of speed setup
- Unit: r/min
- Range: -20000~20000
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: Specify the 6th speed of internal command speeds.

12.5.4.7 Pr310

- Name: 7th speed of speed setup
- Unit: r/min
- Range: -20000~20000
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: Specify the 7th speed of internal command speeds.

12.5.4.8 Pr311

- Name: 8th speed of speed setup
- Unit:
- Range: -20000~20000
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: Specify the 8th speed of internal command speeds.

12.5.5 Pr312~Pr313

Including parameters **Pr312 Acceleration time setup** and **Pr313 Deceleration time setup**.

12.5.5.1 Pr312

- Name: Acceleration time setup
- Unit: ms/(1000r/min)
- Range: 0~10000
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: Specify the acceleration processing time in response to the speed command input.

12.5.5.2 Pr313

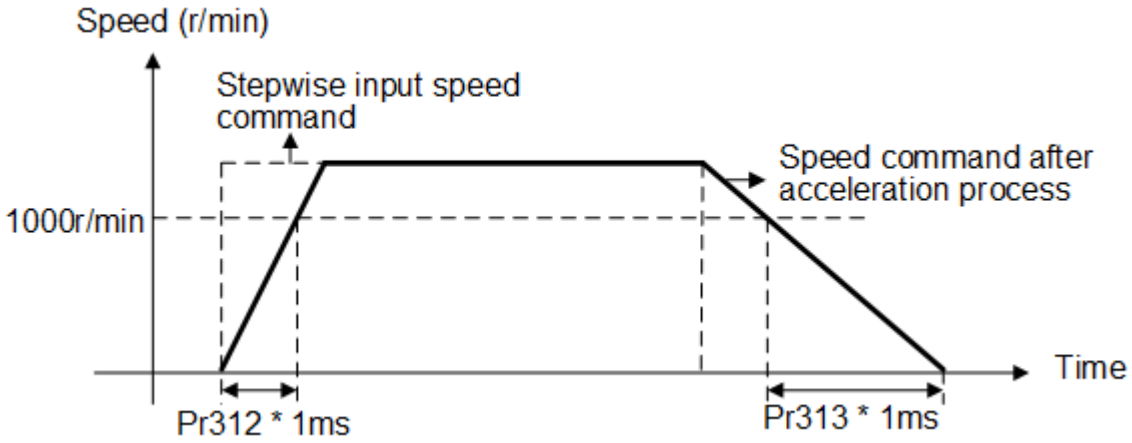
- Name: Deceleration time setup
- Unit: ms/(1000r/min)
- Range: 0~10000
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: Specify the deceleration processing time in response to the speed command input.

12.5.5.3 Relationship between Pr312 and Pr313

When the stepwise speed command is input:

- Set the time required for the speed command to reach to 1000r/min to parameter **Pr312**.
- Set the time required for the speed command to reach from 1000r/min to 0r/min to parameter **Pr313**.

Assuming that the target value of the speed command is Vc (r/min):



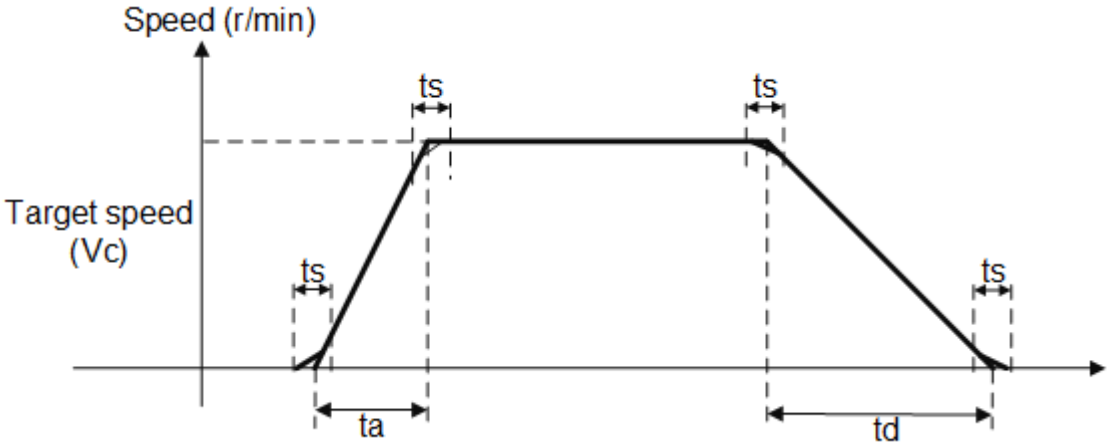
Among them:

Acceleration time (ms) = (Vc/1000) * Pr312 * 1ms

Acceleration time (ms) = (Vc/1000) * Pr313 * 1ms

12.5.6 Pr314

- Name: Sigmoid acceleration/deceleration time setup
- Unit: ms
- Range: 0~1000
- Default value: 0
- Effective time: Immediately
- Related mode: S
- Description: According to **Pr312 Acceleration time setup** and **Pr313 Deceleration time setup**, specify sigmoid time with time width centering the inflection point of acceleration/deceleration.



Among them:

- ta = Vc / 1000 * Pr312 * 1ms
- td = Vc / 1000 * Pr312 * 1ms
- ts = Pr314 * 1ms

Use with the setup of (ta / 2 > ts) and (td / 2 > ts).

12.5.7 Pr315, Pr317, Pr321, Pr322

Including parameters **Pr315 Zero-speed clamp function selection**, **Pr317 Torque command selection**, **Pr321 Speed limit 1**, and **Pr322 Speed limit 2**.

12.5.7.1 Pr315

- Name: Zero-speed clamp function selection
- Unit: -
- Range: 0~3
- Default value: 0
- Effective time: Immediately
- Related mode: S T
- Description: Specify the function of the zero-speed clamp input.
  - 0: Invalid. Zero speed clamp input is ignored.
  - 1: Velocity command is forced to 0 when the zero-speed clamp (ZEROSPD) input signal is turned ON.
  - 2: Speed command is forced to 0 when the zero-speed clamp (ZEROSPD) input signal is turned ON. And when the actual motor speed drops to **Pr316 Speed zero clamp level** or below, the position control is selected and servo lock is activated at this point.
  - 3: When the zero-speed clamp (ZEROSPD) input signal is ON, and speed command is below (Pr316 Speed zero clamp level − 10r/min), then the position control is selected and servo lock is activated at that point.

12.5.7.2 Pr317

- Name: Torque command selection
- Unit: -
- Range: 0~2
- Default value: 0
- Effective time: Immediately
- Related mode: T
- Description: Specify the input of the torque command and the speed limit.

Set Value	Torque Command Input	Velocity Limit Input
0	Bus communication command	Setting is the same with parameter **Pr321**
1	Bus communication command	Bus communication command
0	Setting is the same with parameter **Pr601**	Setting is the same with parameter **Pr321** and **Pr322**

12.5.7.3 Pr321

- Name: Speed limit 1
- Unit: r/min
- Range: 0~20000
- Default value: 0
- Effective time: Immediately
- Related mode: T
- Description: In torque control mode, this parameter is used to limit the maximum of speed. When **Pr317 Torque command selection** is set to **2**, the speed limit of positive direction command.

12.5.7.4 Pr322

- Name: Speed limit 2
- Unit:
- Range: 0~20000
- Default value: 0
- Effective time: Immediately
- Related mode: T
- Description: When **Pr317 Torque command selection** is set to **2**, the speed limit of negative direction command.

12.5.7.5 Relationship among Pr315, Pr317, Pr321 and Pr322

The relationship among parameters Pr315, Pr317, Pr321 and Pr322, zero-speed clamp (ZEROSPD) and speed limit is as follows:

Pr315	Pr317	Pr321	Pr322	ZEROSPD	Speed Limit
0	0	0~20000	No effect	No effect	Value of **Pr321**
1~3	0	0~20000	No effect	OFF	Value of **Pr321**
0	0	0~20000	No Effect	ON	0
0	2	0~20000	0~20000	No Effect	Value of **Pr321** / **Pr322**
1~3	2	0~20000	0~20000	OFF	Value of **Pr321** / **Pr322**
1~3	2	0~20000	0~20000	ON	0

12.5.8 Pr316

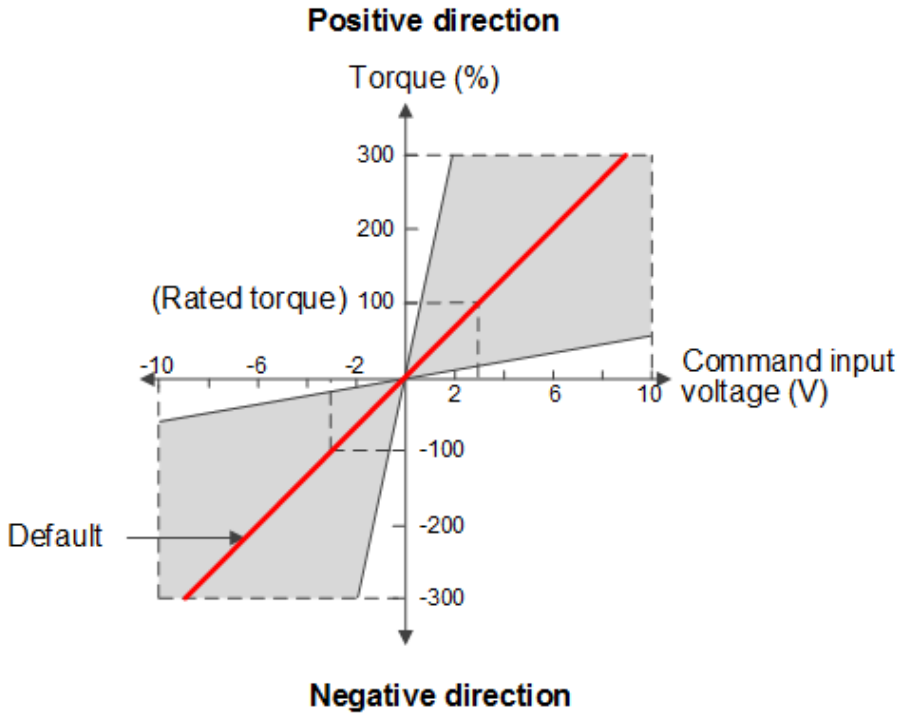
- Name: Zero-speed clamp level
- Unit: r/min
- Range: 10~20000
- Default value: 30
- Effective time: Immediately
- Related mode: S T
- Description: Specify the timing at which the position control is activated when parameter **Pr315 Zero-speed clamp function selection** is set to **2** or **3**.
  If parameter **Pr315** is set to **3**, hysteresis of 10r/min is provided for detection.

