WISE Bus-type Servo Driver

Users' Manual

(1st Edition)

Weihong Electronic Technology Co., Ltd.

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Preface

How to Use This Manual

This manual is intended for end-users. If you use the system for the first time, you need to read through the manual. If you are experienced with the system, you can search for the desired info via the contents.

With 10 chapters, this manual can be divided into 7 parts, as follows:

1) Precaution. This part mainly lists the notices of storage and transportation, installation and wiring, usage and so on. Users should read them carefully to ensure safe operation.
2) Product, including chapter 1. It mainly introduces names of each component of the WISE driver, the operating mode as well as specifications.
3) Connector and wiring, including chapter 2. Wiring and connection examples of WISE servo driver are offered.
4) Operation and adjustment, including chapter 3 to 8. Chapter 3 introduces the front panel and operation; chapter 4 gives knowledge of the absolute system; chapter 5 introduces the operation of motor running function; chapter 6 gives an introduction to gain adjustments and chapter 7 introduces the errors and troubleshooting; chapter 8 introduces the registration function of the driver.
5) Parameter, including chapter 9. It gives a detailed introduction to all parameters in this system.
6) Driver components and wiring diagram, including chapter 10. This part mainly introduces the components and wiring diagram of MA/MB/ME/MN series motor and Panasonic motor, which can be mated with WISE servo driver.
7) Software license agreement, including chapter 11. It gives the detailed items about software license agreement.

Applicable Product Models

This manual is applicable to WSDV series WISE servo driver. Refer to the table below for details.

Product Model	Remarks
WISE servo driver	Hereinafter referred to as WISE. The “driver” in this manual refers to “WISE servo driver”, if there is no particular explanation. At present, there are six models, namely, WSDV-1R2 (100W), WSDV-2R8 (400W), WSDV-5R0 (750W), WSDV-6R8 (1.0kW), WSDV-110 (1.5kW), and WSDV-140 (2.5kW).

Conventions in This Manual

In this manual, the P, S and T in column “Related Mode” represent position control mode, Velocity control mode and torque control mode respectively. The white letters in blue background represent the

corresponding modes are valid while grey letters in blank background represent the corresponding modes are invalid, as shown below.

Signal Name	Symbol	Default	Related Mode		
Command pulse inhibition input	INH	-	P	S	T

Revision History

You can refer to the following table for the revision records of each edition.

Date	Edition	Revision Contents
2017.04	R1	Released for the first time.

Contact Us

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Precautions

Precautions can be divided into caution and warning according to the degree of loss or injury in case of negligence or omission of precautions stipulated in this manual.

CAUTION: General info, mainly for informing, such as supplementary instructions and conditions to enable a function. In case of negligence or omission of this kind of precautions, you may not activate a function. Note that in some circumstances, negligence or omission of even this kind of precautions could cause physical injury or machine damage.

WARNING: Warning info requiring special attention. In case of negligence or omission of this kind of precautions, you may suffer physical injury, or even death, machine damage or other losses.

WARNING

1) Precautions Related to Storage and Transportation

- The products should be transported properly in terms of the weight;
- An excess of specified quantity of stacking products is prohibited;
- Climbing, standing or placing heavy loads on the products is prohibited;
- Dragging or carrying the products via cables or devices connected to them is prohibited;
- Keep away from moisture in storage and transportation.

2) Precautions Related to Installation

- Only when this equipment installed in the qualified electricity cabinet can it be used. The construction of the cabinet must reach IP54 grade of protection;
- Paste sealing strips on the joint of the cabinet to seal all the cracks;
- Cable entry should be sealed while easy-to-open on the spot;
- A fan or heat exchanger should be adopted for the heat dissipation and air convection of the cabinet;
- If a fan is adopted, air strainer is a must in air inlet or air outlet;
- Dust or cutting fluids may have access to the CNC device via the tiny cracks and tuyere. Therefore it is necessary to pay attention to the surroundings and air flow direction of the air vent to make sure that the outflow gas is towards pollution source;

WARNING

- 100 mm space should be preserved between the back of the CNC device and the cabinet wall for plugging cable connected with the device and the ventilation & heat dissipation in the cabinet;
- Space between this device and other equipment should also be preserved according to the requirements;
- The product should be installed firmly and without vibration. During installing, casting, knocking, striking, or loading on the product is forbidden;
- To reduce electromagnetic interference, power-supply components used should be above AC or DC 50V and the space between cable and CNC device should be preserved above 100mm;
- It will be better if CNC device is installed at a position facilitating debugging and maintenance.

3) Precautions Related to Wiring

- Only qualified people are allowed to participate in the wiring and checking;
- The CNC device should be grounded reliably and grounding resistance should be less than 4 ohm. Neutral line is absolutely not allowed to replace earth wire. Otherwise, it may result in malfunction of the device due to the interference;
- Wiring should be firm and steady, or disoperation may occur;
- Voltage values and positive & negative polarity of any connection plug should be in accordance with specifications set forth in the manual, or it may result in breakdowns such as short circuit and permanent damage to the device;
- To guard against electric shock or CNC device damage, fingers should keep dry before plugging or touching switch;
- The connecting wire should not be damaged and squeezed, or the leakage or short circuit may occur;
- It is prohibited to plug or open the chassis of CNC device when power on.

4) Precautions Related to Running & Debugging

- Parameters setting should be checked before running, since wrong setting may lead to accidental movements;
- Modification to parameters should be within the allowable range, or such breakdowns as unsteady running and machine damage will occur.

5) Precautions in Use

- Before power-on, please make sure that the switch is on blackout to avoid occasional start-up;

WARNING

- Please check the electromagnetic compatibility during electrical design in order to avoid or reduce electromagnetic interference to the CNC device. A low pass filter should be employed to reduce electromagnetic interference if there are other electrical devices nearby;
- It is not allowed to frequently power on and power off. It is recommended to power up the machine again at least one (1) minute later after power failure or blackout.

CAUTION

1) Precautions Related to Product and Manual

- Matters related to restrictions and functions available stipulated in the manuals issued by the machine manufacturer is prior to those in this manual;
- This manual assumes adding all optional functions, which you must confirm through manuals issued by the machine manufacturer;
- Please refer to manuals issued by the machine manufacturer for the instructions of machine tools;
- Functions, and software interfaces vary with the system and the version of software. Before using the system, you must confirm specifications.

2) Precautions When Opening the Package

- Please make sure whether the products are what you have ordered;
- 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.

Content

1 Basic Information of Driver

1.1 On Opening the Product Package

After you open the product package, please check:

1. Whether the model number marked on the nameplates of servo driver corresponds to the order. (Refer to the descriptions of model numbers in section 1.3);
2. Whether there is damage or scratch on the appearance;
3. Whether screws are loose or fallen;
4. Whether all parts are included. A complete configuration includes:
   a) One WISE servo driver
   b) One driver side encoder cable plug (SM-6P)
   c) One M-Ⅱ bus cable (CN5 cable)
   d) One *WISE Servo Driver Guide*

1.2 Description of Driver Front Panel

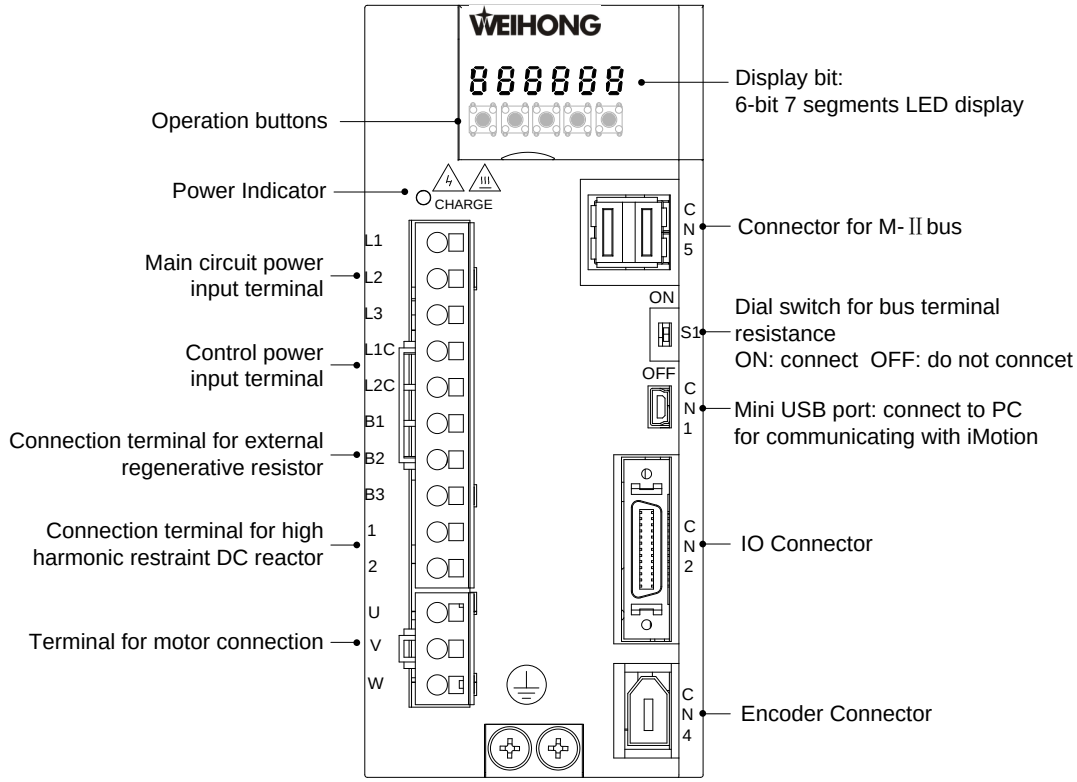
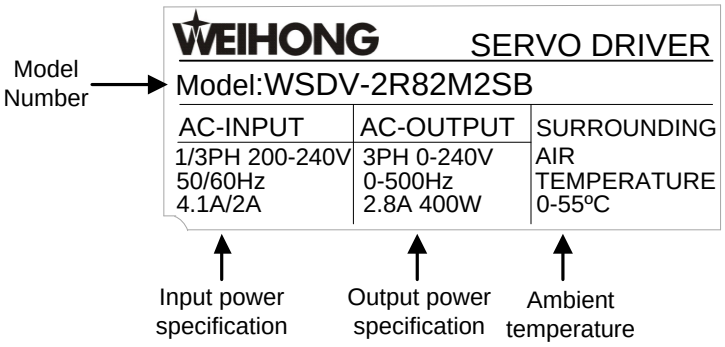


Fig. 1-1 Front panel description of bus driver

1.3 Nameplate Example

- **Nameplate**



- **Model number**

W S D V 2R8 2 0P S B

Product Series

Symbol	Type
WSDV	WISE

Capacity

Symbol	Rated Power(W)
1R2	100
2R8	400
5R0	750
6R8	1000
110	1500
140	2500

Voltage Specification

Symbol	Specification
2	200V

Control Mode

Symbol	Specification
B	Position control/velocity control/torque control
P	Exclusive for position control

Encoder Feedback Type

Symbol	Specification
S	Serial communication encoder

Connector Type

Symbol	Specification
0P	Pulse train command
AP	Analog voltage· pulse train command
M2	M-II bus communication

1.4 Operation Mode

There are three control modes, which can be selected by setting parameter Pr001. Modification to the parameter takes effect after the driver is repowered. See table below for details:

Mode Name	Pr001	Description
Position control	1	The driver receives position command and makes the motor rotate to the target position. Position command of M-Ⅱ bus-type driver is input through M-Ⅱ movement instruction in the type of digital signal.
Velocity control	2	The driver receives velocity command and makes the motor rotate to the target rotational speed. Velocity command controlled by bus instruction is not supported currently by M-Ⅱ bus-type driver.
Torque control	3	The driver receives torque command and makes the motor rotate to the target torque. Torque command controlled by bus instruction is not supported currently by M-Ⅱ bus-type driver.

1.5 Specification

- **Basic specifications**

Main circuit power supply	WSDV-1R2 WSDV-2R8 WSDV-5R0 WSDV-6R8	Single phase/3-phase 200V~240 $^{+10\%}_{-15\%}$, 50/60Hz
	WSDV-110 WSDV-140	3-phase 200V~240V $^{+10\%}_{-15\%}$, 50/60Hz
Control circuit power supply	Single phase 200V~240V $^{+10\%}_{-15\%}$, 50/60Hz	
Withstand Voltage	Withstand AC 1500V or DC 2100V for 1 minute, current leak 10mA max.	
Ambient temperature (working)	0~+55℃ (Free from condensation and freezing)	
Ambient temperature (Storage)	-20~+65℃ (Max. temperature guarantee: 80℃ for 72 hours, with humidity lower than 17% RH)	

Protection level/cleanliness	Protection level: IP1X; cleanliness: 2 Environment requirements: (1) Places where no corrosive gas or inflammable gas. (2) Places where no splashing of water, oil or powder. (3) Places where low degree of dust, powder, salt and iron powder.
Humidity for long-term reliability	90% RH max. (No freezing and condensation)
Control method	SVPWM control mode.
Encoder feedback	17-bit (resolution 131072) 7-wire serial absolute encoder; 20-bit (resolution 10458576) 5-wire serial incremental encoder; 23-bit (resolution 8388608) 7-wire serial absolute encoder.
Pulse direction input signal	High-speed Mechatrolink-Ⅱ bus.
Pulse output	(1) Feedback digital signal by bus command; (2) Output encoder pulse via bus output port (A/B/Z-phase).
Communication	Connect with software iMotion on PC via USB interface.
Control input	7 physical input for general purpose are: (1) General input (GP); (2) Positive direction inhibition signal (POT); (3) Negative direction inhibition signal (NOT); (4) (Homing) deceleration limit switch input (DEC); (5) External lock input signal (EXT1, EXT2, and EXT3); (6) Alarm clear (A-CLR); (7) Internal command velocity selection signal (INTSPD1, INTSPD2, and INTSPD3); (8) Command pulse inhibition (INH); (9) SRV-ON; (10) Gain switching; (11) Zero-speed clamp (ZEROSPD); (12) Deviation counter clear input (CL); (13) Torque limit switching input (TL-SEL); (14) Division/multiplication of command input (DIV1, DIV2); (15) Velocity command symbol input (VC-SIGN); (16) Torque command symbol input (TC-SIGN); (17) Forced alarm input (E-STOP); (18) Absolute data request signal (SEN).
Control output	4 physical output for general purpose, alarm output ALM is fixed allocated to SO3, and the remaining 3 outputs are: (1) External brake release (BRK-OFF); (2) Position complete (INP); (3) Servo ready output (S-RDY); (4) Zero-speed clamp detection (ZSP); (5) Torque limiting (TLC);

	(6) Velocity coincidence (V-COIN); (7) Speed arrival (AT-SPEED); (8) Warning (WARN1, WARN2); (9) Position command output or not (P-CMD); (10) Position complete (INP2); (11) Velocity limiting (V-LIMIT); (12) Alarm attribute output (ALM-ATB); (13) Velocity command output or not (V-CMD).
Front panel	5 buttons and 6 LED indicators.
Regenerative resistor	WSDV-1R2, WSDV-2R8 with no internal regenerative resistor (external resistor only); WSDV-5R0, WSDV-6R8, WSDV-110 and WSDV-140 with internal regenerative resistor (external one is also supported).
Dynamic brake	WSDV-1R2, WSDV-2R8 without dynamic brake; WSDV-5R0, WSDV-6R8, WSDV-110 and WSDV-140 with internal dynamic brake.
Control mode	① position control; ② velocity control; ③ torque control.

- **Function**

Position control	Control input	① Deviation counter clear; ② Command pulse input inhibition; ③ Command division switch; ④ Gain switching input.	
	Control output	Positioning complete output	
	Pulse input	Pulse input method	Bus command input
		Command pulse division/multiplication (electronic gear ratio setup)	Electronic gear ratio is used within range of 1/1000~32000.
		Filter	Command smooth filter; FIR filter; hysteresis filter.
	Pulse output	A/B/Z-phase: line drive output. Division pulse counts: 1~one fourth of encoder resolution.	

Velocity control	Control input	① Internal command velocity selection 1; ② Internal command velocity selection 2; ③ Internal command velocity selection 3; ④ Zero-speed clamp.
	Control output	Speed arrival
	Internal velocity command	Switch among 8 velocity according to external control input.
	Velocity command acceleration/deceleration adjustment	Both individual setup of acceleration/deceleration or sigmoid acceleration/deceleration are enabled.
	Zero-speed clamp	Zero-speed clamp function can be set up in velocity or torque control mode.
Torque control	Control input	Zero-speed clamp input
	Control output	Speed arrival
	Velocity limit	Set velocity limiting through parameter setting.
	Torque command filter	Torque command delay filter; 4 notch filter.

- **Protection**

Hardware protection	Over-voltage, under-voltage, over-current, over-speed, over-load, brake resistor over-load, over-heat of the driver, and encoder error, etc.
Software protection	Register error, initialization error, I/O allocation error, positional deviation excess, etc.
Error protection history	Up to 14 errors can be recorded.

1.6 Installation

1.6.1 Installation Diagram

When there are multiple servo drivers installed side by side in a control panel, they must be placed as Fig. 1-2.

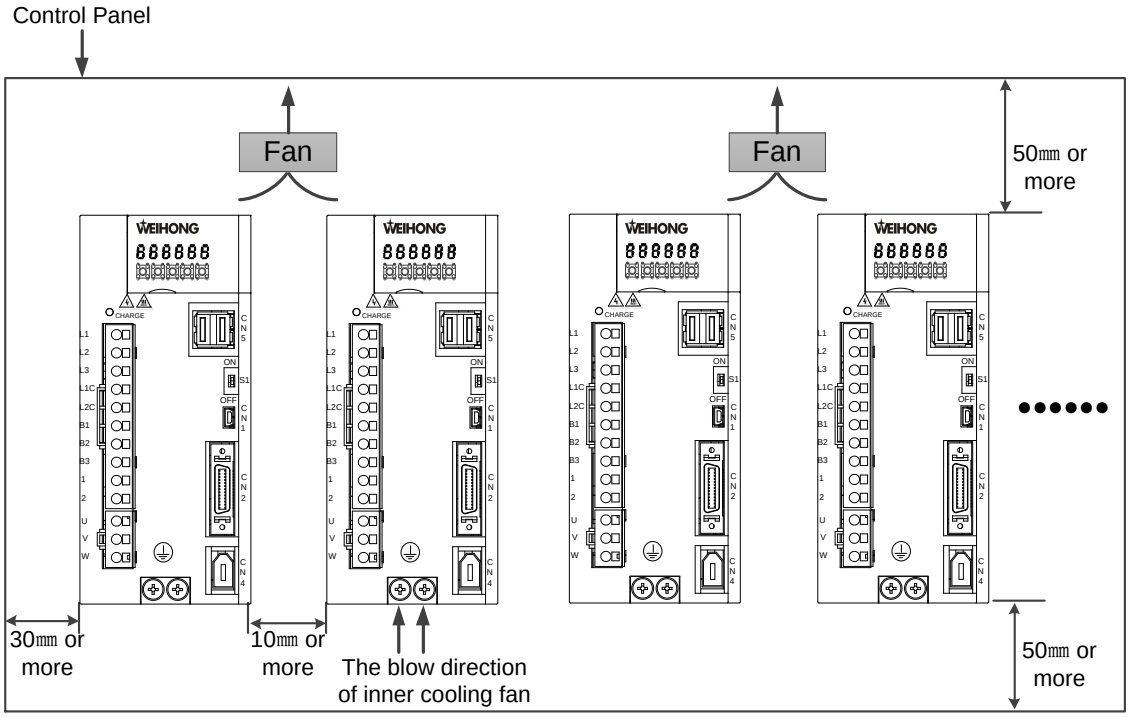


Fig. 1-2 Side-by-side installation diagram

- **Installation orientation**

Install driver perpendicularly to the wall so that the display panel faces to operator, as shown in Fig. 1-3. Secure the driver firmly on the wall via mounting holes, and cool it by cooling fans or nature convection.

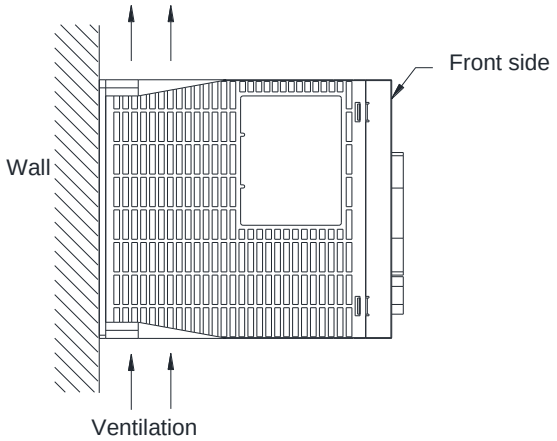


Fig. 1-3 Installation orientation

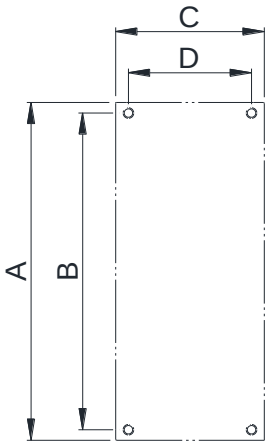
- **Cooling and convection**

When installing drivers side by side, you should provide at least 10mm between and at least 50mm above and below each driver, and install cooling fans above them.

In order to avoid high ambient temperature at part, and maintain even temperature inside the control panel, the environment requirements in the control panel are as below:

1. Ambient temperature: 0~+55℃ (no condensation and freezing);
2. Humidity: 90% RH or less (no freezing or frost);
3. Ambient temperature for long-term reliability: 45℃ max.

1.6.2 Installation Dimension

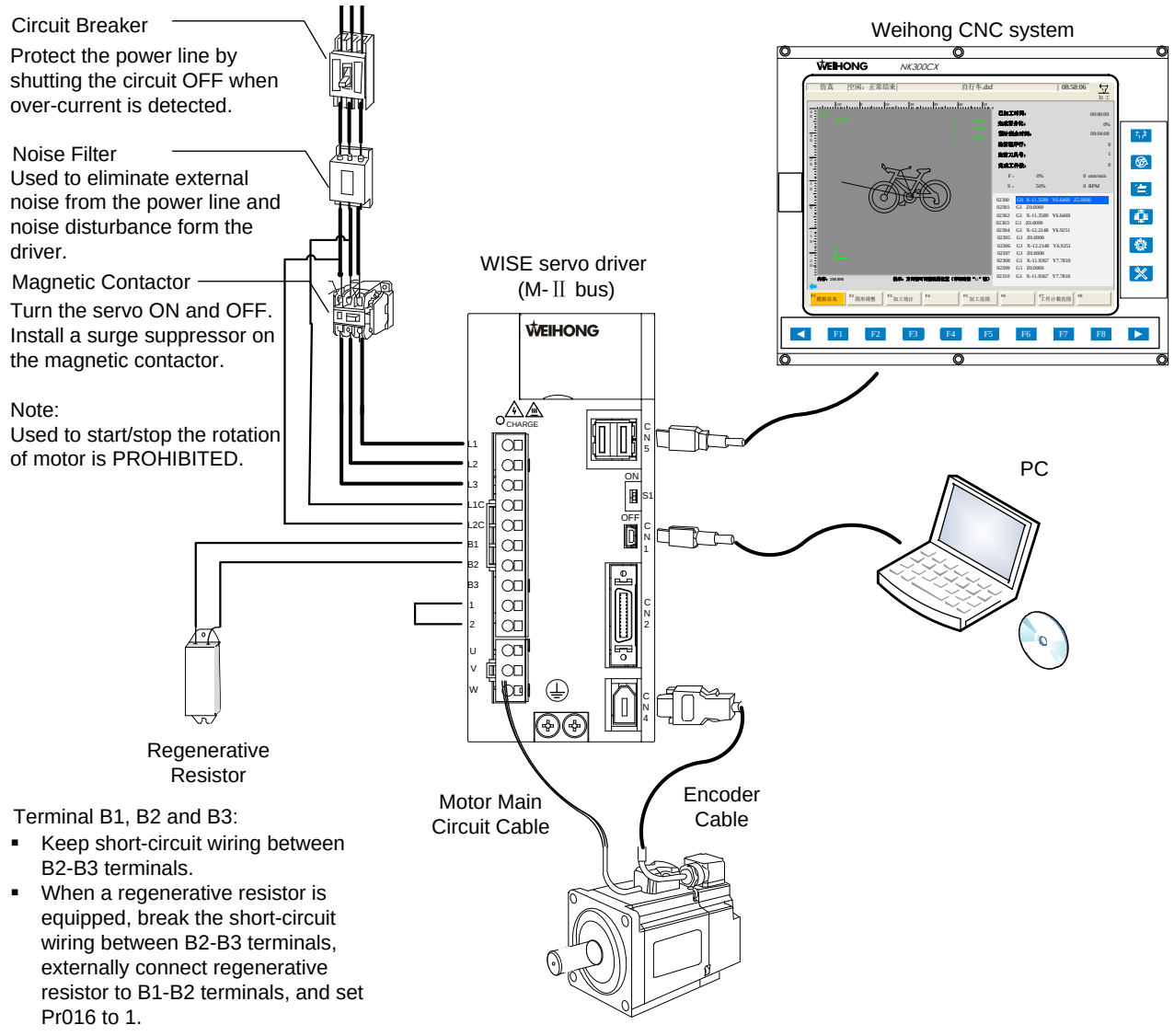


Mounting hole dimension

Driver Model	Dimension (mm)				Screw Size	Screw No.
	A	B	C	D		
WSDV-1R2	160	150	40	30.5	M4	2
WSDV-2R8						
WSDV-5R0	160	150	70	58	M4	3
WSDV-6R8						
WSDV-110	160	150	80	70	M4	4
WSDV-140						

2 Wiring

2.1 Connection with Peripheral Devices



Terminal B1, B2 and B3:

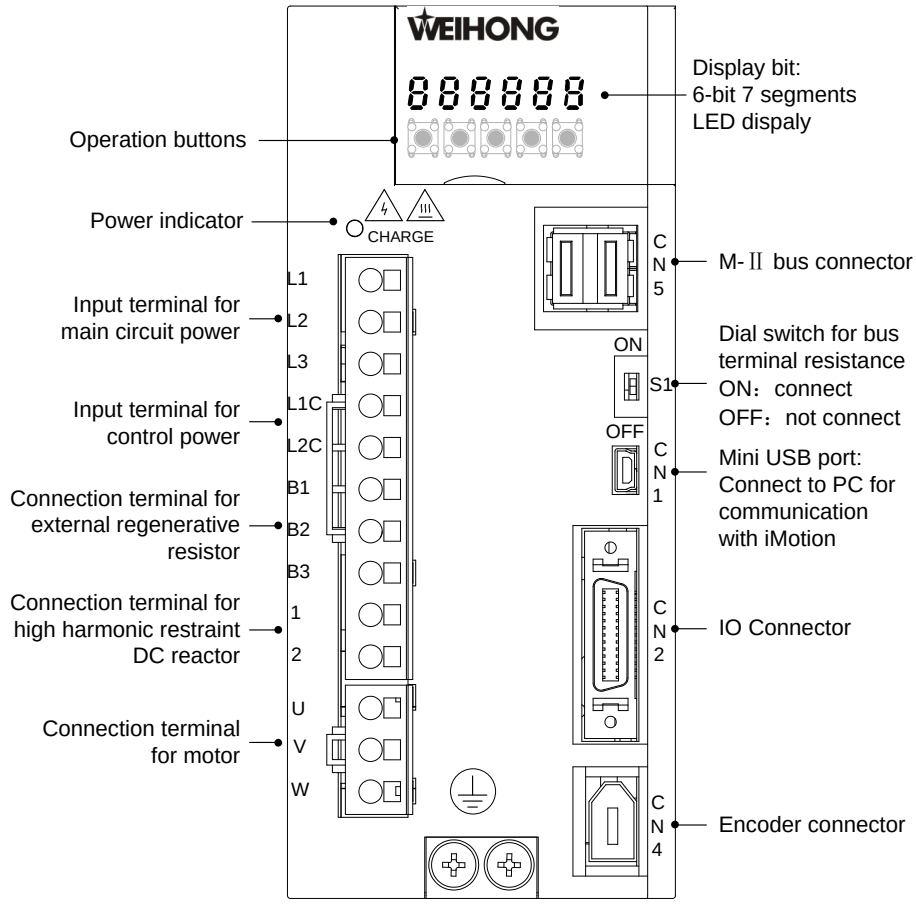
- Keep short-circuit wiring between B2-B3 terminals.
- When a regenerative resistor is equipped, break the short-circuit wiring between B2-B3 terminals, externally connect regenerative resistor to B1-B2 terminals, and set Pr016 to 1.

WARNING

1. When externally wiring to a regenerative resistor, over-temperature protection MUST be provided.
2. Install over-temperature protection fuse and thermostat in the regenerative resistor. And once fuse action occurs, it cannot restore to previous state.
3. Mount the regenerative resistor on incombustible substances such as metal.

2.2 Wiring of Main Circuit

2.2.1 Terminals of Main Circuit



Name	Symbol	Description
Main circuit power input terminal	L1, L2, L3	Any two terminals connected to single phase voltage; All three terminals connected to 3-phase voltage; Voltage specification, 200~240V $^{+10\%}_{-15\%}$, 50/60Hz.
Control power input terminal	L1C, L2C	Connected to single phase voltage, 200~240V $^{+10\%}_{-15\%}$, 50/60Hz.
External regenerative resistor connection terminal	B1, B2, B3	If regenerative resistor capacity is insufficient, connect external one (optional) between B1-B2; If the capacity of inner regenerative resistor is insufficient, remove the wiring between B2-B3 to alter it from short circuit (default) to open circuit, and connect an external regenerative resistor to terminals B1 and B2.

Name	Symbol	Description
Connection terminal for high harmonic restraint DC reactor	1, 2	When high harmonic restraint to power is needed, connect a DC reactor between terminals 1 and 2, which is in short circuit when leaving factory; when it is not needed, please make sure terminals 1 and 2 is short-circuited.
Main circuit front side terminal	1	When DC power input is used for main circuit.
Main circuit side terminal	2	
Connection terminal for motor	U, V, W	Used to connect with servo motor.
Grounding terminal (2)	⏚	Grounding point of AC and motor power line.

2.2.2 Main Circuit Cable Specification

- **Cautions**

1. Allowable temperature: 40℃, which is the specification for rated current flowing through 3 lines.
2. Please use electric wire which can withstand 600V voltage or more.
3. Please consider attenuation coefficient of allowable current, when put binding wires into hard PVC or mental pipe.
4. Because the common PVC wire, which has a faster thermal aging speed, cannot be used anymore after a short term, please use heat resistant wire when ambient or cabinet temperature is very high.

- **Types of cable**

Type		Allowable temperature of conductor (℃)
Symbol	Name	
IV	600V PVC wire	60
HIV	Special heat-resistant PVC wire	75

Relationship between wire diameter and allowable current when 3 wires are used is shown in table below. Values in the table are the maximal specifications in real practice. (Note: the data in table below are the reference value when use 600V special heat-resistant PVC wire.)

AWG Specification	Nominal Cross Section Area (mm^2)	Constitution (wires/ mm^2)	Conductor Resistance (Ω/km)	Allowable Current Under Different Ambient Temperature (A)		
				30℃	40℃	50℃
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

AWG Specification	Nominal Cross Section Area (mm^2)	Constitution (wires/ mm^2)	Conductor Resistance (Ω/km)	Allowable Current Under Different Ambient Temperature (A)		
				30℃	40℃	50℃
14	2.0	7/0.6	9.53	23	20	16
12	3.5	7/0.8	5.41	33	29	24
10	5.5	7/1.0	3.47	43	38	31
8	8.0	7/1.2	2.41	55	49	40
6	14.0	7/1.6	1.35	79	70	57

- **Main circuit cable specification**

	External Terminal Name	Symbol	Cable Specification					
			1R2	2R8	5R0	6R8	110	140
Three-phase 200V	Main circuit power input terminal	L1, L2, L3	HIV1.25 (AWG16)			HIV2.0 (AWG14)		
	Control power input terminal	L1C, L2C	HIV1.25 (AWG16)					
	Connection terminal for motor	U, V, W	HIV1.25 (AWG16)			HIV2.0 (AWG14)		
	External regenerative resistor connection terminal	B1, B2	HIV1.25 (AWG16)					
	Grounding terminal	⏚	HIV2.0 (AWG14) or above					
Single-phase 200V	Main circuit power input terminal	L1, L2, L3 (any two)	HIV1.25			HIV2.0		
	Control power input terminal	L1C, L2C	HIV1.25					
	Connection terminal for motor	U, V, W	HIV1.25			HIV2.0		
	External regenerative resistor connection terminal	B1, B2	HIV1.25					
	Grounding terminal	⏚	HIV2.0 or above					

2.2.3 Cautions for Wiring

- **Main cautions**

1. If the servo driver is directly connected to commercial power supply without using transformer or other devices to isolate, to avoid the servo system contacting with peripheral components, circuit breaker (QF) or protection fuse is needed.
2. There is no inner grounding short circuit in servo driver, so in order to structure a secure system, please equip an electric leakage circuit breaker with over-load, short protection, or together with wiring circuit breaker to install a short protection electric leakage circuit breaker.
3. Do not turn ON/OFF power frequently. Relatively large amount of charging current will occur when power-ON because the power component has capacitor. For this reason, frequent turning ON/OFF power will result in decreased performance of main circuit components.

- **Cautions in wiring**

1. Please shorten the length of cable when designing or arranging the system.
2. Follow cautions below in main circuit wiring:
   a) Use twisted-pair shield wire or stranded shield wire for I/O signal cable or encoder cable.
   b) Maximal length of I/O signal cable is 3m, and maximal length of encoder cable is 20m.
3. Follow cautions below in ground connection:
   a) Use bold wire (2.0mm^2 or more) as you can for ground connection.
   b) It is recommended to use ground cable with 100Ω below resistance.
   c) It must be single point grounding.
   d) If the servo motor is insulated from mechanical parts, ground connecting the motor.
4. Do not bend or pull the cable too tight.

- **Power-control input setup**

When designing power-control input setup, please take the following points into consideration:

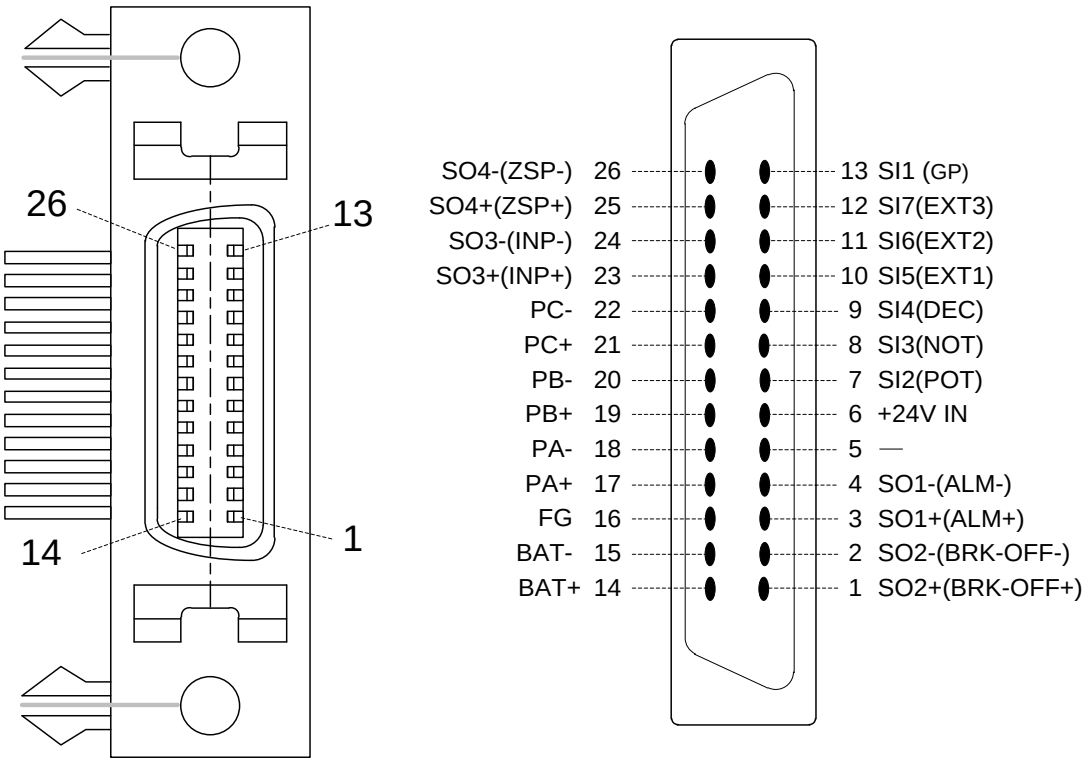
1. Set up as follows: after “Servo alarm” signal output, main circuit power is in OFF status.
2. Power specification of used parts should match with the input power specification.

WARNING

When connecting control power and main circuit power, please turn on main circuit power after control power ON for 1 sec, or turn on two kinds of power at the same time. Similarly, please cut off two powers simultaneously or cut off main circuit power after control power OFF.

2.3 Wiring of CN2 I/O Signal

2.3.1 Illustration of CN2 I/O Connector



CAUTION

1. CN2 joints and CNC system cables can be ordered, if you use the CNC system designed by Weihong Electronic Technology Co., Ltd.
2. Please connect shield layer of I/O signal cable with case of connector, and make frame grounding (FG) through the driver connector.
3. The signals in bracket are default signal when leaving factory, and pin 5 is disabled.
4. Following pins can be allocated to different I/O signals. Although 3/4 (S01) has been specified to output alarm signal, it cannot be allocated anymore. Refer to section 2.4 for the available I/O signals.