12.5.9 Pr318

- Name: Torque command direction selection
- Unit: -
- Range: 0~1
- Default value: 0
- Effective time: Immediately
- Related mode: T
- Description: Specify the method to select positive/negative direction for torque command.
  - 0: Specify the direction with the sign of torque command.
    +: positive direction; **-**: negative direction.
  - 1: Specify the direction with torque command sign (TC-SIGN).

12.5.10 Pr319

- Name: Input gain of torque command
- Unit: 0.1V/100%
- Range: 10~100
- Default value: 30
- Effective time: Immediately
- Related mode: T
- Description: Based on the voltage (V) applied to the analog torque command (T-REF), specify the conversion gain to torque command (%).



12.5.11 Pr320

- Name: Reversal of torque command input
- Unit: -
- Range: 0~1
- Default value: 0
- Effective time: Immediately
- Related mode: T
- Description: Specify the polarity of the voltage applied to analog torque command (T-REF).
  - 0: Non-reversal.
    + voltage: positive direction; -voltage: negative direction.
  - 1: Reversal.
    + voltage: negative direction; - voltage: positive direction.

12.5.12 Pr323

- Name: Encoder type selection
- Unit: -
- Range: 0~9
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the type of feedback encoder.
  - 0: AB-phase output type.
  - 1: sinusoidal output type.
  - 2: exclusively used by manufacturers (Serial communication rotary type).
  - 3: TAMAGAWA single turn absolute type (Serial communication rotary type).
  - 4: TAMAGAWA multi-turn absolute type (Serial communication rotary type).
  - 5: PANASONIC incremental type (Serial communication rotary type).
  - 6: PANASONIC multi-turn absolute type (Serial communication rotary type).
  - 6: YASKAWA 5 absolute type (Serial communication rotary type).
  - 6: YASKAWA 5 incremental type (Serial communication rotary type).
  - 6: NIKON absolute type (Serial communication rotary type).

  Note: If the used encoder type does not match with the value of this parameter, the following errors may occur:
  - **Err21.0: Encoder communication disconnection error protection** occurs due to the exception in disconnection of encoder communication cables.
  - **Err55.0: A / B-phase connection error protection** and **Err55.2 Z-phase connection error protection** occur due to A / B / Z-phase connection error protection.

12.5.13 Pr326

- Name: Reversal of motor phase sequence and CS direction
- Unit: -
- Range: 0~3
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Its value can be obtained from self-learning of the motor. The logic setting of CS signal is valid only when parameter **Pr724 Magnet pole detection scheme selection** is set to **1**.

Value	Phase Sequence of Motor	CS Signal
0	Not reversed	Not reversed
1	Reversed	Not reversed
2	Not reversed	Reversed
3	Reversed	Reversed

12.5.14 Pr327

- Name: Feedback encoder Z-phase disconnection detection disable
- Unit: -
- Range: 0~1
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify whether Z-phase disconnection detection is valid when n feedback encoder of AB phase output type is used.
  - 0: valid.
  - 1: invalid.

12.5.15 Pr343

- Name: Sinusoidal encoder subdivision
- Unit: -
- Range: 0~4096
- Default value: 256
- Effective time: After restart
- Related mode: ALL
- Description: Specify the subdivision of sinusoidal encoder.

12.5.16 Pr344

- Name: A-phase DC bias of sinusoidal encoder
- Unit: -
- Range: 0~4095
- Default value: 2047
- Effective time: After restart
- Related mode: ALL
- Description: Specify B-phase DC bias of sinusoidal encoder.

12.5.17 Pr345

- Name: B-phase DC bias of sinusoidal encoder
- Unit: -
- Range: 0~4095
- Default value: 2047
- Effective time: After restart
- Related mode: ALL
- Description: Specify B-phase DC bias of sinusoidal encoder.

12.5.18 Pr346

- Name: Ratio of Sinusoidal encoder AB phase gain
- Unit: -
- Range: 0~8192
- Default value: 4096
- Effective time: After restart
- Related mode: ALL
- Description: Specify the ratio of AB phase gain for sinusoidal encoder.

12.6 [Class 4] I/F Monitor Setting

12.6.1 Pr400~Pr406

Including parameters **Pr400 SI1 input selection**, **Pr401 SI2 input selection**, **Pr402 SI3 input selection**, **Pr403 SI4 input selection**, **Pr404 SI5 input selection**, **Pr405 SI6 input selection**, and **Pr406 SI7 input selection**.

12.6.1.1 Pr400

- Name: SI1 input selection
- Unit: -
- Range: 0~00FFFFFFh
- Default value: 002E2E2Eh (3026478)
- Effective time: After restart
- Related mode: ALL
- Description: Specify function to SI1 input.

12.6.1.2 Pr401

- Name: SI2 input selection
- Unit: -
- Range: 0~00FFFFFFh
- Default value: 00818181h (8487297)
- Effective time: After restart
- Related mode: ALL
- Description: Specify function to SI2 input.

12.6.1.3 Pr402

- Name: SI3 input selection
- Unit: -
- Range: 0~00FFFFFFh
- Default value: 00828282h (8553090)
- Effective time: After restart
- Related mode: ALL
- Description: Specify function to SI3 input.

12.6.1.4 Pr403

- Name: SI4 input selection
- Unit: -
- Range: 0~00FFFFFFh
- Default value: 00222222h (2236962)
- Effective time: After restart
- Related mode: ALL
- Description: Specify function to SI4 input.

12.6.1.5 Pr404

- Name: SI5 input selection
- Unit: -
- Range: 0~00FFFFFFh
- Default value: 00202020h (2105376)
- Effective time: After restart
- Related mode: ALL
- Description: Specify function to SI5 input.

12.6.1.6 Pr405

- Name: SI6 input selection
- Unit: -
- Range: 0~00FFFFFFh
- Default value: 00212121h (2171169)
- Effective time: After restart
- Related mode: ALL
- Description: Specify function to SI6 input.

12.6.1.7 Pr406

- Name: SI7 input selection
- Unit: -
- Range: 0~00FFFFFFh
- Default value: 002B2B2Bh (2829099)
- Effective time: After restart
- Related mode: ALL
- Description: Specify function to SI7 input.

12.6.1.7.1 Relationship among Pr400~Pr407

The parameters are set in hexadecimals while presented in decimals on the operation panel.

Hexadecimal presentation is followed by a specific control mode designation as follows. Please replace (XX)with the function number:

- 00−−−−XXh: position control
- 00−−XX−−h: velocity control
- 00XX−−−−h: torque control

Allocation of input signal pins is as follows: (Polarity setup of the signal is also shown in the set value, and **-** means no setup):

Signal	a-contact	b-contact	Valid	Invalid
Invalid(-)	00h	-	-	-
Positive direction over-travel inhibition input(POT)	01h	81h	41h	C1h
Negative direction over-travel inhibition input(NOT)	02h	82h	42h	C2h
Servo-ON input(SRV-ON)	03h	83h	43h	C3h
Alarm clear(A-CLR)	04h	-	-	C4h
Gain switching input(GAIN)	06h	86h	46h	C6h
Deviation counter clear input(CL)	07h	-	-	C7h
Command pulse inhibition input(INH)	08h	88h	48h	C8h
Torque limit switching input(TL-SEL)	09h	89h	49h	C9h
Electronic gear switching input 1(DIV1)	0Ch	8Ch	4Ch	CCh
Electronic gear switching input 2(DIV2)	0Dh	8Dh	4Dh	CDh
Selection 1 input of internal command speed(INTSPD1)	0Eh	8Eh	4Eh	CEh
Selection 2 input of internal command speed(INTSPD2)	0Fh	8Fh	4Fh	CFh
Selection 3 input of internal command speed(INTSPD3)	10h	90h	50h	D0h
Speed zero clamp input(ZEROSPD)	11h	91h	51h	D1h
Speed command sign input(VC-SIGN)	12h	92h	52h	D2h
Torque command sign input(TC-SIGN)	13h	93h	53h	D3h
Forced alarm input(E-STOP)	14h	94h	54h	D4h
Absolute data request sign(SEN)	16h	96h	56h	D6h
Forward servo-ON (FWD-SRV-ON)	17h	97h	57h	D7h
Reversal servo-ON (REV-SRV-ON)	18h	98h	58h	D8h
Spindle positioning (SPIND-POS)	19h	99h	59h	D9h
Zero switch single (ZERO-SNGL)	1Ah	9Ah	5Ah	DAh
Deceleration limit switching input(DEC)	22h	A2h	62h	E2h

Signal	a-contact	b-contact	Valid	Invalid
External lock input 1(EXT1)	20h	A0h	60h	E0h
External lock input 2(EXT2)	21h	A1h	61h	E1h
External lock input 3(EXT3)	2Bh	ABh	6Bh	EBh
Common input(GP)	2Eh	AEh	6Eh	EEh

Note:

- Please do not set to a value other than that specified in the table.
- Duplicated assignment will cause **Err33.0 I/F input multiple assignment error 1**.
- Please set all modes when assigning EXT1, EXT2 and EXT3. Otherwise, **Err33.0 I/F input multiple assignment error 1** occurs.

12.6.2 Pr408~Pr411

Including parameters **Pr408 SO1 output selection**, **Pr409 SO2 output selection**, **Pr410 SO3 output selection**, and **Pr411 SO4 output selection**.