   Input: 13 (SI1), 7 (SI2), 8 (SI3), 9 (SI4), 10 (SI5), 11 (SI6), 12 (SI7)

   Output: 1/2 (SO2), 23/24 (SO3), 25/26 (SO4)

Signal Name	Pin No.	Default Signal	Description	
Input signal				
SI1	13	GP	Common input	
SI2	7	POT	Positive over-travel	When machine moves out of limits, stop motor driving

Signal Name	Pin No.	Default Signal	Description	
			inhibition	(over-travel protection function).
SI3	8	NOT	Negative over-travel inhibition	
SI4	9	DEC	Deceleration limit switching	
SI5	10	EXT1	3 external locks signal input	
SI6	11	EXT1		
SI7	12	EXT1		
+24V IN	6	+24V IN	Power input: Allowable voltage range: +11V~+25V (+24V power is prepared by the user).	
Output signal				
—	17 18	PAO /PAO	A-phase signal	Division pulse output signal of 90 degree phase-deviation encoder.
	19 20	PBO /PBO	B-phase signal	
	21 22	PCO /PCO	C-phase signal	Output signal of origin pulse.
—	Case	FG	If the shield layer of I/O signal cable has been connected to the case of connector, frame grounding has been made.	
SO1	3/4	ALM	Output signal in alarm status.	
SO2	1/2	BRK-OFF	Time sequence signal of electric-magnetic brake action is fed out. Release time sequence of electric-magnetic brake and connect with transistor.	
SO3	23/24	INP	Output positioning complete signal. Turn transistor ON at positioning complete status.	
SO4	25/26	ZSP	Output zero-speed clamp detection signal. Turn transistor ON at zero-speed clamp detection status.	

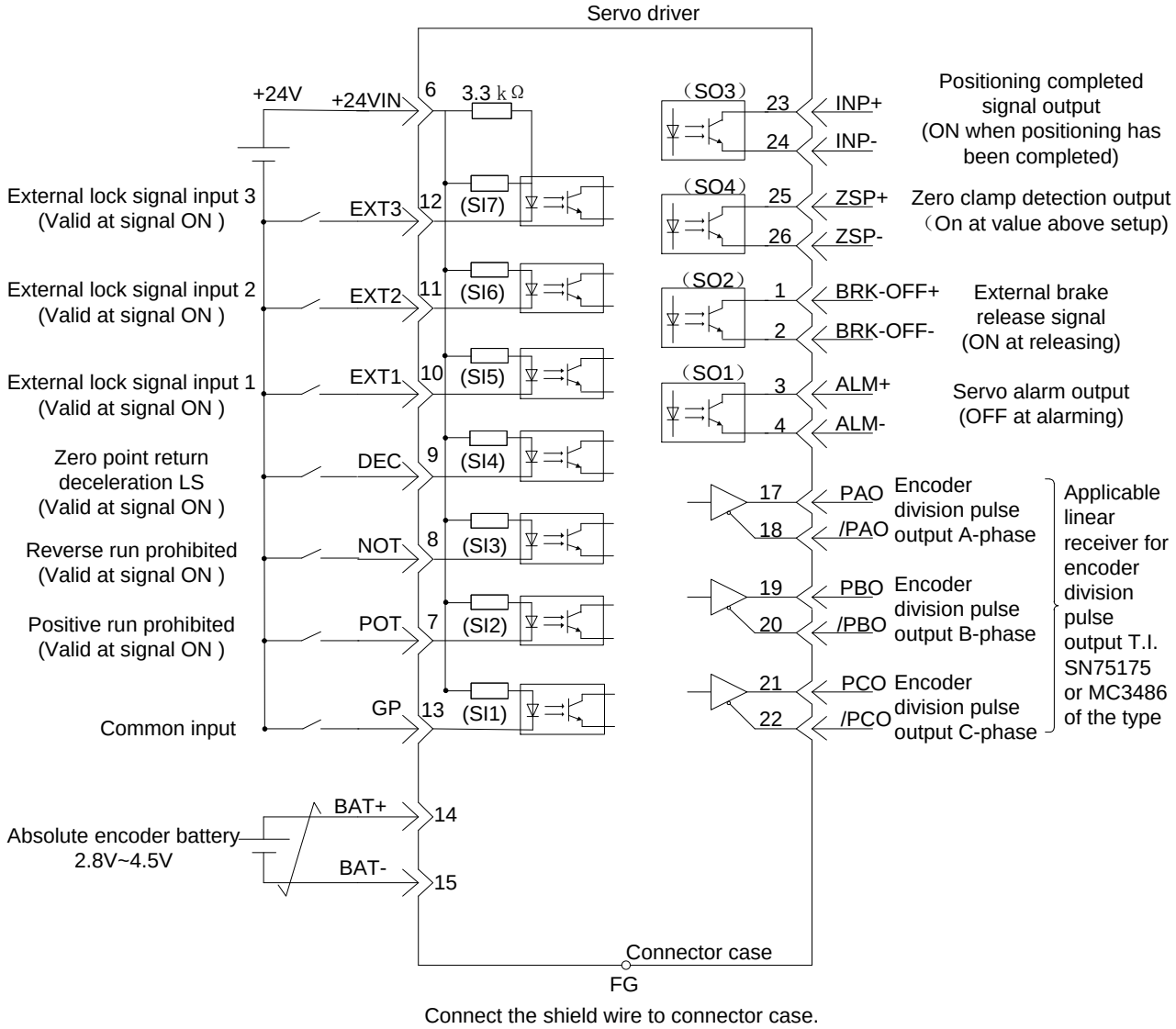
CAUTION

I/O signal allocation for SI1~SI7 and SO1~SO4 can be changeable. Refer to “2.4 I/O Signal Allocation” for details.

All default signals in this table are the default signals under position control mode when leaving factory.

2.3.2 Connection Examples in Three Control Mode

- **Connection example of I/O signal connector in position control**

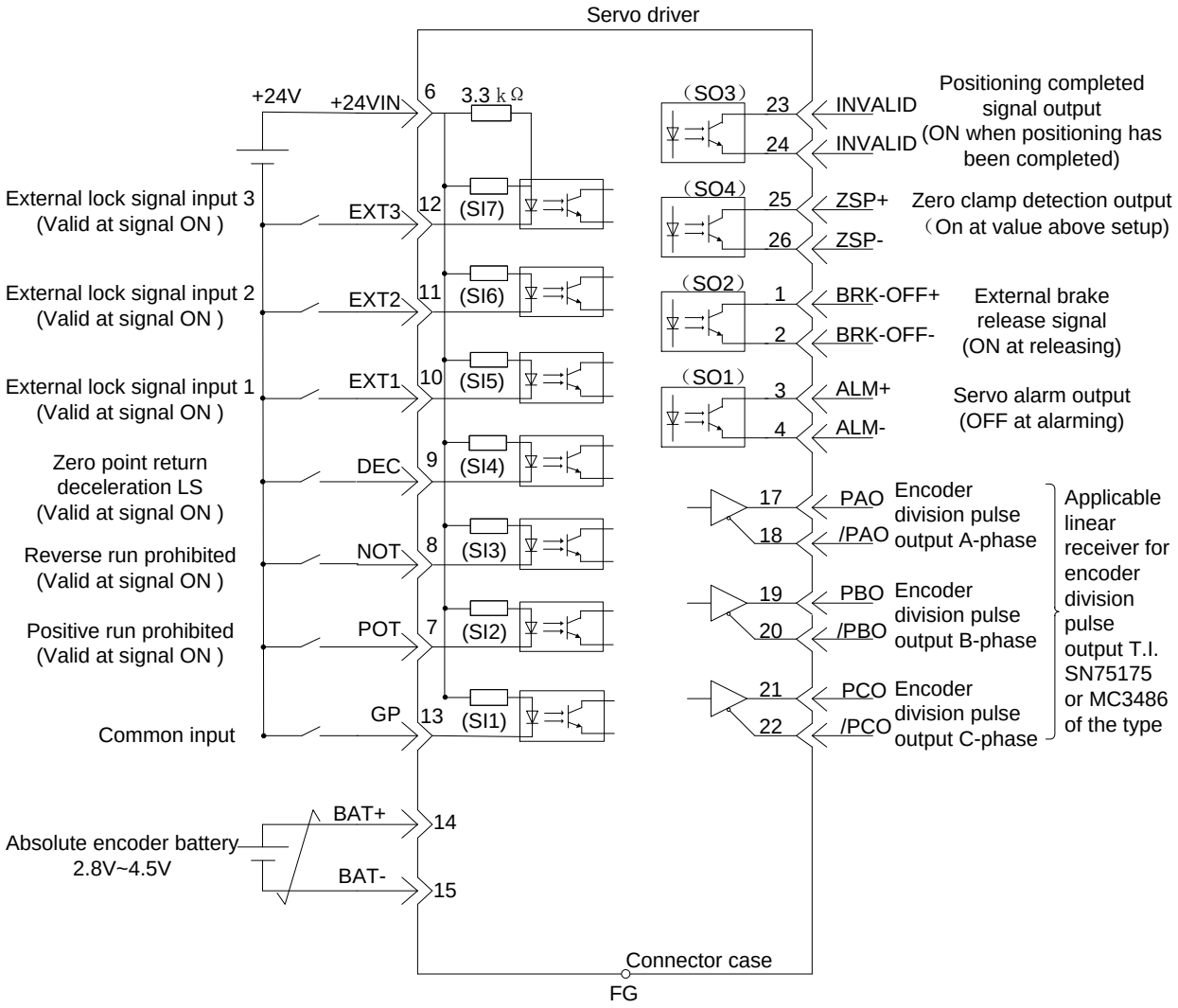


Connect the shield wire to connector case.

CAUTION

1. ⎍ represents twisted-pair wires.
2. DC24V power supply should be prepared by user.
3. Bus command supports position control mode.

- **Connection example of I/O signal connector in velocity control**

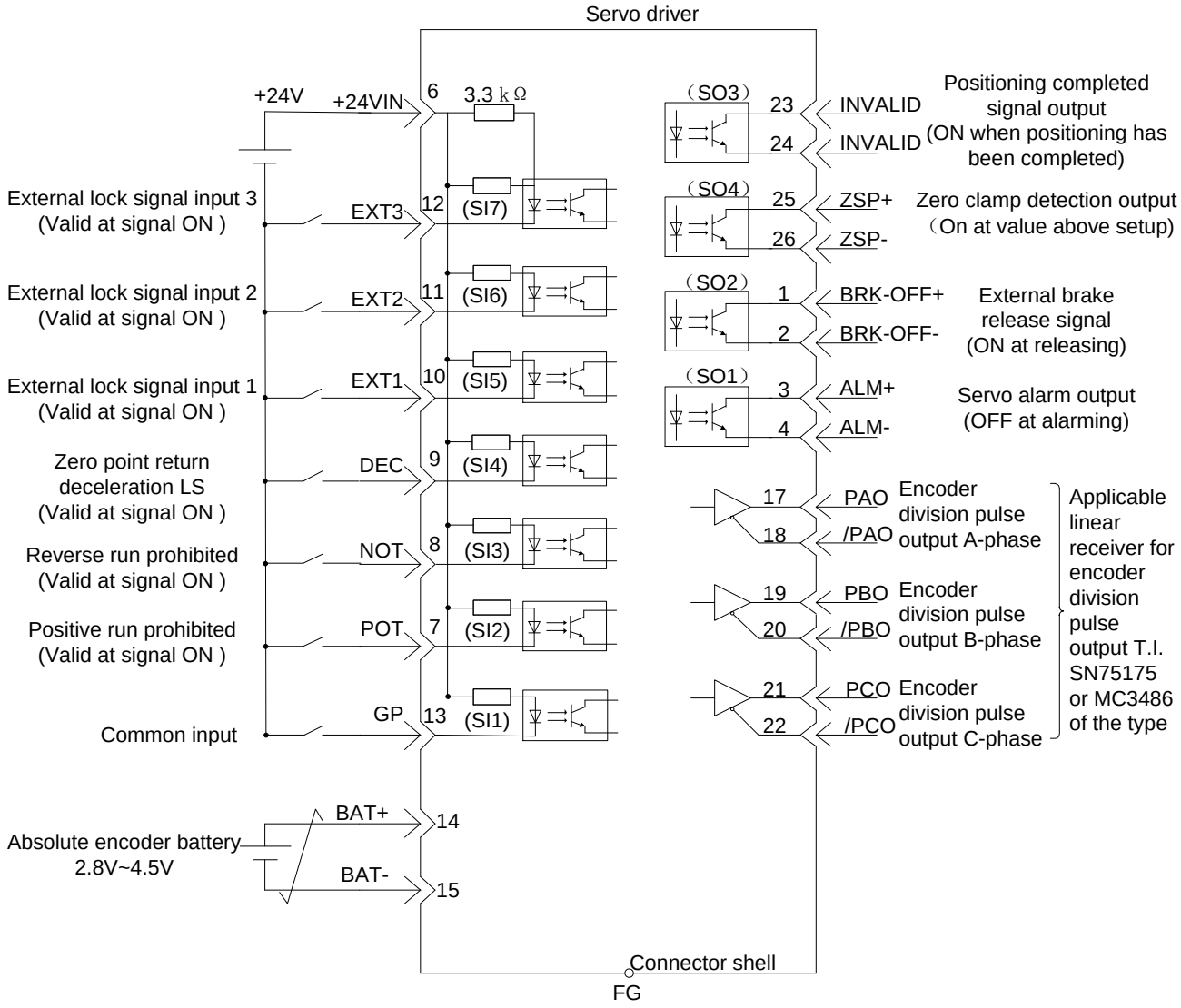


Connect the shield wire to connector case.

CAUTION

1. ⎍ represents twisted-pair wires.
2. DC24V power supply should be prepared by user.
3. Bus command does not support position control mode.

- **Connection example of I/O signal connector in torque control**



CAUTION

1. Torque command is set by Pr601 “Torque command setup”.
2. DC24V power supply should be prepared by user.
3. Bus command does not support torque control mode.

2.4 I/O Signal Allocation

2.4.1 Default Allocation Status of Input Signal

Pin No.	Port No.	Para.	Default	Factory Setting Layout					
				Position Control		Velocity Control		Torque Control	
				Signal Name	Logic	Signal Name	Logic	Signal Name	Logic
13	SI1	Pr400	002E2E2EH (3026478)	GP	a contact	GP	a contact	GP	a contact
7	SI2	Pr401	00818181H (8487297)	POT	b contact	POT	b contact	POT	b contact
8	SI3	Pr402	00828282H (8553090)	NOT	b contact	NOT	b contact	NOT	b contact
9	SI4	Pr403	00222222H (2236962)	DEC	a contact	DEC	a contact	DEC	a contact
10	SI5	Pr404	00202020H (2105376)	EXT1	a contact	EXT1	a contact	EXT1	a contact
11	SI6	Pr405	00212121H (2171169)	EXT2	a contact	EXT2	a contact	EXT2	a contact
12	SI7	Pr406	002B2B2BH (2829099)	EXT3	a contact	EXT3	a contact	EXT3	a contact

CAUTION

1. Pins function can be changed by setting relevant parameter.
2. A-contact means function is active low, while b-contact means function is active high. See following for details.

   a-contact: function is disabled when input signal is disconnected with COM (OFF); function is enabled when input signal is connected with COM (ON).

   b-contact: function is enabled when input signal is disconnected with COM (ON); Function is disabled when input signal is connected with COM (OFF).

2.4.2 Signal Which Can Be Allocated to Control Input

Signal Name	Symbol	Default	Related Mode		
Common input	GP	13(SI1)	P	S	T

Description:

- Used for common input.

Signal Name	Symbol	Default	Related Mode		
Positive direction over-travel inhibition input	POT	7 (SI2)	P	S	T

Description:

- It is positive over-travel inhibition input.
- When this input is ON, action can be set by parameter Pr504 “Over-travel inhibition input setup”.
- To enable it, please set Pr504 “Over-travel inhibition input setup” as 0. If machine is able to move beyond the positive travel range, turn this input signal to ON.

Signal Name	Symbol	Default	Related Mode		
Negative direction over-travel inhibition input	NOT	8 (SI3)	P	S	T

Description:

- It is negative over-travel inhibition input.
- When this input is ON, action can be set by parameter Pr504 “Over-travel inhibition input setup”.
- To enable it, please set Pr504 “Over-travel inhibition input setup” as 0. If machine is able to move beyond the negative travel range, turn this input signal to ON.

Signal Name	Symbol	Default	Related Mode		
Zero point return deceleration LS input	DEC	9 (SI4)	P	S	T

Description:

- Velocity switching input when returning to zero point.

Signal Name	Symbol	Default	Related Mode		
External lock signal input 1	EXT1	10 (SI5)	P	S	T
External lock signal input 2	EXT2	11 (SI6)	P	S	T
External lock signal input 3	EXT3	12 (SI7)	P	S	T

Description:

- Used for external lock signal input.

Signal Name	Symbol	Default	Related Mode		
Alarm clear input	A-CLR	—	P	S	T

Description:

- Used to clear alarm/warning status.
- This function can only clear the alarms with clearable attribute. For attribution of alarm, refer to chapter 7 “Alarm Description”.

Signal Name	Symbol	Default	Related Mode		
Servo-ON input	SRV-ON	—	P	S	T

Description:

- Servo-ON control signal (power on/off the motor).

Signal Name	Symbol	Default	Related Mode		
Gain switching input	GAIN	—	P	S	T

Description:

- To switch the 1st/2nd gain.

Signal Name	Symbol	Default	Related Mode		
Deviation counter clear input	CL	—	P	S	T

Description:

- Clear positional deviation counter.

Signal Name	Symbol	Default	Related Mode		
Command pulse inhibition input	INH	—	P	S	T

Description:

- Ignore positional command pulse.
- Please set Pr518 “Command pulse inhibition input validation setup” as 0.

Signal Name	Symbol	Default	Related Mode		
Torque limit switching input	TL-SEL	—	P	S	T

Description:

- To switch 1st /2nd torque limit, refer to “Setting of change rate during torque limit switching” for detailed description.

Pr521	Torque limit switching input	Torque Limit Switching Setup	CW Torque Limit	CCW Torque Limit
1	—	—	Pr0	
2	—	—	Pr013	Pr522
3	OFF	Valid	Pr013	
	ON		Pr522	
6	OFF	—	Pr013	Pr522
	ON		Pr525	Pr526

Signal Name	Symbol	Default	Related Mode		
Command division/multiplication switching input 1	DIV1	—	P	S	T
Command division/multiplication switching input 2	DIV2	—	P	S	T

Description:

- When DIV1 and DIV2 are used as numerator switching input of command division/multiplication, up to 4 can be switched.
- The relationship between DIV2/DIV2 and numerator/denominator of command division/multiplication is shown as below:

DIV1	DIV2	Command Division/Multiplication Treatment	
		Numerator	Denominator
OFF	OFF	Pr009	Pr010
ON	OFF	Pr500	Pr010
OFF	ON	Pr501	Pr010
ON	ON	Pr502	Pr010

Signal Name	Symbol	Default	Related Mode		
Internal command velocity selection 1	INTSPD1	—	P	S	T
Internal command velocity selection 2	INTSPD2	—	P	S	T
Internal command velocity selection 3	INTSPD3	—	P	S	T

Description:

- Select internal command velocity 1~8. For detailed description, please refer to the table below. This table shows the relationship among Pr300 “Internal and external switching of velocity setting”, internal velocity command selection 1~3, and velocity command selection.

Pr300	Internal Command Velocity Selection 1 (INTSPD1)	Internal Command Velocity Selection 2 (INTSPD2)	Internal Command Velocity Selection 3 (INTSPD3)	Velocity Command Selection
1	OFF	OFF	No effect	1st
	ON	OFF		2nd
	OFF	ON		3rd
	ON	ON		4th
2	OFF	OFF	No effect	1st
	ON	OFF		2nd
	OFF	ON		3rd
3	Same with Pr300=1		OFF	1st~4th
	OFF	OFF	ON	5th
	ON	OFF	ON	6th
	OFF	ON	ON	7th
	ON	ON	ON	8th

Signal Name	Symbol	Default	Related Mode		
Zero-speed clamp input	ZEROSPD	—	P	S	T

Description:

- Set velocity command as 0.
- To enable this function, please set Pr315 “Zero-speed clamp function selection” ≠0.

Signal Name	Symbol	Default	Related Mode		
Velocity command symbol input	VC-SIGN	—	P	**S**	T

Description:

- Specify velocity command input symbol when velocity control mode is enabled.
- Refer to Pr301 “Specify selection of velocity command direction” for details.

Signal Name	Symbol	Default	Related Mode		
Torque command symbol input	TC-SIGN	—	P	S	**T**

Description:

- Specify torque command input symbol when torque control mode is enabled.
- ON: CCW OFF: CW
- Refer to Pr318 “Specify selection of torque command direction” for details.

Signal Name	Symbol	Default	Related Mode		
Forced alarm input	E-STOP	—	**P**	**S**	**T**

Description:

- Specify forced alarm input symbol when velocity control mode is enabled.
- Err87.0 “Forced alarm input exception” occurs, when there is signal input.

Signal Name	Symbol	Default	Related Mode		
Absolute data request signal	SEN	—	**P**	**S**	**T**

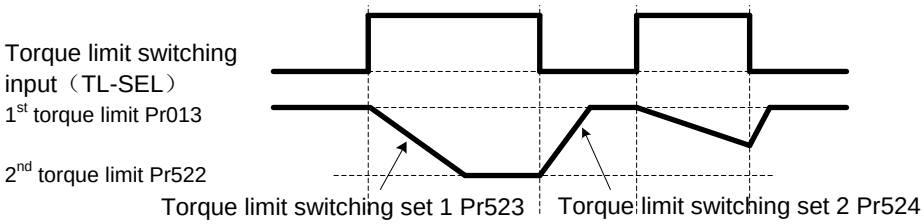
Description:

- Initial absolute data request.

- **Setting of change rate during torque limit switching**

When Pr521 “Torque limit section” is set as 3, torque limit value can be switched in accordance with a certain slope.

1. When switching from 1st torque limit to 2nd torque limit, changing slope set by Pr523 “Torque limit switching setting 1” is applicable;
2. When switching from 2nd torque limit to 1st torque limit, changing slope set by Pr524 “Torque limit switching setting 2” is applicable;
3. The symbol of changing rate, also called slope, could be automatically switched in driver according to the relationship between 1st torque limit and 2nd torque limit. If Pr523 “Torque limit switching setting 1” and Pr524 “Torque limit switching setting 2” are set to 0, switching will execute immediately.



CAUTION

When switching the 1st torque limit (Pr013) and 2nd torque limit via the front panel or communication, the switched torque limit will take effect immediately, regardless of changing rate. Only when switching according to torque limit switching input (TL-SEL), the changing rate is valid.

2.4.3 Default Allocation Status of Output Signal

Functions can be allocated to pins, while the logic cannot be changed.

(Note: functions can be changed by setting relevant parameters. Among them, 3/4 (SO1) is fixed to output alarm signal.)

Pin No.	Port No.	Parameter	Default setup	Leaving Factory Setup Status		
				Position Control	Velocity Control	Torque Control
3/4	SO1	Pr408	00010101H (65793)	ALM	ALM	ALM
1/2	SO2	Pr409	00030303H (197379)	BRK_OFF	BRK_OFF	BRK_OFF
23/24	SO3	Pr410	00000004H (4)	INP	INVALID	INVALID
25/26	SO4	Pr411	00070707H (460551)	ZSP	ZSP	ZSP

2.4.4 Function Which Can Be Allocated to Control Output

Signal Name	Symbol	Default	Related Mode		
Servo alarm output	ALM	3/4（SO1）	P	S	T

Signal Name	Symbol	Default	Related Mode		
External brake release signal	BRK-OFF	1/2（SO2）	P	S	T

Description:

- Output time sequence signal which can control electrical magnetic brake action.
- Release time sequence of electrical magnetic brake to make output transistor conducted.

Signal Name	Symbol	Default	Related Mode		
Positioning complete	INP	23/24（SO3）	P	S	T

Description:

- Output positioning complete signal 1.
- After positioning completed, turn output transistor to ON.

Signal Name	Symbol	Default	Related Mode		
Zero-speed clamp detection signal	ZSP	25/26（SO4）	P	S	T

Description:

- Output zero-speed clamp detection signal.
- Under zero-speed clamp detection condition, turn output transistor to ON.

Signal Name	Symbol	Default	Related Mode		
Servo ready output	S-RDY	—	P	S	T

Description:

- Output signal when servo driver is power on.
- After confirm the control power and main power of servo driver are normal and both of them are not in alarm status, turn on output transistor.
- In addition, when I/F function of the reducer in absolute mode is enabled, except above conditions, turn output transistor to ON when absolute data transmission completed.

Signal Name	Symbol	Default	Related Mode		
Speed arrival output	AT-SPPED	—	P	S	T

Description:

- Output speed arrival signal.
- Under speed arrival condition, turn output transistor to ON.

Signal Name	Symbol	Default	Related Mode		
Torque in-limit signal output	TLC	—	P	S	T

Description:

- Output torque in-limit signal.
- Under torque in-limit condition, turn output transistor to ON.

Signal Name	Symbol	Default	Related Mode		
Velocity coincidence output	V-COIN	—	P	S	T

Description:

- Output velocity coincidence signal.
- Under velocity coincidence condition, turn output transistor to ON.

Signal Name	Symbol	Default	Related Mode		
Alarm output 1	WARN1	—	P	S	T

Description:

- Output alarm output signal set by Pr439 “Alarm output selection 1”.
- When alarm occurs, turn output transistor to ON.

Signal Name	Symbol	Default	Related Mode		
Alarm output 2	WARN2	—	P	S	T

Description:

- Output alarm output signal set by Pr440 “Alarm output selection 2”.
- When alarm occurs, turn output transistor to ON.

Signal Name	Symbol	Default	Related Mode		
Positional command output	P-CMD	—	P	S	T

Description:

- When there is position command, turn output transistor to ON.

Signal Name	Symbol	Default	Related Mode		
Positioning complete 2	INP2	—	**P**	S	T

Description:

- Output positioning complete signal 2.
- After positioning completed, turn output transistor to ON.
- INP2 is completely unaffected by Pr431 “Positioning complete output setup”.

Signal Name	Symbol	Default	Related Mode		
Velocity in-limit output	V-LIMIT	—	P	S	**T**

Description:

- Under velocity in-limit condition with torque control mode is enabled, turn output transistor to ON.

Signal Name	Symbol	Default	Related Mode		
Alarm attribution output	ALM-ATB	—	**P**	**S**	**T**

Description:

When clearable alarm exists, turn output transistor to ON.

Signal Name	Symbol	Default	Related Mode		
Velocity command output	V-CMD	—	P	**S**	T

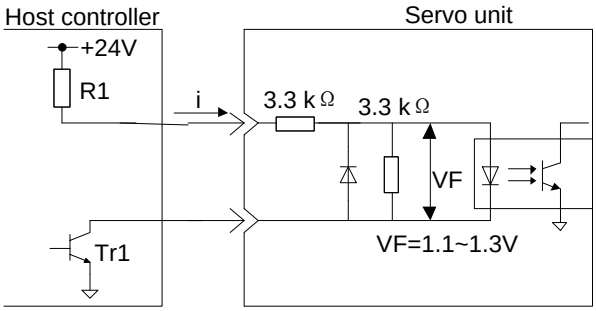
Description:

- When there is velocity command, turn output transistor to ON.

2.5 Wiring Example of CN2 Connector

2.5.1 Wiring Example of Input Loop and Servo Driver

SI1~SI7 input ports can support the open collector output loop used for the host controller. The connecting example is shown as below.



Input current range : 5mA~10mA
Open collector output (power prepared by user)

2.5.2 Wring Example of Output Loop and Servo Driver

There are two types of signal output loop.

- **Optoelectronic coupler output loop**

The output loop of pins 1~4 and 23~26 on CN2 are optoelectronic coupler output loop. Here are two examples.

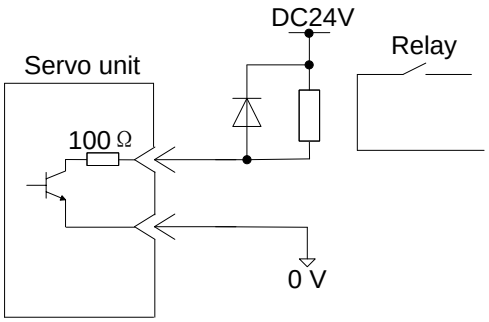


Fig. 2-1 Example of relay loop

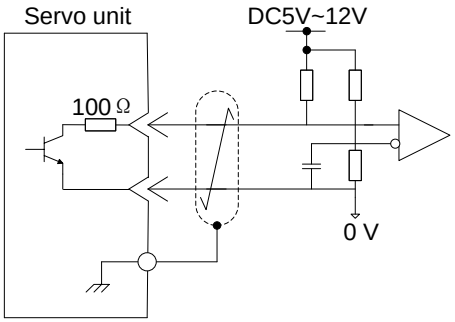
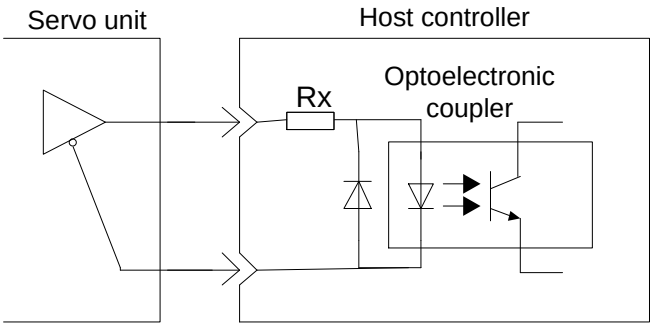


Fig. 2-2 Example of line receiver loop

- **Line driver output loop**

In CN2 connector, terminals 17/18 (A-phase signal), 19/20 (B-phase signal), and 21/22 (C-phase signal) adopt line driver output loop. Below is an example.



Calculate Rx according to actual situation of the circuit

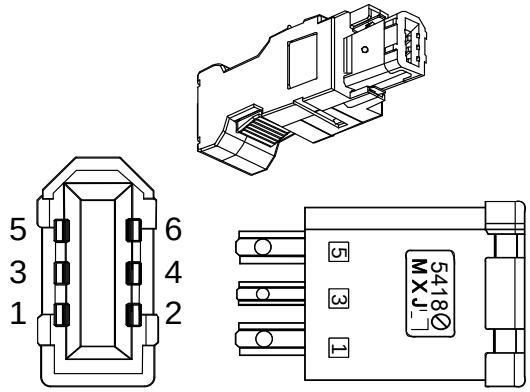
Switch encoder serial data to 2-phase (A-phase and B-phase) pulse output signal (PAO /PAO, PBO /PBO) and origin pulse signal (PCO/PCO), and feed them out via linear driver output loop.

2.6 Wiring Example of CN4 Connector

WISE series servo driver supports serial 17-bit, 23-bit and 20-bit communication encoder. This section gives introduction to the wiring of CN4 connector, position feedback signal and motor side encoder feedback signal of WISE series servo driver.

2.6.1 CN4 (Driver Encoder Connector)

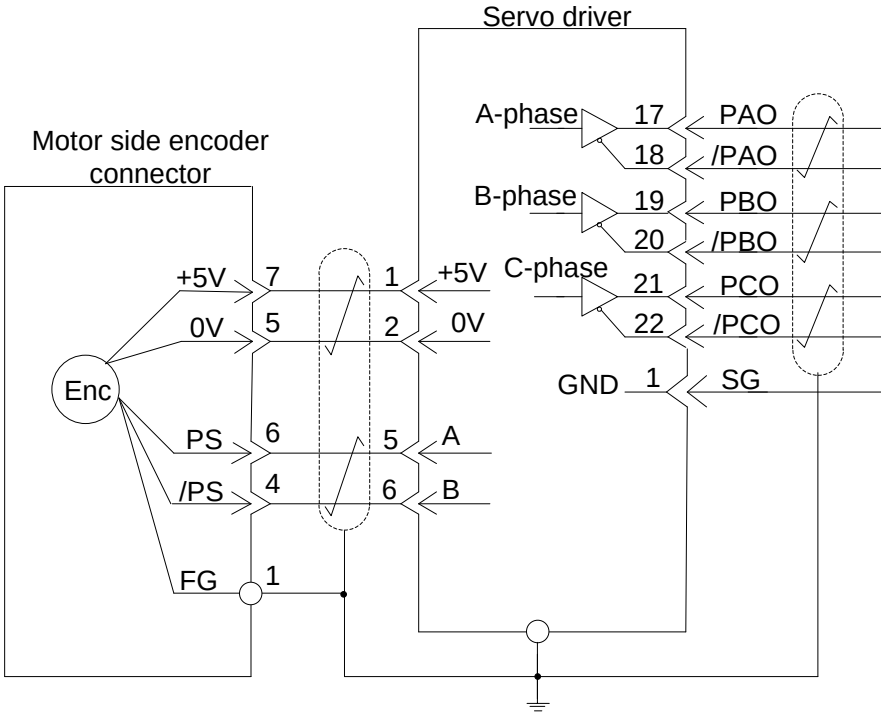
The terminal arrangement of CN4 driver encoder connector is shown as below:



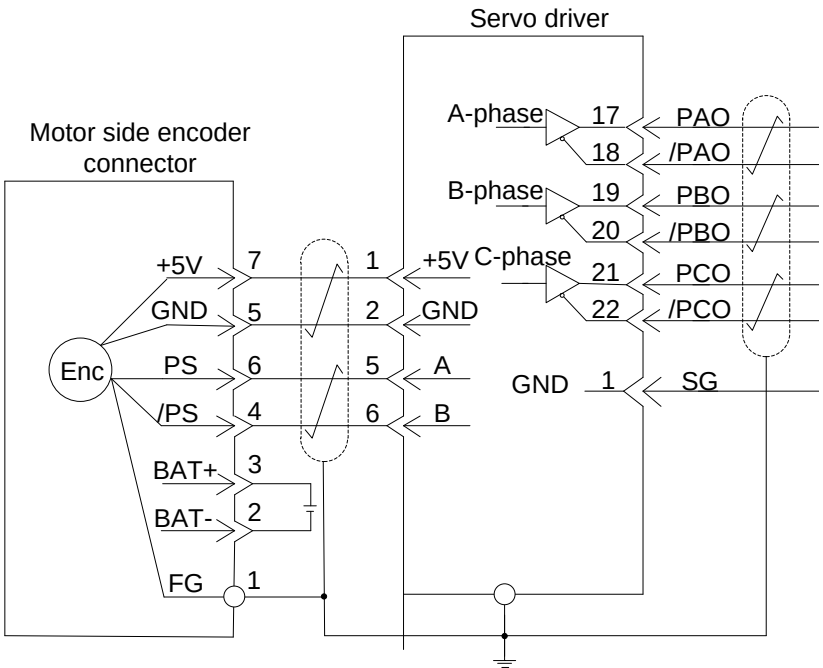
Pin	Signal	Description
1	+5V	Power supply +5V
2	⏚	Ground
3	—	—
4	—	—
5	A	Serial signal +
6	B	Serial signal -

2.6.2 Wiring Example of MA/MN/ME/MB Series Motor Encoder

- **17-bit incremental encoder**



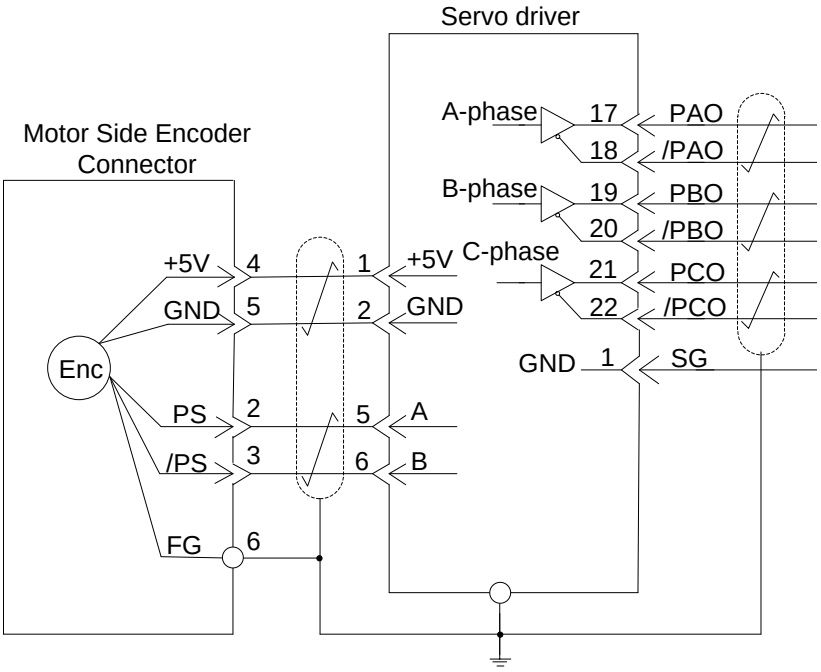
- **17/23-bit absolute encoder**



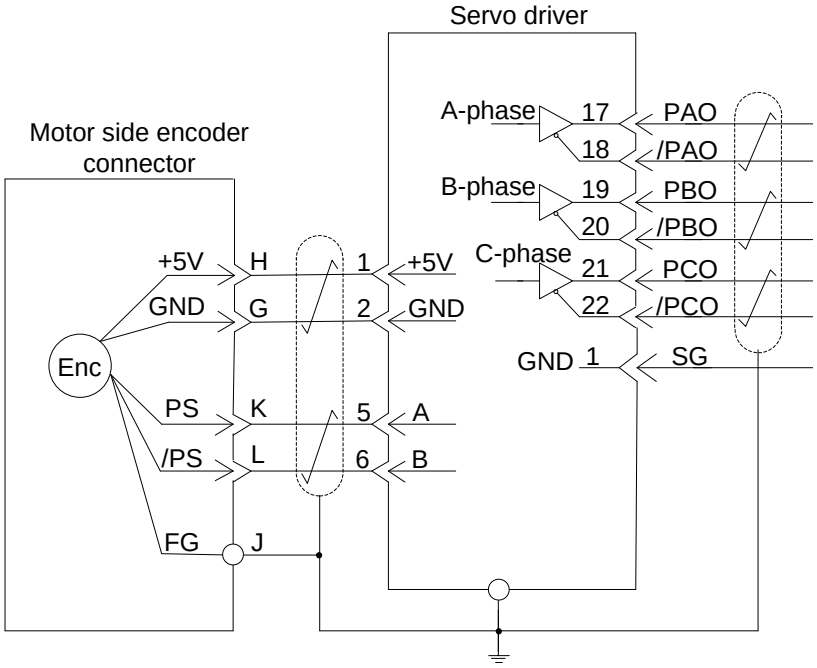
2.6.3 Wiring Example of Panasonic A5/A5-II Series Motor Encoder

- **20-bit incremental encoder**

Following is wiring of 20-bit incremental encoder used in MHMD, MHMJ, and MSMD series motor (750W or less).

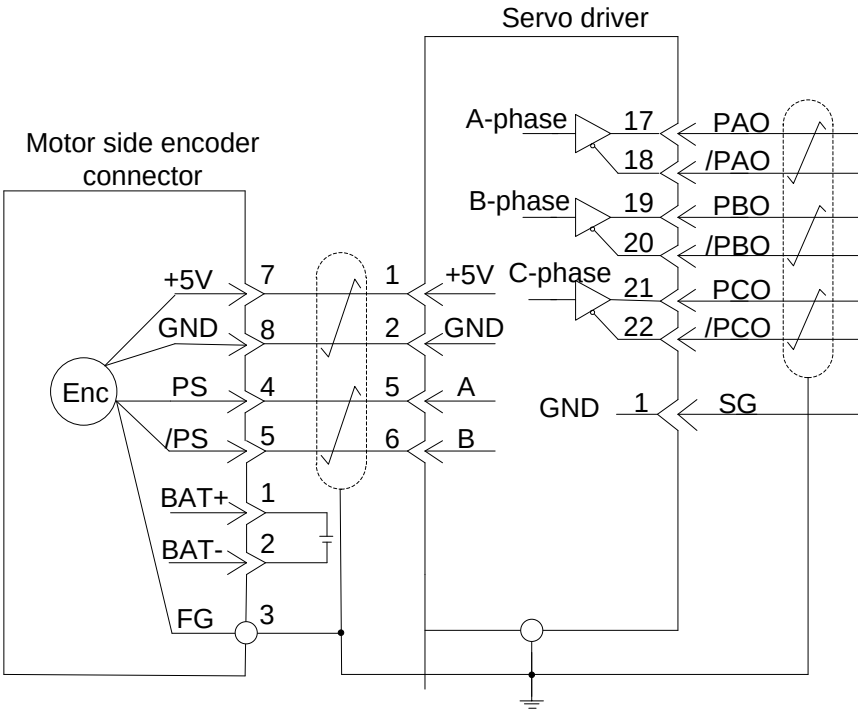


Following is wiring of 20-bit incremental encoder used in MHMD and MHME series motor (1.0 kW or less).

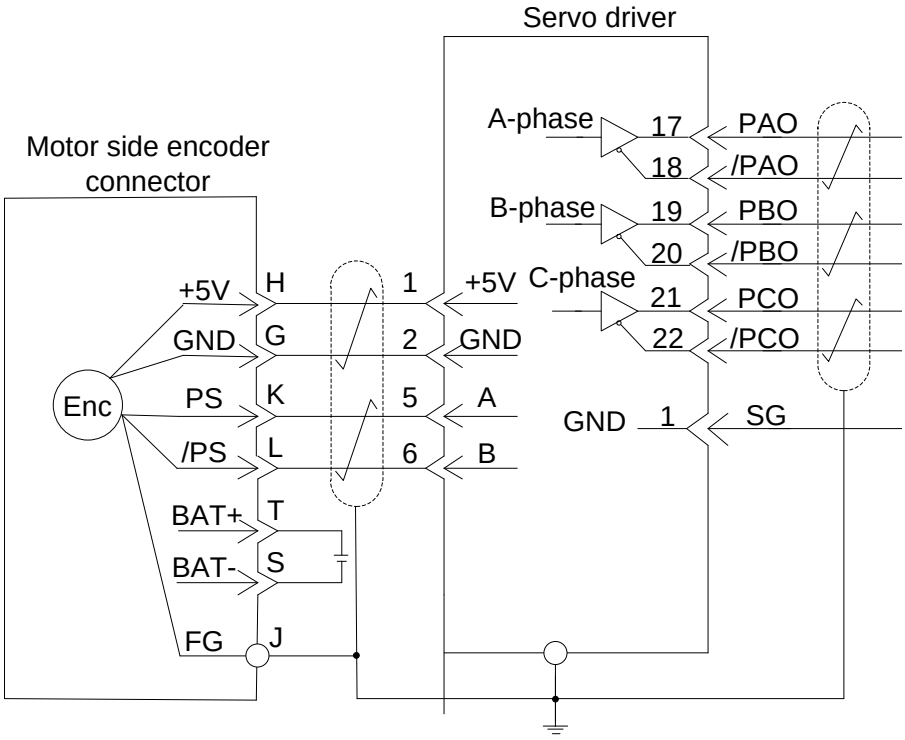


- **17-bit absolute encoder**

Following is wiring of 17-bit absolute encoder used in MHMD, MHMJ, and MSMD series motor (750W or less).



Following is wiring of 17-bit absolute encoder used in MHMD and MHME series motor (1.0kW or above).



2.7 Regenerative Resistor

When the directions of motor torque and rotation are opposite, the motor will change from rotating status to regenerating status. Regenerative energy will be fed back to DC circuit, after rectified by diode. Because the energy in DC circuit cannot be fed back to power grid, and can only be absorbed by the capacitor of driver, 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 driver will be damaged due to the high DC voltage. Regenerative resistor can be connected both internally and externally.

2.7.1 Capacitance Calculation of Regenerative Brake Resistor

- **Specifications of Regenerative Brake Resistor**

Driver Model	Internal Brake Resistor		Min. Allowable Resistance of External Regenerative Resistor (Ω)	Min. Allowable Power of External Brake Resistor (W)
	Resistance (Ω)	Power Pr(W)		
WSDV-1R2-	—	—	40	20
WSDV-2R8-	—	—	40	80
WSDV-5R0-	50	40	30	150
WSDV-6R8-	50	40	30	200
WSDV-110-	20	50	20	300
WSDV-140-	20	50	20	500

Check parameter Pr017 for the recommended specification of external resistor. Refer to section 9.1 for more details about Pr017.

- **Energy handled by single internal capacitor**

Table 2-1 Absorbable energy regenerated in WISE series driver

Driver Model	Power (W)	Absorbable Regenerated Energy (J)
WSDV-1R2-	100	9
WSDV-2R8-	400	18
WSDV-5R0-	750	36
WSDV-6R8-	1000	36
WSDV-110-	1500	59
WSDV-140-	2500	59

- **Rotation energy calculation of servo system**

The rotation energy (Es) of servo system can be calculated according the following equation.

$$Es = \frac{1}{2} * J * \omega^2 = \frac{1}{2} * J \times (Spd * \frac{\pi}{30})^2 = J * Spd^2 / 182(J)$$

$J = J_M + J_L$

J_M : Rotational inertia of servo motor ($kg \cdot m^2$)

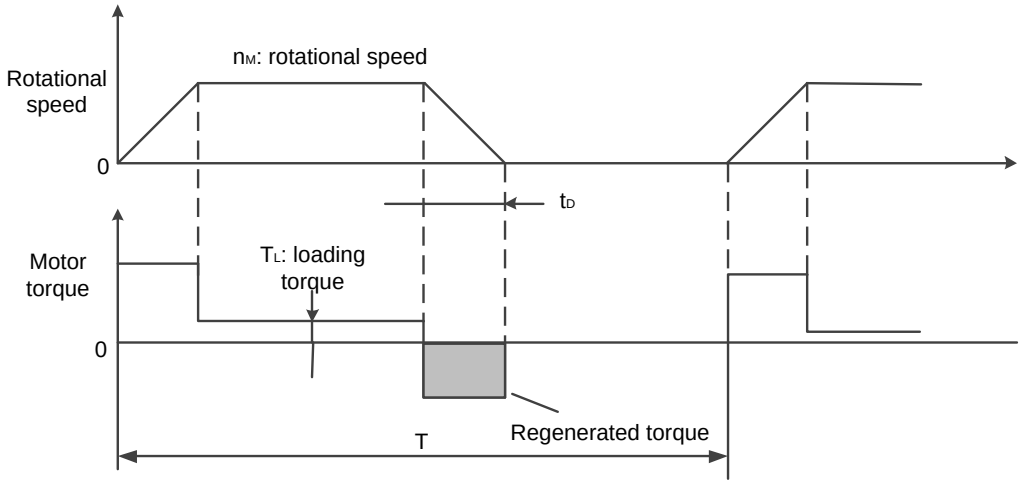
J_L: Rotational inertia of motor axis load ($kg \cdot m^2$)

ω: Angular speed of servo motor (rad/s)

Spd : Rotaional speed of servo motor (r/min)

- **Capacitance calculation of regenerative resistor**

Below is a sketch of motor run cycle.



When the motor accelerates or decelerates according to the cycle shown above, the capacitance of regenerative resistor can be calculated in the following steps.

Step	Items to be calculated	Symbol	Equation
1	Rotation energy of servo system	E_S	$Es = J * Spd^2 / 182$
2	Energy consumed by load system during deceleration	E_L	$E_L = (\pi / 60) * Spd * T_L * t_D$ (Set as zero if not sure)
3	Energy consumed by coil resistor of servo motor	E_M	Neglected
4	Absorbable energy by servo unit	E_C	See Table 2-1
5	Energy consumed by regenerative resistor	E_K	$E_K = Es - (E_L + E_M + E_C)$
6	Necessary capacity W of regenerative resistor	W_K	$W_K = E_K / (0.3 * T)$

Note: In the W_K equation, “0.3” represents that the load ratio of regenerative resistor is 30%.

W_K : Necessary capacity of regenerative resistor(W)

J: = $J_M + J_L$ (kg•m^2)

Spd : Rotational speed of servo motor (r/min)

T_L : Load torque (N•m)

t_D : Deceleration stop time (s)

T : Repeated cycles of *s*ervo motor (s)

In actual calculation, the energy consumed by load system can be neglected. You can calculate the necessary capacitance of servo system only by the rotation energy (Es).

For example:

For WISE 750W servo system, with rated rotational speed and 400% inertia ratio, the rotational energy can be calculated as below.

$$Es = J * Spd^2 / 182 = 5 * 1.51 * 10^{-4} * 3000^2 / 182 = 37J$$

In Table 2-1, you can know the absorbed energy by internal capacitor is about 36J. It proves that the rotational energy cannot be completely absorbed by internal capacitor. Therefore, the remaining part needs to be consumed by external resistor.

The energy needing to be consumed by regenerative resistor is: 37-36=1J

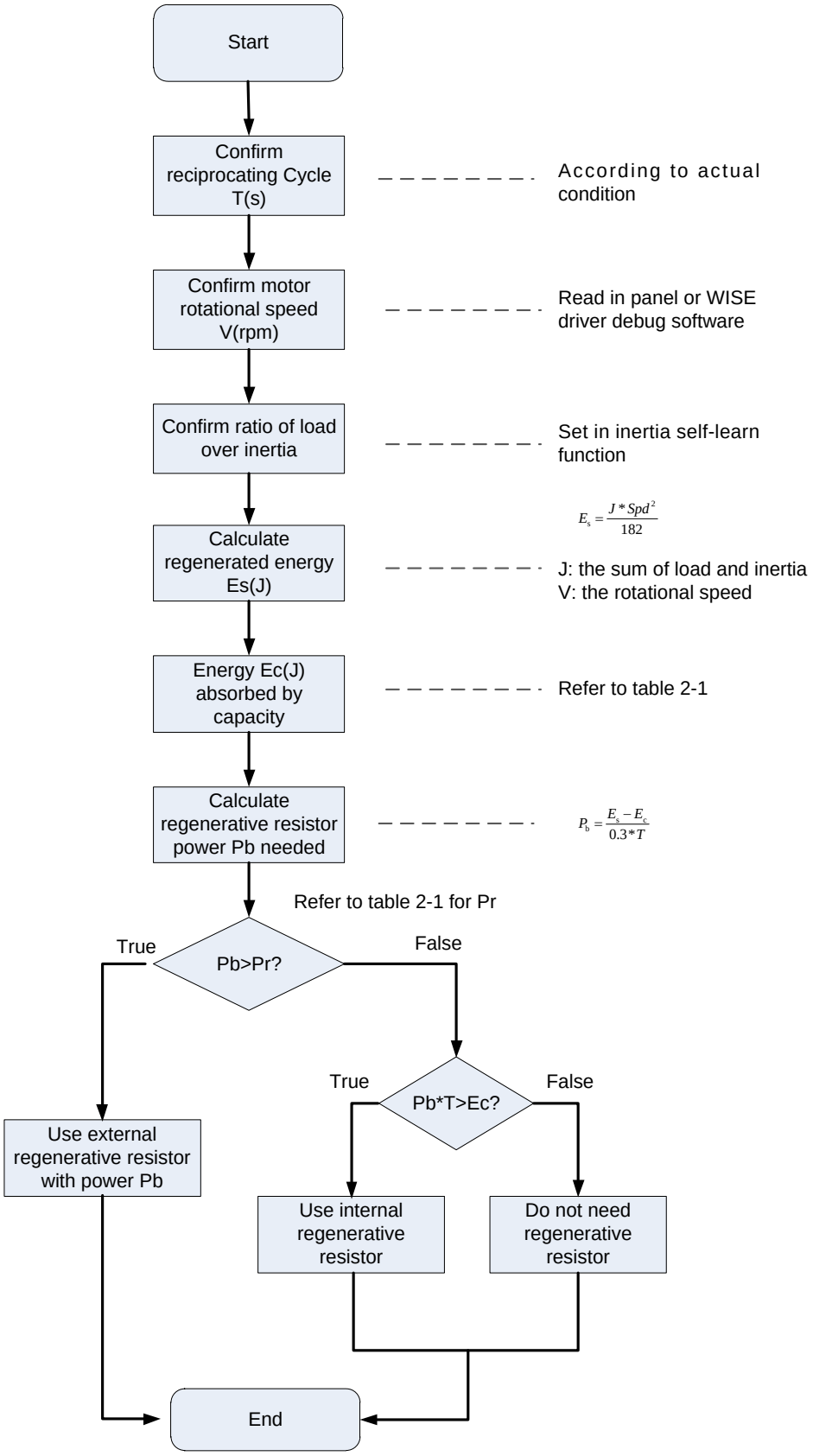
Assuming that the acceleration and deceleration cycle of motor is 1s, the capacitance of regenerative resistor is:

$W_K = E_K / (0.3 * T) = 1 / 0.3 = 3W$, which is less than 40W, the capacity of internal brake resistor. Therefore, using an internal brake resistor is enough.

If the inertia ratio is changed from 400% to 800%, and the other items remain the same, the needed resistor power is:

$W_K = \frac{E_K}{0.3 * T} = \frac{J * Spd^2 / 182 - 36}{0.3 * T} = \frac{9 * 1.51 * 10^{-4} * 3000^2 / 182 - 36}{0.3 * 1} = 103W$, which is more than that can be handled by internal resistor. Therefore, an external brake resistor is needed. The recommended power of external brake resistor is 103W.

2.7.2 Model Selection of Regenerative Resistor



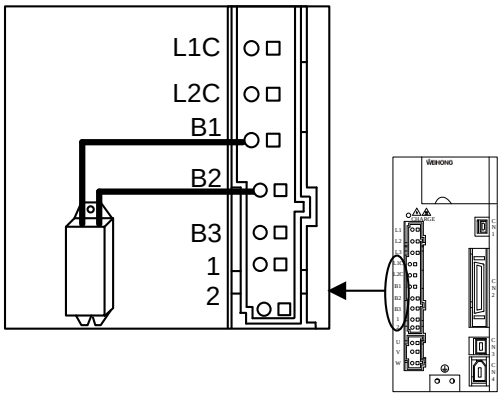
2.7.3 Connection of Regenerative Resistor

Following is an introduction to the connection of regenerative resistor and the capacitance setting of external regenerative resistor.

Select internal or external regenerative resistor and its corresponding power by setting parameter Pr016. When Pr016 is set as 0, internal regenerative resistor is enabled, while set Pr016 as 1, the external one is enabled.

For WSDV-1R2 and WSDV-2R8, there is no built-in regenerative resistor and Pr016 cannot be set to 0 with default value is 3; while for WSDV-5R0/ WSDV-6R8/WSDV-110/WSDV-140 a built-in regenerative resistor is used and Pr016 is set to 0 by default.

When an external regenerative resistor is needed, please disconnect wiring between B2-B3, connect the external regenerative resistor between B1-B2, and set up Pr016 to 1. Method to connect an external regenerative resistor is as shown below.



WARNING

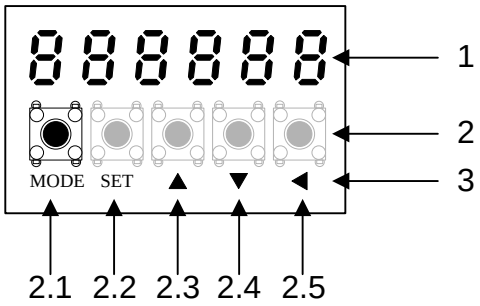
1. When an external regenerative resistor is used, please ensure that wire between B2-B3 is removed.
2. Please ensure that the wiring of regenerative resistor is correct, or it might result in machine damage or fire hazard.

3 Display and Operation on Panel

3.1 Front Panel

- **The details of front panel**

The figure below is an illustration of driver front panel. See following table for details about each section.



No.	Name	Description
1	Display LED (6-digit)	Switch to error display screen when error occurs, and LED will flash (about 2 Hz).
2	Button	Five buttons
3	Button description	—
2.1	Mode switching button	4 modes can be selected by this button: Monitor mode Parameter set up mode EEPROM writing mode Auxiliary function mode
2.2	Setting button	Press this button to switch between “Selection” and “Execution” display.
2.3	UP button	Press these two buttons to change display and data, select parameters and execute actions. Flashing digit means the current digit is debugging. Press ▲ to increase the value and ▼ to decrease it.
2.4	DOWN button	
2.5	LEFT button	Press this button to select debugging digit.

- **Initial status of LED**

When diver is power on, the display of front panel is shown as below:

If diver sends alarm signal, the front panel will display the following repeatedly. (0.8s display/0.3s display).

Here are possible causes for the driver alarm.

Alarm No.	Alarm	Cause
A0	Overload alarm	Load factor is 85% or more the protection level.
A1	Over-regeneration alarm	Regenerative load factor is 85% or more the protection level.
A2	Battery alarm	The voltage of battery is below 3.2V.
A3	Fan alarm	Fan has stopped for 1 sec.
A4	Encoder communication alarm	The number of successive encoder communication errors exceeds the specified value.
A5	Encoder overheat alarm	Encoder overheat is detected.
A6	Vibration detection alarm	Vibration is detected.
A7	Lifetime detection alarm	Registration time of the driver becomes shorter than 24 hours.
A8	Grating scale error alarm	Feedback grating scale detects alarm.
A9	Grating scale communication alarm	The number of successive feedback grating scale communication errors exceeds the specified value.
A10	MECHATROLINK data setting alarm	The parameter number, data range or value is over specified value.
A11	MECHATROLINK unsupported alarm	Unsupported command is received.
A12	Alarm of MECHATROLINK not meet execution condition	Command execution is in unsupported layer which does not meet the execution condition.

3.2 Lock Front Panel

To prevent operation error, i.e. unintentional parameter modification, you can lock the front panel.

- **Explanation**

The limited items in locked status of front panel are as shown in following:

Mode	Limit When Front Panel Locked
Motor mode	No limit: all monitor data can be checked.
Parameter set up mode	Parameter cannot be changed, but its setting value can be checked.
EEPROM writing mode	Cannot be run, and no display.
Auxiliary function mode	Cannot be executed, except for “Release the lock of front panel”, and no display.

- **Related parameter**

The rated parameter is Pr535.

- **Operation steps of locking front panel (via front panel or support software of host controller)**

1. Set parameter Pr535 “Lock setup of the front panel” to 1, and write the setting to EEPROM;
2. Turn off the power of driver and repower it;
3. The front panel is locked.

- **Operation steps of unlocking the front panel (via front panel)**

1. Execute front panel lock release function under auxiliary function mode;
2. Turn off the power of driver and repower it;
3. The front panel is unlocked.

- **Operation steps of unlocking the front panel (via support software of host controller)**

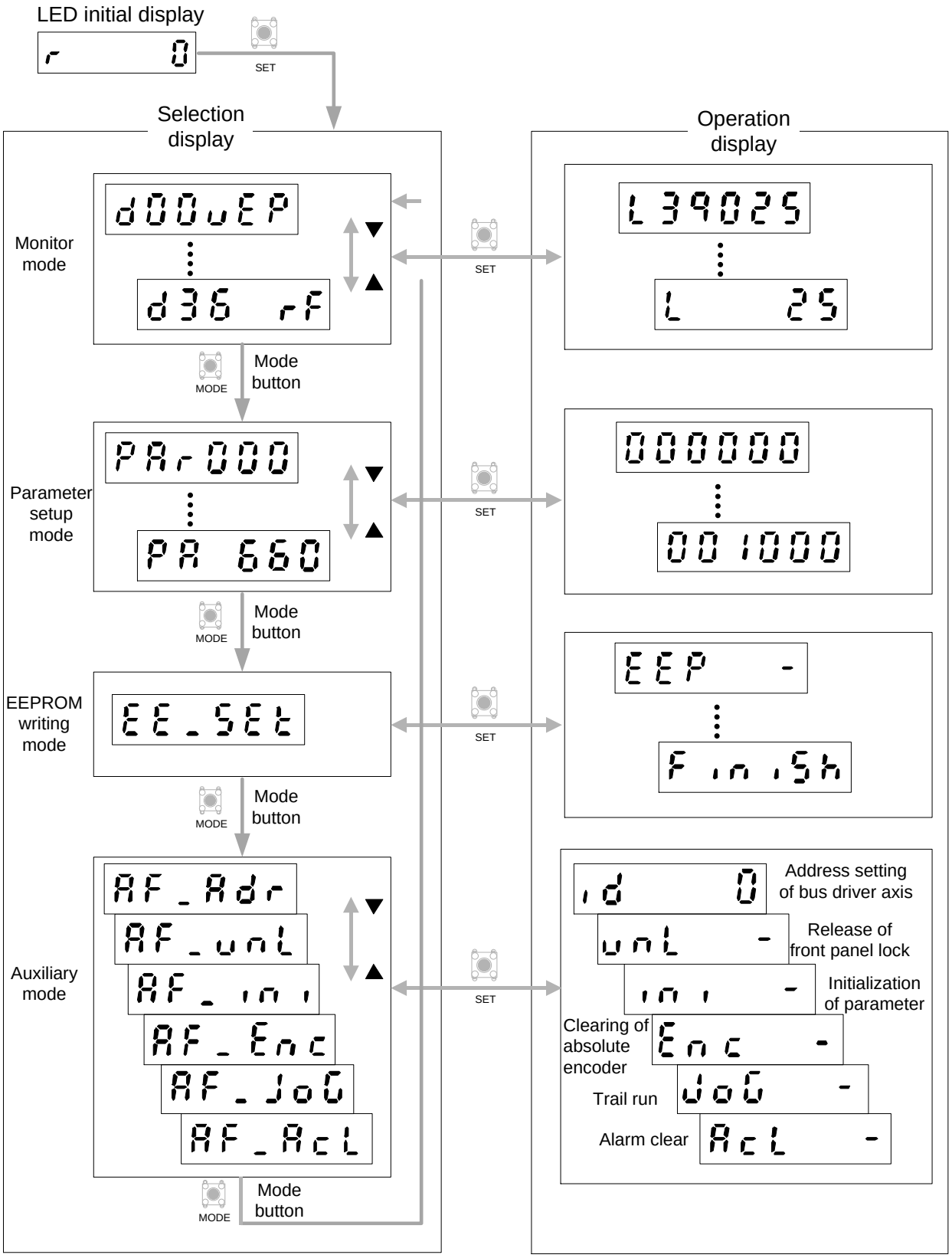
1. Set parameter Pr535 “Lock setup of the front panel” to 0, and write the setting to EEPROM;
2. Turn off the power of driver and repower it;
3. The front panel is unlocked.

3.3 Mode Structure

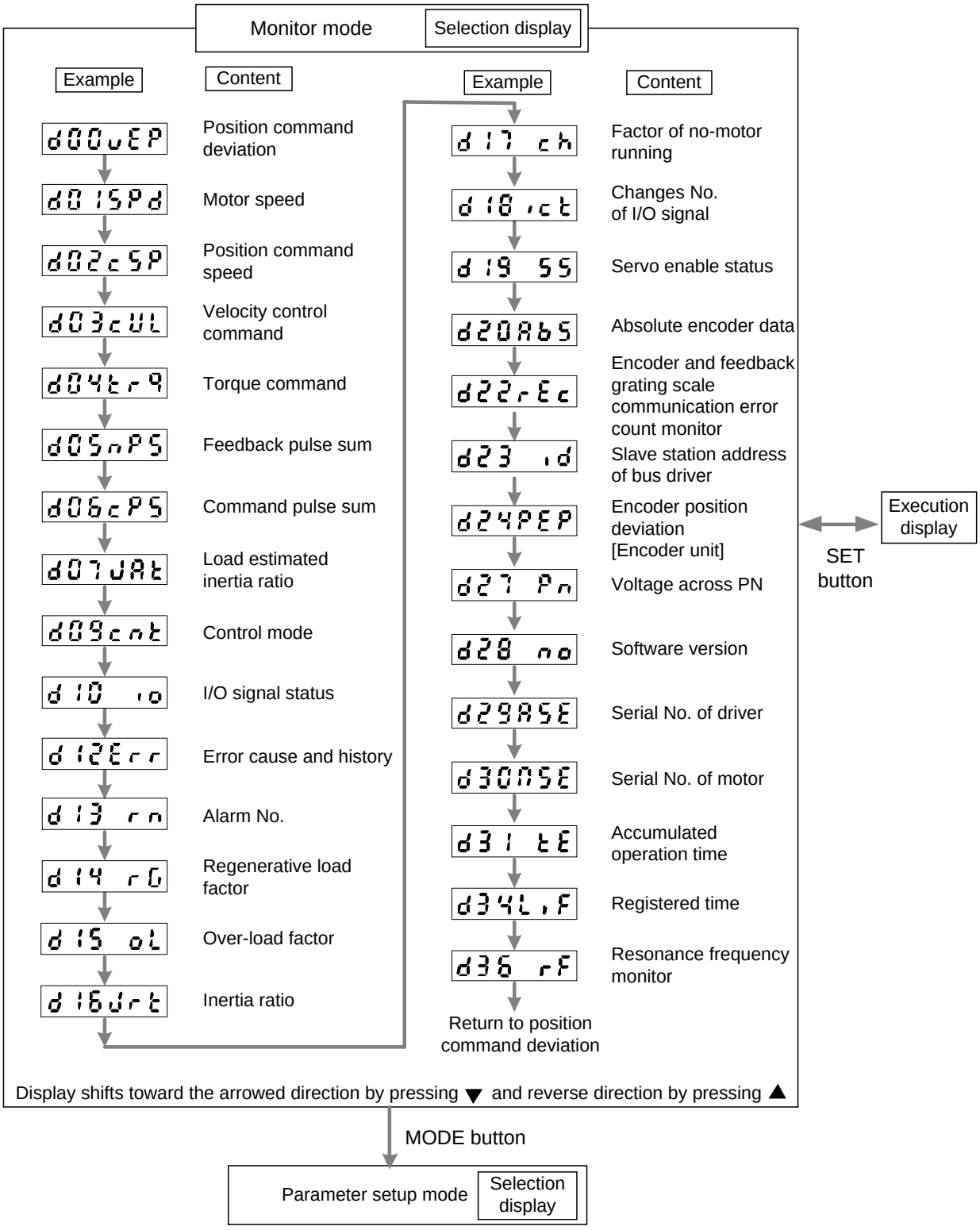
3.3.1 Overview of Mode Structure

Step	Operation	Description
First level	Select mode	After power on, press SET to switch to “Select mode”, and press MODE to switch among monitor mode, parameter setup mode, EEPROM writing mode and auxiliary function mode.
Second level	Select option	After a mode is selected, press ▲ and ▼ to select a desired option.
Third level	Set concrete command	After an option is selected, press SET to set a concrete command.

Illustration of operation steps is as shown below.



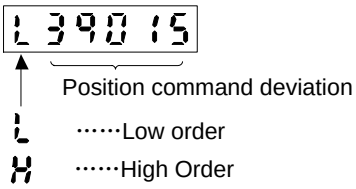
3.3.2 Monitor Mode



After monitor mode is selected by pressing MODE button, press SET to access following options. After a desired option is toggled, press SET to view the detailed information and execute concrete operation; press SET again to return to “Selection display”.

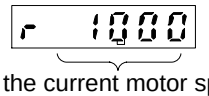
1	Positional command deviation	Display	d00uEP

- Press SET to access this option, and the display will show position command deviation, as shown on the right side.
- Press ◄ button to switch between low order (L) and high order (H).



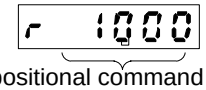
2	Motor speed	Display	d01SPd

- Press SET to access this option, and the display will show the current motor speed, as shown on the right side.



3	Position command speed	Display	d02cSP

- Press SET to access this option, and the display will show position command speed, as shown on the right side.



4	Velocity control command	Display	d03cUL

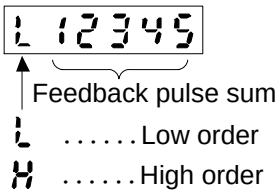
- Press SET to access this option, and the display will show velocity control command, as shown on the right side.

5	Torque Command	Display	d04tr9

- Press SET to access this option, and the display will show Torque Command, as shown on the right side.

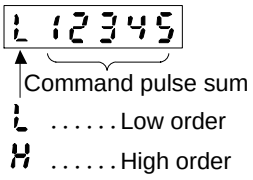
6	Feedback pulse sum	Display	d05nPS

- Press SET to access this option, as shown on the right side.
- Press ◄ button to switch between low order (L) and high order (H).



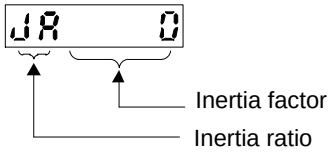
7	Command pulse sum	Display	d06cPS

- Press SET to access this option, as shown on the right side.
- Press ◄ button to switch between low order (L) and high order (H).



8	Load estimated inertial ratio	Display	d07JAt

- Press SET to access this option, and the display will show load estimated inertial ratio, as shown on the right side.



9	Control mode	Display	d09cnt

- Press SET to access this option, as shown on the right side.
- Related parameter is Pr001 “Control mode setup”.

PoScnt ……Position control mode

SPdcnt ……Velocity control mode

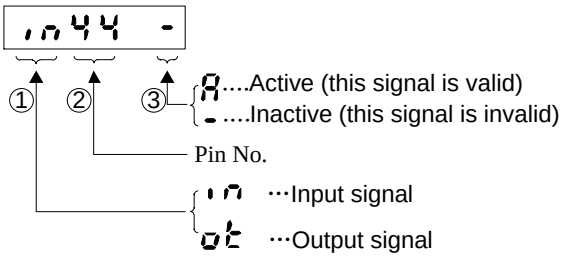
trqcnt ……Torque control mode

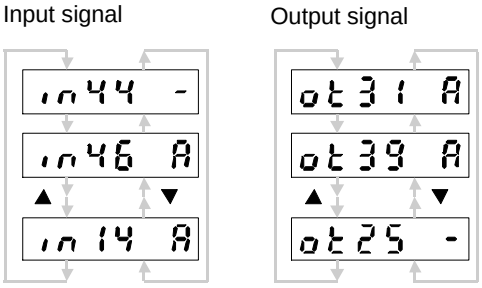
10	I/O signals status	Display	d10 io

- Press SET to access this option, as shown on the right side.
- Press ◄ to switch between ① and ②.

When ① flashing, press ▲ or ▼ button to switch status between “in” and “ot”.

When ② flashing, press ▲ or ▼ button to switch the pin No. There are 8 types of input signal and 7 types of output signal. Refer to section 2.4 “I/O Signal Allocation” for details.



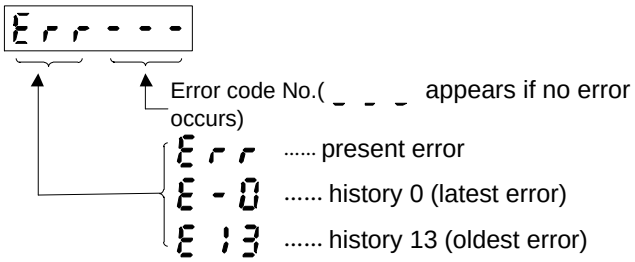


11	Error cause and history	Display	d12Err

- Press SET to access this option, where up to 14 causes can be viewed including the current one. Press ▲ ▼ to select the one you need.
- Refer to section 7.1 for detailed error causes

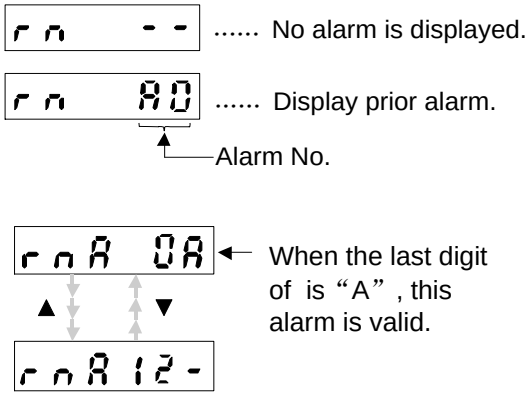
CAUTION

When a history error occurs again, the current error will share the error code No. with history 0.



12	Alarm No.	Display	d13 rn

Press SET to access this option then press ▲ ▼ buttons to display alarm occurrence condition. Refer to the list of error code for detailed description.



13	Regenerative load factor	Display	d 14 rG

- Press SET to access this option, and the display will show the occurrence level factor of regeneration over-load protection, as shown on the right side.
- This is valid when the parameter Pr016 “External regeneration resistor” is set to 1 or 0.

Display occurrence level factor of regeneration over-load protection (%).

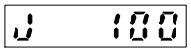
14	Over-load factor	Display	d 15 oL

- Press SET to access this option, and the display will show ratio against rated load, as shown on the right side.
- Refer to section 7.2 for details.

Display the ration against rated load.

15	Inertia ratio	Display	d 16 Jrt

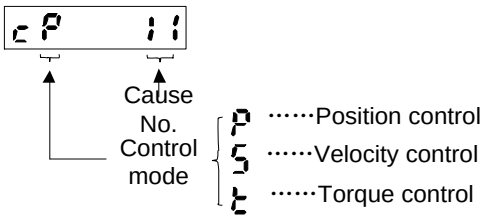
- Press SET to access this option, and the display will show the setup of Pr004, as shown on the right side.



Inertia ratio (%)

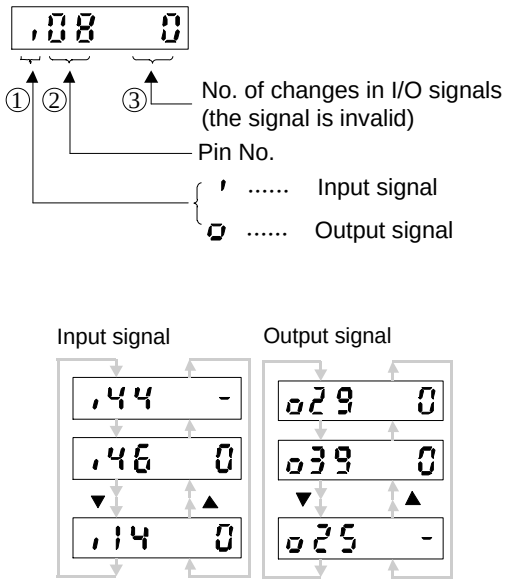
16	Causes for non-motor running	Display	d 17 Ch

- Press SET to access this option, and the display will show the cause number under the current control mode.
- Refer to list of non-motor running causes below for detailed information.



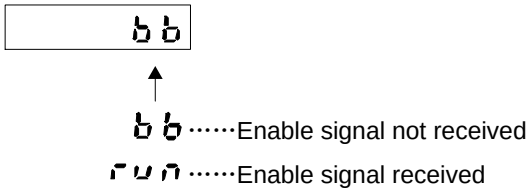
17	No. of changes in I/O signals	Display	d 18 ,c t

- Press SET to access this option, as shown on the right side.
- Press ◄ button to switch between ① and②. The decimal point flashes.
- When ① flashing, press ▲ or ▼ buttons to switch status “i” and “o”.
- When ② flashing, press ▲ or ▼ buttons to switch among pin No. There are 8 types of input signal and 7 types of output signal. Refer to section 2.4 for details.
- Press ▲ or ▼ buttons to switch to the pin No. whose changes number needs to be displayed.



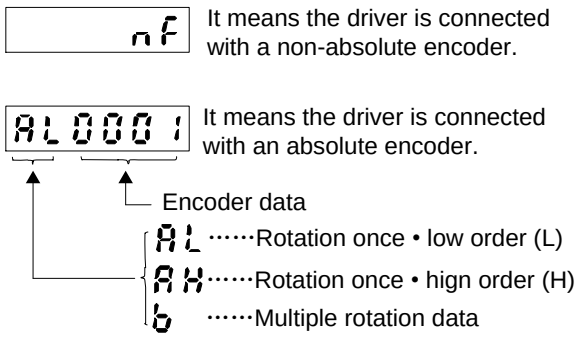
18	Servo enable status	Display	d 19 55

- Press SET to access this option, as shown on the right side.



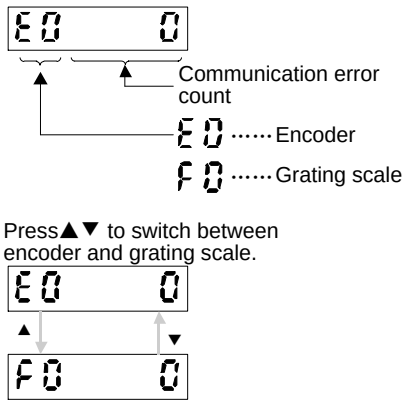
19	Absolute encoder data	Display	d20Ab5

- Press SET to access this option. When the driver is connected with an absolute encoder motor, the display is as shown on the right side.



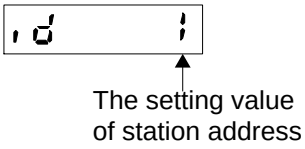
20	Encoder and feedback grating scale communication error count monitor	Display	d22rEc

- Press SET to access this option.



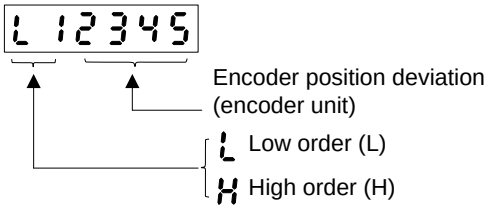
21	Slave station address of bus driver	Display	d23 id

- Press SET to access this option.