12.6.2.1 Pr408

- Name: SO1 output selection
- Unit: -
- Range: 0~00FFFFFFh
- Default value: 00010101h (65793)
- Effective time: After restart
- Related mode: ALL
- Description: Specify function to SO1 output.

12.6.2.2 Pr409

- Name: SO2 output selection
- Unit: -
- Range: 0~00FFFFFFh
- Default value: 00030303h (197379)
- Effective time: After restart
- Related mode: ALL
- Description: Specify function to SO2 output.

12.6.2.3 Pr410

- Name: SO3 output selection
- Unit: -
- Range: 0~00FFFFFFh
- Default value: 00000004h (4)
- Effective time: After restart
- Related mode: ALL
- Description: Specify function to SO3 output.

12.6.2.4 Pr411

- Name: SO4 output selection
- Unit: -
- Range: 0~00FFFFFFh
- Default value: 00070707h (460551)
- Effective time: After restart
- Related mode: ALL
- Description: Specify function to SO4 output.

12.6.2.5 Relationship among Pr408~Pr407

The parameters are set in hexadecimals while presented in decimals on the operation panel.

Hexadecimal presentation is followed by a specific control mode designation as follows. Please replace (XX)with the function number:

- 00----XXh: position control
- 00--XX--h: velocity control
- 00XX----h: torque control

Allocation of output signal pins is as follows (Polarity setup of the signal is also shown in the set value):

Signal	a-contact	b-contact
Invalid(-)	00h	-
Servo alarm output(ALM)	81h	01h
Servo ready output(S-RDY)	02h	82h
External brake release signal(BRK-OFF)	03h	83h
Positioning complete(INP)	04h	84h
Speed arrival output (AT-SPPED)	05h	85h
Torque limiting signal output(TLC)	06h	86h
Zero-speed clamp detection (ZSP)	07h	87h
Speed coincidence output(V-COIN)	08h	88h
Warning output 1(WARN1)	09h	89h
Warning output 2(WARN2)	0Ah	8Ah
Positional command ON/OFF output(P-CMD)	0Bh	8Bh
Positioning complete 2(INP2)	0Ch	8Ch
Speed limiting output(V-LIMIT)	0Dh	8Dh
Alarm attribute output(ALM_ATB)	0Eh	8Eh
Velocity command ON/OFF output(V-CMD)	0Fh	8Fh

Note:

- Please do not set to a value other than that specified in the table.
- Same output signal can be assigned to 2 or more output signals.
- SO1 output should be fixed set to ALM output. Otherwise, **Err33.4 I/F output function number error 1** occurs.
- Control output pin set to invalid always has the output transistor turned OFF.

12.6.3 Pr430

- Name: Positioning complete (In-position) range
- Unit: Command unit / encoder unit
- Range: 0~262144
- Default value: 800
- Effective time: Immediately
- Related mode: P
- Description: Specify the timing of positional deviation at which the positioning complete signal (INP1) is output.
  Parameter unit can be changed by parameter **Pr520 Position setup unit selection**. At this time, the unit of parameter **Pr014 Positioning unit selection** is changed too.

12.6.4 Pr431

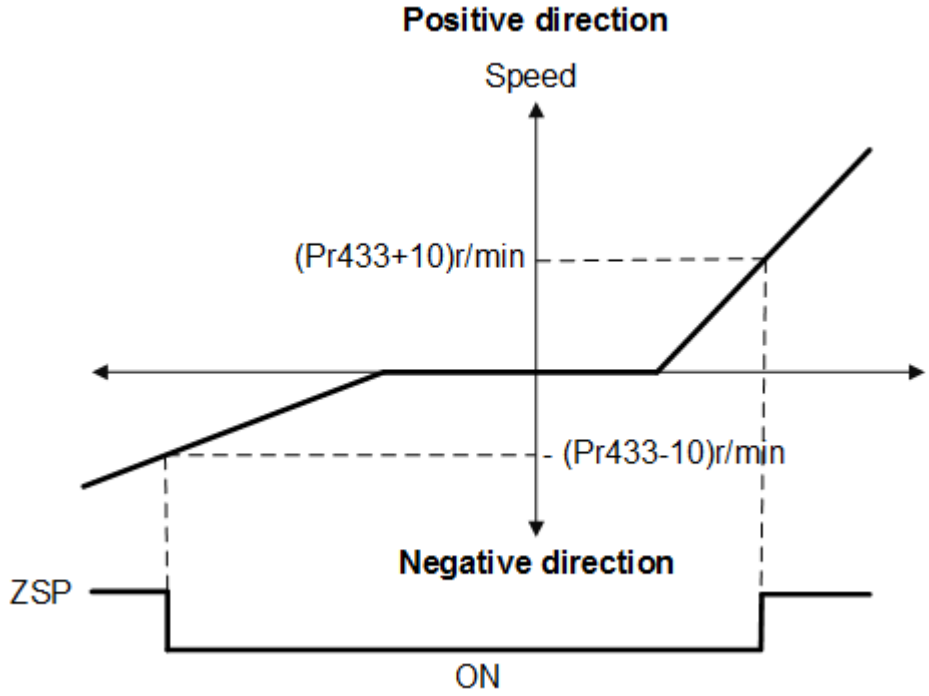
- Name: Positioning complete (In-position) output setup
- Unit: -
- Range: 0~3
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the condition to output the positioning complete signal (INP1).
  - 0: The signal will turn on when the positional deviation is less than the value of parameter **Pr430 Positioning complete range**.
  - 1: The signal will turn on when there is no position command and the positional deviation is less than the value of **Pr430 Positioning complete range**.
  - 2: The signal will turn on when there is no position command, zero-speed detection signal is turned on, and the positional deviation is less than **Pr430 Positioning complete range**.
  - 3: The signal will turn on when there is no position command and the positional deviation is less than the value of **Pr430 Positioning complete range** until the value of parameter **Pr432 INP hold time** reaches. After the INP hold time, the drive turns INP output to **ON** / **OFF** according to the current position command and positional deviation.

12.6.5 Pr432

- Name: INP hold time
- Unit: 1ms
- Range: 0~30000
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the hold time when **Pr431 Positioning complete output setup** is set to 3.
  - 0: the hold time is maintained definitely, keeping ON status until the next positional command is received.
  - 1~30000: ON status is maintained for the setup time but switched to OFF status as the position command is received during hold time.

12.6.6 Pr433

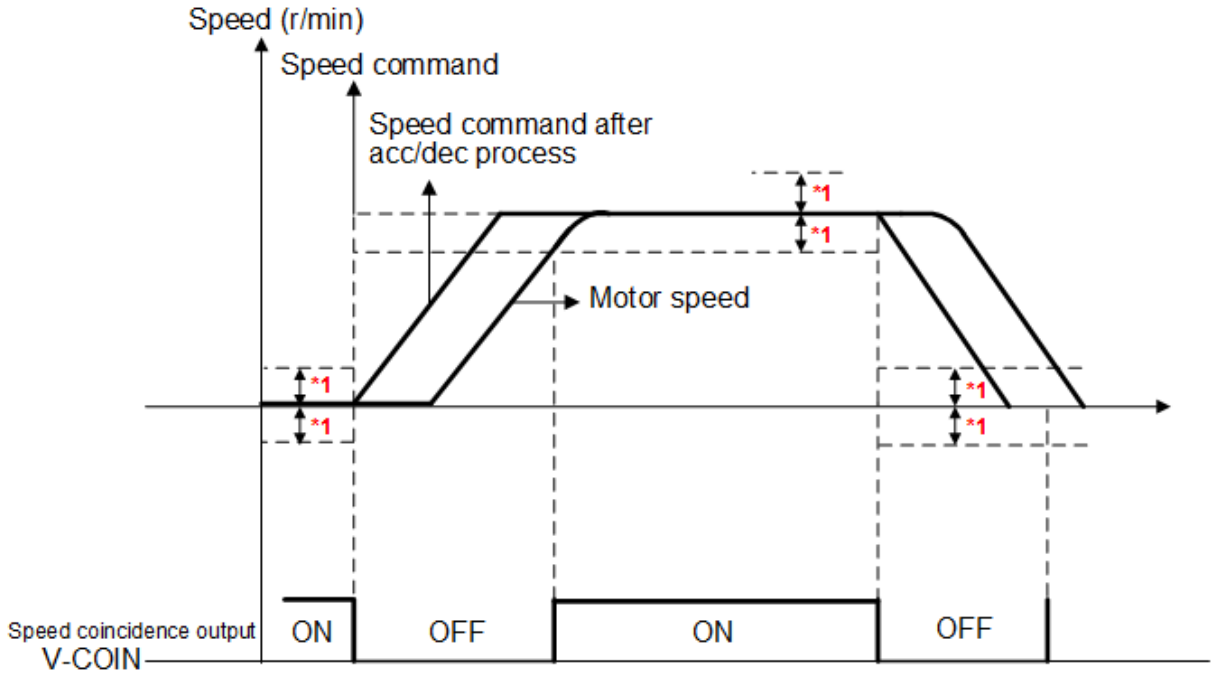
- Name: Zero-speed
- Unit: r/min
- Range: 10~20000
- Default value: 50
- Effective time: Immediately
- Related mode: ALL
- Description: The zero speed detection signal (ZSP) will be fed out when the motor speed is less than the setup of this parameter.



The setup of this parameter is valid for both positive and negative direction regardless of the motor rotating direction.

12.6.7 Pr434

- Name: Speed coincidence range
- Unit: r/min
- Range: 10~20000
- Default value: 50
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the detection timing of speed coincidence (V-COIN).
  When the difference between the speed command and the motor speed is less than the speed specified by this parameter, output the speed coincidence (V-COIN).
  Note: The speed coincidence detection is associated with 10r/min hysteresis.