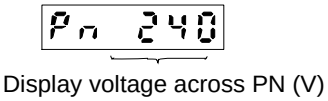
22	Encoder position deviation [Encoder unit]	Display	d24PEP

- Press SET to access this option, as shown on the right side.
- Press ◄ button to switch between high order (H) and low order (L).



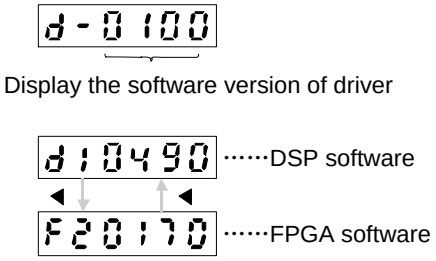
23	Voltage across PN	Display	d27 Pn

- Press SET to access this option, and the display will show the voltage across PN, as shown on the right side. The value displayed is only for reference, not a measuring one.



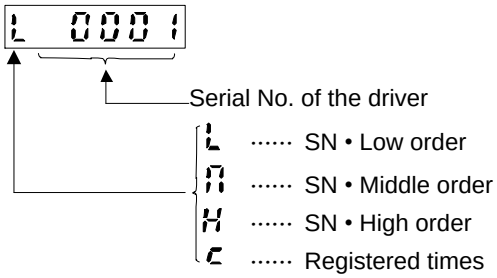
24	Software version	Display	d28 no

- Press SET to access this option, and the display will show the software version of driver, as shown on the right side.
- Software of the driver is divided into two kinds, DSP and FPGA. Press ◄ button to switch over.



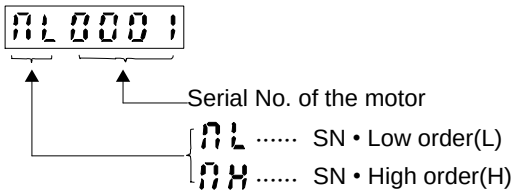
25	Serial No. of driver	Display	d29ASE

- Press SET to access this option, and the display will show the serial No. of driver, as shown on the right side.
- Press ▲ or ▼ button to switch among high order, low order, middle order as well as registered times.



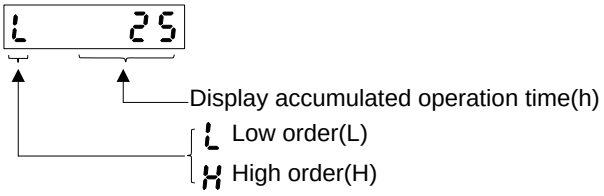
26	Serial No. of motor	Display	d30nSE

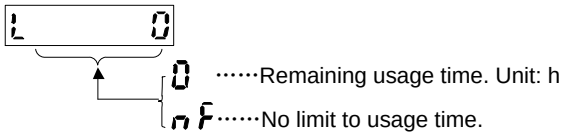
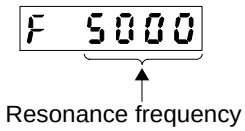
- Press SET to access this option, and the display will show the serial No. of motor, as shown on the right side.
- Press ▲ or ▼ button to switch between high order (H) and low order (L).



27	Accumulated operation time	Display	d31 tE

- Press SET to access this option, and the display will show the accumulated operation time, as shown on the right side.
- Press ◄ button to switch between high order (H) and low order (L).



28	Registered time	Display	d34L.F
• Press SET to access this option, as shown on the right side.			
29	Resonance frequency monitor	**Display**	d36 rF
• Press SET to access this option, as shown on the right side.			

- **Alarm list**

Alarm No.	Alarm	Content	Latch time
A0	Overload alarm	Load factor is 85% or more the protection level.	1~10s or ∞
A1	Over-regeneration alarm	Regenerative load factor is 85% or more the protection level.	1~10s or ∞
A2	Battery alarm	The voltage of battery is below 3.2V.	∞
A3	Fan alarm	Fan has stooped for 1 sec.	1~10s or ∞
A4	Encoder communication alarm	The number of successive encoder communication errors exceeds the specified value.	1~10s or ∞
A5	Encoder overheat alarm	The encoder detects overheat alarm.	1~10s or ∞
A6	Vibration detection alarm	Oscillation or vibration is detected.	1~10s or ∞
A7	Lifetime detection alarm	Registration time of the driver becomes shorter than 24 hours.	∞
A8	Grating scale error alarm	Feedback grating scale detects alarm.	1~10s or ∞
A9	Grating scale communication alarm	The number of successive feedback grating scale communication errors exceeds the specified value.	1~10s or ∞
A10	MECHATROLINK data setting alarm	The parameter number, data range or value is over specified value.	1~10s or ∞
A11	MECHATROLINK unsupported alarm	Unsupported command is received.	1~10s or ∞

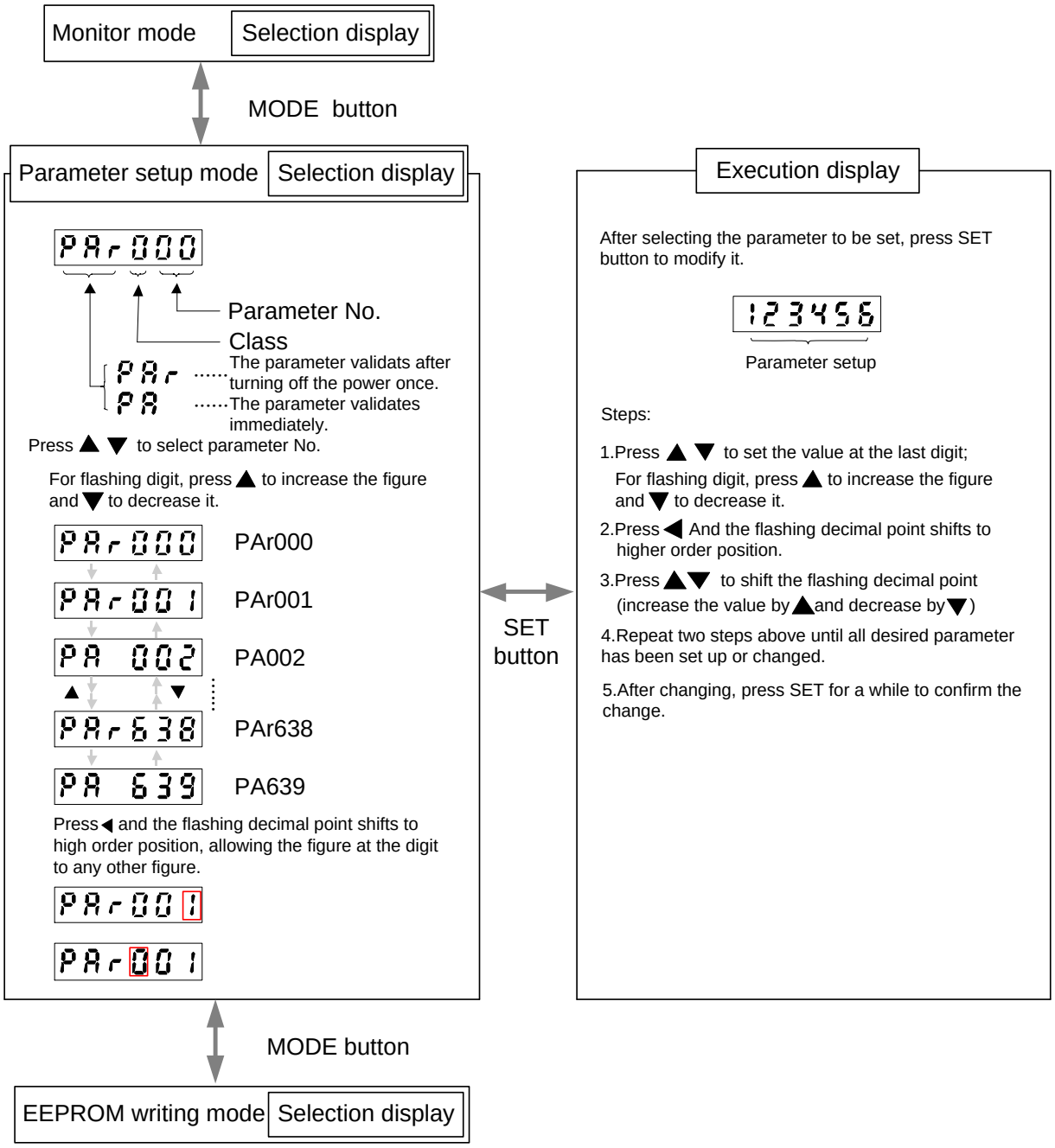
Alarm No.	Alarm	Content	Latch time
A12	Alarm of MECHATROLINK not meeting execution condition	Command execution is in unsupported layer, which does not meet the execution condition.	1~10s or ∞

- **Cause list for non-motor running**

Error No.	Name	Content	P	S	T
Flashing	Error or warning occurs.	There is active error or warning.	●	●	●
00	No reason	No factor is detected for no-motor running.	●	●	●
01	Main power shutoff	The main power of driver is not turned on.	●	●	●
02	No SRV-ON input	The SRV-ON input is not connected to COM-.	●	●	●
03	Over-travel inhibition input is valid	When Pr504=0 (over-travel inhibition input enabled), When positive direction over-travel inhibition input (POT) is valid, the velocity command is positive. When negative direction over-travel inhibition input (NOT) is valid, the velocity command is negative.	●	●	●
04	Torque limit setup is small	Either one of the valid torque limit setup value of Pr013 (1st) or Pr522 (2nd) is set to 5% or lower than the rated value.	●	●	●
06	INH input is valid	Pr518=0, command pulse inhibition input is valid, and INH is open circuit.	●		
07	Low input frequency of command pulse	Command pulse has not been input correctly. Input types selected for Pr006 and Pr007 are different. Two causes above result in that position command of each control cycle is below 1 pulse.	●		
08	CL input is valid	Deviation counter clear input CL is connected to COM-.	●		
09	ZEROSPD input is valid	When Pr315=1 (Zero-speed clamp enable), zero-speed clamp input (ZEROSPD) is open circuit.		●	●
11	Internal velocity command is 0	When internal velocity command is enabled, its set value is below 30 (r/min).		●	
12	Torque command is small	Torque command input is lower than the rated value 5%.			●

Error No.	Name	Content	P	S	T
13	Speed limit is small	When Pr317=0, set value of Pr321 is too small. When Pr317=2, set values of Pr321 and Pr322 are too small.			●
14	Other causes	Remove cause 1~13. But if the motor speed remains 20 (r/min) or less, possible causes may be too small command, over-load, lock or collision status of the motor or errors in the driver or the motor.	●	●	●

3.3.3 Parameter Setup Mode

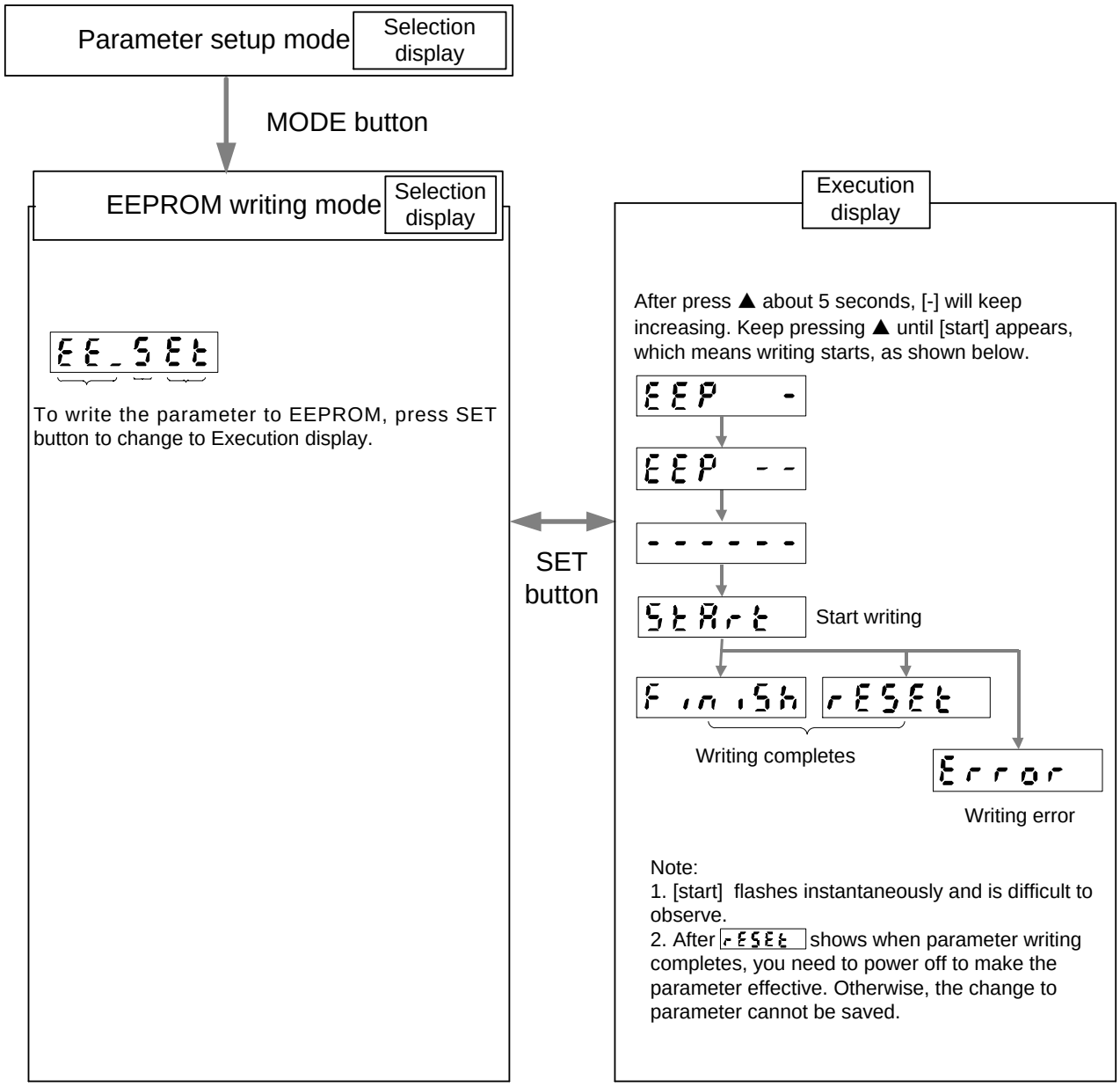


CAUTION

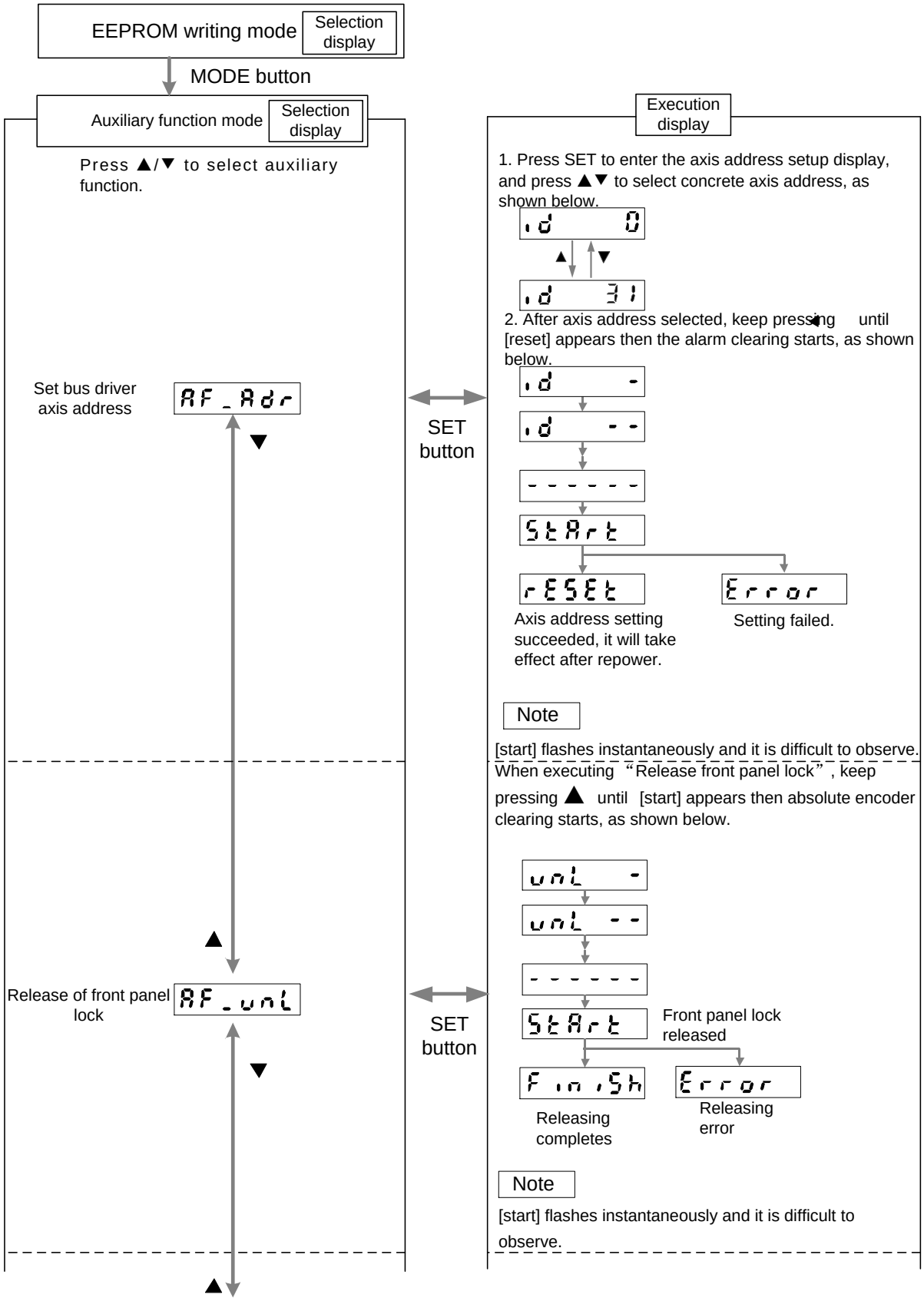
1. After parameter is changed, it won't take effect without holding SET button for a while. If the modification succeeded, it will be reflected in the control. You can press MODE button to cancel the change and return to parameter No. display.

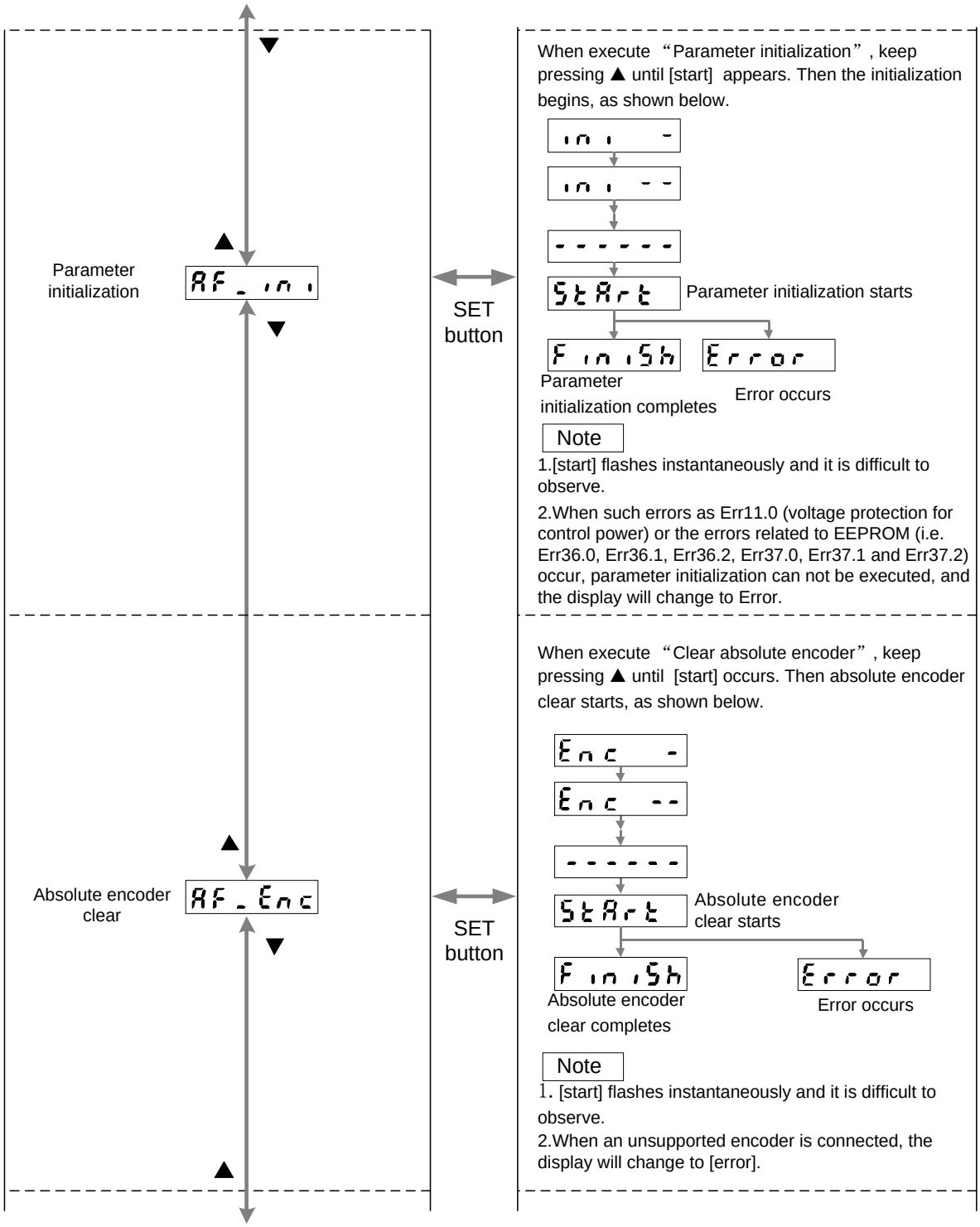
2. Do not extremely change parameters which might affect the motor movement very much, especially the velocity loop or position loop gains. It is recommended to make several changes step by step instead of change to a large value at one time.
3. For parameters whose validations needs re-power ON, you can return to the parameter display interface and press MODE button to access EEPROM mode.

3.3.4 EEPROM Writing Mode



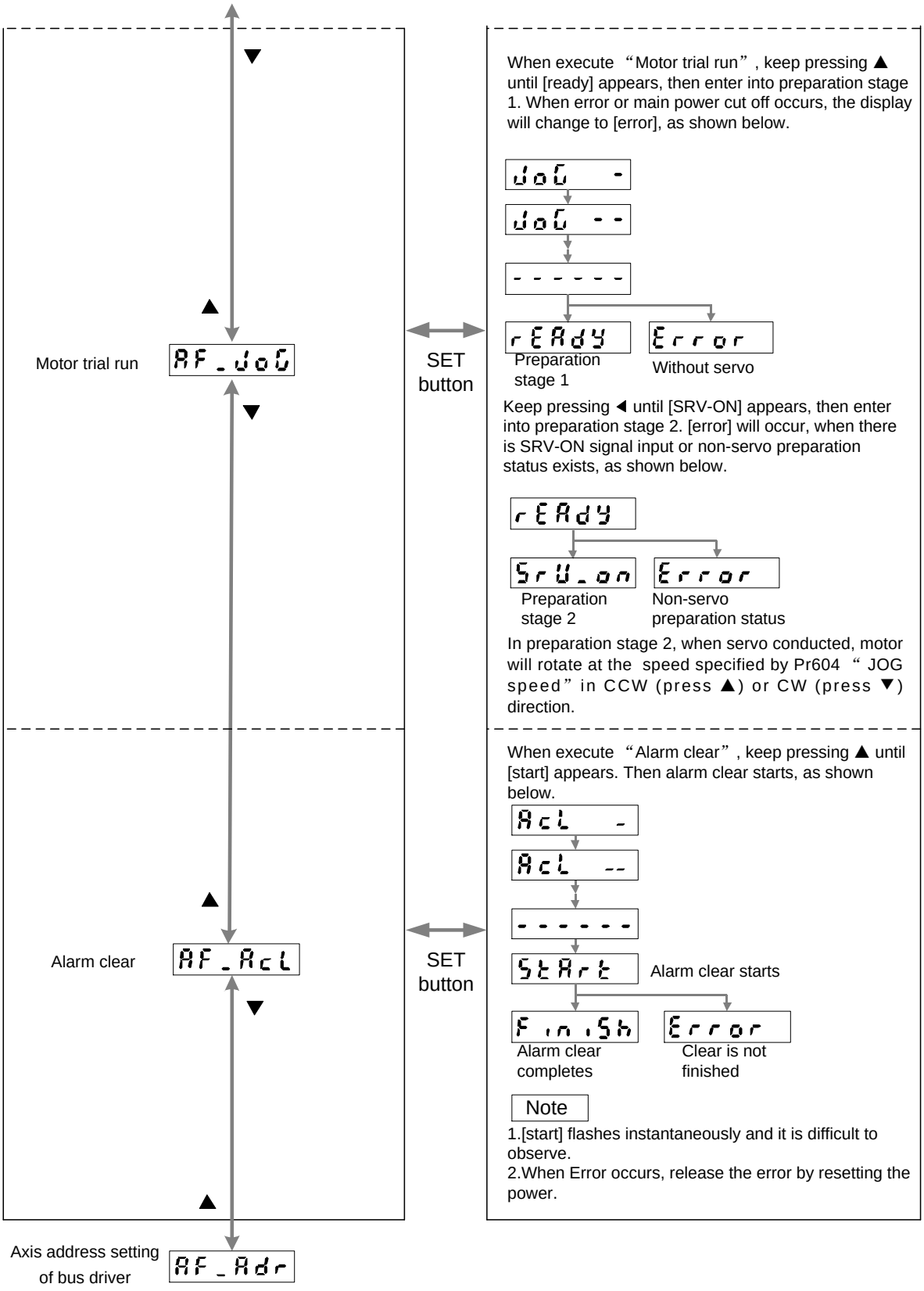
3.3.5 Auxiliary Function Mode




Parameter initialization
AF_ini
SET button
When execute "Parameter initialization", keep pressing ▲ until [start] appears. Then the initialization begins, as shown below.
ini -
ini --

StArt
Parameter initialization starts
Finish
Error
Parameter initialization completes
Error occurs
Note
1.[start] flashes instantaneously and it is difficult to observe.
2.When such errors as Err11.0 (voltage protection for control power) or the errors related to EEPROM (i.e. Err36.0, Err36.1, Err36.2, Err37.0, Err37.1 and Err37.2) occur, parameter initialization can not be executed, and the display will change to Error.
Absolute encoder clear
AF_Enc
SET button
When execute "Clear absolute encoder", keep pressing ▲ until [start] occurs. Then absolute encoder clear starts, as shown below.
Enc -
Enc --

StArt
Absolute encoder clear starts
Finish
Error
Absolute encoder clear completes
Error occurs
Note
1. [start] flashes instantaneously and it is difficult to observe.
2.When an unsupported encoder is connected, the display will change to [error].


Motor trial run
AF_JoG
SET button
When execute "Motor trial run", keep pressing ▲ until [ready] appears, then enter into preparation stage 1. When error or main power cut off occurs, the display will change to [error], as shown below.
JoG -
JoG --
------
rEAdy
Error
Preparation stage 1
Without servo
Keep pressing ◄ until [SRV-ON] appears, then enter into preparation stage 2. [error] will occur, when there is SRV-ON signal input or non-servo preparation status exists, as shown below.
rEAdy
SrV_on
Error
Preparation stage 2
Non-servo preparation status
In preparation stage 2, when servo conducted, motor will rotate at the speed specified by Pr604 " JOG speed" in CCW (press ▲) or CW (press ▼) direction.
Alarm clear
AF_AcL
SET button
When execute "Alarm clear", keep pressing ▲ until [start] appears. Then alarm clear starts, as shown below.
AcL -
AcL --

StArt
Alarm clear starts
FinISh
Error
Alarm clear completes
Clear is not finished
Note
1.[start] flashes instantaneously and it is difficult to observe.
2.When Error occurs, release the error by resetting the power.
Axis address setting of bus driver
AF_Adr

- **Motor trial run**

You need to check the following items before the trial run.

Inspection Steps	Content
Inspection on wiring	Is there any miswiring? (especially power input and motor output). Short or grounded? Loose connection?
Confirmation of the power supply and voltage	Within rated voltage?
Fixing of the servo motor	Unstable mounting?
Separation from the mechanical system	—
Release of the brake	—
Turn to Servo-OFF after finishing the trial run by pressing SET button.	—

CAUTION

1. Please be absolutely sure that the motor load is discharged, and disconnect the connector CN2 during the motor trail run.
2. Please restore set values of all users' parameters (especially Pr004, Pr101~Pr104) to default settings before normal usage.
3. To make a trial run, set parameters related to gain to appropriate values, especially set Pr004 (Inertia ratio) when discharging the load, to avoid unexpected vibration.
4. In trial run, the motor will take action in velocity control mode. Please correctly set the related parameters to make the motor run normally.
5. In trial run, Error will be displayed when SRV-ON is active, and you can press MODE button the exit the JOG mode and shift to normal operation status.
6. In case of disconnection of cable or fall of connectors during trial run, the motor might perform out of control for max. 1 sec, please be careful.
7. After trial run completes, refer to section 3.3 to return to “Selection display”

4 Absolute system

4.1 Abstract

When you compose an absolute system using absolute encoder, you are not requires to carry out homing at the power-on, and this function suits very well to such an application as robot.

Connect the host controller with driver and the absolute encoder motor or dual specification motor which has both incremental and absolute function, and set up Pr015 “Absolute encoder setup” to 0, then connect the battery for absolute encoder to compose an absolute system with which you can capture the exact present position information after power on.

Shift the system to origin once after installing the battery and clear the multi-turn data by absolute encoder clear function, then you can detect the absolute position without carry out homing operation.

4.2 Installation of Battery

4.2.1 First-time Installation and Replacement of Battery

Battery for absolute encoder: 3.6V, 2000mAh.

- **First installation of battery**

After installing and connecting the battery to the motor, execute encoder initialization setup.

After installing the battery, it is recommended to perform ON/OFF action once a day for refreshing the battery. If you did not refresh the battery, a battery error may occur due to voltage delay.

- **Replacement of battery**

It is necessary to replace the battery for absolute encoder when battery alarm occurs.

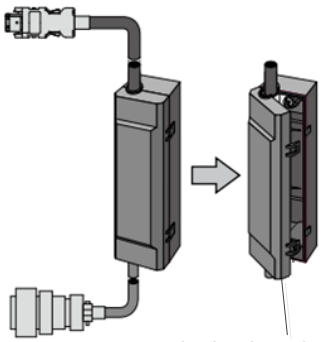
Replace while turning on the control power. Data stored in the encoder might be lost when you replace the battery while the control power of the driver is off.

After replacing the battery, use the alarm clear function on the front panel to clear the battery alarm.

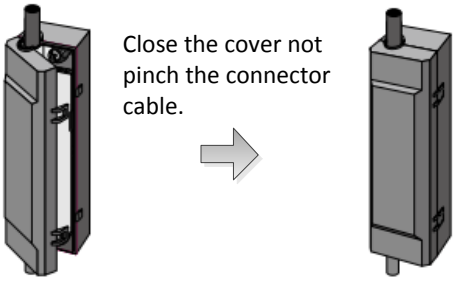
When you clear the absolute encoder with the front panel or via communication, all errors and multi-turn data will be cleared together with alarm, and you are required to execute the operation introduced in section 4.2.4.

4.2.2 How to Install Battery

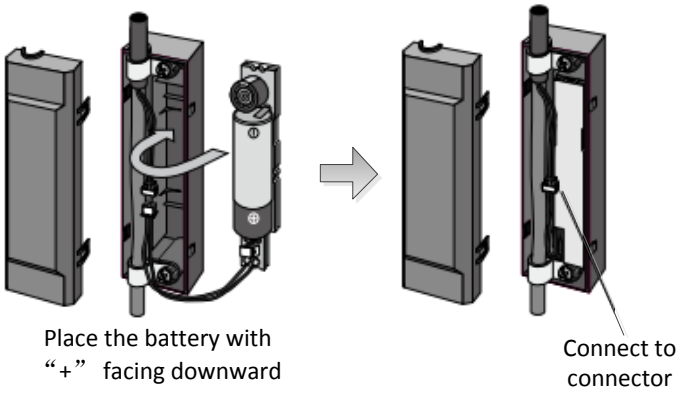
1) Take off the cover of the battery box



3) Close the cover of the battery box



2) Install the battery to the battery box



WARNING

1. Insert the battery with its “+” and “-” electrodes oriented correctly.
2. Do not leave batteries which have been used for a long period of time or which is no longer usable inside the product.
3. The electrolyte inside the battery is highly corrosive, and if it leaks out, it will not only corrode the surrounding parts but also result in the danger of short circuit because of its electrical conduction. Therefore, ensure that the battery is replaced periodically. It is recommended to replace the battery every two years.
4. Do not disassemble the battery or throw it into fire. Otherwise it may cause it to rupture.
5. Do not make the battery short-circuited. And do not peel off the battery tube.
6. When the “+” and “-” electrodes of the battery contact with metal, it may cause a high current to flow all at once, which will not only reduce the battery performance but also generate considerable heat, possibly leading to the rupture of the battery.
7. Please ensure the disposal of battery is in accordance with these regulations and restrictions imposed by local governing authorities.

4.2.3 Make Your Own Cable for Absolute Encoder

When you make your own cable for absolute encoder, you should prepare a battery connector for absolute encoder, and install the battery according to the wiring diagram shown in Fig. 4-1.

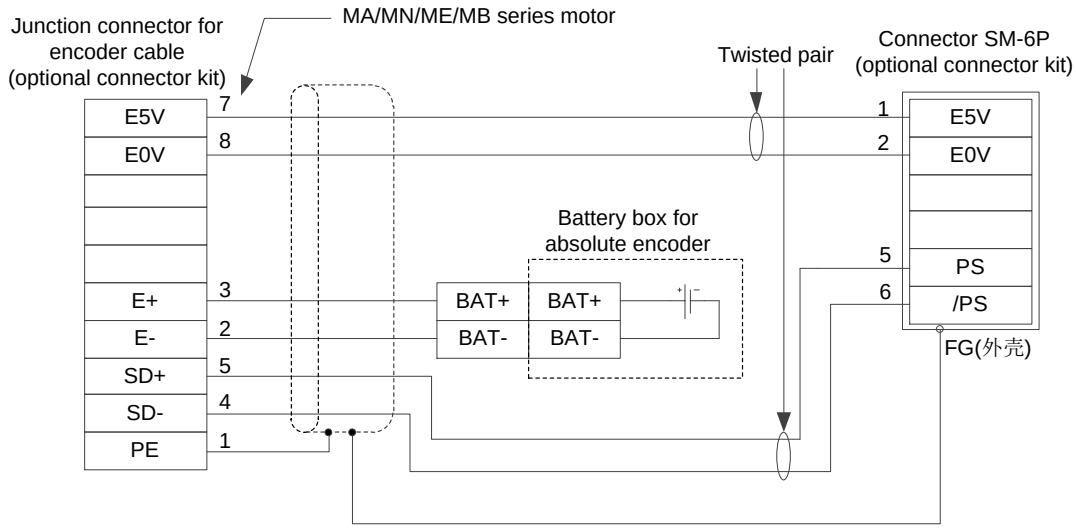


Fig. 4-1 Wiring diagram of absolute encoder cable

- **Installation place**

1. Indoors, where the products are free from rain or direct sun beam.
2. 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.
3. Places where is well-ventilated and humid and dust-free.
4. Vibration-free place.

WARNING

Please install and fix the battery securely. Otherwise, it may cause the wire breakdown or damage of the battery. You can refer to the instruction manual of the battery for battery handling.

4.2.4 Setup (Initialization) of Absolute Encoder

Absolute multi-turn data will be maintained by the absolute encoder battery. Therefore, when operating the machine for the first time after installing the battery to the absolute encoder, clear the encoder data (multi-turn data) to 0 at the origin by operation on the front panel or the support software iMotion. After data clearing, turn off power and then on again.

4.2.5 Battery Alarm Display

When the front panel is enabled as alarm execution mode of monitor mode, the alarm shown as Fig. 4-2 will occur. Press ▲ and ▼ to scroll alarm condition, as shown in Fig. 4-3.

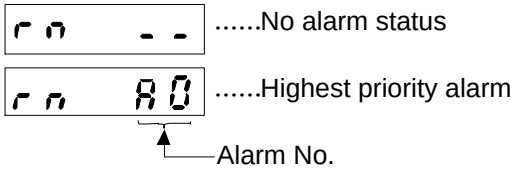


Fig. 4-2

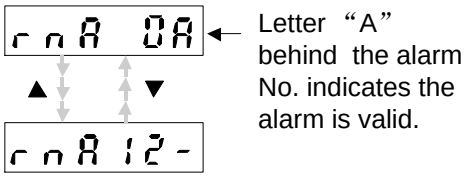


Fig. 4-3

- **Alarm list**

Alarm No.	Alarm	Content	Latched Time
A0	Overload alarm	Load factor is 85% or more the protection level.	1~10s or ∞
A1	Over-regeneration alarm	Regenerative load factor is 85% or more the protection level.	1~10s or ∞
A2	Battery alarm	The voltage of battery is below 3.2V.	∞
A3	Fan alarm	Fan has stopped for 1 sec.	1~10s or ∞
A4	Encoder communication alarm	The number of successive encoder communication errors exceeds the specified value.	1~10s or ∞
A5	Encoder overheat alarm	Encoder overheat is detected.	1~10s or ∞
A6	Vibration detection alarm	Vibration is detected.	1~10s or ∞
A7	Lifetime detection alarm	Registration time of the driver becomes shorter than 24 hours.	∞
A8	Grating scale error alarm	Feedback grating scale detects alarm.	1~10s or ∞
A9	Grating scale communication alarm	The number of successive feedback grating scale communication errors exceeds the specified value.	1~10s or ∞
A10	MECHATROLINK data setting alarm	The parameter number, data range or value is over specified value.	1~10s or ∞
A11	MECHATROLINK unsupported alarm	Unsupported command is received.	1~10s or ∞

Alarm No.	Alarm	Content	Latched Time
A12	Alarm of MECHATROLINK not meeting execution condition	Command execution is in unsupported layer, which does not meet the execution condition.	1~10s or ∞

- **How to clear the battery alarm**

When battery alarm occurs, refer to section 4.2.2 to replace the battery for the absolute encoder. After replacement, clear the battery alarm as following 3 methods.