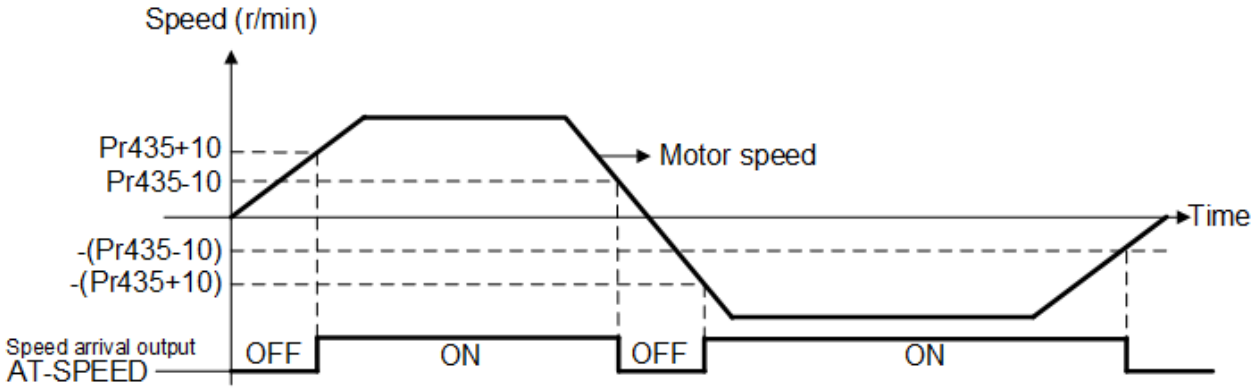
Among them:

- *1: Pr434 Speed coincidence range.
- Timing of speed coincidence output:
  - From OFF to ON: speed deviation < (Pr434 - 10) r/min.
  - From ON to OFF: speed deviation > (Pr434 + 10) r/min.

12.6.8 Pr435

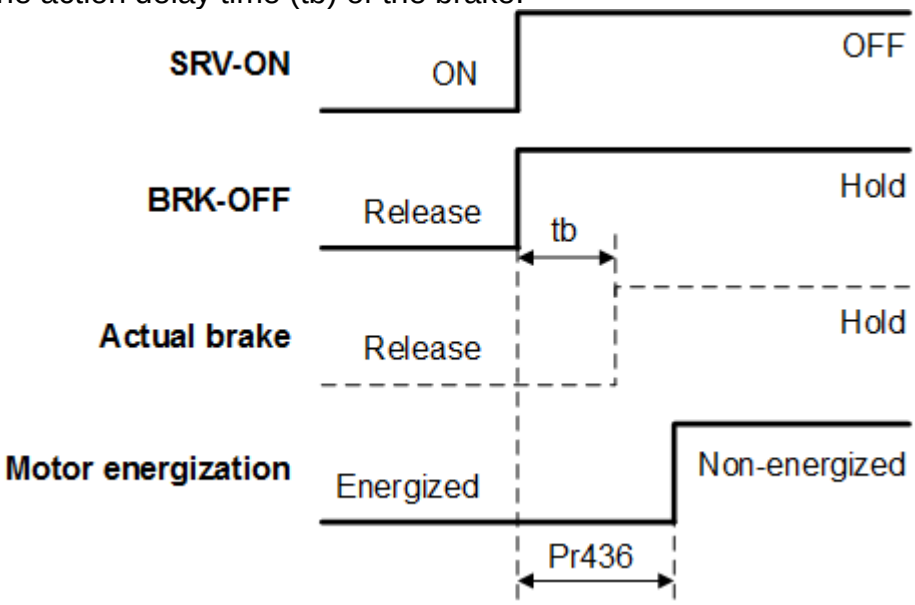
- Name: At-speed (Speed arrival)
- Unit:
- Range: 10~20000
- Default value: 1000
- Effective time: Immediately
- Related mode: S T

- Description: Specify the detection timing of the speed arrival output (AT-SPEED). When the motor speed exceeds this set value, the speed arrival output (AT-SPEED) is output. Detection is associated with 10r/min.



12.6.9 Pr436

- Name: Mechanical brake action at stalling setup
- Unit: ms
- Range: 0~10000
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the time from the brake release signal (BRK-OFF) turns off to when the motor is de-energized (Servo free), when the motor turns to Servo-OFF while the motor is at stall, so as to prevent a minor travel/drop of the motor due to the action delay time (tb) of the brake.

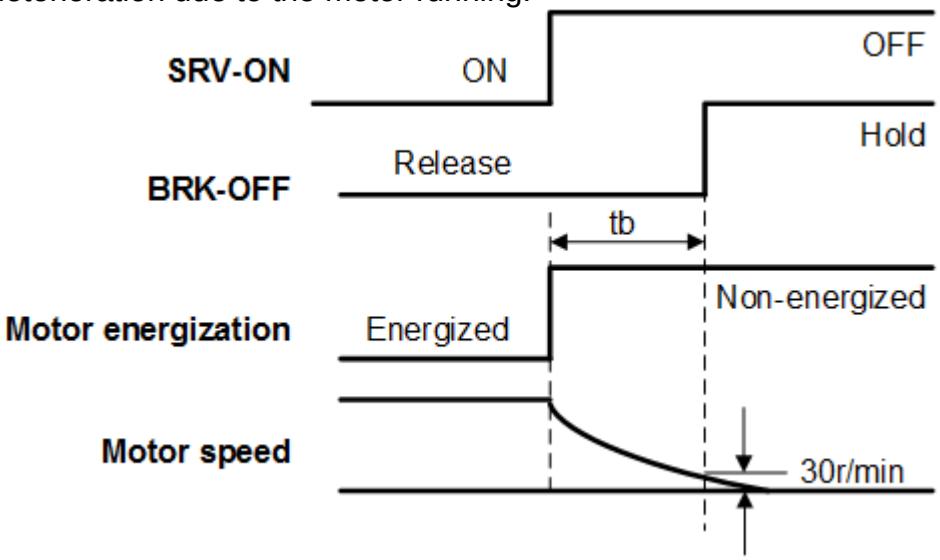


Among them:

  - tb (delay time of the brake): please set it greater than this parameter.
  - The servo drive turns to Servo-OFF after the brake is actually activated.

12.6.10 Pr437

- Name: Mechanical brake action at running setup
- Unit: ms
- Range: 0~10000
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the time from when detecting the off of SVR-ON input signal (SRV-ON) is to when external brake release signal (BRK-OFF) turns off, while the motor turns to servo off during the motor in motion, so as to prevent the brake deterioration due to the motor running.



  - tb: it refers to the smaller one between the value of this parameter and the time that the motor speed falls below 30r/min.
  - OFF: it refers to the time from the time of SERVO-OFF to the time when the motor speed falls below 30r/min:
    - If it is greater than the value of this parameter, the action of BRK-OFF signal will be done as the value of this parameter.
    - If it is less than the value of this parameter, the action of BRK-OFF signal will be done as the time when motor speed is decreased to 30r/min.

12.6.11 Pr438

- Name: Brake release speed setup
- Unit: r/min
- Range: 30~3000
- Default value: 30
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the speed timing of brake output checking during operation.

12.6.12 Pr439~Pr440

Including parameters **Pr439 Selection of alarm output 1** and **Pr440 Selection of alarm output 2**.

12.6.12.1 Pr439

- Name: Selection of alarm output 1
- Unit: -
- Range: 0~16
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the type of alarm issued as the alarm output 1.

12.6.12.2 Pr440

- Name: Selection of alarm output 2
- Unit: -
- Range: 0~16
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the type of alarm issued as the alarm output 2.

12.6.12.3 Setting Values

The description of setting values is as follows:

- 0: OR output of all alarms.
- 1: overload alarm. Load factor is 85% or more than the protection level.
- 2: over-regeneration alarm. Regenerative load factor is 85% or more the protection level.
- 3: battery alarm. Battery voltage is 3.2V or lower.
- 4: fan alarm. Fan has stopped for 1s.
- 5: encoder communication alarm. The number of successive encoder communication errors exceeds the specified value.
- 6: encoder overheat alarm. The encoder overheat is detected.
- 7: vibration detection alarm. The motor vibration is detected.
- 8: registered time overdue. The servo drive has been registered for less than 24 hours.
- 9: external scale error alarm. The alarm of feedback scale is detected.
- 10: external scale communication alarm. The number of successive feedback scale communication errors exceeds the specified value.
- 11: MECHATROLINK data setup alarm. Parameter No., data range and parameter value exceed the specified values.
- 12: MECHATROLINK unsupported command alarm. Unsupported commands are received.
- 13: MECHATROLINK command executing condition not met alarm. Command is run in unsupported layer and does not meet the command executing conditions.
- 14~16: internal use.

12.6.13 Pr441

- Name: 2nd Positioning complete (In-position) range
- Unit: command unit
- Range: 0~4191304
- Default value: 800
- Effective time: Immediately
- Related mode: P
- Description: Specify the timing of positional deviation at which the 2nd positioning complete signal (INP2) is output.
  The INP2 turns ON whenever the positional deviation is less than the value of this parameter, without being affected by parameter **Pr431 Positioning complete (In-position) output setup**.
  Note: Parameter unit and calculation mode can be changed by parameter **Pr520 Position setup unit selection**.

12.6.14 Pr442~Pr443

Including parameters **Pr442 Linear acceleration constant in standard position mode** and **Pr443 Linear deceleration constant in standard position mode**.

12.6.14.1 Pr442

- Name: Linear acceleration constant in standard position mode
- Unit: 10000 command unit / s^2
- Range: 1~20971520
- Default value: 100
- Effective time: Immediately
- Related mode: P
- Description: Specify the acceleration in standard position mode. Please set it before operation.

12.6.14.2 Pr443

- Name: Linear deceleration constant in standard position mode
- Unit: 10000 command unit / s^2
- Range: 1~20971520
- Default value: 100
- Effective time: Immediately
- Related mode: P
- Description: Specify the deceleration in standard position mode. Please set it before operation.

12.6.15 Pr444

- Name: Command pulse count per revolution of machine
- Unit: command unit
- Range: 1~1073741823
- Default value: 4096
- Effective time: After restart
- Related mode: P
- Description: Specify the command pulse count per revolution of machine.

$$Pr444 = \text{Encoder resolution} * \frac{\text{Electronic gear ratio (Denominator)}}{\text{Electronic gear ratio (Numerator)}} * \text{Mechanical reducer ratio}$$

12.6.16 Pr445

- Name: Pr445 Oriented angle setup
- Unit: 0.01°
- Range: 0~36000
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the oriented angle.

12.6.17 Pr446

- Name: External positioning final travel distance
- Unit: command unit
- Range: -1073741823~1073741823
- Default value: 100
- Effective time: Immediately
- Related mode: P
- Description: Specify the final moving distance after externally inputting positioning signal.

12.6.18 Pr447~Pr448

Including parameters **Pr447 Monitor 1 selection** and **Pr448 Monitor 2 selection**.

12.6.18.1 Pr447

- Name: Monitor 1 selection
- Unit: -
- Range: 0~65535
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the monitor data for the parameter.

12.6.18.2 Pr448

- Name: Monitor 2 selection
- Unit: -
- Range: 0~65535
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the monitor data for the parameter.

12.6.18.3 Monitor Data

The monitor data for parameters **Pr447** and **Pr448** include the following:

- 0x0: feedback speed (1000000H/inspection speed)
- 0x1: velocity command (1000000H/inspection speed)
- 0x2: torque command (1000000H/Maximum torque)
- 0x3: positional deviation (command unit)
- 0xA: feedback position in machine coordinate system (low-order 32bit) (command unit)
- 0xB: feedback position in machine coordinate system (high-order 32bit) (command unit)
- 0x10: feedback speed (r/min)
- 0x11: velocity command (r/min)
- 0x12: torque command (%)
- 0x16: output signal
- 0x17: positional command speed (r/min)
- 0x18: positional deviation (command unit)
- 0x19: accumulated torque load factor (%)
- 0x1A: regenerative load factor (%)
- 0x1C: position command (command unit)
- 0x1D: feedback pulse (encoder unit)
- 0x23: initial multi-turn data (Rev)
- 0x24: initial incremental data (Pulse)
- 0x33: position command (high-order 32bit) (command unit)
- 0x34: feedback latch position in machine coordinate system (high-order 32bit) (command unit)
- 0x80: previous value of feedback latch position LPOS (Pulse)

12.6.19 Pr450

- Name: Function selection application switch 2
- Unit: -
- Range: -2147483648~2147483647
- Default value: 0
- Effective time: After restart
- Related mode: P
- Description: Specify bit unit to set each function.
  - 0: P_TLIM and N_TLIM in the MECHATROLINK command is used as the limit value of torque. 0: invalid; 1: valid.
  - 1: TFF in the MECHATROLINK command is used as the feed forward input of torque. 0: invalid; 1: valid.
  - 2: Exclusively used by manufacturers. Please set it to **0**.
  - 3: Positioning mode. 0: invalid; 1: valid.
  - 4~31: Exclusively used by manufacturers. Please set it to **0**.

12.7 [Class 5] Enhancing Setting

12.7.1 Pr500~Pr502

Including parameters **Pr500 2nd numerator of electronic gear**, **3rd numerator of electronic gear** and **4th numerator of electronic gear**.

12.7.1.1 Pr500

- Name: 2nd numerator of electronic gear
- Unit: -
- Range: 0~1073741824
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the 2rd numerator of division/multiplication operation made according to the command pulse input.

12.7.1.2 Pr501

- Name: 3rd numerator of electronic gear
- Unit: -
- Range: 0~1073741824
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the 3rd numerator of division/multiplication operation made according to the command pulse input.

12.7.1.3 Pr502

- Name: 4th numerator of electronic gear
- Unit: -
- Range: 0~1073741824
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify the 4th numerator of division/multiplication operation made according to the command pulse input.

12.7.2 Pr503

- Name: Denominator of pulse output division
- Unit: -
- Range: 0~16777216
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: When the number of output pulses per one motor revolution is not an integer, please set this parameter to a value except 0.
  The upper end counts the pulse number by 4 times:

$$\text{Pulse output resolution per one motor revolution} = \frac{Pr011}{Pr503} * \text{Encoder resolution}$$

12.7.3 Pr504

- Name: Over-travel inhibition input
- Unit: -
- Range: 0~2
- Default value: 1
- Effective time: After restart
- Related mode: ALL
- Description: Specify the operation of the over-travel inhibition (POT, NOT) inputs.
  - 0: POT input inhibit positive direction travel. NOT input inhibit negative direction travel.
  - 1: POT and NOT are invalid.
  - 2: POT or NOT input triggers **Err38.0 Driver inhibited input protection**.

12.7.4 Pr505

- Name: Sequence at over-travel inhibition
- Unit: -
- Range: 0~2
- Default value: 0
- Effective time: After restart
- Related mode: ALL

- Description: Specify the status during deceleration and stop after application of the over-travel inhibition (POT, NOT) when **Pr504 Over-travel inhibition input** is set to **0**.

Setting Value	During Deceleration	After Stopping	Deviation Counter Content
0	Dynamic brake action	Torque command = 0 towards inhibited direction	Hold
1	Torque command = 0 towards inhibited direction	Torque command = 0 towards inhibited direction	Hold
2	Stop immediately	Torque command = 0 towards inhibited direction	Clear before/after deceleration

12.7.5 Pr506

- Name: Sequence at Servo-off
- Unit: -
- Range: 0~9
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the status during deceleration and after stop after servo-off.

Setting Value	During Deceleration*1	After Stooping	Positional Deviation
0	DB*2 action	DB action	Clear*3
1	Free-run (DB OFF)	DB action	Clear
2	DB action	Free-run (DB OFF)	Clear
3	Free-run (DB OFF)	Free-run (DB OFF)	Clear
4	DB action	DB action	Clear
5	Free-run (DB OFF)	DB action	Clear
6	DB action	Free-run (DB OFF)	Clear
7	Free-run (DB OFF)	Free-run (DB OFF)	Clear
8	Emergency stop*4	DB action	Clear
9	Emergency stop	Free-run(DB OFF)	Clear

- *1: it refers to the time required for the speed of running motor decreasing to 30r/min. Once the motor speed is less than 30r/min, it is treated as in stop status regardless of its speed.
- *2: it refers to one way to make the servo motor stop immediately by short cutting motor electric circuit. The dynamic brake is embedded in the servo drive.
- *3: positional deviation is always cleared to 0.
- *4: it refers to change working status to immediate stop with servo-on. The torque command is limited during this process by parameter **Pr511 Emergency stop torque setup**.

Note: If an error occurs during servo-off, the operation of the servo drive follows parameter **Pr510 Sequence at alarm**. If the main power is turned off during servo-off, the operation of the servo drive follows parameter **Pr507 Sequence at main power interruption**.

12.7.6 Pr507

- Name: Sequence at main power OFF
- Unit: -
- Range: 0~9
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the status during deceleration after main power interruption or after stopping.
  The value, the operation and process relationship of deviation counters of this parameter is the same as that of parameter **Pr506 Sequence at Servo-off**.
  If an error occurs when the main power is turned off, the operation of the servo drive follows parameter **Pr510 Sequence at main power interruption**. If the main power is turned off during servo-on, **Err13.0 Main power under voltage error** will occurs when parameter **Pr508 LV trip selection with main power off** is set to **1**, and the operation of the servo drive follows parameter **Pr510 Sequence at alarm**.

12.7.7 Pr508

- Name: LV trip selection at main power OFF
- Unit: -
- Range: 0~1
- Default value: 1
- Effective time: Immediately
- Related mode: ALL
- Description: While the main power shutoff continues for the setup of parameter **Pr509 Main power OFF detection time**, select whether to activate **Err13.1 Main power supply under-voltage protection (AC interception detection)** function.
  - 0: When the main power is shut off during servo on, **Err13.1** will not be triggered and the drive turns to servo off, and the servo drive returns to servo on again after the main power resumption.
  - 1: When the main power is shut off during servo on, **Err13.1** occurs.

  Note: This parameter is invalid when the value of parameter **Pr509 Detection time of main power OFF** is set to **2000**. **Err13.0 Main power supply under-voltage protection (between P and N)** will be triggered when the value of parameter **Pr509** is too large and P-N voltage of the main converter is less than the specified value before detecting the main power shutoff, regardless of the value of this parameter.

12.7.8 Pr509

- Name: Detection time of main power OFF
- Unit: ms
- Range: 70~2000
- Default value: 70
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the time to detect the shutoff while the main power is kept shut off continuously. The main power off detection is invalid when this parameter is set to **2000**.

12.7.9 Pr510

- Name: Sequence at alarm
- Unit: -
- Range: 0~7
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the status during deceleration and after stop when an alarm occurs.

Setting Value	During Deceleration[*1]	After Stooping	Positional Deviation
0	DB[*2] action	DB action	Clear
1	Free run (DB OFF)	DB action	Clear
2	DB action	Free run (DB OFF)	Clear

Setting Value	During Deceleration*1	After Stooping	Positional Deviation
3	Free run (DB OFF)	Free run (DB OFF)	Clear*3
4	Action A: emergency stop; action B: DB action	DB action	Clear
5	Action A: emergency stop; action B: DB OFF	DB action	Clear
6	Action A: emergency stop; action B: DB action*4	Free run (DB OFF)	Clear
7	Action A: emergency stop; action B：DB OFF	Free run (DB OFF)	Clear

- *1: it refers to the time required for the speed of running motor decreasing to 30r/min. Once the motor speed is less than 30r/min, it is treated as in stop status regardless of its speed.
- *2: it refers to one way to make the servo motor stop immediately by short cutting motor electric circuit. The dynamic brake is embedded in the servo drive.
- *3: positional deviation is always cleared to 0.
- *4: whether the dynamic brake stops immediately when an alarm occurs. When this parameter is set to **4**~**7**, causing an emergency stop, the action A is selected. And when an alarm not belonging to emergency stop occurs, the action B is selected.