1. When the bus driver reconnects with master station, the alarm will be cleared automatically.
2. Use alarm clear button on support software iMotion to clear battery alarm.
3. Execute the alarm clear function in auxiliary function mode by using the front panel.

4.3 Reception/Transmission Sequence of Absolute Data

The following will introduce the sequence from receiving the absolute encoder output signal to sending the absolute data to the host controller via servo unit.

4.3.1 Absolute Data Request Signal

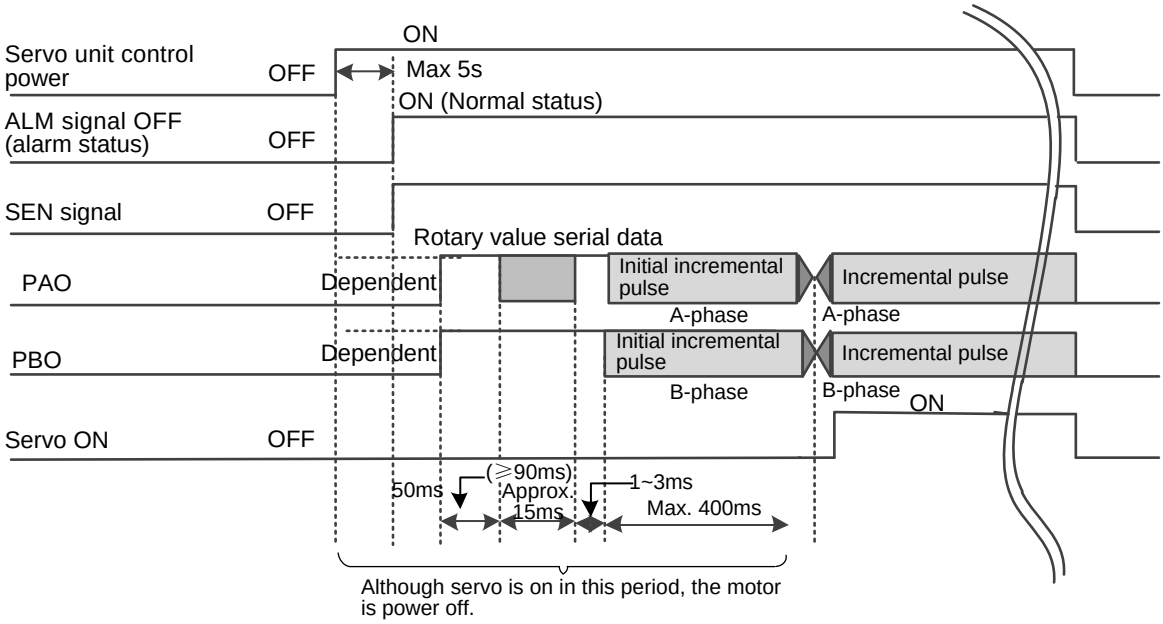
When sending absolute data from the servo unit, input absolute data request signal (SEN) will be asked for. Detailed information of SEN signal is shown as below.

Signal name	Symbol	Default	Related mode		
Absolute data request data	SEN	—	P	S	T

Description:

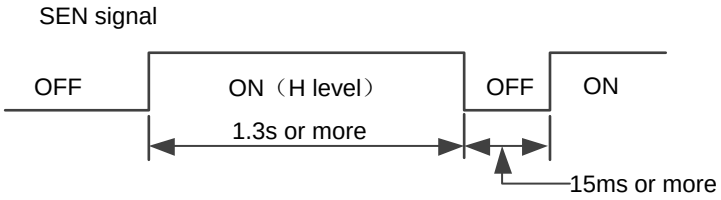
- Absolute data initialization request.

1. Input SEN as following logic sequence.



When turn off control power, turn SEN off.

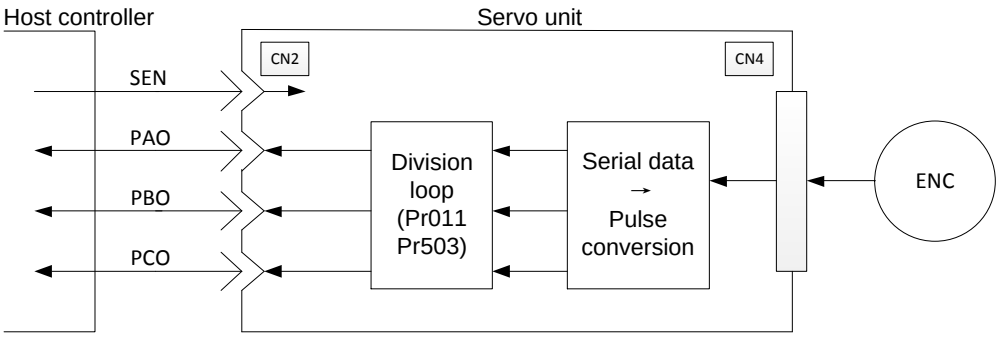
2. Before turn SEN signal at active low again, maintain the pervious active high about 1.3s, as shown below.



3. When servo is ON, SEN signal cannot be received.

4.3.2 Absolute Data

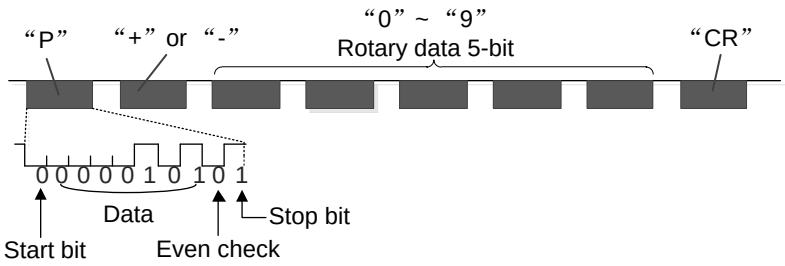
As shown below, the rotary serial data and pulse of absolute encoder sent by servo unit are output through terminals “PAO, PBO, PCO”.



Signal name	Status	Content
PAO	At initialization	Rotary serial data Initial incremental data
	At most time	Incremental data
PBO	At initialization	Initial incremental data
	At most time	Incremental data
PCO	At any time	Origin pulse

- **Rotary serial data**

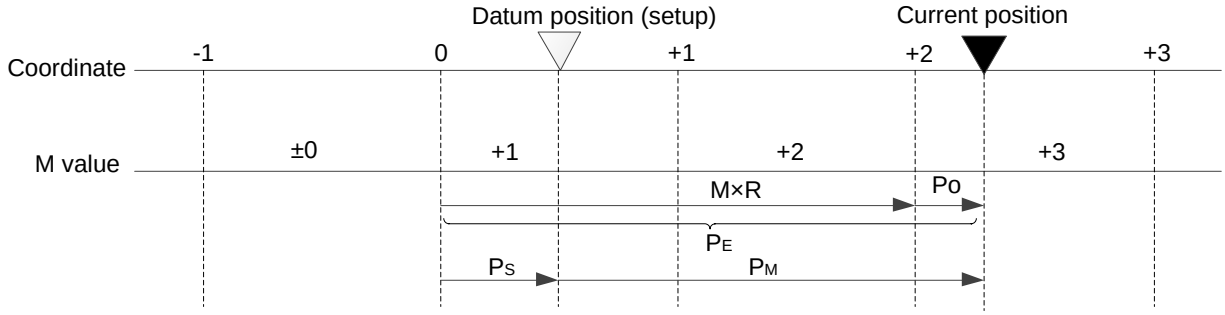
It represents the motor shaft position after several revolutions with respect to the datum position (decided by set value). Rotary serial data is fed out through PAO. The specification list is shown as below:

Transmission method	Start-stop Synchronization (ASYNC)
Baud rate	9600bps
Start bit	1-bit
Stop-bit	1-bit
Parity check	Even
Character	ASCII 7 bits
Data format	8 characters, as shown below:  Note: (1) Range of rotary data will be "P+00000" (CR) or "P-00000" (CR) when without rotation. (2) Range of rotary value is "-32768~+32767". If it exceeds this range, data at "+32767" turns to "-32768", while data at "-32768" turns to "+32768".

- **Initial incremental pulse**

Pulse will be output with the pulse speed as that of the motor rotating from origin position to current motor shaft position. The pulse speed is affected by parameter Pr011. Refer to the table below for details. Similar to the common incremental pulse, initial incremental pulse is fed out after it is divided in the servo unit.

Pr011 set value	Pulse Output Speed of Absolute Encoder in 1 Circle	Pulse Output Time of Absolute Encoder in 1 Circle
16~16384	680×Pr011 /16384 [kpps]	Max. 25 ms
16386~32768	680×Pr011 /32768 [kpps]	Max. 50 ms
32722~65536	680×Pr011 /65536 [kpps]	Max. 100 ms
65544~131072	680×Pr011 /131072 [kpps]	Max. 200 ms
131088~262144	680×Pr011 /262144 [kpps]	Max. 400 ms
262176~524288	680×Pr011 /524288 [kpps]	Max. 800 ms
524352~1048576	680×Pr011 /11048576 [kpps]	Max. 1600 ms
1048704~2097152	680×Pr011 /2097152 [kpps]	Max. 3200 ms



The final absolute data P_M can be calculated by the equations shown below.

$P_E = M \times R + P_O$

$P_S = M_S \times R + P_S^{'}$

$P_M = P_E - P_S$

Symbol	Meaning	Symbol	Meaning
P_E	Read the current position value from the encoder.	M_S	It represents the rotary data read from basic setting.
M	It represents the rotary serial data.	$P_S^{'}$	It represents the initial incremental pulse read from basic setting.
P_O	It represents the initial incremental pulse.	P_M	The current position value which needs to be set up in the system.
P_S	It represents the absolute data read from the preset point (this value is saved and managed by the host controller).	R	It represents the pulse number per one revolution of encoder (divided)

Note:

In reversal mode, (Pr000=0), equations are as shown below.

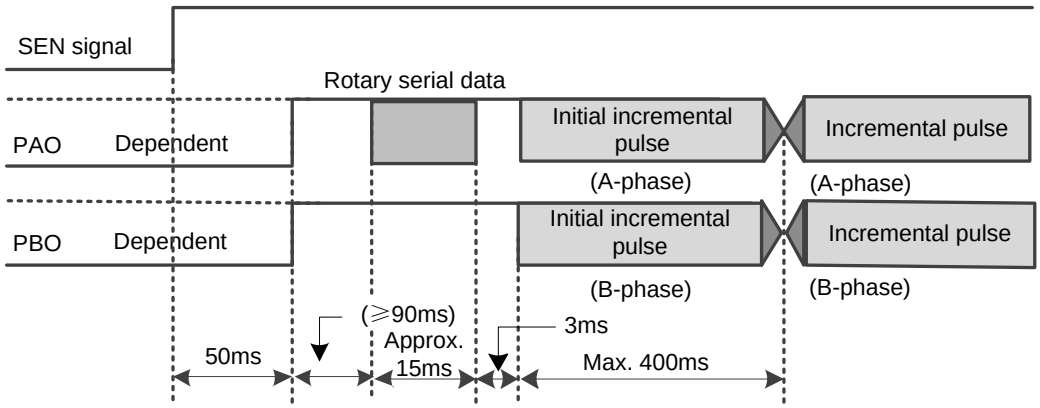
$$P_E = -M \times R + P_O$$

$$P_S = M_S \times R + P_S^{'}$$

$$P_M = P_E - P_S$$

4.3.3 Reception and Transmission Sequence of Absolute Data

1. Turn SEN signal to ON (H level).
2. After approx. 100ms, enter waiting status for receiving rotary serial data, in which reversible counter for incremental pulse will be cleared.
3. Receive rotary serial data with 8 characters.
4. After receiving the last rotary serial data approx. 400ms, enter normal incremental action status.



5 Motor Running

5.1 Check and Preparation before Motor Run

You need to check the following items before motor running.

Wiring:
a) Miswiring? (Especially power input and motor output)
b) Short circuit or grounded?
c) Loose connection?

Power supply and voltage: Within the range of rated voltage?

Fixing of motor: Unstable mounting?

5.2 Basic Setting for Motor Running Function

5.2.1 Control Mode Selection

Pr001 Set Value	Control mode	Abstract
1	Position control	Controller uses bus motion command to send absolute position value to control position. Position control only can be used in positioning status.
2	Velocity control	Velocity command controlled by bus instruction is not supported in bus-type driver.
3	Torque control	Torque command controlled by bus instruction is not supported in bus-type driver.

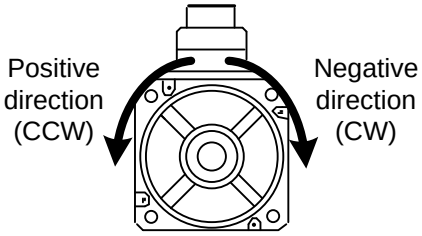
5.2.2 Servo-ON

It is used to control the power ON/OFF status of the servo motor. There are two methods to control Servo-ON (Note: after one method is enabled, the other is invalid).

- After bus is connected, motor is enabled automatically.
- Turn servo on by trail run function, which only can be used during trail run.

5.2.3 Motor Rotational Direction Selection

The motor rotational direction is decided by the setting of parameter Pr000. In this way, you can make command polarity be the same with rotational direction without changing the symbol of interpolation position value. In standard setting, the positive direction is seen like rotating in counter clockwise (CCW) in view of servo motor load.

Pr000 Set Value	Command Direction	Motor Rotational Direction	Positive Direction Over-travel Inhibition Input	Negative Direction Over-travel Inhibition Input	Motor Rotational Direction Diagram
0	Positive direction	CW	Valid	—	
	Negative direction	CCW	—	Valid	
1	Positive direction	CCW	Valid	—	
	Negative direction	CW	—	Valid	

5.2.4 Over-travel Protection Function

Over-travel protection function for servo unit indicates when the machine moves out of the specified safety range or movable area, limit switch is enabled, and the servo motor will be forced to stop in order to secure safety.

- **Signal setup**

Type	Signal Name	Pin No. of Connector	Status	Motor Action
Input	POT	CN2-7	ON	Forward rotation inhibition
			OFF	Forward rotation
	NOT	CN2-8	ON	Reversal rotation inhibition
			OFF	Reversal rotation

- **Enable/disable over-travel inhibition function**

You can enable or disable the over-travel inhibition function by setting Pr504. When this function is disabled, the servo motor can rotate in both positive direction and negative direction without connecting to NOT signal or POT signal.

Pr504 Set Value	Action
0	POT: Positive direction over-travel inhibition NOT: Negative direction over-travel inhibition
1	POT and NOT are invalid.
2	When there is any input of POT/NOT, Err38.0 “Over-travel inhibition input protection” will occur.

- **Method to stop motor when over-travel inhibition function is active**

When Pr504 “Over-travel inhibition input setup” is 0, you can set the status in deceleration or after stopping by setting Pr505.

Pr504	Pr505	In Deceleration	After Stopping	Content of Deviation Counter
0	0	Dynamic brake action	Torque command of over-travel inhibition direction=0	Hold
	1	Torque command of over-travel inhibition direction=0	Torque command of over-travel inhibition direction=0	Hold
	2	Stop immediately	Over-travel inhibition direction command=0	Clear before/after deceleration

5.2.5 Brake

Brake is used to maintain the position where it is at servo-OFF, preventing moving parts of the machine from additional movement caused by self-mass or external force. Brake is embedded in servo motor. Built-in brake is a specialized brake without magnetic excitation, which cannot be used for braking purpose. Please enable it only when servo motor stops.

5.2.6 Methods to Stop Motor at Servo-OFF or at Alarm

- **Set status in deceleration and after stopping at servo-OFF by setting Pr506**

Set Value	In deceleration	After stopping	Position Deviation	Remark
0	Dynamic brake (DB) action	Dynamic brake (DB) action	Clear	1. Dynamic brake (DB): one way to make servo motor stop immediately by short cutting motor electric circuit. It is embedded in servo unit. 2. Stop immediately: make motor stop immediately by control function at servo-ON. 3. Clear: make positional deviation maintain zero. 4. In deceleration: indicates the motor speed decelerates from the current speed to below 30r/min.
1	Free run (DB OFF)	Dynamic brake (DB) action	Clear	
2	Dynamic brake (DB) action	Free run (DB OFF)	Clear	
3	Free run (DB OFF)	Free run (DB OFF)	Clear	
4	Dynamic brake (DB) action	Dynamic brake (DB) action	Clear	
5	Free run (DB OFF)	Dynamic brake (DB) action	Clear	
6	Dynamic brake (DB) action	Free run (DB OFF)	Clear	
7	Free run (DB OFF)	Free run (DB OFF)	Clear	
8	Stop immediately	Dynamic brake (DB) action	Clear	
9	Stop immediately	Free run (DB OFF)	Clear	

- **Set status in deceleration and after stopping at alarm by setting Pr510**

Set Value	In deceleration	After stopping	Position Deviation	Remark
0	Dynamic brake (DB) action	Dynamic brake (DB) action	Clear	1. Dynamic brake (DB): one way to make servo motor stop immediately by short cutting motor electric circuit. It is embedded in servo unit. 2. Stop immediately: make motor stop immediately by control function at servo-ON. 3. Clear: make positional deviation maintain zero. 4. In deceleration: indicates the motor speed decelerates from the current speed to below
1	Free run (DB OFF)	Dynamic brake (DB) action	Clear	
2	Dynamic brake (DB) action	Free run (DB OFF)	Clear	
3	Free run (DB OFF)	Free run (DB OFF)	Clear	
4	Action A: Stop immediately Dynamic brake (DB) action	Dynamic brake (DB) action	Clear	

5	Action A: Stop immediately Action B: Dynamic brake (DB) action	Dynamic brake (DB) action	Clear	30r/min
6	Action A: Stop immediately Action B: Dynamic brake (DB) action	Free run (DB OFF)	Clear	
7	Action A: Stop immediately Action B: Dynamic brake (DB) action	Free run (DB OFF)	Clear	

5.2.7 Setting of Motor Over-load Factor

In this servo unit, you can set up overload level by setting Pr512, which can modify overload error Err16.0 and overload alarm detected time while not changing overload characteristics.

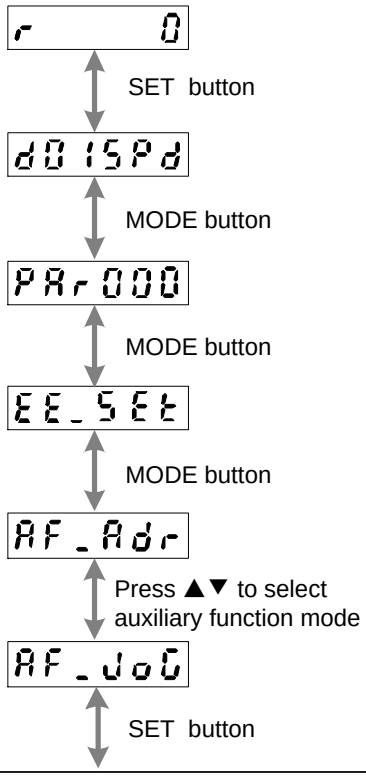
5.3 Trial Run

When you receive the driver, you should make use of the trail run function to run the motor for checking whether it works normally.

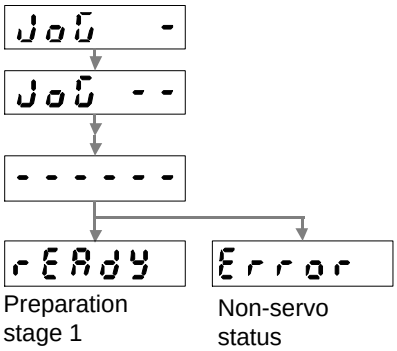
Please well connect the driver main power, control power, motor dynamic cable and encoder cable according to the wiring diagram offered in section 2.1. Do not connect with mechanical load in first-time trail run. There are two ways to trail run.

- **Trial run with the front panel of the driver**

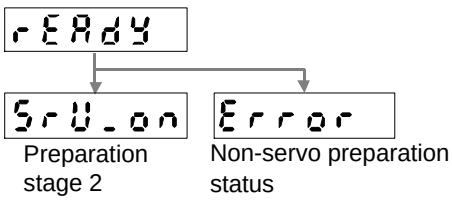
You can enable servo and run the motor by following the steps shown below. The motor speed can be controlled by setting Pr604 “JOG speed”, with acceleration and deceleration time fixed at 1(r/min)/ms. You can refer to section 3.3.5 “Auxiliary function mode” for the explanation of JOG mode.



When execute "motor trial run", keep pressing ▲ until [ready] appears then enter into preparation stage 1. When main power is off or error occurs, [error] will appear, as shown below.



Keep pressing ◀ until [SRV-ON] appears then enter into preparation stage 2. When there are SRV-ON signal input or non-servo preparation status, [error] occurs, as shown below.



In preparation stage 2, after servo is ON, press ▲/▼ to make the motor rotate in CCW/CW direction at the speed specified by Pr604 "JOG speed".

- **Trial run with support software iMotion of host controller**

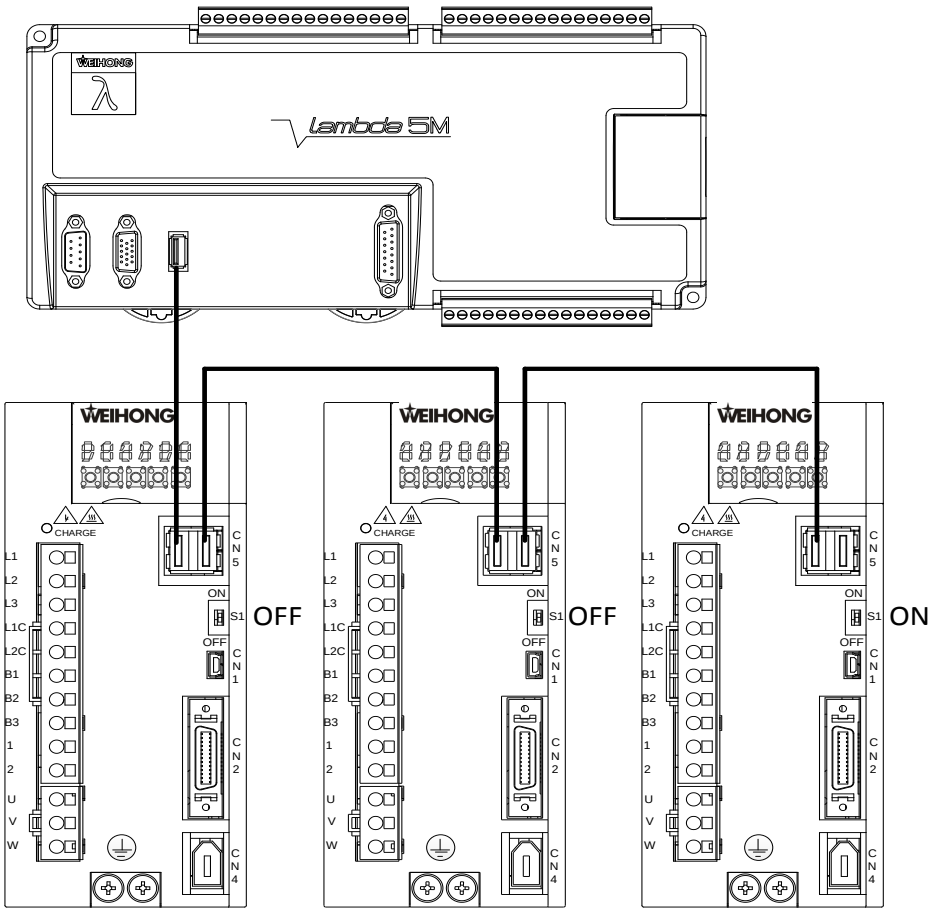
1. Install the support software iMotion of host controller;
2. Connect USB cable, with one end to USB interface on PC and the other end to CN1 connector of the driver.
3. Turn on the power for the driver.
4. Click “Trial run” on the iMotion function menu;
5. After trial run window is opened, refer to the Chapter “Trial run” in *Operating Manual of iMotion* to run the motor.

5.4 Position control

When driver uses position control, please ensure Pr001 has been set to 1.

5.4.1 Connection with Controller

Here is the wiring example of bus driver and control system. Please note that the dial switch S1 of last driver must be ON and the others must be OFF; otherwise, the system communication may be effected. The function of dial switch is to enable terminal resistor. When it is ON, terminal resistor is enabled, while disabled.

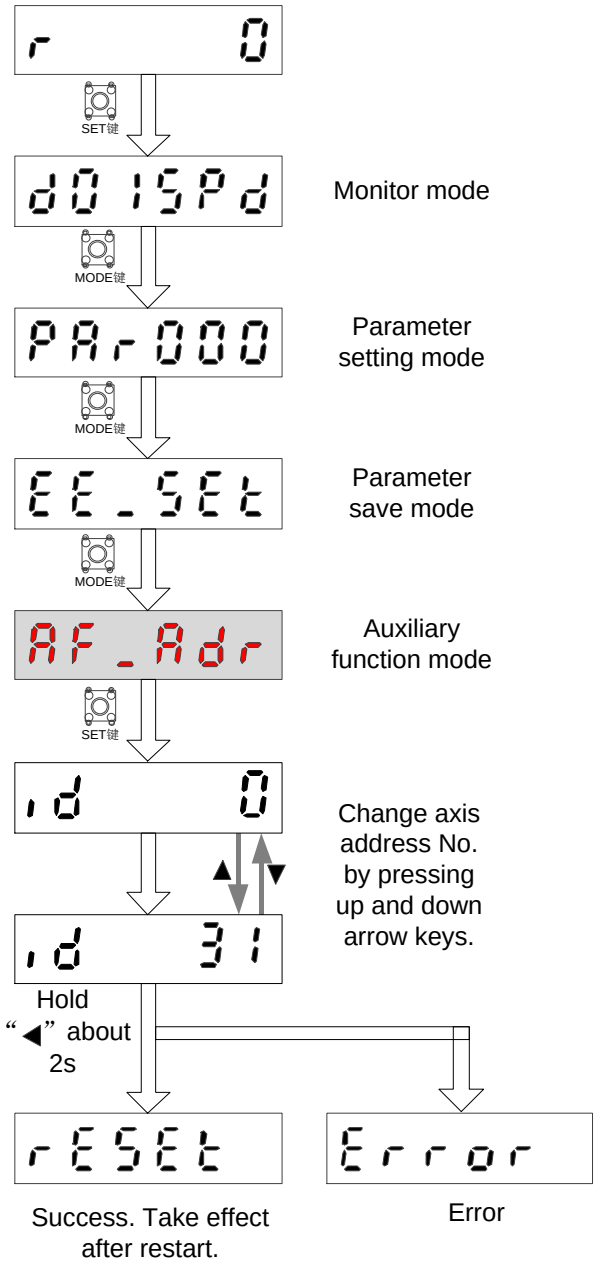


5.4.2 Axis Address Setting

After each component is connected well, axis address is necessary to set. It is recommended to set in sequence i.e. X-axis: 1, Y-axis: 2, Z-axis: 3, etc. When the axis address is set to 0, it means the communication function is disabled. You can set axis address via support iMotion software (version 1.2.3 or above) or the front panel of the driver.

- **Setting via Driver Panel**

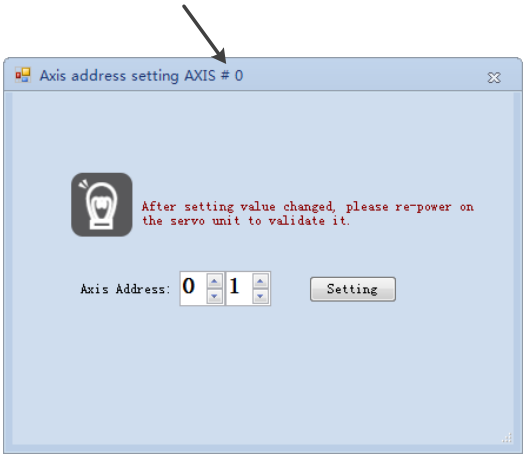
The concrete procedure of axis address modification is shown as below, and the modification will take effect after the driver is restarted.



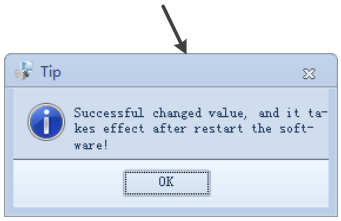
- **Setting via iMotion software**

1 After the driver is connected, you should click “Axis setting” to enter “Axis setting” interface.

2 Set the axis address and click “Setting”. (In the same control system, the number of the axis address of every driver is the unique one)



3 Then a prompt box will pop out and you should click “OK”.



5.4.3 Related Parameters Setting of Controller

Here will take Weihong NcStudio V10 (XYZ1Z2) control system as an example to introduce the related parameters setting, when M-Ⅱ bus-type driver is mated with NcStudio V10.

Set control system type	Set parameter “N50000 Control System Type” to 1. (1: Bus control system; 0: Non-bus control system) N50000 Control System Type 1 Reboot 0: Non-bus control system; 1: B
Set servo type	Set parameter “N16050 Servo Type” to be 2. (0: Yaskawa Σ5 servo; 1: Yaskawa Σ7 servo; 2: WISE servo) N16050 Servo Type Reboot 0: Yaskawa Σ5 servo; 1: Yaskaw X 1 Reboot Y 1 Reboot Z 1 Reboot
Set station address	Set the station address corresponding to the axes on the NC control system by setting parameter “N16000 Driver Station Address” according to axis address number of the driver. (Note: the number of station address should be the same with that of corresponding axis address set via the driver.) N16000 Driver Station Address Reboot It should be the same with rot X 1 Reboot Y 2 Reboot Z1 3 Reboot Z2 4 Reboot

Set encoder digit	Set parameter “N16020 Encoder Digit” according to the servo motor encoder digits used by the axes. N16020 Encode Digit — Reboot The digit number of encoder of X 24 Reboot Y 24 Reboot Z 24 Reboot
Set encoder type	Set parameter of “N11010 Encoder Type” according to encoder models used by the axes. (0: incremental encoder; 1: absolute encoder) N11010 ENCODER_TYPE — Reboot 0: Incremental encoder; 1: Absc X 0 Reboot Y 0 Reboot Z 0 Reboot

Modifications to parameters will take effect after restarting the software.

The default electronic gear ratio in the system parameter is 1:1. You can set it based on your own demands. However, you should ensure that the electronic gear ratio of the NC system is the same with that of the corresponding driver.

5.5 Velocity Control

Velocity control command is not supported by bus-type servo driver.

5.6 Torque Control

Torque control command is not supported by bus-type servo driver.

6 Gain Adjustment

In order to make motor move promptly and precisely according to the instructions sent by host controller, and obtain mechanical performance with the maximum limit, the gain adjustment for driver is necessary.

6.1 Preparation for Gain Adjustment

You can make gain adjustment for bus-type driver through the front panel, support software iMotion of the host controller, or bus control system if it is connected.

The operation steps of executing analog measurement or monitoring to signals are as following: connect the computer and driver via USB cable, with one end to the PC and the other end to CN1 connector of the driver. Then run the iMotion software to connect with the driver. After the software and the driver are connected successfully, you can begin adjustment.

Before adjusting, you should make the following settings appropriately according to using condition.

- **Set over-travel inhibition input**

Collision to the machine end can be avoided by inputting a limit sensor signal to the driver. Please refer to interface specification to correctly connect positive direction over-travel inhibition input and negative direction over-travel inhibition input (POT/NOT). In addition, you also need to set the parameters Pr504 “Over-travel inhibition input setup” and Pr505 “Sequence setup at over-travel inhibition” which are related to over-travel inhibition input. Refer to section 9.6 for details.

- **Set torque limit**

To reduce the damage caused by machine bite and collision, the max. torque of machine should be limited. And this purpose can be achieved by setting parameter Pr013 “1st torque limit”. Refer to section 9.1 for details.

Please note if you restrain the max. torque below actual requirement level, over-speed protection caused by overshoot or positional deviation protection caused by command reception delay may occur. In addition, you can externally detect the torque limit status by allocating “Torque in-limit signal output” with CN2 terminal specification to output signal.

- **Set over-speed protection**

When the motor speed becomes extremely high, Err26.0 “Over-speed protection” will occur.

The default motor speed has been specified as 1.2 times of the max. speed (r/min) of the applicable motor. If the maximum speed of the running motor does not reached the specified maximum speed, please use the equation below to set parameter Pr513 “Over-speed setup”.

$$Pr513 = V_{max} \times (1.2\sim1.5)$$

V_{max}: the max. speed [r/min] of the motor running.

1.2~1.5: the safety coefficient to avoid frequent occurrence of over-speed.

In addition, you can run the motor at low speed at the primary adjustment phase, or add the safety coefficient, which can protect the motor when oscillation occurs.

Refer to section 9.6 for over-speed protection setup of Pr513.

- **Set positional deviation excess protection**

In position control mode, once difference between detected positional command and motor position is large, Err24.0 “Positional deviation excess protection” will occur.

You can set positional deviation excess level by setting Pr014 “Positional deviation excess level setup”, whose default setting is 100000 pulse. Besides, you can select command position deviation (pulse) or encoder position deviation (pulse) by setting Pr520 “Unit selection of position setup”. Refer to section 9.1and 9.6 respectively for the setting of Pr014 and Pr520.

The position deviation of normal action is changing according to the setting of movement speed and gain. Therefore, please use the equation below to set Pr014 in accordance with the actual running condition.

➢ **In case of Pr520 ＝ 0 (with command position deviation detection):**

$$Pr014= Vc/K_p \times (1.2\sim2.0)$$

V_c: max. frequency (pulse/s) of positional command pulse.

K_p: the position loop gain (1/s).

1.2~2.0: the safety coefficient to avoid frequent occurrence of over-speed.

CAUTION

1. When switching position loop gain (Kp), use the min. value to calculate.
2. When position command filter is enabled, plus following value: Vc× time constant of filter (s)

➢ **In case of Pr520 ＝ 1 (with encoder positional deviation detection):**

$$Pr014= Ve/Kp \times (1.2\sim2.0)$$

V_e: the max. pulse (pulse/s) of encoder unit.

Kp: the position loop gain (1/s).

CAUTION

1. When switching position loop gain (Kp), use the min. value to calculate.
2. In case of Pr520 ＝1, setting of positional command filter will not affect the setting of Pr014.

- **Set motor working range**

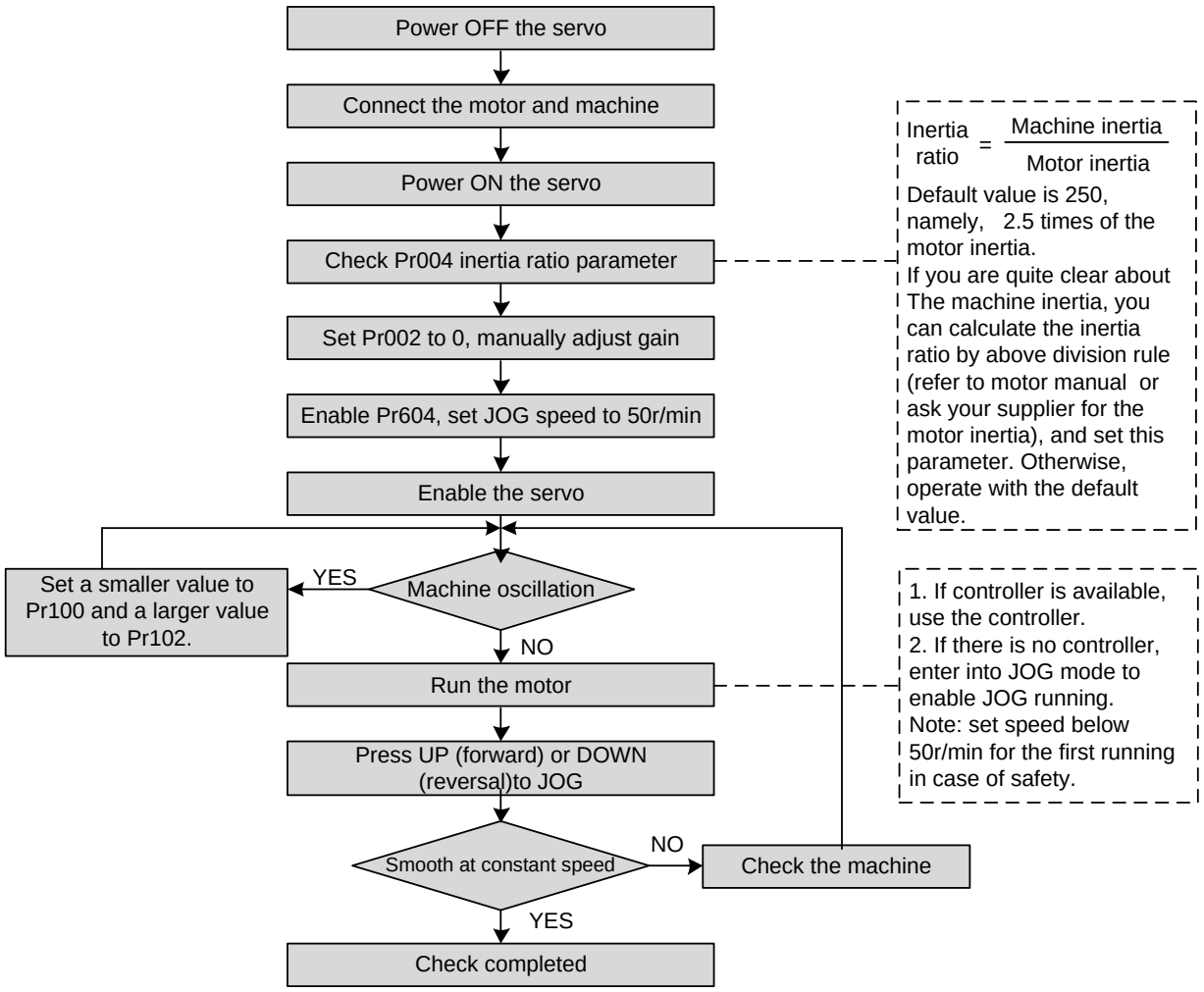
In position control mode, if detect that the range of the current position command exceeds the value set by Pr514 “Motor working range setup”, Err34.0 “ Motor working range protection” will occur. Refer to section 9.6 for the setting of Pr514.

6.2 Real-time Auto Gain Adjustment

In order to enable auto gain adjustment, following conditions should be met:

1. Servo should be ON.
2. Correctly set input signals such as deviation counter clear, command input inhibition, and other parameters unrelated to control, i.e. torque limit setup. In addition, the motor can run normally without obstacles.

6.2.1 Flowchart of Primary Estimation of Inertia



Two causes may lead to machine oscillation when the motor is in first time running together with machine.

1. The machine actual inertia is too large. For example, some machine inertia is 15 times or above of the motor inertia, while the default inertia ratio of driver is just 2.5 times. In this case, appropriately increase the value of inertia ratio parameter Pr004 to resolve this problem.
2. The set value of speed gain parameter is too large. In this case, machine oscillation may be removed by reducing value of Pr101 and increase time constant of velocity loop integration.

6.2.2 Related Parameters

- **Parameters to be updated**

According to Pr002 “Real time auto-tuning gain setup” and Pr632 “Real time auto-tuning gain custom setup”, instantly adjust the load characteristics estimate value and update the following parameters.

Para. No.	Para. Name	Function
Pr004	Inertia ratio	Update this parameter when the real time auto-tuning inertia ratio update is valid.
Pr607	Torque command additional value	Update this parameter when vertical axis mode for real time auto-tuning is valid.
Pr608	Positive direction torque compensation value	Update this parameter when friction compensation mode for real time auto-tuning is valid.
Pr609	Negative direction torque compensation value	Update this parameter when friction compensation mode for real time auto-tuning is valid.

- **Parameters which will be updated to setup value corresponding to stiffness setup**

According to setup of Pr003「Real time auto-tuning stiffness setup」, automatically update following basic gain setup parameters.

Para. No.	Para. Name	Function
Pr100	1st gain of position loop	When stiffness setup is valid, update these parameters based on the setup value. Refer to basic gain parameter setup table in section 6.2.4.
Pr101	1st gain of velocity loop	
Pr102	1st time constant of velocity loop integration	
Pr104	1st torque filter	
Pr105	2nd gain of position loop	
Pr106	2nd gain of velocity loop	
Pr107	2nd time constant of velocity loop integration	
Pr109	2nd torque filter	

- **Parameters which are set to fixed value**

The following parameters will be set to fixed values by real time auto-tuning function.

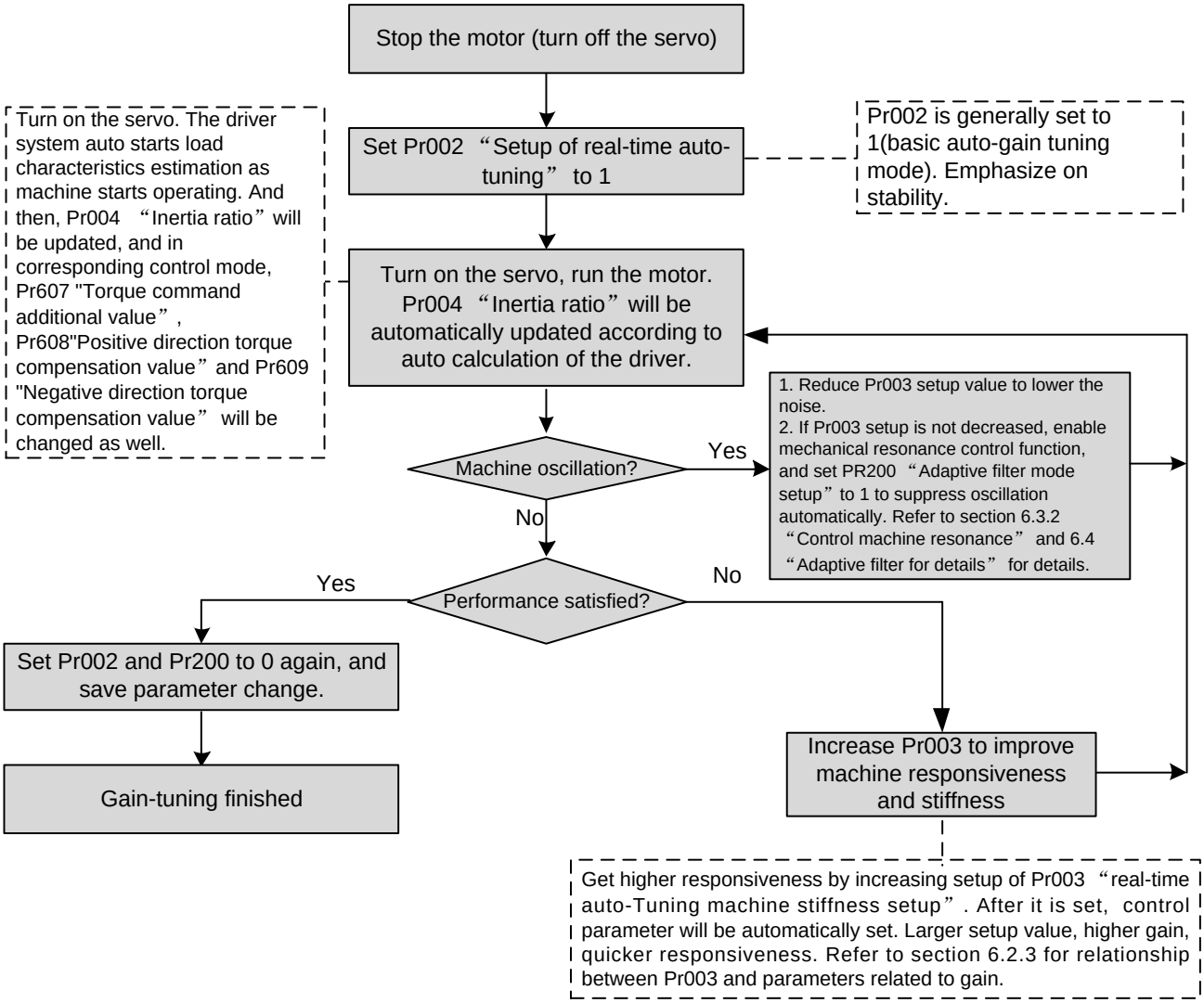
Para. No.	Para. Name	Setting Value
Pr103	1st filter of speed detection	0
Pr108	2nd filter of speed detection	
Pr110	Velocity feed forward gain	300（30%）
Pr111	Velocity feed forward filter	200（2ms）
Pr112	Torque feed forward gain	0
Pr113	Torque feed forward filter	

- **Parameters which are set in response to gain switching setup**

The real-time auto-tuning function sets the following parameters as the gain switched.

Para. No.	Para. Name	Function
Pr114	2nd gain setup	Set to 1 if the current setting is not maintained.
Pr115	Position control switching mode	Set to 2~10 to enable gain switching. Set to 0 to disable gain switching.
Pr116	Position control switching delay time	Set to 50 if the current setting is not maintained.
Pr117	Position control switching level	
Pr118	Position control switching hysteresis	Set to 33 if the current setting is not maintained.
Pr119	Position gain switching time	
Pr120	Velocity control switching mode	Set to 0 if the current setting is not maintained.
Pr121	Velocity control switching delay time	
Pr122	Velocity control switching level	
Pr123	Velocity control switching hysteresis	
Pr124	Torque control switching mode	
Pr125	Torque control switching delay time	
Pr126	Torque control switching level	
Pr127	Torque control switching hysteresis	

6.2.3 Auto Gain Adjustment Operation Steps



CAUTION

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, you can manually write parameter to EEPROM and then turn OFF the power.

6.2.4 Cautions for Automatic Gain Adjustment

- **Cautions**

1. When you turn ON the servo for the first time or increase the value of Pr003 “Real time auto-tuning stiffness setup”, the load characteristics estimation entering into stable status immediately or gradually is normal condition. If abnormal sound or oscillation occurs, there may

be some wrong. If such abnormality lasts or repeats for 3 seconds or more reciprocating operations, take the following counter-measures:

a) Lower the setup of Pr003 “Selection of machine stiffness at real time auto-gain tuning”.

b) Set Pr002 “Real time auto-tuning setup” to 0 to disable the real time auto-tuning.

c) Set Pr004 “Inertia ratio” to the value calculated by the equipment and set Pr607 “Torque command additional value”, Pr608 “Positive direction torque compensation value” and Pr609 “Negative direction torque compensation value” to 0.

2. When abnormal sound and oscillation occur, the parameters Pr004, Pr607, Pr608 and Pr609 might be changed to extreme values. Take the measures mentioned above to resolve this problem.
3. During the real time auto-tuning process, the values of Pr004, Pr607, Pr608 and Pr609 will be written into EEPROM every 30 minutes. When you turn on the driver again, the drive will take these values as initial data to execute auto adjustment.

- **Invalidation of real time auto-gain tuning**

You can set Pr002 “Real time auto-gain tuning setup” to 0 and stop the automatic calculation of Pr004 “Inertia ratio” to invalidate the real time auto-gain tuning. To save the estimation result of Pr004 “Inertia ratio”, if the parameter becomes obviously abnormal, you can use general mode to carry out auto adjustment or manually set appropriate value which is obtained from suitable formula or calculation.

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, you can manually write parameter to EEPROM and then turn OFF the power.

- **Conditions for inertia ratio estimation**

1. Load inertia: load is too small or large compared to the rotor inertia; the load inertia changes too quickly.
2. Load: the machine stiffness is extremely low; there is a nonlinear characteristic such as backlash.
3. Action requirements: velocity higher than 200r/min, acceleration higher than 80r/s^2. When run support software iMotion, velocity higher than 500r/min and acceleration time 100ms.

- **Relationship between gain adjustment and stiffness**

You can enhance the machine stiffness through following measures:

1. Well mount the equipment on the ground base and secure no vibration.
2. Use the servo couplings with high stiffness.
3. Use wide synchronization belt. Furthermore, 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 adjustment of the servo machine; for machines with low resonance frequency (low machine stiffness), response setup of the servo machine cannot be set too high.

- **Basic gain parameter setup table**

Stiff-ness	1st Gain				2nd Gain			
	Pr100	Pr101	Pr102	Pr104	Pr105	Pr106	Pr107	Pr109
	Gain of Position Loop (0.1/s)	Gain of Velocity Loop (0.1Hz)	Time Constant of Velocity Loop Integration (0.1ms)	Time Constant of Torque Filter (0.01ms)	Gain of Position Loop (0.1/s)	Gain of Velocity Loop (0.1Hz)	Time Constant of Velocity Loop Integration (0.1ms)	Time Constant of Torque Filter (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
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

6.3 Manual Gain Adjustment

As explained previously, WISE series driver features the automatic gain tuning function. However, there might be some cases where this automatic gain tuning cannot be adjusted properly depending on the limitation on load conditions. You might need to readjust the tuning to obtain the optimum response or stability corresponding to each load.

When the servo driver oscillation occurs or the control performance is not satisfied during manual adjustment process, you can manually tune the gain by adjusting parameters related to velocity loop or position loop, in order to enhance the system performance or remove oscillation.

- **General principles and methods for manual gain tuning**

Tuning Items	Description
Gain of velocity loop	It is mainly used to determine the response speed of velocity loop. On condition that no vibration exists, the set value of this parameter is larger, the response speed is higher.
Time constant of velocity loop integration	There is integration component in velocity loop, which can feed back minor input. The integration component will delay working of the servo system. Therefore, with time constant increasing, response time slows and required positioning setup time will be longer. If the load inertia is large, or vibration occurs to the mechanical system frequently, time constant of velocity loop integration should be large enough; otherwise, vibration will occur.
Notch frequency	On some circumstances, sharp noise will be generated due to resonance in mechanical system. At this time, notch filter should be executed to remove resonance.
Position loop gain	It determines the response of the servo system. When gain of position loop is set to a high value, the response speed increases and positioning time will be shortened. In addition, stiffness and natural frequency of the mechanical system should be high enough.

CAUTION

1. On most occasions, you should secure that gain of velocity loop is larger than gain of position loop. When gain of position loop is larger than gain of velocity loop greatly, adjustment out of available range may occur caused by filter signal, which will severely destroy system performance.
2. Parameters of the system are inter-restricted. Sole increase of gain of position loop may result in instability of position loop output command, finally causing instability of whole servo system.

- **Steps of manual gain adjustment:**

Step	Content	Adjustment Description
1	Adjust set value of Pr101	1) After the servo system is well installed, in order to obtain stable motor rotation, you can set position proportion gain Pr100 to 50 (5HZ) or less and set Pr102 time constant of velocity loop integration to 10000. 2) Then gradually increase the set value of Pr101, at the same time, observe whether there is oscillation when motor stopping. Besides, manually adjust the set value of Pr101 and observe that if rotational speed is uneven, namely, speeding up and slowing down. 3) When above phenomena occur after Pr101 increased, you need to decrease the set value to remove oscillation and obtain smooth rotational speed. This value will be the initial setup for Pr101.
2	Adjust set value of Pr102	1) You can gradually decrease the set value of Pr102 to display the integration effect. 2) Similar to the step 1, when you decreasing the value of Pr102, there will be oscillation and instability. At this time, you must increase the set value of Pr101 to remove oscillation and obtain smooth speed. This value will be the initial setup for Pr102.
3	Adjust set value of Pr100	If the value of Pr100 position proportion gain is too large, the over-travel adjustment range during motor positioning might be too large, causing instability. At this time, you need to decrease setup of Pr100 in order to decrease over-travel adjustment range and avoid instable range. However, the setup cannot be too small either. Because a too small value can reduce positioning efficiency. You need to obtain a good balance.

- **Here are introductions to several typical examples (in each situation, only a parameter will be changed):**

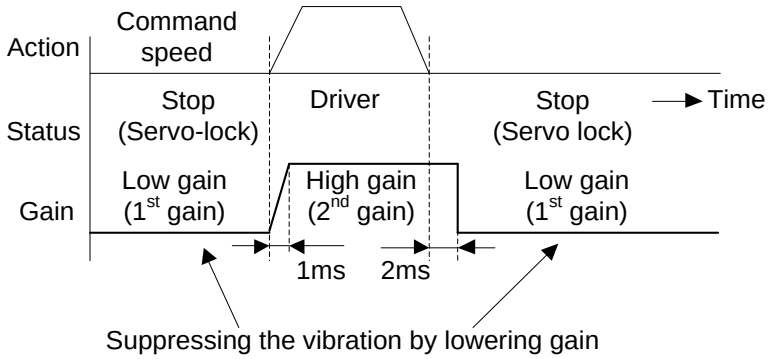
Typical Example	Description
Appropriate parameter setting	In this situation, parameter setting is proper, where motor speed is in accordance with the positional command, velocity is within allowable range and positioning time is short.
Time constant of velocity loop integration is relatively small	Velocity loop of the servo driver should feature quickly response ability. Small time constant of velocity loop integration will damage the stability of velocity loop and cause motor speed vibration and unstable motor running.
Time constant of velocity loop integration is relatively large	In this situation, parameter setting is slightly different from that in proper setting situation. Velocity loop integration exerts a relatively small impact on velocity-positional command following, but too large velocity loop integration time will prolong the responsive time of velocity loop.

Typical Example	Description
Gain of velocity loop is relatively large	In this situation, when motor speed fluctuates, effect of the fluctuation is the same with that of a too short velocity integration time, two of which should be orchestrated. That is, increase the velocity integration time as increase of gain of velocity loop; otherwise, oscillation will occur to the servo system.
Gain of velocity loop is too small	Reduction of gain of velocity loop leads to fluctuation of motor speed. Compared with a too high gain of velocity loop, fluctuation frequency of motor speed is lower, which fully shows that a higher gain of velocity gain gets increased working frequency and better responsiveness of the control system, effectively curtailing effect of disturbance.
Gain of position loop is too small	Working frequency of the position loop is far smaller than that of velocity loop in servo system. While a too small gain of position loop is inadequate to counteract with positional deviation during velocity response, causing prolonged period between motor speed-positional command following. The high accuracy and quick responsiveness of positioning system is greatly affected.
Gain of position loop is too large	In position control mode, gain of position loop affects stability as well. A too large gain of position loop may cause motor speed fluctuation. Besides, compared with a too small gain of position loop, pure delay time of responsiveness of motor speed to the positional command is reduced.

6.3.1 Gain Switching

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

1. Decrease the gain at the time of stopping (servo lock) to reduce vibration.
2. Increase the gain at the time of stopping (setting) to shorten the setting time.
3. Increase the gain during operation to improve command compliance.
4. Based on condition of the equipment, change the gain with external signal.



- **Example**

Following is the example when you want to reduce the noise at motor in stall (servo lock) by setting up to lower gain after the motor stops. Please refer to section 6.2.4 “Basic Gain Parameter Setup Table” to make adjustment.

Param No.	Name	Execute manual gain tuning without gain switching	Set up the same value as Pr105~Pr109(2nd gain) to Pr100~Pr104	Setup Pr114~Pr119(Gain switching condition)	Adjust Pr101 and Pr104 at sopping (1st gain)
Pr100	1st gain of position loop	630			
Pr101	1st gain velocity loop	350			270
Pr102	1st time constant of velocity integration	160			
Pr103	1st filter of velocity detection	0			
Pr104	1st torque filter	65			84
Pr110	Velocity feed forward	300			
Pr111	Filter of velocity feed forward	50			
Pr105	2nd gain of position loop		630		
Pr106	2nd gain of velocity loop		350		
Pr107	2nd time constant of velocity integration		160		
Pr108	2nd filter of velocity detection		0		
Pr109	2nd torque filter		65		
Pr114	2nd gain setup	0		1	
Pr115	Position control switching mode			7	
Pr116	Delay at position control mode switching			30	
Pr117	Level of position control switching			0	
Pr118	Hysteresis at position control switching			0	
Pr119	Position gain switching time			0	
Pr004	Inertia ratio	• Input the known value from load calculation • Measure the inertia ratio by executing normal auto gain tuning. • Default is 250.			

- **Setup of gain switching condition**

In the following three tables, “●” represents “valid”, while “—” represents “invalid”.

➢ **Position control mode**

Setup of Gain Switching Condition			Parameters at Position Control Mode		
Pr115	Switching condition to 2nd gain	Fig.	Delay time*1	Level	Hysteresis*2
			Pr116	Pr117	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)

Setup of Gain Switching Condition			Parameters at Position Control Mode		
Pr115	Switching condition to 2nd gain	Fig.	Delay time *1	Level	Hysteresis *2
			Pr116	Pr117	Pr118
7	Position command exists	E	●	—	—
8	Not in positioning complete	F	●	—	—
9	Actual speed	C	●	● (r/min)	● (r/min)
10	Positional command + velocity	C	●	● (r/min)	● (r/min)

➢ **Speed control mode**

Setup of Gain Switching Condition			Parameters at Velocity Control Mode		
Pr120	Switching condition to 2nd gain	Fig.	Delay time *1	Level	Hysteresis *2
			Pr121	Pr122	Pr123
0	Fixed to 1st gain		—	—	—
1	Fixed to 2nd gain		—	—	—
2	Gain switching input		—	—	—
3	Torque command	A	●	● (%)	● (%)
4	Velocity command variation	B	—	●	●
5	Velocity Command	C	●	● (r/min)	● (r/min)

➢ **Torque control mode**

Setup of Gain Switching Condition			Parameters at Torque Control Mode		
Pr124	Switching condition to 2nd gain	Fig.	Delay time *1	Level	Hysteresis *2
			Pr125	Pr126	Pr127
0	Fixed to 1st gain		—	—	—
1	Fixed to 2nd gain		—	—	—
2	Gain switching input, GAIN ON		—	—	—
3	Torque command	A	●	● (%)	● (%)

CAUTION

*1: Delay time (Pr116, Pr121 and Pr125) will be valid only when returning from 2nd gain to 1st gain.

*2: Hysteresis (Pr118, Pr123 and Pr127) is defined as the figure below.

*3: Designate the encoder resolution through control mode.

*4: When there is a speed variation of 10r/min in 1 sec, set the value to 1.

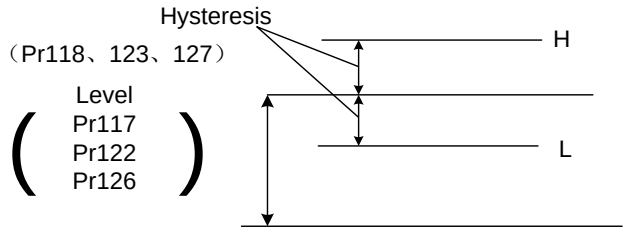
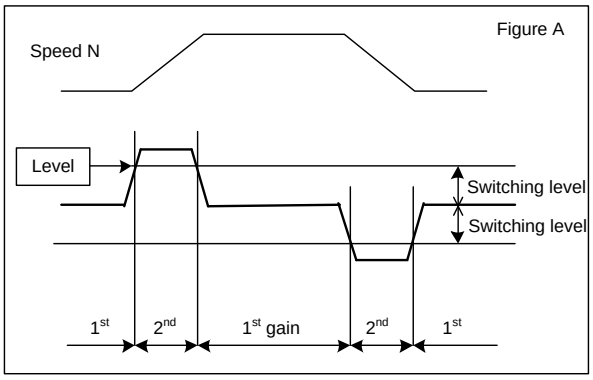
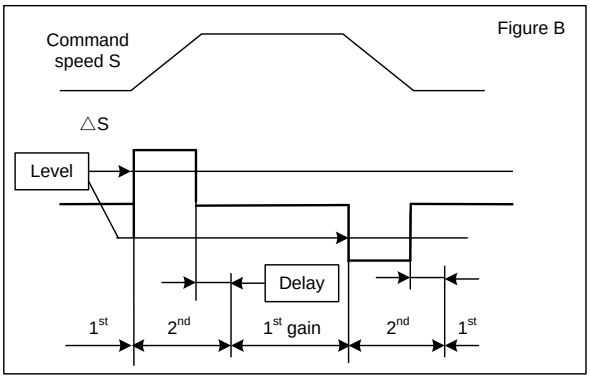


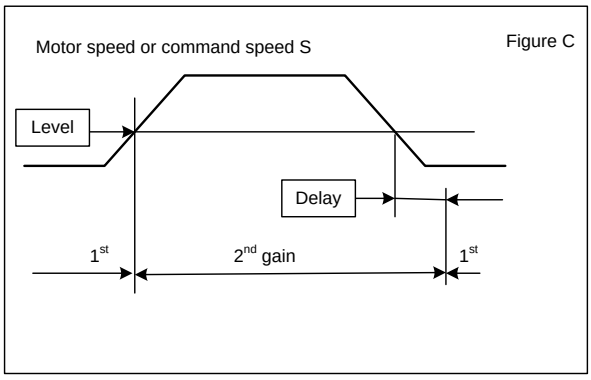
Fig. 6-1 Definition of Hysteresis

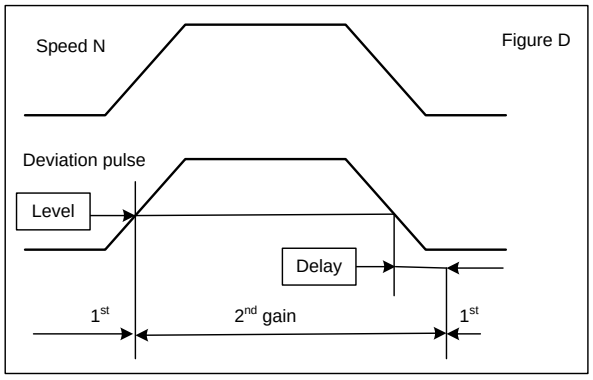
The time sequences of gain switching in these three control modes are shown as below.

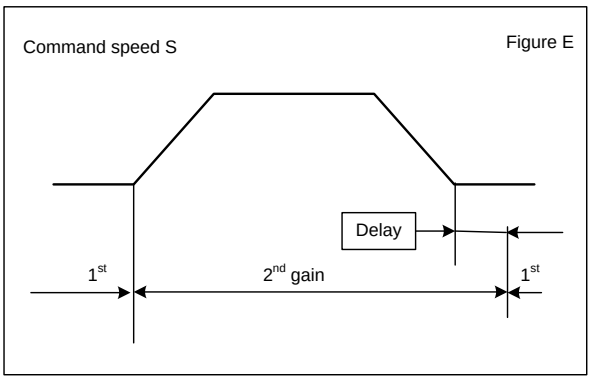
Note: Figures below do not reflect a timing lag of gain switching due to hysteresis (Pr118, Pr123, and Pr127).

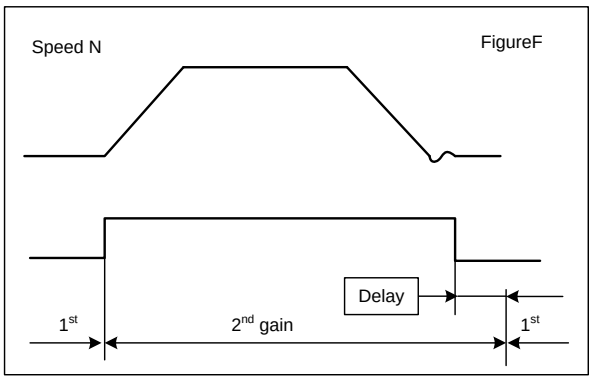












6.3.2 Suppression of Machine Resonance

In case of low machine stiffness, you cannot set up a higher gain because vibration and noise occur due to resonance caused by axis distortion or other causes. By suppressing the resonance peal at the notch filter, higher gain can be obtained or the level of vibration can be lowered.

- **Torque command filter (Pr104，Pr109)**

Set up the filter time constant so as to damp the frequency at vicinity of resonance frequency.

You can obtain the cut off frequency of the torque command filter in formula below.

Cut off frequency (Hz)fc ＝ 1/ (2× parameter set value×0.00001)

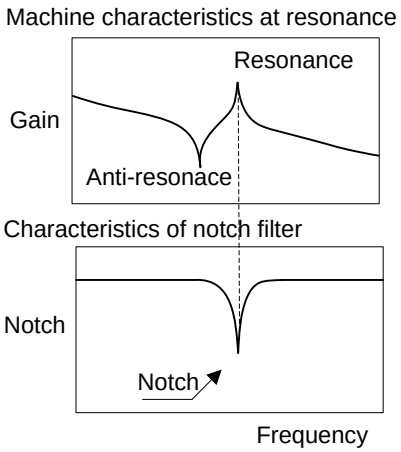
- **Notch filter (Pr201~212)**

Generally, the system is equipped with four notch filters, which can be adjusted by setting frequency, width and depth, etc.

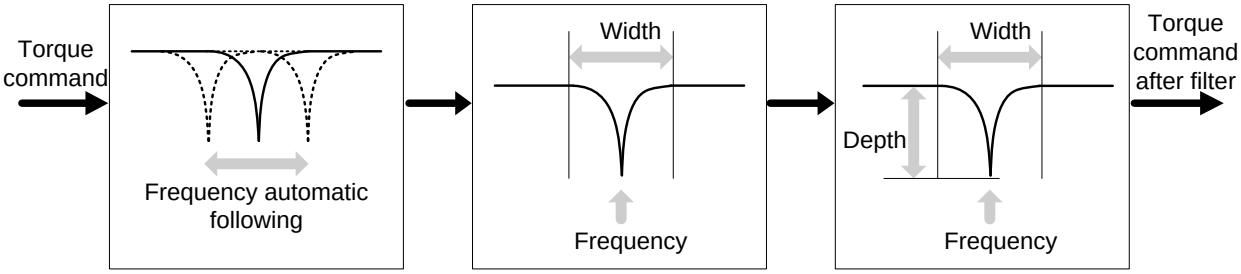
Para. No.	Para. Name	Function
Pr201*1	1st notch frequency	Set the frequency of the 1st notch filter.
Pr202	1st notch width selection	Set the width of notch at the center frequency of the 1st notch filter.
Pr203	1st notch depth selection	Set the depth of notch at the center frequency of the 1st notch filter.
Pr204*1	2nd notch frequency	Set the frequency of the 2nd notch filter.
Pr205	2nd notch width selection	Set the width of notch at the center frequency of the 2nd notch filter.
Pr206	2nd notch depth selection	Set the depth of notch at the center frequency of the 2nd notch filter.
Pr207*1	3rd notch frequency	Set the frequency of the 3rd notch filter.
Pr208	3rd notch width selection	Set the width of notch at the center frequency of the 3rd notch filter.
Pr209	3rd notch depth selection	Set the depth of notch at the center frequency of the 3rd notch filter.
Pr210*1	4th notch frequency	Set the frequency of the 4th notch filter.
Pr211	4th notch width selection	Set the width of notch at the center frequency of the 4th notch filter.
Pr212	4th notch depth selection	Set the depth of notch at the center frequency of the 4th notch filter.

CAUTION

*1: when this parameter is set to “5000”, notch filter function is disabled.

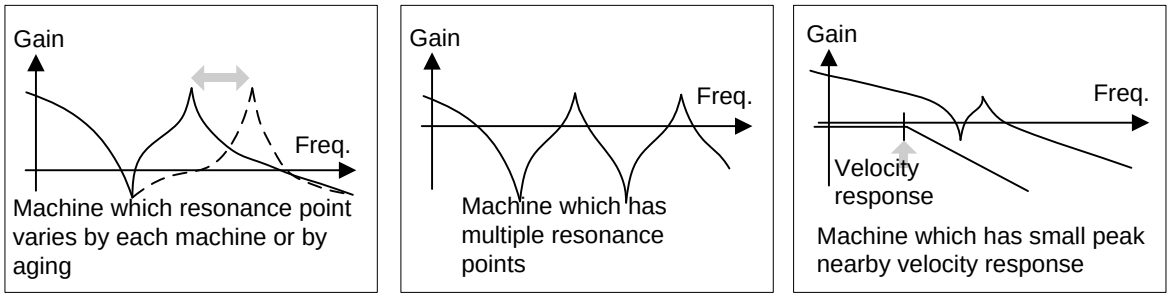


Adjust the frequency, width and depth of the notch filter:



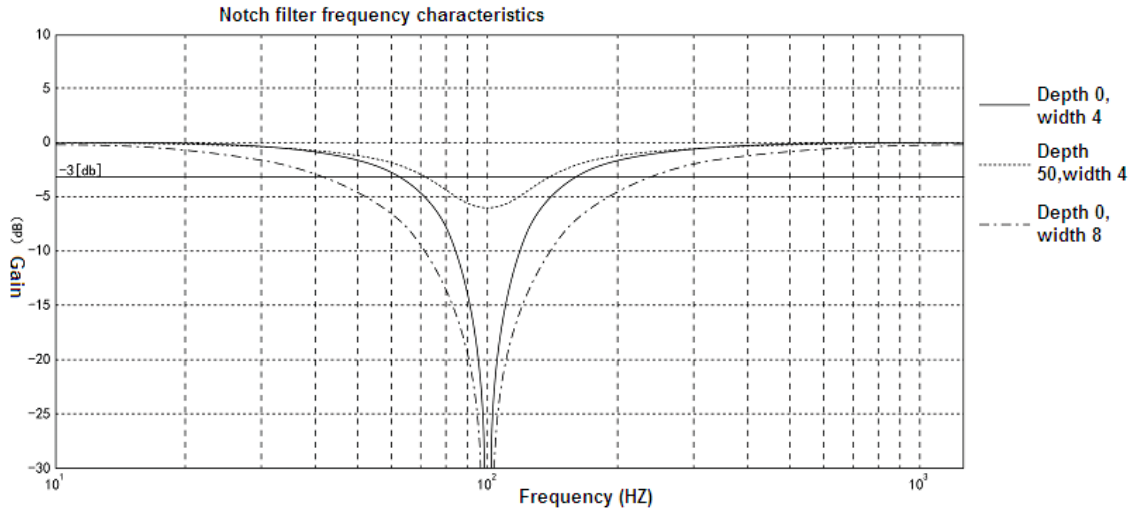
Adaptive filter | 1st notch filter | 2nd ~4th notch filter

Examples:



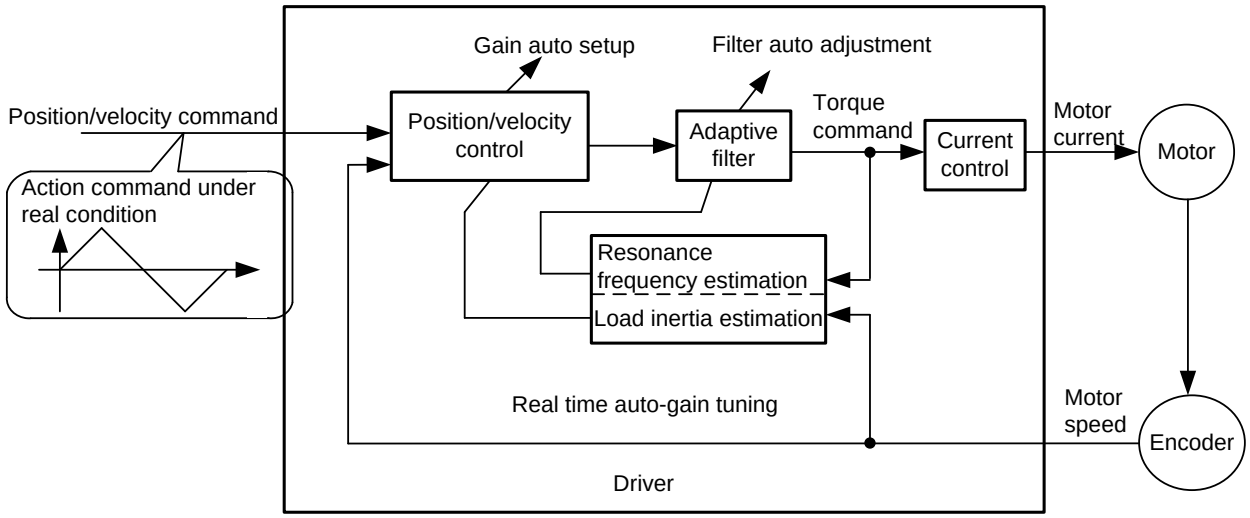
Adaptive filter enabled | Adaptive filter and notch filter enabled | Depth adjustment enabled

Characteristics of notch filter frequency:



6.4 Adaptive Filter

In actual practice, adaptive filter estimates the resonance frequency according to the vibration components presented by motor speed, and removes the resonance component from the torque command by setting the notch filter coefficient automatically, hence reduces the resonance vibration.



- **Applicable conditions**

The function works under the following conditions.

	Conditions under which the adaptive filter is activated
Control Mode	Applies to other control mode than torque control.
Others	Should be servo-ON status. Elements other than control parameters, such as deviation counter clear command inhibit and torque limit are appropriately set, enabling the motor to run normally.

- **Caution**

Under the following conditions, the driver may not work normally. At this time, please manually set the notch filter to prevent resonance.

	Conditions which obstruct adaptive filter action
Resonance point	Resonance frequency is lower than 3 times of velocity loop band width. Resonance peak is low, or control gain is low where the motor speed is not affected by this. Multiple resonance points exist.
Load	Motor speed variation with high harmonic component is generated due to non-linear factors such as backlash.
Command pattern	Acceleration/deceleration is rapid such as 30000r/min per 1s.

- **Operation Methods**

Enter the action command with Pr200 “Adaptive filter mode” set to a value other than 0. If the resonance point affects motor speed, the parameters of 3rd and 4th notch filters will be set automatically according to the number of adaptive filters.

Set the operation of the adaptive filter to the following parameter.

Para. No.	Para. Name	Set value	Function	
Pr200	Adaptive filter mode setup	0	Adaptive filter is invalid	The adaptive filter is disabled. Parameters related to the 3rd and 4th notch filters hold the current set value.
		1	1 adaptive filter is invalid	One adaptive filter is enabled. Parameters related to the 3rd notch filter will be updated based on adaptive performance.
		2	2 adaptive filters are valid	Two adaptive filters are enabled. Parameters related to the 3rd notch filter will be updated based on adaptive performance. And the parameters of 4th notch filter can be set according to the 2nd resonance point read by “FFT analysis” oscillogram which is generated by support software iMotion.

Para. No.	Para. Name	Set value	Function	
		3	Resonance frequency measurement mode	Measure the resonance frequency. Result of measurement can be checked with iMtion. Parameters related to the 3rd and 4th notch filter hold the current setting value.
		4	Clear adaptation result	Parameters related to the 3rd and 4th notch filter are disabled and results of adaptive operation are cleared.

At the same time, the following parameters will be automatically set.

Para. No.	Para. Name	Description
Pr207	3rd notch frequency	When no resonance point is found, set the frequency to 5000.
Pr208	3rd notch width selection	Automatically set when the adaptive filter is enabled.
Pr209	3rd notch depth selection	
Pr210	4th notch frequency	Notch frequency is automatically set to the 2nd resonance frequency estimated by the adaptive filter. When no resonance point is found, set the frequency to 5000.
Pr211	4th notch width selection	Automatically set when 2 adaptive filters are enabled.
Pr212	4th notch depth selection	

- **Caution**

1. Immediately after the first servo-on at start, or after increasing stiffness setting with the real time auto-tuning enabled, abnormal sound or oscillation may be generated until the adaptive filter stabilizes. If such abnormality lasts or repeats for 3 or more reciprocating operations, take the following countermeasures.
   a) Write the parameters which have given the normal operation into EEPROM.
   b) Lower the setup of Pr003 “Selection of machine stiffness at real time auto gain tuning”.
   c) Set Pr200 “Adaptive filter mode setup” to 0 to disable the adaptive filter.
   d) Manually set the notch filter.
2. Abnormal sound or oscillation may excessively change the set value of 3rd and 4th notch filters. If such change occurs, disable the adaptive filter as described in step c) above, change set value of Pr207 “3rd notch frequency” and Pr210 “4th notch frequency” to 5000 (disable), and then enable the adaptive filter again.
3. The 3rd filter (Pr207~Pr209) and 4th notch filter (Pr210~Pr212) are written to EEPROM every 30 minutes. Upon power up, these data are used as default values during adaptive process.