12.7.10 Pr511

- Name: Torque setup for emergency stop
- Unit: %
- Range: 0~500
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the torque limit at E-stop. Generally, it is set to the default value **0**.

12.7.11 Pr512

- Name: Over-load level setup
- Unit: %
- Range: 0~500
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the overload level. The overload level becomes 115% when this parameter is set to **0** or greater than 115. Generally, it is set to the default value **0**, and set to other value only when you need to lower the over-load level.

12.7.12 Pr513

- Name: Over-speed level setup
- Unit:
- Range: 0~20000
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the over-speed level. **Err26.0 Over-speed protection** occurs when the motor speed exceeds the value of this parameter. When this parameter is set to 0, the over-speed level becomes 1.2 times of the maximum motor speed.

  $$Pr513 = Vmax * (1.2 \sim 1.5)$$

  Among them:
  - Vmax: the maximum speed (r/min) of the servo motor during running.
  - 1.2~1.5: the safety coefficient to avoid the frequent occurrence of over-speed.

12.7.13 Pr514

- Name: Motor working range setup
- Unit: 0.1 rev.
- Range: 0~1000
- Default value: 10
- Effective time: Immediately
- Related mode: P
- Description: Specify the moveable range of the motor against the position command input range. **Err34.0 Motor movable range protection** occurs when the motor movement exceeds the value of this parameter to prevent the work from colliding with the end of the machine tool caused by motor oscillation.

12.7.14 Pr516

- Name: Alarm clear input setup
- Unit: -
- Range: 0~1
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the recognition time of alarm clear input (A-CLR).
  - 0: 120ms.
  - 1: 1ms.

12.7.15 Pr520

- Name: Position setup unit selection
- Unit: -
- Range: 0~1
- Default value: 0
- Effective time: After restart
- Related mode: P
- Description: Specify the unit to determine the range of positioning complete and excessive positional deviation.
  - 0: command unit.
  - 1: encoder unit.

12.7.16 Pr521

- Name: Torque limit selection
- Unit: -
- Range: 0~6
- Default value: 1
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the torque limiting method.
  - 0, 4, 6: used by the manufacturer.
  - 1: please set the value of parameter **Pr013 1st torque limit**.
  - 2: please set the value of parameter **Pr013 1st torque limit** in positive direction; please set the value of parameter **Pr522 2nd torque limit** in negative direction.
  - 3: please set the value of parameter **Pr013 1st torque limit** when TL-SEL is OFF; please set the value of parameter **Pr522 2nd torque limit** when TL-SEL is ON.
  - 5: bus communication command.

12.7.17 Pr522

- Name: 2nd torque limit
- Unit: %
- Range: 0~500
- Default value: 500
- Effective time: Immediately
- Related mode: P S
- Description: Specify the 2nd limit value of the motor output torque. The value is restricted by the maximum torque of the applicable motor.

12.7.18 Pr523

- Name: Torque limit switching setup 1
- Unit: ms/100%
- Range: 0~4000
- Default value: 0
- Effective time: Immediately
- Related mode: P S

- Description: Specify the rate of change (slope) from 1st torque limit to 2nd torque limit during torque limit switching.

12.7.19 Pr524

- Name: Torque limit switching setup 2
- Unit: ms/100%
- Range: 0~4000
- Default value: 0
- Effective time: Immediately
- Related mode: P S
- Description: Specify the rate of change (slope) from 2nd torque limit o 1st torque limit during torque limit switching.

12.7.20 Pr525

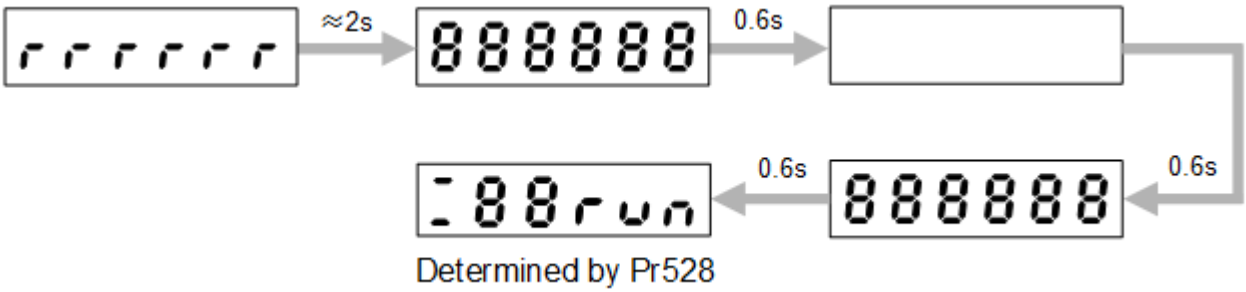
- Name: External input positive direction torque limit
- Unit: %
- Range: 0~500
- Default value: 500
- Effective time: Immediately
- Related mode: P S
- Description: Specify positive direction torque limit upon receiving TL-SEL when **Pr521 Torque limit selection** is set to **6**. The value is restricted by the maximum torque of the applicable motor.

12.7.21 Pr526

- Name: External input negative direction torque limit
- Unit: %
- Range: 0~500
- Default value: 500
- Effective time: Immediately
- Related mode: P S
- Description: Specify negative direction torque limit upon receiving TL-SEL when **Pr521 Torque limit selection** is set to **6**. The value is restricted by the maximum torque of the applicable motor.

12.7.22 Pr528

- Name: LED initial status
- Unit: -
- Range: 0~36
- Default value: 1
- Effective time: After restart
- Related mode: ALL
- Description: Select the type of data to be displayed on the 7-segment LED operation panel at the initial status after power-on.



  - 0: positional command deviation
  - 1: motor speed
  - 2: positional command speed
  - 3: velocity control command
  - 4: torque command
  - 5: feedback pulse sum
  - 6: command pulse sum
  - 7: load estimated inertial ratio
  - 9: control Modes
  - 10: I/O signals status
  - 12: error causes and history
  - 13: alarm number
  - 14: regenerative load factor
  - 15: over-load factor
  - 16: inertia ratio
  - 17: causes for non-motor running
  - 18: number of changes in I/O signals
  - 19: servo enable status
  - 20: absolute encoder data
  - 22: encoder and feedback grating scale communication error count monitor
  - 23: slave address of bus-type drive
  - 24: encoder positional deviation
  - 27: voltage across PN
  - 28: software version
  - 29: serial number of the drive
  - 30: serial number of the motor
  - 31: accumulated operation time
  - 34: remaining time of the drive
  - 36: real-time resonance frequency

12.7.23 Pr533

- Name: Pulse regenerative output limit setup
- Unit: -
- Range: 0~1
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify whether detection of **Err28.0: Pulse regeneration limit protection** is valid.
  - 0: invalid.
  - 1: valid.

12.7.24 Pr535

- Name: Front panel lock setup
- Unit: -
- Range: 0~1
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify whether locking the front panel is valid.
  - 0: invalid.
  - 1: valid.

12.7.25 Pr542~Pr545

Including parameters **Pr542 Flux weakening enable**, **Pr543 Depth of flux weakening**, **Pr544 Time constant of flux weakening** and **Pr545 Maximum current of flux weakening**.

12.7.25.1 Pr542

- Name: Flux weakening enable
- Unit: -
- Range: 0~1
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify whether flux weakening is valid.
  - 0: invalid.
  - 1: valid.

12.7.25.2 Pr543

- Name: Depth of flux weakening
- Unit: %
- Range: 50~110
- Default value: 95
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the depth of flux weakening.

12.7.25.3 Pr544

- Name: Time constant of flux weakening
- Unit: 0.1ms
- Range: 50~10000
- Default value: 600
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the time constant of flux weakening.

12.7.25.4 Pr545

- Name: Maximum current of flux weakening
- Unit: %
- Range: 0~200
- Default value: 60
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the percent relative to the rated current of the motor.

12.8 [Class 6] Special Setting

12.8.1 Pr601

- Name: Torque command setup
- Unit: %
- Range: -500~500
- Default value: 0
- Effective time: Immediately
- Related mode: T
- Description: Specify input range for torque command, when parameter **Pr001 Control mode setup** is set to **3**.

12.8.2 Pr602

- Name: Velocity deviation excess setup
- Unit:
- Range: 0~100
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: When the velocity deviation (difference between internal positional command speed and actual speed) exceeds this value, **Err24.1 Velocity deviation excess protection** occurs. When it is set to **0**, this protection is not detected.

12.8.3 Pr604

- Name: JOG trial run command speed
- Unit: r/min
- Range: 0~500
- Default value: 300
- Effective time: Immediately
- Related mode: ALL

- Description: Specify the command speed used for JOG trial run in velocity control mode.

12.8.4 Pr607

- Name: Torque command additional value
- Unit: %
- Range: -100~100
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the load compensation usually added to the torque command in position and velocity control mode.
  Please update this parameter when parameter **Pr002 Real-time auto-gain tuning setup** is set to **3**.

12.8.5 Pr608

- Name: Positive direction torque compensation
- Unit: %
- Range: -100~100
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: In position control mode, specify the dynamic friction compensation added to the torque command when positive position command is received.
  Please update this parameter when parameter **Pr002 Real-time auto-gain tuning setup** is set to **3**.

12.8.6 Pr609

- Name: Negative direction torque compensation
- Unit: %
- Range: -100~100
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: In position control mode, specify the dynamic friction compensation added to the torque command when negative position command is received.
  Please update this parameter when parameter **Pr002 Real-time auto-gain tuning setup** is set to **3**.

12.8.7 Pr611

- Name: Current response setup
- Unit: %
- Range: 20~500
- Default value: 100
- Effective time: Immediately
- Related mode: ALL
- Description: Finely tune the current response as 100% as leaving factory.

12.8.8 Pr612

- Name: Positive direction torque compensation filter
- Unit: 0.01ms
- Range: 0~30000
- Default value: 200
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the time constant of positive or negative torque compensation filter. The greater the set value, the smoother the positive or negative torque compensation, the better the stability of the system. However, if the set value is too large, the effect of torque compensation will be affected.