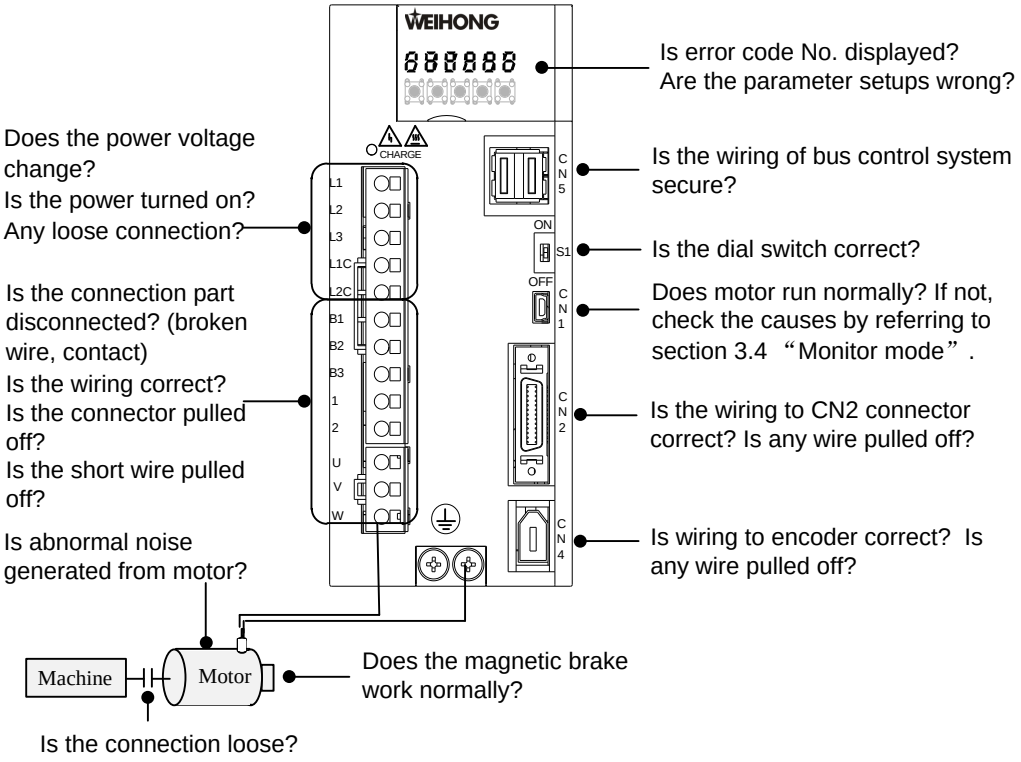
6.5 Adjustment with Bus Control System

Weihong control system used in WISE bus-type driver and the adjustment function in WISE driver are supported. The brief introduction of auto adjustment steps is shown as below. Please refer to corresponding bus control system manual for more details.

1. After wiring completed, you can do such basic settings as control system mode and driver mode in control system. Enter the “Servo Parameter” interface of control system then click “Auto Adjustment” to open the adjustment window.
2. Set 1st limit, 2nd limit, initial mode and initial stiffness; then click “ADJ start”. The motor will start running and the system will automatically estimate inertia ratio, friction and variable load. After deduction finished, the result will be written into the related parameters automatically.
3. Click “Next” to enter “Gain Adjustment” interface, and set the related parameters. Click “Start” to run the motor and check the result. If the result is satisfying, click “Save” to save the set parameter and exit adjustment. Then repower the driver to validate the adjustment result. If the result is not satisfying, you can click “Stop” to modify the parameters again and repeat the steps mentioned above to check it until you obtain a perfect one.

7 Error and Troubleshooting

In case of driver failure, you can refer to the figure below to debug and troubleshoot.



7.1 Error Code List

WISE driver boasts of various protection mechanisms. When protection function is enabled, the motor stop rotating and alarms occur with servo alarm signal (ALM) feeding out.

- **Alarm status and treatment**

1. During error status, error code (Err.) will be displayed on front panel LED and the servo cannot be enabled.
2. You can clear the error status by alarm clear input (A-CLR) in 120ms or longer.

When over-load protection is triggered, you can clear it by alarm clear input (A-CLR) in 10 sec or longer after the error occurs. You can clear the overload protection time characteristics (refer to section 7.2.1) by turning off the control power supply of the driver.

3. You can clear the above errors through key operations on front panel or with the help of support software iMotion on PC.
4. Be sure to clear the alarm during motor stop after removing the cause of the error and securing safety.

- **Overall list of error code**

The error codes are displayed in the format of Err XX.Y (XX: main code; Y: sub code) in this manual, that is, Err XX.Y will be displayed on the front panel when alarm occurs. The list of error codes is shown as below. ● represents the attribute of the relevant error code.

Error Code	Name	Attribute		
		History	Clearable	Stop Immediately
Err 11.0	Control power under-voltage protection		●	
Err 12.0	Over-voltage protection	●	●	
Err 13.0	Main power supply under-voltage protection (between P and N)		●	
Err 13.1	Main power supply under-voltage protection (AC interception detection)		●	
Err 14.0	Over-current protection	●		
Err 14.1	IPM error protection	●		
Err 15.0	Over-heat protection	●		●
Err 16.0	Over-load protection	●	●	●
Err 18.0	Regeneration over-load protection	●		●
Err 18.1	Regeneration Tr error protection	●		
Err 19.0	DB (dynamic brake) over-load protection	●		
Err 21.0	Encoder communication disconnect error protection	●		
Err 21.1	Encoder communication error protection	●		
Err 23.0	Encoder communication data error protection	●		
Err 24.0	Positional deviation excess protection	●	●	●
Err 24.1	Velocity deviation excess protection	●	●	●
Err 26.0	Over-speed protection	●	●	●
Err 26.1	2nd over-speed protection	●	●	
Err 27.0	Command pulse input frequency error protection	●	●	●
Err 27.1	Command pulse division/multiplication error protection	●	●	●
Err 28.0	Pulse regeneration limit protection	●	●	●
Err 29.0	Deviation count overflow protection			
Err 33.0	IF duplicated allocation error 1	●		

Error Code	Name	Attribute		
		History	Clearable	Stop Immediately
Err 33.2	IF input function number error 1	●		
Err 33.3	IF input function number error 2	●		
Err 33.4	IF output function number error 1	●		
Err 34.0	Software limit function	●	●	●
Err 36.0~Err 36.2	EEPROM parameter error protection			
Err 37.0~Err 37.2	EEPROM code error protection			
Err 38.0	Driver inhibited input protection		●	●
Err 40.0	Absolute encoder system down error protection	●		
Err 41.0	Absolute count overflow error protection	●		
Err 42.0	Absolute encoder over-speed error protection	●	●	
Err 43.0	Encoder initialization error protection	●		
Err 44.0	Absolute encoder single turn count error protection	●		
Err 45.0	Absolute encoder multi-turn count error protection	●		
Err 46.0	Absolute encoder overheat protection	●		
Err 47.0	Absolute status error protection	●		
Err 48.0	Encoder Z-phase error protection	●		
Err 49.0	Encoder CS signal error protection	●		
Err 56.0	ABZ incremental encoder over-speed error protection	●		
Err 56.1	ABZ incremental encoder UVW error protection	●		
Err 56.2	ABZ incremental encoder ABZ error protection	●		
Err 57.0	Current sampling offset excess protection	●		
Err 57.1	Current gain diagnosis error protection	●		
Err 58.0	Chip working error protection	●		
Err 59.0	Registered time expired	●		
Err 59.1	Mismatching software version	●		

Error Code	Name	Attribute		
		History	Clearable	Stop Immediately
Err 60.0	M-II communication ASIC fault 1	●		●
Err 61.0	M-II communication ASIC fault 2	●		●
Err 62.0	M-II internal synchronous error 1	●	●	●
Err 63.0	M-II transmission cycle setup error	●	●	●
Err 64.0	M-II synchronous error		●	●
Err 64.1	M-II synchronous failure	●	●	●
Err 65.0	M-II communication fault (receipt error)		●	●
Err 65.1	M-II transmission cycle error (synchronous interval error)	●	●	●
Err 87.0	Forced alarm input protection		●	●
Err 95.0~Err 95.4	Motor automatic recognition error			
Other	Other error protection	●		

7.2 Introduction to Error Codes (Causes and Remedy)

When an alarm with remark ★ occurs, it cannot be cleared by “Alarm clear input (A-CLR)”. To return to the normal operation, you need to turn off the power, remover the cause and then turn on the power again.

Refer to section 2.2 “Wiring Diagram of Main Circuit” and chapter 9 for more details.

Error code	Name	Cause	Remedy
Err 11.0	Control power under-voltage protection	The voltage between P-N of control power converter is lower than rated value. a) When the power voltage is low, instantaneous power failure will occur. b) Lack of power capacity, power supply voltage has fallen down due to inrush current at the main power-on. c) Failure of servo driver (failure of the circuit).	Measure the voltage between connectors and terminals. a) Increase the power capacity and change the power supply. b) Increase the power capacity. c) Replace the driver with a new one.

Error code	Name	Cause	Remedy
Err 12.0	Over-voltage protection	The voltage between P-N of the converter has exceeded the specified value: a) The voltage of power supply has exceeded the permissible input voltage. Voltage surge generated by reactive compensation capacitor and UPS (uninterruptible power supply). b) Disconnection of the regeneration discharge resistor. c) External regeneration discharge resistor is not appropriate and could not absorb the regeneration energy. d) Failure of servo driver (failure of the circuit).	Measure the voltage between lines of connector (L1, L2 and L3). a) Input correct voltage. Remove a reactive compensation capacitor. Measure resistance of the external resistor for P-B of the driver. b) If the value is ∞, replace the external resistor. c) Change the resistance and wattage of generative resistor. d) Replace the driver with a new one.
Err 13.0	Main power supply under-voltage protection (PN)	When Pr508 is set to 1, the instantaneous power failure time between L1-L3 is longer than that specified by Pr509, or the voltage between P-N of main power converter is lower than the specified value. a) Power supply voltage is low. Instantaneous power failure occurs. b) Lack of power capacity, power supply voltage has fallen down due to inrush current at the main power-on. c) Lack of phase…3-phase input driver has been operated with single phase input. d) Failure of servo driver (failure of the circuit).	Measure the voltage between lines of connector (L1, L2 and L3). a) Increase the power capacity and change the power supply. After exclude the causes of the magnetic contactor shutdown of the main power supply, re-enter the power. b) Set a larger value to Pr509, and set each phase power correctly. c) Increase power capacity. d) Connect each phase of the power supply (L1, L2 and L3). For single phase, use any two of the three terminals. e) Replace the driver with a new one.
Err 13.1	Main power supply under-voltage protection (AC)		

Error code	Name	Cause	Remedy
Err 14.0	★Over current protection	The current through converter has exceeded the specified value. a) Failure of servo driver (failure of the circuit, IGBT or other components). b) Short of motor cable (U, V and W). c) Earth fault of motor cable. d) Burnout of motor. e) Poor contact of motor cable. f) Timing of pulse input is same as or earlier than Servo-ON.	a) Disconnect motor cable and turn the servo on. If failure occurs immediately, please replace the driver with a new one. b) Check whether the motor cable U, V and W is short-circuited, and whether there are rags on the cables. Make a correct wiring connection. c) Measure the insulation resistance between motor wires, U, V and W and earth wire. In case of poor insulation, replace the motor. d) Check the balance of resistor between each motor line, and if unbalance is found, replace the motor. e) Check the loose connectors. If they are loose or fall off, fix them securely. f) Enter the pulse after servo has been turned on about 100ms or longer.
Err 14.1	★ IPM error protection		
Err 15.0	★ Over heat protection	The temperature of heat sink or power components has been exceeded the specified value. a) The driver operating temperature has been over the specified value. b) Over load.	a) Reduce the ambient temperature and improve the cooling condition. b) Increase the capacity of driver and motor, prolong the acceleration/deceleration time, and lower the load.
Err 16.0	Over-load protection	When the value of torque command exceeds the over-load level set by Pr512, the over-load protection will be activated according to the time characteristics. a) Load is heavy, the actual torque exceeds the rated	Check whether there is an oscillation or a large fluctuation of torque (current) waveform by reading the oscillogram generated by the support software. Check the over-load alarm and load factor with the

Error code	Name	Cause	Remedy
		torque and the motor has kept running for a long time. b) Oscillation, vibration and abnormal sound occur due to poor gain adjustment. The setup value of inertia ratio Pr004 is wrong. c) Incorrect wiring and disconnection of the motor. d) Due to machine collision or heavy load, machine has been distorted. e) Electromagnetic brake has been kept engaged. f) While wiring multiple axes, miswiring has occurred by connecting the motor cable to the other axis.	help of the support software. a) Increase the capacity of driver and motor, prolong the acceleration/deceleration time, and lower the load. b) Readjust gain c) Wire the motor and remove cables correctly according to the wiring diagram. d) Remove the cause of twine and lower the load. e) Release the brake, and measure the voltage between brake terminals. f) Wire the motor cable and encoder cable correctly in accordance the corresponding axes.
		CAUTION Refer to section 7.2.1 for details about over-load protection time characteristics. Once the error occurs, it cannot be cleared at least for 10 seconds.	

Error code	Name	Cause	Remedy
Err 18.0	★ Regeneration over-load protection	The regenerative energy has exceeded the capacity of regenerative resistor. a) The regenerative energy generated in deceleration process due to large inertia makes the converter voltage rise. Therefore, the detection value rises and is large than the normal level, due to the lack of regenerative resistor capacity of absorbing this energy. b) Regenerative energy cannot be completely absorbed during the rated deceleration time, due to high motor rotation speed. c) The active limit of external regenerative resistor has been limited to 10% over-load factor.	Confirm the load factor of regenerative resistor with the help of front panel or communication. Do not use in continuous regenerative brake application. a) Check the running pattern (velocity monitor). Check the over-regeneration alarm and load factor of the regenerative resistor. Increase the capacity of driver and motor, prolong the deceleration time, lower the motor rotation speed and connect an external regenerative resistor. b) Check running pattern (velocity monitor). Check the over-regeneration alarm and load factor of the regenerative resistor. Increase the capacity of driver and motor, prolong the deceleration time, lower the motor rotation speed and connect an external regenerative resistor. c) Set Pr016 to 2.
		WARNING When you set Pr016 to 2, external protection devices must be installed such as thermal fuse. If there is no protection for regenerative resistor, it may be burnt out due to abnormal heat.	
Err 18.1	★ Regenerative transistor error protection	Regenerative driver transistor on the servo driver malfunctioned.	Replace the driver.

Error code	Name	Cause	Remedy
Err 19.0	★ DB(Dynamic brake) over-load protection	a) The motor has been driven by external power. b) Rotating energy when DB is stopping exceeds the resistor capacity of DB. c) Failure of the driver. d) Too much power has been consumed by dynamic brake.	a) Don't drive the motor with external power or force. b) Decrease the command velocity of the driver. Decrease load inertia ratio. Reduce times of DB stopping. c) Replace the driver.
Err 21.0	★ Encoder communication disconnection error protection	Communication between the encoder and the driver has been interrupted in certain times, and disconnection detecting function has been triggered.	Please check whether the signal of encoder cable is twisted pair, SD+ and SD-. Refer to the wiring diagram to make a correct wiring connection of the encoder, and correct the miswiring of connector pins.
Err 21.1	★ Encoder communication error protection	Although the encoder is connected, communication has some errors due to noise.	a) Ensure the power voltage of encoder is DC 5V±5% (4.75~5.25V). Please pay attention when the encoder cable is a little long. b) Please check whether the signal of encoder cable is twisted pair, SD+ and SD-. Separate the encoder cable and the motor cable if they are bound together. c) Connect the shield to FG.
Err 23.0	★ Encoder communication data error protection	a) Data communication between the encoder is normal, but contents of data are not correct. b) Mainly data error due to noise. c) Encoder cables are connected, but communication data has some error.	

Error code	Name	Cause	Remedy
Err 24.0	Position deviation excess protection	Position deviation pulse has exceeded the setup of Pr014. a) The motor has not followed the command. b) Set value of Pr014 is too small.	a) Check that the motor follows to the position command pulses. Check that the output torque has not saturated in torque monitor. Make a gain adjustment. Set up maximum value to Pr013 and Pr522. Make encoder wiring as the wiring diagram. Set a longer acceleration/deceleration time. Lower the load and speed. b) Set a larger value for Pr014.
Err 24.1	Velocity deviation excess protection	The deviation between internal position command speed and actual speed (speed deviation) has exceeded the set value of Pr602. **CAUTION** If the internal position command speed is forced to be changed to 0 due to instantaneous stop caused by the command pulse inhibit input (INH) or positive/negative over-travel inhibition input, the speed deviation will be rapidly increased at this moment The speed deviation also largely increases on the rising edge of the internal positional command speed. Therefore, Pr602 set value should have sufficient margin.	a) Increase the set value of Pr602. b) Make the acceleration/deceleration time of internal positional command speed longer, or improve the follow-up characteristic by adjusting the gain. c) Disable the excess speed deviation detection (Pr602 ＝ 0).
Err 26.0	Over-speed protection	The motor rotational speed has exceeded the set value of Pr513.	a) Avoid an excessive speed command. b) Check the command pulse input frequency and division/multiplication ratio. c) Make a gain adjustment when an overshoot has occurred due to a poor gain adjustment.
Err 26.1	2nd over-speed protection	The motor rotational speed has exceeded the set value of Pr615.	

Error code	Name	Cause	Remedy
			d) Make a wiring connection of the encoder as the wiring diagram.
Err 27.0	Command pulse input frequency error protection	Command pulse input frequency has exceeded 1.2 times of the Pr532 set value.	Check the command pulse input.
Err 27.1	Command pulse division/multiplication error protection	Division and multiplication ratio which are set up with the command pulse counts per single turn and the 1st~4th numerator/denominator of the electronic gear are not appropriate.	Check set values of division and multiplication ratio of command pulse division/multiplication.
Err 28.0	Pulse regeneration limit protection	The output frequency of pulse regeneration has exceeded the limit.	a) Check the set value of Pr011 and Pr503. b) To disable the detection, set Pr533 to 0.
Err 29.0	Deviation count overflow protection	The standard position deviation of encoder pulse or the standard grating close loop deviation has exceeded 2^{29}(536870912).	Use position command pulse to check whether the motor is rotating.
Err 33.0	★ I/F input duplicated allocation error1 protection	Input signals (SI1, SI1, SI2, SI3, SI4, SI5, SI6, and SI7) are assigned with duplicate functions.	Please allocate correct function to each connector pin.
Err 33.2	★ I/F input function number error1	Input signals (SI1, SI1, SI2, SI3, SI4, SI5, SI6, and SI7) are assigned with undefined number.	
Err 33.3	★ I/F output function number2	When enable Lambda communication function, input signal SI1 has been assigned with other function.	
Err 33.4	★ I/F output function number error1	Output signals (SO1, SO2, SO3, and SO4) are assigned with undefined number.	

Error code	Name	Cause	Remedy
Err 34.0	Motor moveable range setup error protection	According to the position command output range, motor has moved out of the specified range set by Pr514. a) Appropriate adjustment. b) The set value of Pr514 is too small.	a) Check gain (the balance between position loop gain and velocity loop gain) and inertia ratio. b) Set a larger value for Pr514, or set it to 0 to disable the protection function.
Err 36.0 Err 36.1 Err 36.2	★ EEPROM parameter error protection	Data in parameter storage area has been damaged when reading the data from EEPPOM at power-on.	Set up all parameters again. If the error persists, replace the driver (it may be a failure). And return the problem product to the manufacturer.
Err 37.0 Err 37.1 Err 37.2	★ EEPROM check code error protection	Operating to EEPROM failed when reading data from EEPROM at power-on.	
Err 38.0	★ Over-travel inhibit input protection	a) When Pr504 “Over-travel inhibit input setup” = 0, both positive and negative over-travel inhibit inputs (POT/NOT) have been ON. b) When Pr504 = 2, positive or negative over-travel inhibit inputs has turned ON.	Check that there are not any errors in switches, wires or power supply which are connected to positive/negative direction over-travel inhibit input. Especially check that the rising time of the control power supply (DC12 ~ 24V) is not slow.
Err 40.0	★ Absolute system down error protection	Voltage of the built-in capacitor has fallen below the specified value because the power supply or battery for the absolute encoder has been down.	After connecting the power supply for the battery, clear the absolute encoder.
		CAUTION Once this error occurs, the alarm cannot be cleared until the absolute encoder is reset.	

Error code	Name	Cause	Remedy
Err 41.0	★ Absolute encoder count error protection	Multi-turn counter of the absolute encoder has exceeded the specified value.	a) Set Pr015 to 2 to ignore multi-turn counter overflow. b) Limit the travel from machine origin within 32767 revolutions.
Err 42.0	Absolute encoder over-speed error protection	The motor speed has exceeded the specified value, when only encoder battery supplies power at power failure.	Check the supply voltage at the encoder side (5V±5%) Check the connecting condition of the connector CN2.
		CAUTION Once this error occurs, the alarm cannot be cleared until the absolute encoder is reset.	
Err 43.0	★ Encoder initialization error protection	Error has been detected during initializing the encoder.	Replace the motor.
Err 44.0	Absolute encoder single turn count error protection	Absolute encoder: single turn count error protection. Incremental encoder: single turn count error protection.	Replace the motor.
Err 45.0	★ Absolute encoder multi-turn count error protection	Absolute encoder: multi-turn count error protection. Incremental encoder: single turn count error protection.	Replace the motor.
Err 46.0	Absolute encoder overheat protection	Encoder temperature is too high.	Cool down the ambient temperature of the motor.
Err 47.0	★ Absolute encoder status error protection	Encoder has been running at a faster speed than the specified value at power-on.	Avoid motor running when power is connected.
Err 48.0	★ Encoder Z-phase error protection	The missing pulses of Z-phase of incremental encoder have been detected. The encoder might be a failure.	Replace the motor.

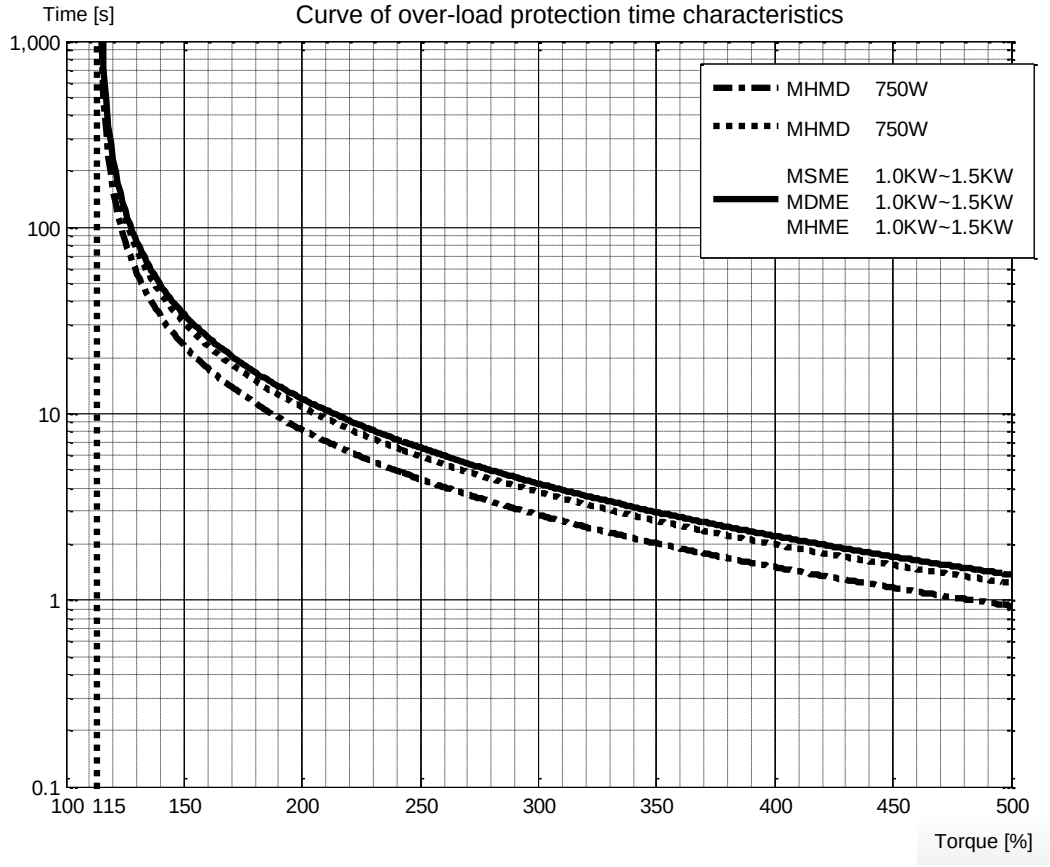
Error code	Name	Cause	Remedy
Err 49.0	★Encoder CS signal error protection	CS signal logic error of incremental encoder has been detected. The encoder might be a failure.	Replace the motor.
Err 56.0	ABZ incremental encoder over-speed error protection	The motor rotational speed has been exceeded the specified value.	Avoid the motor rotating too fast. Cut off the control power and restart the driver.
Err 56.1	ABZ incremental encoder UVW error protection	The logic error of U, V, and W signal of incremental encoder has been detected. The encoder might be a failure.	a) Check whether the wiring of U, V and W signal is correct. b) Check whether there is any strong interference around the encoder,
Err 56.2	ABZ incremental encoder ABZ error protection	The missing pulses of A, B and Z-phase of incremental encoder have been detected. The encoder might be a failure.	a) Check whether the wiring of A, B, and Z signal is correct. b) Check whether there is any strong interference around the encoder,
Err 57.0	Current sampling offset excess protection	The working of current sampling chip circuit is abnormal.	Cut off the power and connect it again. If the error still exists, there might be a failure. Please stop using and replace the motor and driver, and return them to factory for repair. Check the connection condition of connector X4.
Err 57.1	★Current gain diagnosis error protection	Power circuit has an error, or the U, V and W cables of the motor are disconnected.	a) Cut off the power and connect it again. If the error still exists, there might be a failure. Please stop using and replace the motor and driver, and return them to factory for repair. b) Check whether the cables U, V, and W of the motor are disconnected.

Error code	Name	Cause	Remedy
Err 58.0	★Chip working error protection	Error caused by power supply for the chip or noise.	Cut off the power and connect it again. If the error still exists, there might be a failure. Please stop using and replace the motor and driver, and return them to factory for repair.
Err 59.0	Registered time expired	Detect the remaining usage time.	Contact supplier or manufacturer.
Err 59.1	Mismatching software version	Detect the software version.	
Err 60.0	M-II communication ASIC fault 1	The MECHATROLINK communication component of servo unit might be a failure.	Repower the servo unit. If the alarm still exists, the servo unit might be a failure. Replace it with a new one.
Err 61.0	M-II internal synchronous error 1	The setup of MECHATROLINK communication parameter has been exceeded the specified range.	Check the set value of MECHATROLINK communication parameter. Change the set value to a right one.
Err 62.0	M-II internal synchronous error 1	The transmission cycle of MECHATROLINK changed. Servo unit might be a failure	Eliminate the causes which made the transmission cycle of host controller changed. Repower the servo unit. If the alarm still exists, the servo unit might have a failure. Replace it with a new one.
Err 63.0	M-II transmission cycle setup error	The setup of MECHATROLINK transmission cycle has been exceeded the specified range.	Check the set value of MECHATROLINK transmission cycle. Change the set value to a right one.
Err 64.0	M-II synchronous error	Update error of host controller WDT data has been occurred. Servo unit might be a failure	Check the update of WDT data. Update WDT data correctly. Repower the servo unit. If the alarm still exists, the servo unit might have a failure. Replace it with a new one.

Error code	Name	Cause	Remedy
Err 64.1	M-II synchronous failure	When synchronous communication starts, if the update error of host controller WDT data is detected, the synchronous communication will fail. Servo unit might be a failure	Check the update of WDT data. Update WDT data correctly. Repower the servo unit. If the alarm still exists, the servo unit might have a failure. Replace it with a new one.
Err 65.0	M-II communication fault (receipt error)	The wiring of MECHATROLINK is wrong. The communication address of servo unit is not same with the setting of host controller. Servo unit might be a failure	Wire MECHATROLINK communication cables and terminal resistors correctly. Check the setting of servo unit communication address. Repower the servo unit. If the alarm still exists, the servo unit might have a failure. Replace it with a new one.
Err 65.1	M-II transmission cycle error (synchronous interval error)	MECHATROLINK transmission cycle has changed. Servo unit might be a failure	Check the setting value of MECHATROLINK transmission cycle. Eliminate the causes which made the transmission cycle of host controller changed. Repower the servo unit. If the alarm still exists, the servo unit might have a failure. Replace it with a new one.
Err 87.0	Forced alarm input protection	Forced alarm input (E-STOP) has been applied.	Check the wiring of forced alarm input (E-STOP).
Err 95.0	Motor automatic recognition error	The motor and voltage specification of the driver does not match.	Replace the motor with another one which matches to the driver.
Err 95.1		The motor and encoder connector of the driver does not match.	
Err 95.2		The motor and power rate of the driver does not match.	

Error code	Name	Cause	Remedy
Err 95.3		The motor encoder and driver setup does not match.	Check the type of motor encoder and the setting of the driver parameter Pr015.
Err 95.4		Read-write error of encoder EEPROM has been occurred.	Turn off the power once, and re-power ON. Stop using if the error persists. Replace the motor and the driver. Return the products to the manufacturer for repair.
Other error code	★Other error	a) Control circuit has malfunctioned due to excess noise or other causes. b) The self-diagnosis function of driver has been active due to inside error of the driver.	Turn off the power once, and re-power ON. Stop using if the error persists. Replace the motor and the driver.

7.2.1 Over-load Protection Time Characteristics (Err16.0)



Use the motor so that actual torque stays in the continuous running range as shown in “S-T characteristics” of the motor.

7.2.2 Software Limit Function (Err34.0)

With respect to the position command input range, when the motor travels exceeding the movable range which is set up by Pr514 (Motor working range setup), you can make an alarm stop of the motor with software limit protection (Err34.0). With this function, you can prevent the work from colliding with the machine end caused by motor oscillation.

- **Applicable range**

- Position control mode.
- Should be in servo-on condition;
- 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, assuring that the motor can run smoothly.

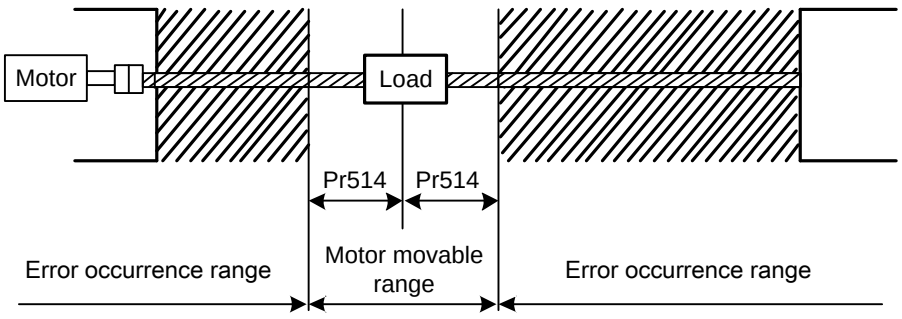
- **Cautions**

- This function is not a protection against the abnormal positional command.
- When this software limit protection is activated, the motor will decelerate and stop according to Pr510 (Sequence at alarm).
- The work (load) may collide to the machine end and be damaged depending on the load during this deceleration, therefore, set up the range of Pr514 including the deceleration movement.

- **Example of movement**

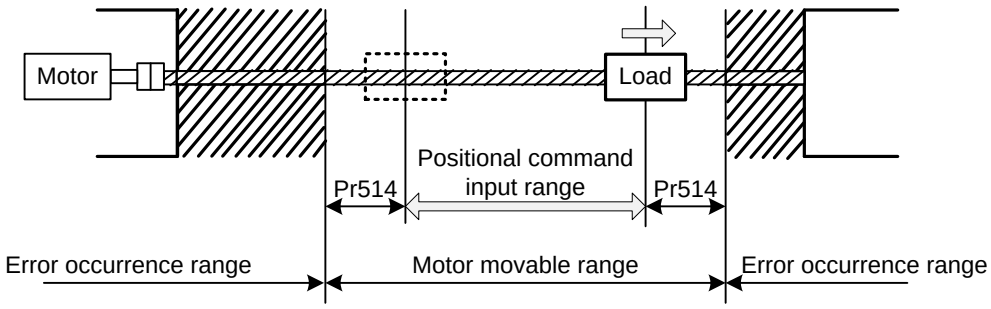
- When no position command is entered (Servo-ON status)

The motor movable range will be the travel range which is set at both sides of the motor with Pr514 since no position command is input. When the load enters into Err34.0 occurrence range (oblique line range) due to oscillation, software limit protection will be activated.



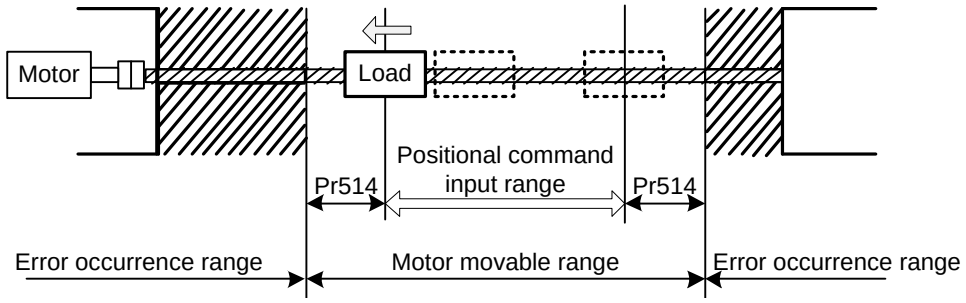
- When the load moves to the right (at Servo-ON)

When the position command to the right direction is input, the motor movable range will be expanded by entered position command, and the movable range will be the position command input range + Pr514 set values in both sides.



➢ When the load moves to the left (at Servo-ON)

When the position command to the left direction is input, the motor movable range will be expanded further.



- **Condition under which the position command input range is cleared.**

The position command input range will be 0-cleared under following conditions.

➢ When the power is turned on.

➢ While the position deviation is being cleared「Deviation counter clear is valid, Pr505 (Sequence at over-travel inhibition) ＝ 2, and over-travel inhibition input is valid」.

➢ At the beginning and ending of trial run during communication between driver and iMotion.

8 Driver Registration Function

8.1 Configuration and Registration

Driver registration function can restrict driver working time and protect the rights of customers through encrypting registration code.

You can register different time length or infinite time to specify the working time of driver. When the actual accumulated working time of the driver reaches the registered time length, alarm “Registered time expired (Err59.0)” will appear and the driver cannot work normally.

- **Basic configuration**

The basic configuration for driver registration is as follows.

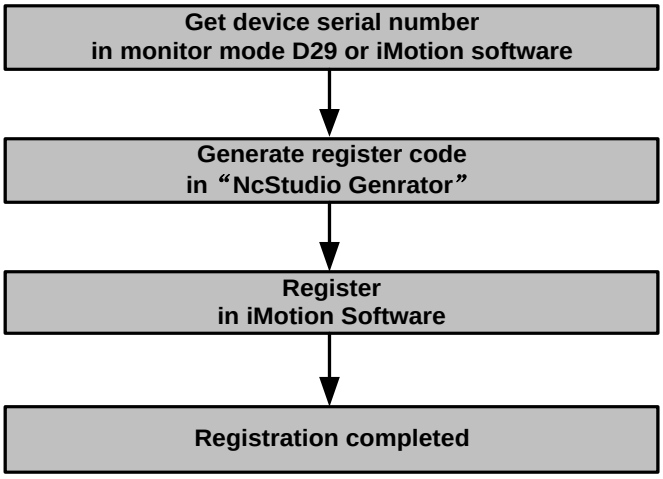
- WISE driver
- USB cable
- Mobile APP “NcStudio Generator”[*1]
- PC with iMotion software installed[*2]

CAUTION

*1: Search the Apple APP store for “NcStudio Generator” or “Weihong”, and you can find the APP “NcStudio Generator”. Download and install it. You need to register with your phone number and be recorded by Weihong to use the APP. Please refer to the help document in the APP for more details.

*2: The iMotion software installed on the PC must be version 1.19 or above.

- **Registration steps**



8.2 Get Device Serial Number

- **Read in panel**

Switch the driver panel to monitor mode “d29ASE” by pressing▲or▼, and press SET button to enter displaying. For example, device serial number “WSDV–2B67–1111–1111–000” will be displayed in the following format.

Order	High	Middle	Low	Lowest
Letter	H	n	L	C
Value	11111	1111	1111	000

CAUTION

Decimal value is displayed in high order “H” of the panel. In order to be entered into the generator, the decimal value should be transformed into hexadecimal value. For example, “11111” must be transformed into hexadecimal value “2B67”. Values of other bits keep unchanged.

- **Read in iMotion software**

Connect the driver with PC via a USB cable, and then open iMotion software for communication connection. There are two methods to check driver serial number.

1. In the “Connect” dialog box as shown below, you can read the “Driver SN”, which is the device serial number.

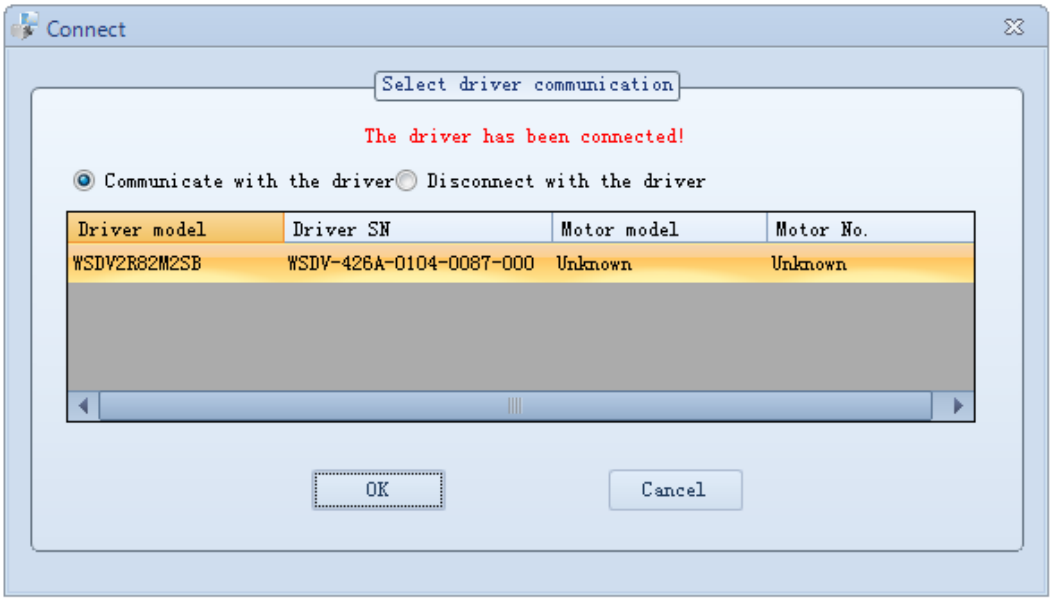


Fig. 8-1 Communication interface of iMotion

2. Under function tab “Function preview”, select sub-menu “About iMotion” of menu “Other”, and you can read the “Driver SN”, which is the device serial number.