12.8.9 Pr615

- Name: 2nd over-speed level setup
- Unit:
- Range: 0~20000
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the over-speed level. When this parameter is set to **0**, over-speed level becomes 1.2 times of the maximum motor speed. **Err26.1 2nd over-speed protection** occurs when the motor speed exceeds the value of this parameter.

12.8.10 Pr617

- Name: Front panel parameter writing selection
- Unit: -
- Range: 0~1
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify whether synchronously writing into EEPROM is valid when parameter is edited from the front panel.
    - 0: invalid.
    - 1: valid.

12.8.11 Pr623

- Name: Disturbance torque compensation gain
- Unit: %
- Range: -100~100
- Default value: 0
- Effective time: Immediately
- Related mode: P S
- Description: Specify compensation gain against disturbance torque.
  After setting the value of parameter **Pr624 Disturbance observer filter**, please increase the value of this parameter. Increasing the gain can increase the disturbance suppressing capability, but operation noises may increase. Please find a balance by adjusting the value of parameter **Pr624**.

12.8.12 Pr624

- Name: Disturbance observer filter
- Unit: 0.01ms
- Range: 0~2500
- Default value: 50
- Effective time: Immediately
- Related mode: P S
- Description: Specify the time constant of the filter according to the disturbance torque compensation.
  Please firstly set it to a greater value and check the operation with a low value of parameter **Pr623 Disturbance torque compensation gain**, and then gradually decrease the value of this parameter. A lower value of this parameter assures disturbance torque estimation with small delay and effectively suppresses effects of disturbance, but operation noises may increase. Please find a balance.

12.8.13 Pr627

- Name: Alarm latch time selection
- Unit: s
- Range: 0~10
- Default value: 5
- Effective time: After restart
- Related mode: ALL
- Description: Specify the latch time.
  - 0: infinite.
  - 1~10: 1s~10s.

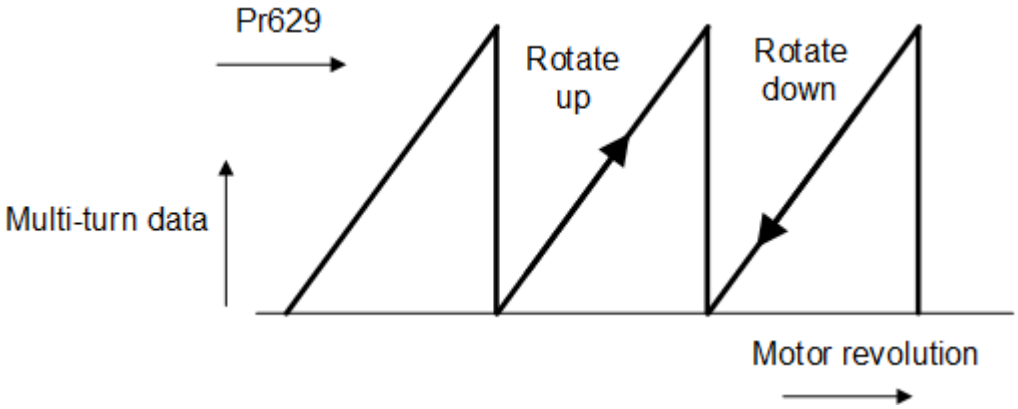
12.8.14 Pr628

- Name: Auto resonance detection level
- Unit: %
- Range: 30~1000
- Default value: 100
- Effective time: Immediately
- Related mode: ALL
- Description: The smaller the set value, the more sensitive the resonance detection.

12.8.15 Pr629

- Name: Absolute multi-turn data upper limit
- Unit: rev
- Range: 0~65534
- Default value: 0
- Effective time: Immediately
- Related mode: ALL

- Description: Specify the upper limit of multi-turn data for any absolute encoders. If multi-turn data exceeds the value of this parameter, multi-turn data turns to **0**. Otherwise, multi-turn data rotates down and turns to the value of this parameter. When the value of parameter **Pr015 Absolute encoder setup** is set to **4**, this parameter is valid.



Note: When the value of parameter **Pr015** is set to **0** or **2**, this parameter is invalid. That is, no matter the value of this parameter, the internal data is always 65535.

12.8.16 Pr630

- Name: Anti-vibration filter ON/OFF switch
- Unit: -
- Range: 0~2
- Default value: 0
- Effective time: Immediately
- Related mode: P
- Description: Specify whether anti-vibration filter is valid.
  - 0: invalid.
  - 1: valid.
  - 2: exclusively used by manufacturers.

12.8.17 Pr632

- Name: Real time auto tuning custom setup
- Unit: -
- Range: 0~65535
- Default value: 0
- Effective time: Immediately
- Related mode: ALL

- Description: Specify the automatic adjusting function when parameter **Pr002 Real-time auto-gain tuning setup** is set to **6**.
  Please set this parameter with bit unit. To avoid mistakes, it is suggested to set this parameter by iMotion software.
  - Bit 1~0 (Load characteristics estimation): Enable/disable the load estimation function.
    - 0: disable
    - 1: enable

    If the load characteristics estimation is disabled, the current setup cannot be changed even if the inertia ratio is updated according to the estimated value.
  - Bit 2~3 (Inertia ratio)
    Set up update to be made based on result of the load characteristics estimation of parameter **Pr004 Inertia ratio**.
    - 0: use current setup.
    - 1: update by the estimated value.
  - Bite 6~4 (Torque compensation)
    Set up the update to be made according to the results of load characteristics estimation of parameter **Pr607 Torque command additional value**, **Pr608 Positive direction torque compensation value** and **Pr609 Negative direction torque compensation value**.

Setting Value	Function	Compensa-tion 1	Compensa-tion 2	Compensa-tion 3
0	Use current setup	Pr607	Pr608	Pr609
1	Disable torque compensation	Zero	Zero	Zero
2	Vertical axis mode	Update	Zero	Zero
3	Friction compensation (low)	Update	Low compensation	Low compensation
4	Friction compensation (middle)	Update	Middle compensation	Middle compensation
5	Friction compensation (high)	Update	High compensation	High compensation

  - Bit 7 (Stiffness setup)
    Enable/disable the basic gain setup to be made according to parameter **Pr003 Real-time auto tuning machining stiffness setup**.
    - 0: disable
    - 1: enable

- Bit 8 (Fixed parameter setup)
  Enable/disable the change of parameter that is normally set at a fixed value.
  - 0: use current setup.
  - 1: set to a fixed value.
- 10~9 (Gain switching setup)
  Select the gain switching related parameter to be used when the real time auto tuning is enabled.
  - 0: use current setup.
  - 1: disable gain switching
  - 2: enable gain switching

Setup procedure of bitwise parameter:

a. Identify the LSB of the setup.
   Example: LSB of the torque compensation function is 4.
b. Multiply the setup value by power of 2 (LSB).
   Example: To set the torque compensation function to friction compensation (middle): $2^4 * 4 = 64$.
c. Perform steps 1and 2 for every setup, sum up the values which are to be the value of parameter **Pr632**.
   Example: Load characteristics measurement = enable, inertia ratio update = enable, torque compensation = friction compensation (middle), stiffness setup = enable, fixed parameter = set to a fixed value, gain switching setup = enable, then, $2^0 * 1 + 2^2 * 1 + 2^4 * 4 + 2^7 * 1 + 2^8 * 1 + 2^9 * 2 = 1477$.

12.8.18 Pr633

- Name: Speed setting at friction compensation taking effect
- Unit: 0.1rpm
- Range: 0~1000
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the speed point of friction torque compensation taking effect. Since friction is different for different structures, the speed point can be different. Please set it according to actual conditions.

12.8.19 Pr638

- Name: Alarm mask setup
- Unit: -
- Range: 0~65535
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the alarm detection mask. Placing **1** to the corresponding bit position disables detection of the alarm condition.

12.8.20 Pr640

- Name: Absolute origin position offset
- Unit: command unit
- Range: -1073741823~1073741823
- Default value: 0

- Effective time: Immediately
- Related mode: ALL
- Description: Specify the position offset between encoder position (external scale position) and machine position when an absolute encoder (absolute external scale) is enabled.

12.8.21 Pr642

- Name: Two-stage torque filter time constant
- Unit: 0.01ms
- Range: 0~2500
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Set the time constant of the filter according to the torque command, regardless of gain selecting status. Tool large value of this parameter will cause vibration.
  When the value of parameter **Pr643 Two-stage torque filter attenuation term** is less than 50 (using filter twice), the time constant is **5**~**159** (0.05ms~1.59ms) and frequency is 100Hz~3000Hz.
  - 0: filter is invalid.
  - 1~4: time constant 5 (3000Hz)
  - 5~158: time constant 5~158 (100Hz~3000Hz).
  - 159~2500: time constant 159 (100Hz).

12.8.22 Pr643

- Name: Two-stage torque filter attenuation term
- Unit: -
- Range: 0~1000
- Default value: 1000
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the attenuation term of 2-stage torque filter. Too small or tool large value of this parameter will cause vibration.
  - 0~49: operate as filter one time.
  - 50~1000: operate as filter twice.

  Generally, it is set to the default value **1000**, that is ζ is equal to 1 (ζ= Pr643 / 1000).

12.8.23 Pr650

- Name: Viscous friction compensation gain
- Unit: 0.1% /10000r/min
- Range: 0~10000
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the viscous friction compensation gain.

12.8.24 Pr651

- Name: Immediate cessation completion wait time
- Unit: ms

- Range: 0~10000
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the time during which the current flows through the motor after turning off brake release output (BRK-OFF), when the immediate stop alarm occurs. The fall prevention function is invalid when this parameter is set to **0**.

12.8.25 Pr652

- Name: Runaway protection
- Unit: -
- Range: 0~1
- Default value: 1
- Effective time: Immediately
- Related mode: ALL
- Description: Specify whether runaway protection is valid.
  - 0: invalid.
  - 1: valid.

12.8.26 Pr653

- Name: Current threshold of runaway.
- Unit: %
- Range: 100~400
- Default value: 200
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the current threshold of runaway.

12.8.27 Pr654

- Name: Speed threshold of runaway
- Unit: Rpm
- Range: 1~1000
- Default value: 50
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the speed threshold of runaway.

12.8.28 Pr655

- Name: Speed filter time of runaway
- Unit: ms
- Range: 1~100
- Default value: 2
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the speed filter time of runaway.

12.8.29 Pr656

- Name: Detection time of runaway
- Unit: ms

- Range: 10~1000
- Default value: 30
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the detection time of runaway.

12.8.30 Pr660

- Name: Internal use.
- Unit: -
- Range: -32768~32767
- Default value: 0
- Effective time: Immediately
- Related mode: ALL
- Description: Please set it to **0**.

12.8.31 Pr661

- Name: Time window of motor stall over-temperature protection
- Unit: ms
- Range: 10~65535
- Default value: 200
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the time window of motor stall over-temperature protection.

12.8.32 Pr662

- Name: Motor stall over-temperature detection
- Unit: -
- Range: 0~1
- Default value: 1
- Effective time: Immediately
- Related mode: ALL
- Description: Specify whether motor stall over-temperature detection is valid.
    - 0: invalid.
    - 1: valid.

12.9 [Class 7] Motor Setting

12.9.1 Pr700

- Name: Motor type selection
- Unit: -
- Range: 0~2
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the type of a motor that will be connected.
    - 1: linear type.
    - 2: rotary type.

  When it is set to **0**, **Err70.0 Motor setting error protection** occurs.

12.9.2 Pr701

- Name: Motor rated current effective value
- Unit: 0.1Arms
- Range: 0~65535
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the effective value of rated current of motor.
  When it is set to **0**, **Err70.0 Motor setting error protection** occurs. Besides, if it is greater than the allowable rated current of the servo drive, **Err70.1 Motor combination error 1 protection** occurs.

12.9.3 Pr702

- Name: Rated motor torque
- Unit: 0.1N.m
- Range: 0~65535
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the rated torque for the motor.
  When it is set to **0**, **Err70.0 Motor setting error protection** occurs.

12.9.4 Pr704

- Name: Maximum motor speed
- Unit: r/min
- Range: 0~65535
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the maximum speed for the motor.
  When it is set to **0**, **Err70.0 Motor setting error protection** occurs.

12.9.5 Pr705

- Name: Motor pole logarithm
- Unit: poles
- Range: 0~255
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the pole logarithm for the motor.
  When it is set to **0**, **Err70.0 Motor setting error protection** occurs.

12.9.6 Pr706

- Name: Motor Back EMF constant
- Unit: 0.1V/(1000rpm)
- Range: 0~65535
- Default value: 0
- Effective time: After restart

- Related mode: ALL
- Description: Specify the back EMF constant for the motor.
  When it is set to **0**, **Err70.0 Motor setting error protection** occurs.

12.9.7 Pr707

- Name: Motor phase resistance
- Unit: 0.01Ω
- Range: 0~65535
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the phase resistance for the motor.
  When it is set to **0**, **Err70.0 Motor setting error protection** occurs.

12.9.8 Pr709

- Name: Motor phase inductance
- Unit: 0.01mH
- Range: 0~65535
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the phase inductance for the motor.
  When it is set to **0**, **Err70.0 Motor setting error protection** occurs.

12.9.9 Pr710

- Name: Motor inertia
- Unit: 0.01kg.cm2
- Range: 0~6553500
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the motor inertia.
  When it is set to **0**, **Err70.0 Motor setting error protection** occurs.

12.9.10 Pr711

- Name: Encoder single turn digit
- Unit: Bit
- Range: 0~31
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify single turn digit for the serial communication rotary encoder.
  When it is set to **0**, **Err70.0 Motor setting error protection** occurs.

12.9.11 Pr712

- Name: Number of encoder turns
- Unit: Turns
- Range: 0~31
- Default value: 0

- Effective time: After restart
- Related mode: ALL
- Description: Specify the number of encoder turns for the serial communication rotary encoder.

12.9.12 Pr713

- Name: Number of encoder pulses per rotation
- Unit: pulse
- Range: 0~16777216
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the number of pulses of the feedback encoder per revolution when AB phase output type or sinusoidal output type feedback encoder is used. When it is set to a value out of range, **Err70.0 Motor setting error protection** occurs.

12.9.13 Pr714

- Name: Internal use.
- Unit: -
- Range: 0~65535
- Default value: 1
- Effective time: After restart
- Related mode: ALL
- Description: Please set it to **0**.

12.9.14 Pr715

- Name: Motor maximum instantaneous current
- Unit: 0.1Arms
- Range: 0~65535
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the maximum instantaneous current of the motor.
  When it is set to **0**, **Err70.0 Motor setting error protection** occurs. Besides, if it is greater than the allowable instantaneous current of the servo drive, **Err70.1 Motor combination error 1 protection** occurs.

12.9.15 Pr718

- Name: Initial magnet pole angle
- Unit: 0.1°(Electrical angle)
- Range: -3600~3600
- Default value: -3600
- Effective time: After restart
- Related mode: ALL
- Description: Specify initial magnet pole angle.

12.9.16 Pr720

- Name: Motor thermal time constant

- Unit: 0.1s
- Range: 1~32767
- Default value: 1600
- Effective time: After restart
- Related mode: ALL
- Description: Specify thermal time constant of the motor.

12.9.17 Pr724

- Name: Pole detection method
- Unit: -
- Range: 0~4
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify how to detect a pole position.
  - 0: none
  - 1: CS signal
  - 2: Pole position estimation
  - 3: Pole position recovery
  - 4：CS signal (wire saving)

  When it is set to **0**, **Err70.0 Motor setting error protection** occurs.

12.9.18 Pr725

- Name: CS phase
- Unit: 0.1°(Electrical angle)
- Range: 0~3600
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Specify the relative phase between the induced voltage of the motor and the CS signal when parameter **Pr724 Magnet pole detection scheme selection** is set to **1**.

12.9.19 Pr726

- Name: Magnet pole position estimation / torque command time
- Unit: ms
- Range: 0~200
- Default value: 200
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the command torque time for estimating pole position when parameter **Pr724 Magnet pole detection scheme selection** is set to **2**.
  When the moving pulse count if the motor is greater than parameter **Pr728 Magnet pole position estimation / zero moving pulse width for estimating pole position**, the torque command stops even if the time does not expire. If the setting value is small, the motor will not work adequately, resulting in a bad estimation accuracy or pole position estimation error.

12.9.20 Pr727

- Name: Magnet pole position estimation / torque command
- Unit: %
- Range: 0~300
- Default value: 50
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the command torque for magnet pole position estimation when parameter **Pr724 Magnet pole detection scheme selection** is set to **2**.
  If the setting value is small, the motor will not work adequately, resulting in a bad estimation accuracy or pole position estimation error. The actual command torque is limited by the maximum allowable torque of the motor.

12.9.21 Pr728

- Name: Magnet pole position estimation / zero moving pulse width for estimating pole position
- Unit: pulse (encoder)
- Range: 0~32767
- Default value: 100
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the pulse width for judging as a zero moving in the pole position estimation when parameter **Pr724 Magnet pole detection scheme selection** is set to **2**.
  When the motor moving pulse is less than this setting value regardless of the torque application under parameter **Pr726 Torque command time for magnet pole position estimation** and **Pr727 Command torque for magnet pole position estimation** conditions, it is judged as a zero travel.
  The travel amount can be reduced in the pole position estimation by reducing the setting value, but the estimated accuracy may be poor. Roughly speaking, set the number of pulses corresponding to the electric angle.

12.9.22 Pr729

- Name: Magnet pole position estimation / stop pulse count
- Unit: pulse (encoder)
- Range: 0~32767
- Default value: 40
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the condition for judging the motor as stopped in the pole position estimation when parameter **Pr724 Magnet pole detection scheme selection** is set to **2**.
  When the motor moving pulse is less than the setting value and greater than the value of parameter **Pr730 Magnet pole position estimation / stop time** (unit: ms), the motor is judged as stopped and next torque command is applied.

12.9.23 Pr730

- Name: Magnet pole position estimation / stop time
- Unit: ms

- Range: 0~32767
- Default value: 40
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the condition for judging the motor as stopped in the pole position estimation when parameter **Pr724 Magnet pole detection scheme selection** is set to **2**.
  When the motor moving pulse is less than parameter **Pr729 Magnet pole position estimation / stop pulse count** and greater than the setting value, the motor is judged as stopped and next torque command is applied.

12.9.24 Pr731

- Name: Magnet pole position estimation / stop time limit
- Unit: ms
- Range: 0~32767
- Default value: 1000
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the time limit for judging the motor as stopped in the pole position estimation when parameter **Pr724 Magnet pole detection scheme selection** is set to **2**.
  If the motor is not judged as stopped even if a value is greater than the setting value, **Err711 Magnet pole position estimation error 2 protection** occurs.

12.9.25 Pr732

- Name: Magnet pole position estimation / torque command filter
- Unit: 0.01ms
- Range: 0~5000
- Default value: 1000
- Effective time: Immediately
- Related mode: ALL
- Description: Specify the time constant of the filter for the torque command in the pole position estimation when parameter **Pr724 Magnet pole detection scheme selection** is set to **2**.
  If the setting value is **0**, the filter will be invalid and only a step command will be available.

12.9.26 Pr734

- Name: Internal use.
- Unit: -
- Range: 0~327670000
- Default value: 0
- Effective time: After restart
- Related mode: ALL
- Description: Please set it to **0**.

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Shanghai Weihong Electronic Technology Co., Ltd.

Address: No. 1590, Huhang Rd., Fengxian, Shanghai, China, 201401

Hot-line: 400 882 9188

Website: www.weihong.com.cn/en