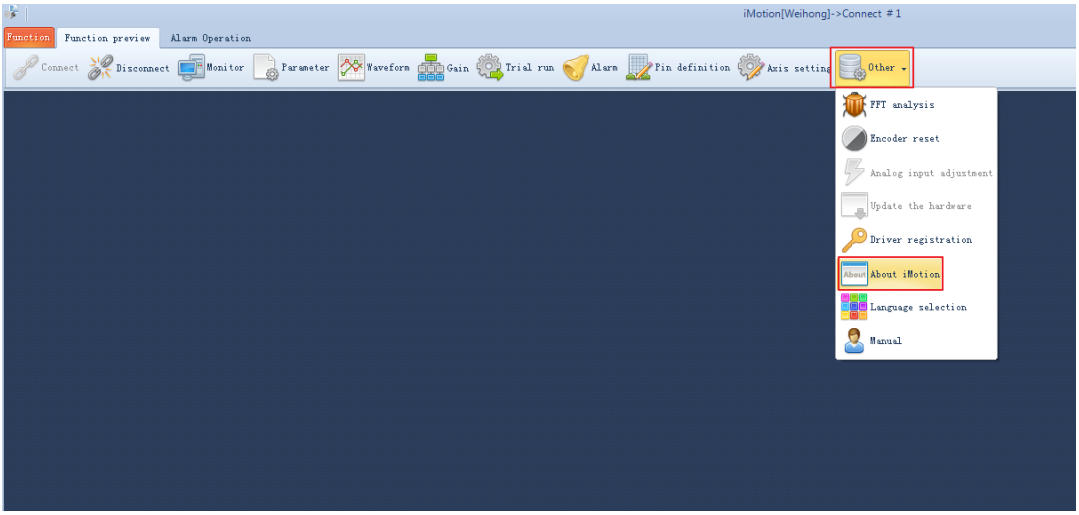


Fig. 8-2 “Other | About iMotion” function menu

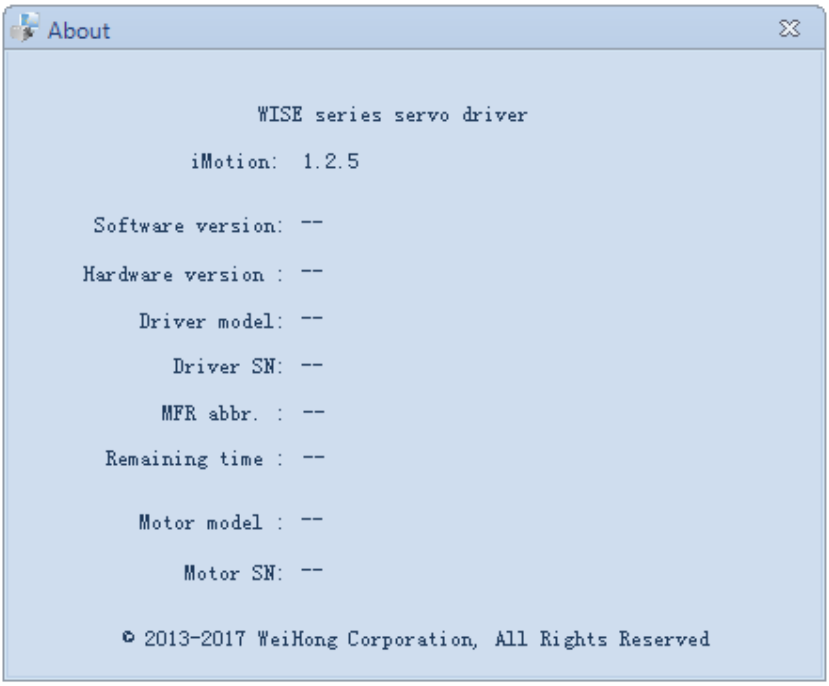


Fig. 8-3 “About” interface

8.3 Generate Register Code

Open “NcStudio Gnerator”. The generation steps of register code are as shown below.

Fig. 8-4 Generate registration code with NcStudio generator

8.4 Register

Open iMotion software. After the driver is connected successfully, click function menu “Other | Driver Registration” then the driver registration dialog box will pop up as shown below.

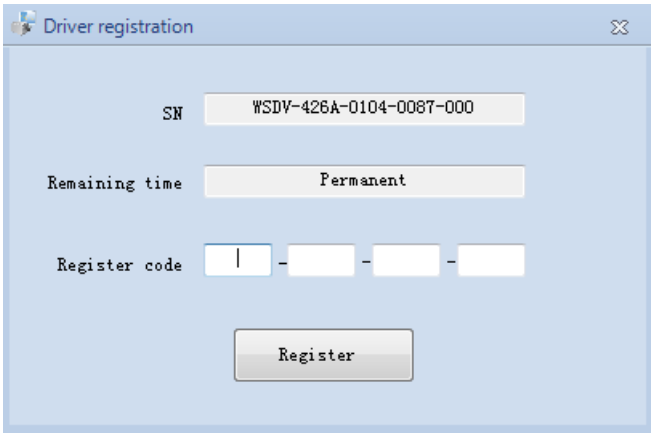


Fig. 8-5 “Driver Registration” interface

CAUTION

WISE driver registration function is currently supported in part of the Lambda controllers and NcStudio, which can realize direct registration without the help of iMotion software. Please contact us for detailed product model of the software if you need to register in the software.

9 Parameter

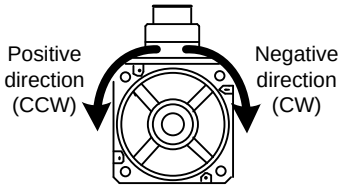
9.1 【Class 0】Basic Setting

For parameters whose No. have a suffix of “*”, changed contents will be validated when you turn on the control power; for parameters whose No. have no suffix of “*”, changed contents will be validated immediately.

Pr000*	Name	Range	Unit	Default	Related Control Mode		
	Rotational direction setup	0~1	—	1	P	S	T

Description

- Specify the relationship between the direction of command and direction of motor rotation.
- 0: when positive direction command is received, motor turns in CW, which can be viewed from load side shaft end.
- 1: when positive direction command is received, motor turns in CCW, which can be viewed from load side shaft end.



Set Value	Command Direction	Motor Rotational Direction	Positive Direction Over-travel Inhibition Input	Negative Direction Over-travel Inhibition Input
0	Positive	CW	Valid	—
	Negative	CCW	—	Valid
1	Positive	CCW	Valid	—
	Negative	CW	—	Valid

Pr001*	Name	Range	Unit	Default	Related Control Mode		
	Control mode setup	0~3	—	1	P	S	T

Description

- Specify the control mode.

Set Value	Content
0	Invalid
1	Position control
2	Velocity control
3	Torque control

Pr002	Name	Range	Unit	Default	Related Control Mode		
	Real-time auto-gain tuning setup	0~6	—	0	P	S	T

Description

- Set the control mode for auto adjustment.

Set Value	Mode	Variation Degree of Load Inertia in Motion
0	Invalid	Real-time auto-gaining function is invalid.
1	Standard	Basic mode, which emphasizes stability. In this mode, changeable load, friction compensation and gain-switching cannot be used.
2	Positioning*1	This mode is mainly applied in positioning. It is suggested to use this mode on equipment with no unbalanced horizontal axis, ball screw driving equipment with low friction, etc.
3	Vertical axis*2	With additional feature of the positioning mode, use this mode to positively and effectively compensate for unbalanced load to the vertical axis or minimize variations in setting time.
4	Friction compensation*3	With additional feature of the vertical axis mode, use this mode to positively and effectively reduce positioning setting time when the belt driving axis has high friction.
5	Load characteristic measurement	Estimate the load characteristics without changing current parameter setting. This mode requires use of the setup support software.
6	Customize*4	Functions of real-time auto-gain tuning can be customized to meet the requirements of the specific application by combining desired functions according to the Pr632 “Real-time auto-gain tuning custom setting”.

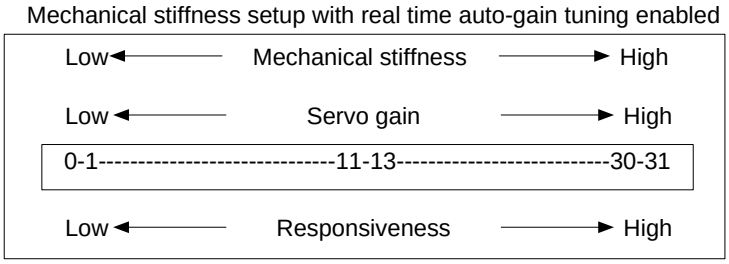
*1: Velocity and torque control modes are the same as in the standard mode.

*2: Torque control is the same as in the standard mode.

*3: Velocity control is the same as in the vertical axis mode. Torque control is the same as in the standard mode.

*4: Certain function (s) is not available in a specific control mode. Refer to description in Pr632.

	Name	Range	Unit	Default	Related Control Mode		
Pr003	Setting of machine stiffness at real-time auto-gain tuning	0~31	—	13	P	S	T



CAUTION

The greater the set value is, the higher velocity response and servo stiffness will be obtained. However, when increasing the value, check the resulting operation to avoid oscillation or vibration.

	Name	Range	Unit	Default	Related Control Mode		
Pr004	Inertia ratio	0~10000	%	250	P	S	T

Description

- Specify inertia ratio.
- Specify the ratio of the load inertia against the rotor (of the motor) inertia.

$$Pr004 = \frac{\text{Load inertia}}{\text{Rotor inertia}} \times 100\ [\%]$$

- The inertia ratio will be estimated at all time while the real-time auto-gain tuning is valid, and its result will be saved to EEPROM every 30 minutes.

CAUTION

If the inertia ratio is correctly set, the setup unit of Pr101 and Pr106 is Hz.

When the inertia ratio of Pr004 is larger than the actual, the setup unit of the velocity loop gain becomes larger, and when the inertia ratio of Pr004 is smaller than the actual, the setup unit of the velocity loop gain becomes smaller.

Pr008*	Name	Range	Unit	Default	Related Control Mode		
	Command pulse counts per motor revolution	0~8388608	pulse	0	P	S	T

Description

- Specify the command pulse that is caused by single turn of the motor shaft.
- When this parameter is set to 0, Pr009 "1st numerator of electronic gear" and Pr010 "Denominator of electronic gear" are valid.

Pr009	Name	Range	Unit	Default	Related Control Mode		
	1st numerator of electronic gear	0~1073741824	—	1	P	S	T

Description

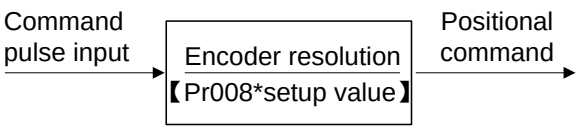
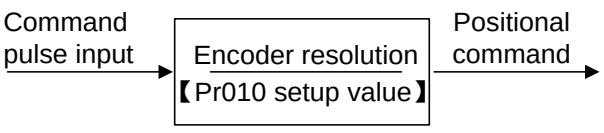
- Specify the numerator of division/multiplication operation for the command pulse input.
- Pr008 "Command pulse counts per motor revolution" is valid when it is set to 0.
- When this parameter is set to 0, the encoder resolution will be specified as the numerator.

Pr010	Name	Range	Unit	Default	Related Control Mode		
	Denominator of electronic gear	1~1073741824	—	1	P	S	T

Description

- Specify the denominator of division/multiplication operation for the command pulse input.
- Pr008 "Command pulse counts per motor revolution" is valid when it is set to 0.

Interrelationship among Pr008, Pr009 and Pr010

Pr008	Pr009	Pr010	Comment
$1\sim2^{20}$	— (No effect)	— (No effect)	 Regardless of setup of Pr009 and Pr010, this operation is processed according to the set value of Pr008.
0	0	$1\sim2^{30}$	 When both Pr008 and Pr009 are set to 0, this operation is processed according to the set value of Pr010.

Pr008	Pr009	Pr010	Comment
	$1\sim2^{30}$	$1\sim2^{30}$	Command pulse input → 【Pr009 setup value】/【Pr010 setup value】 → Positional command When set value of Pr008is 0, and Pr009≠0, this operation is processed according to the set value of Pr009 and Pr010.

Pr011*	Name	Range	Unit	Default	Related Control Mode		
	Output pulse counts per one motor revolution	1~2097152	pulse	2500	P	S	T

Description

- Specify the output pulse counts per one motor revolution for each OA and OB with the Pr011 set value.
- Therefore, 4 times of output pulse counts will be:
- Output pulse counts per one motor revolution=Pr011 “Pulse output divider numerator”×4

Pr503*	Name	Range	Unit	Default	Related Control Mode		
	Denominator of pulse output division	0~8388608	—	0	P	S	T

Description

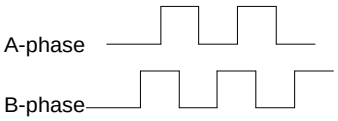
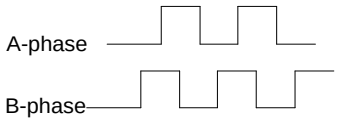
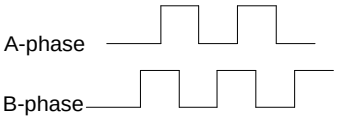
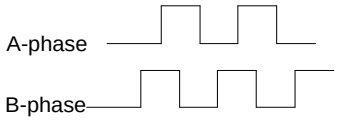
- If the number of output pulses per motor revolution is not an integer, set this parameter to a value other than 0, dividing ratio can be set by using Pr011 as the numerator and Pr503 as the denominator. Therefore, the upper end counts the pulse number by 4 times, as shown below:

$$\text{Output pulse counts per one revolution} = \frac{\text{【Pr011 set value】}}{\text{【Pr503 set value】}} \times \text{Encoder resolution}$$

Pr012*	Name	Range	Unit	Default	Related Control Mode		
	Reversal of pulse output logic	0~1	—	0	P	S	T

Description

- Specify the B-phase logic and the output source of the pulse output.
- With this parameter, you can reverse the phase relation between the A-phase and B-phase pulse by reversing the B-phase logic. As illustrated below:

Set Value	B-phase Logic	Output Source	CCW Direction Rotation	CW Direction Rotation
0	Non-reversal	Encoder		
1	Reversal	Encoder		

Pr013	Name	Range	Unit	Default	Related Control Mode		
	1st torque limit	0~500	%	300	P	S	T

Description

- Specify the limit value of the motor output torque.

Pr014	Name	Range	Unit	Default	Related Control Mode		
	Position deviation excess setup	0~1073741824	Command unit	35000000	P	S	T

Description

- Specify excess range of positional deviation by the command unit (default).
- You can set parameter unit and deviation calculation method by setting Pr520 “Position setup unit selection”.
- Err24.0 “Error detection of position deviation excess” is invalid when you set the parameter to 0.

Pr015*	Name	Range	Unit	Default	Related Control Mode		
	Absolute encoder setup	0~2	—	0	P	S	T

Description

- Specify the using method of 17/23-bit absolute encoder.

Set Value	Function
0	Use as an absolute encoder.
1	Use as an incremental encoder.
2	Use as an absolute encoder, but ignore the multi-turn

	Name	Range	Unit	Default	Related Control Mode		
Pr016*	External regenerative resistor setup	0~3	—	0	P	S	T

Description

With this parameter, you can select either to use the built-in regenerative resistor of the driver, or to separate this built-in regenerative resistor and externally install the regenerative resistor, and etc. See table below for details:

Set Value	Regenerative Resistor to Be Used	Function
0	Built-in resistor	Regenerative processing circuit will be activated and regenerative resistor overload protection will be triggered according to the built-in resistor (approx. 1% duty).
1	External resistor	The driver trips due to regenerative overload protection (Err18.0), when regenerative processing circuit is activated and its active ratio exceeds 10%.
2	External resistor	Exclusively used by manufacturers (setup is prohibited).
3	No resistor	Both regenerative processing circuit and regenerative protection are not activated, and built-in capacitor handles all regenerative power.

WARNING

1. 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.
2. Default set value for driver without built-in resistor is 3, and that of the driver with built-in resistor is 0.
3. When you use the built-in regenerative resistor, never to set up other value than 0.
4. Don't touch the external regenerative resistor.
5. External regenerative resistor gets very hot, and might cause burning

	Name	Range	Unit	Default	Related Control Mode		
Pr017*	Load factor of external regenerative resistor selection	0~4	—	0	P	S	T

Description

When selecting the external regenerative resistor (Pr016=1, 2), set according to the resistor parameter and power model.

Set Value	Application Range
0	Set when external resistor is about 40 Ω and 200W(for 400W model)
1	Set when external resistor is about 40 Ω and 400W(for 750W model)
2	Set when external resistor is about 30 Ω and 500W(for 1kW model)
3	Set when external resistor is about 20 Ω and 800W(for 1.5kW model)
4	Set when external resistor is about 20 Ω and 1.2kW(for 2.5kW model)

9.2 【Class 1】Gain Adjustment

For parameters whose No. have a suffix of "*", changed contents will be validated when you turn on the control power; for parameters whose No. have no suffix of "*", changed contents will be validated immediately.

Pr100	Name	Range	Unit	Default	Related Control Mode		
	1st gain of position loop	0~30000	0.1/S	320	P	S	T

Description

- Specify the response of the positional control system.
- Higher the gain of position loop you set, faster the positioning time you can obtain. Note that too high set value may cause oscillation.

Pr101	Name	Range	Unit	Default	Related Control Mode		
	1st gain of velocity loop	1~32767	0.1Hz	180	P	S	T

Description

- Specify the response of the velocity loop.
- In order to increase the response of overall servo system by setting high position loop gain, you need set the velocity loop gain greater as well. However, too great set value may cause oscillation.

Pr102	Name	Range	Unit	Default	Related Control Mode		
	1st time constant of velocity loop integration	1~10000	0.1ms	310	P	S	T

Description

- Specify the integration time constant of velocity loop.
- The smaller the set value, the faster you can dog-in deviation at stall to 0.
- The integration will be maintained by setting to "9999". The integration effect will be lost by setting to "10000".

	Name	Range	Unit	Default	Related Control Mode		
Pr103	1st filter of speed detection	0~10000	0.01ms	0	P	S	T

Description

- The greater the set value, the greater the time constant you can obtain so that you can decrease the motor noise, however, response becomes slow.
- Use with a default value of 0 in normal operation.

	Name	Range	Unit	Default	Related Control Mode		
Pr104	1st time constant of torque filter	0~2500	0.01ms	126	P	S	T

Description

- Specify the time constant of the 1st delay filter inserted in the torque command portion.
- You might expect suppression of oscillation caused by distortion resonance.

	Name	Range	Unit	Default	Related Control Mode		
Pr105	2nd gain of position loop	0~30000	0.1/s	380	P	S	T
Pr106	2nd gain of velocity loop	1~32767	0.1Hz	180	P	S	T
Pr107	2nd time constant of velocity loop integration	1~10000	0.1ms	10000	P	S	T
Pr108	2nd filter of speed detection	0~10000	0.01ms	0	P	S	T
Pr109	2nd time constant of torque filter	0~2500	0.01ms	126	P	S	T

Description

- Position loop, velocity loop, velocity loop detection filter and torque filter have their 2 pairs of gain or time constant (1st and 2nd).
- Function and content of 1st is the same with that of 2nd. Generally, 1st gain is specified as default setting, you can manually adjust the parameters of 1 gain. For details of switching the 1st and 2nd gain or time constant, refer to related content in chapter 6.

Pr110	Name	Range	Unit	Default	Related Control Mode		
	Velocity feed forward gain	0~1000	0.1%	300	P	S	T

Description

- Multiply the velocity control command which is calculated according to the internal positional command by the ratio of this parameter and add the result to the speed command resulting from the positional control process.

Pr111	Name	Range	Unit	Default	Related Control Mode		
	Velocity feed forward filter	0~6400	0.01ms	200	P	S	T

Description

- Specify the time constant of 1st delay filter which affects the input of velocity feed forward.
- For example: the velocity feed forward will become effective as the velocity feed forward gain is gradually increased with the velocity feed forward filter set at approx. 50 (0.5ms). The positional deviation during operation at a constant velocity is reduced as shown in following equation in proportion to the value of velocity feed forward gain.

$$\text{Positional deviation[unit of command]} = \frac{\text{Command speed[unit of command/S]}}{\text{Positional loop gian[1/S]}} \times \frac{\text{100-velocity feed forward gain[\%]}}{100}$$

Pr112	Name	Range	Unit	Default	Related Control Mode		
	Torque feed forward gain	0~1000	0.1%	0	P	S	T

Description

- Multiply the torque command which is calculated according to the velocity control command by the ratio of this parameter and add the result to the torque command resulting from the velocity control process.
- 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.

Pr113	Name	Range	Unit	Default	Related Control Mode		
	Torque feed forward filter	0~6400	0.01ms	0	P	S	T

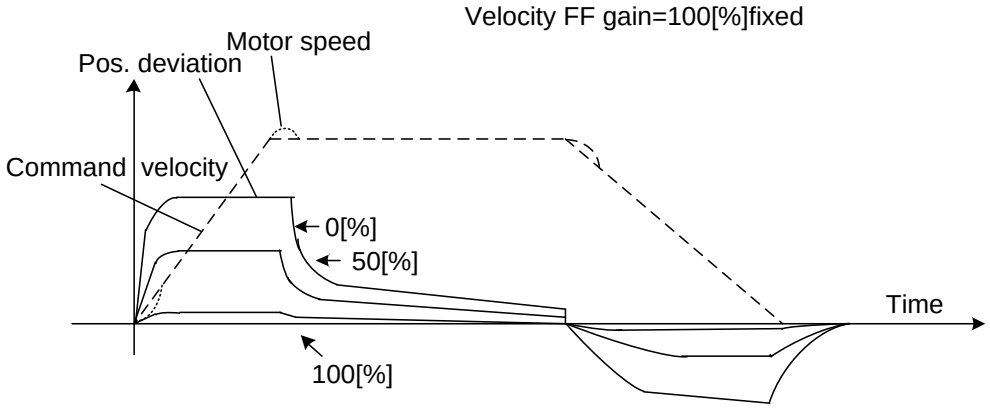
Description

- Specify the time constant of 1st delay 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 the torque feed forward filter is set at approx. 50 (0.5ms).
- Similar to velocity feed forward, if the time constant of torque feed forward filter is

increased, the position deviation of acceleration point will be larger.

For example:

1) To use the torque feed forward, correctly set the inertia ratio. Use the value that was determined at the start of the real time auto tuning, or set the inertia ratio that can be calculated from the machine specification to Pr004「Inertia ratio」.
2) The torque feed forward will become effective as the torque feed forward gain is gradually increased with the torque feed forward filter is set at approx. 50 (0.5ms).



3) Positional deviation can be minimized to close to 0 by increasing torque feed forward gain while driving in trapezoidal speed pattern under ideal condition where disturbance torque is not active.

CAUTION

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

Pr114	Name	Range	Unit	Default	Related Control Mode		
	2nd gain setup	0~1	—	1	P	S	T

Description

- By using the gain switching function, arrange this parameter when performing optimal adjustment.

Set Value	Gain Selection/Switching
0	1st gain is fixed at a value. By using the gain switching input (GAIN), change the velocity loop operation from PI to /P. GAIN input photo coupler OFF→PI operation GAIN input photo coupler ON→P operation *The above description applies when the logical setting of GAIN input is a-contact. OFF/ON of photo coupler is reversed when b-contact.
1	Enable gain switching of 1st gain (Pr100~Pr104) and 2nd gain (Pr105~Pr109).

- For switching condition of the 1st and the 2nd, refer to section 6.3.1 for details.

Pr115	Name	Range	Unit	Default	Related Control Mode		
	Mode of position control switching	0~10	—	0	P	S	T

Description

Specify the triggering condition of gain switching for position control.

Set Value	Switching Condition	Gain Switching Condition
0	Fixed to 1st gain	Fixed to the 1st gain (Pr100~Pr104).
1	Fixed to 2nd gain	Fixed to the 2nd gain (Pr105~Pr109).
2	With gain switching input	(1) 1st gain when the gain switching input (GAIN) is open. (2) 2nd gain when the gain switching input (GAIN) is connected to COM-. (3) If no input signal is allocated to the gain switching input (GAIN), the 1st gain is fixed.
3	Torque command is large	(1) Shift to the 2nd gain when the absolute value of the torque command exceeded (level+hysteresis) [%] previously with the 1st gain. (2) Return to the 1st gain when the absolute value of the torque command was kept below (level+hysteresis) [%] previously during delay time with the 2nd gain.
4	Speed command change is large	(1) Only valid for velocity control. (2) Shift to the 2nd gain when the absolute value of the speed command exceeded (level+hysteresis) [10r/min/s] previously with the 1st gain. (3) Return to the 1st gain when the absolute value of the speed command was kept below (level+hysteresis) [10r/min/s] previously during delay time with the 2nd gain. (4) For others except velocity control, fixed at 1st Gain.

Set Value	Switching Condition	Gain Switching Condition
5	Speed command is large	(1) Valid for position and velocity control. (2) Shift to the 2nd gain when the absolute value of the speed command exceeded (level+hysteresis) [r/min] previously with the 1st gain. (3) Return to the 1st gain when the absolute value of the speed command kept below (level+hysteresis) [r/min] previously during delay time with the 2nd gain.
6	Positional deviation is large	(1) Valid for position control. (2) Shift to the 2nd gain when absolute value of the positional deviation exceeded (level+hysteresis) [pulse] previously with the 1st gain. (3) Return to the 1st gain when the absolute value of the positional deviation was kept below (level+hysteresis) [pulse] previously over delay time with the 2nd gain. (4) Unit of level and hysteresis [pulse] is set as the encoder resolution for positional control.
7	With position command	(1) Valid for position control. (2) Shift to the 2nd gain when the positional command was not 0 previously with the 1st gain. (3) Return to the 1st gain when the positional command was kept 0 previously during delay time with the 2nd gain.
8	Positioning not completed	(1) Valid for position control. (2) Shift to the 2nd gain when the positioning was not completed previously with the 1st gain. (3) Return to the 1st gain when the positioning was kept in completed condition previously during delay time with the 2nd gain.
9	Actual speed is large	(1) Valid for position control. (2) Shift to the 2nd gain when the absolute value of the actual speed exceeded (level+hysteresis) [r/min] previously with the 1st gain. (3) Return to the 1st gain when the absolute value of the actual speed was kept below (level+hysteresis) [r/min] previously during delay time with the 2nd gain.

Set Value	Switching Condition	Gain Switching Condition
10	Position command exists + Actual speed	(1) Valid for position control. (2) Shift to the 2nd gain when the positional command was not 0 previously with the 1st gain. (3) Return to the 1st gain when the positional command was kept at 0 during the delay time and the absolute value of actual speed was kept below (level+hysteresis) [r/min] previously with the 2nd gain.

Pr116	Name	Range	Unit	Default	Related Control Mode		
	Delay time of position control switching	0~10000	0.1ms	50	P	S	T

Description

- For position control, if Pr115 is set to 3, 5, 6, 7, 8, 9 or 10, when shifting from the 2nd gain to the 1st gain, set up the delay time from trigger detection to the switching operation.

Pr117	Name	Range	Unit	Default	Related Control Mode		
	Level of position control switching	0~20000	Mode dependent	50	P	S	T

Description

- For position control, set up triggering level when Pr115 is set at 3, 5, 6, 9, and 10.
- Unit of setting varies with switching mode.

CAUTION

Please set the level equal to or higher than the hysteresis.

Pr118	Name	Range	Unit	Default	Related Control Mode		
	Hysteresis at position control switching	0~20000	Mode dependent	33	P	S	T

Description:

- For position control, set up triggering hysteresis when Pr115 is set at 3, 5, 6, 9, and 10.
- Unit of setting varies with switching mode.

CAUTION

When level< hysteresis, the hysteresis is internally adjusted so that it is equal to level.

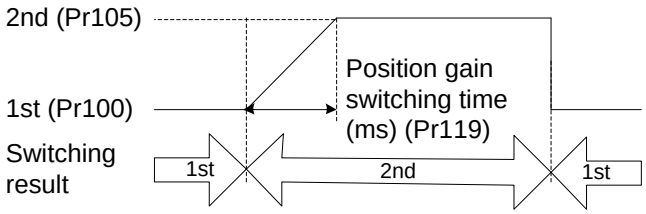
Pr119	Name	Range	Unit	Default	Related Control Mode		
	Position gain switching time	0~10000	0.1 ms	33	**P**	S	T

Description

- For position controlling, if the difference between Pr100 “1st gain of position loop” and Pr105 “2nd gain of position loop” is large, the increasing rate of position loop gain can be limited by this parameter.
- “Position gain switching time”:
- When using position control, gain of position loop rapidly changes, causing torque change and vibration. By adjusting Pr119 “Position gain switching time”, increasing rate of the position loop gain can be decreased and vibration level can be reduced.

CAUTION

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).



Pr120	Name	Range	Unit	Default	Related Control Mode		
	Mode of velocity control switching	0~5	—	0	P	**S**	T

Description

- For velocity control mode, set the condition to trigger gain switching.

Set Value	Switching Condition
0	Fixed to the 1st gain
1	Fixed to the 2nd gain
2	Gain switching input
3	Torque command
4	Speed command variation is large
5	Speed command is large

Pr121	Name	Range	Unit	Default	Related Control Mode		
	Delay time of velocity control switching	0~10000	0.1ms	0	P	S	T

Description

- For velocity control mode, when shifting from the 2nd gain to the 1st gain with Pr120 set to 3, 4 or 5, set the delay time from trigger detection to the switching operation.

Pr122	Name	Range	Unit	Default	Related Control Mode		
	Level of velocity control switching	0~20000	Mode-dependent	0	P	S	T

Description

- For velocity controlling, set up triggering level when Pr120 is set to 3, 4 or 5. Unit of setting varies with switching mode.

CAUTION

Please set the level equal to or higher than the hysteresis.

Pr123	Name	Range	Unit	Default	Related Control Mode		
	Hysteresis at velocity control switching	0~20000	Mode dependent	0	P	S	T

Description

- For velocity controlling, set up triggering hysteresis when Pr120is set to 3, 4 or 5. Unit of setting varies with switching mode.

CAUTION

When level < hysteresis, the hysteresis is internally adjusted so it is equal to level.

Pr124	Name	Range	Unit	Default	Related Control Mode		
	Mode of torque control switching	0~3	—	0	P	S	T

Description

- For torque controlling, set the condition to trigger gain switching.

Set Value	Gain Switching Condition
0	Fixed to the 1st gain
1	Fixed to 2nd gain
2	Use gain switching input
3	Torque command

Pr125	Name	Range	Unit	Default	Related Control Mode		
	Delay time of torque control switching	0~10000	0.1ms	0	P	S	T

Description

- For torque controlling, when shifting from the 2nd gain to the 1st gain with Pr124 set to 3, set up the delay time from trigger detection to the switching operation.

Pr126	Name	Range	Unit	Default	Related Control Mode		
	Level of torque control switching	0~20000	Mode dependent	0	P	S	T

Description

- For torque controlling, set up triggering level when Pr124 is set to 3. Unit varies depending on the setup of mode of control switching.

CAUTION

Please set the level equal to or higher than the hysteresis.

Pr127	Name	Range	Unit	Default	Related Control Mode		
	Hysteresis at torque control switching	0~20000	Mode dependent	0	P	S	T

Description

- For torque controlling, set up triggering hysteresis when Pr124 is set to 3. Unit of setting varies with switching mode.

CAUTION

When level < hysteresis, the hysteresis is internally adjusted so that it is equal to level.

9.3 【Class 2】Damping Control

For parameters whose No. have a suffix of "*", changed contents will be validated when you turn on the control power; for parameters whose No. have no suffix of "*", changed contents will be validated immediately.

Pr200	Name	Range	Unit	Default	Related Control Mode		
	Adaptive filter mode setup	0~4	—	0	P	S	T

Description

- Specify the resonance frequency to be estimated by the adaptive filter and specify the operation after estimation. Refer to section 6.4 for details.

Set Value	Content	
0	Adaptive filter: invalid	Parameters related to the 3rd and 4th notch filter hold the current value.
1	Adaptive filter: 1 filter is valid	One adaptive filter is enabled. Parameters related to the 3rd notch filter will be updated based on adaptive performance.
2	Adaptive filter: 2 filter are valid	Two adaptive filters are enabled. Parameters related to the 3rd will be updated based on adaptive performance, while the parameters related to 4th notch filter should be set based on the 2nd resonance point read from the "FFT analysis" oscillgram generated by iMotion software.
3	Resonance frequency measurement mode	Measure the resonance frequency. Result of measurement can be checked with "iMotion". Parameters related to 3rd and 4th notch filter hold 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.

Pr201	Name	Range	Unit	Default	Related Control Mode		
	1st notch frequency	50~5000	Hz	5000	P	S	T

Description

- Specify the frequency of the 1st notch filter.

CAUTION

The notch filter function will be invalid when his parameter is set to "5000".

Pr202	Name	Range	Unit	Default	Related Control Mode		
	1st notch width selection	0~20	—	2	P	S	T

Description

- Specify the width of notch at the frequency of the 1st notch filter.

CAUTION

The higher the set value, the larger the notch width you can obtain. Use with default setup in normal operation.

Pr203	Name	Range	Unit	Default	Related Control Mode		
	1st notch depth selection	0~99	—	0	P	S	T

Description

- Specify the depth of notch at the frequency of the 1st notch filter.

CAUTION

The higher the set value, the shallower the notch depth and smaller the phase delay you can obtain.

Pr204	Name	Range	Unit	Default	Related Control Mode		
	2nd notch frequency	50~5000	Hz	5000	P	S	T

Description

- Specify the center frequency of the 2nd notch filter.

CAUTION

The notch filter function will be invalid when this parameter is set to “5000”.

Pr205	Name	Range	Unit	Default	Related Control Mode		
	2nd notch width selection	0~20	—	2	P	S	T

Description

- Specify the width of notch at the center frequency of the 2nd notch filter.

CAUTION

Higher the setup, larger the notch width you can obtain. Use with default setup in normal operation.

Pr206	Name	Range	Unit	Default	Related Control Mode		
	2nd notch depth selection	0~99	—	0	P	S	T

Description

- Specify the depth of notch at the center frequency of the 2nd notch filter.

CAUTION

Higher the set value, shallower the notch depth and smaller the phase delay you can obtain.

Pr207	Name	Range	Unit	Default	Related Control Mode		
	3rd notch frequency	50~5000	Hz	5000	P	S	T

Description

- Specify the frequency of the 3rd notch filter.

CAUTION

The notch filter function will be invalid when this parameter is set to “5000”.

Pr208	Name	Range	Unit	Default	Related Control Mode		
	3rd notch width selection	0~20	—	2	P	S	T

Description

- Specify the width of notch at the center frequency of the 3rd notch filter.

CAUTION

The higher the set value, larger the notch width you can obtain. Use with the default setup in normal operation.

Pr209	Name	Range	Unit	Default	Related Control Mode		
	3rd notch depth selection	0~99	—	0	P	S	T

Description

- Specify the depth of notch at the center frequency of the 3rd notch filter.

CAUTION

The higher the set value, shallower the notch depth and smaller the phase delay you can obtain.

Pr210	Name	Range	Unit	Default	Related Control Mode		
	4th notch frequency	50~5000	Hz	5000	P	S	T

Description

- Specify the frequency of the 4th notch filter.

CAUTION

The notch filter function will be invalid when this parameter is set to "5000".

Pr211	Name	Range	Unit	Default	Related Control Mode		
	4th notch width selection	0~20	—	2	P	S	T

Description

- Specify the width of the notch at the center frequency of 4th notch filter.

CAUTION

The higher the set value, larger the notch width you can obtain. Use with default setup in normal operation.

Pr212	Name	Range	Unit	Default	Related Control Mode		
	4th notch depth selection	0~99	—	0	P	S	T

Description

- Specify the depth of notch at the center frequency of the 4th notch filter.

CAUTION

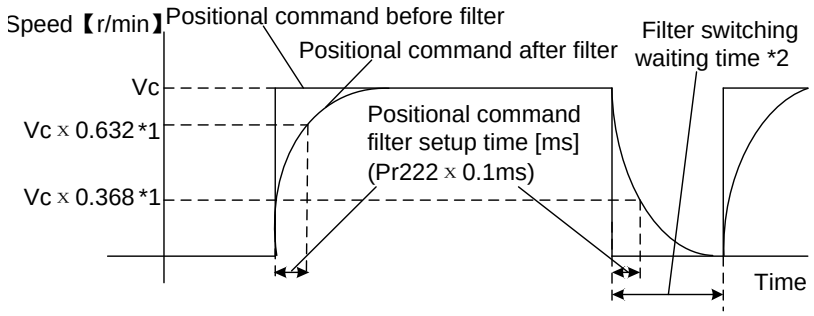
The greater the set value, the shallower the notch depth and smaller the phase delay you can obtain.

	Name	Range	Unit	Default	Related Control Mode		
Pr214	1st damping frequency	0~2000	0.1Hz	0	**P**	S	T
Pr215	1st damping ratio	0~500	0.001	0	**P**	S	T
Pr216	2nd damping frequency	0~2000	0.1Hz	0	**P**	S	T
Pr217	2nd damping ratio	0~500	0.001	0	**P**	S	T
Pr218	3rd damping frequency	0~2000	0.1Hz	0	**P**	S	T
Pr219	3rd damping ratio	0~500	0.001	0	**P**	S	T
Pr220	4th damping frequency	0~2000	0.1Hz	0	**P**	S	T
Pr221	4th damping ratio	0~500	0.001	0	**P**	S	T

Pr222	Name	Range	Unit	Default	Related Control Mode		
	Positional command smoothing filter	0~32767	0.1ms	0	**P**	S	T

Description

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



*1: Actual filter time constant (set value×0.1ms) has the maximum absolute error of 0.2ms for a time constant below 100ms and the maximum relative error of 0.1% for a time constant 20ms or more.

*2: Switching of Pr222 is performed, as the command pulse within each control cycle is changed from 0 to a value other than 0 and the positioning complete is being output.

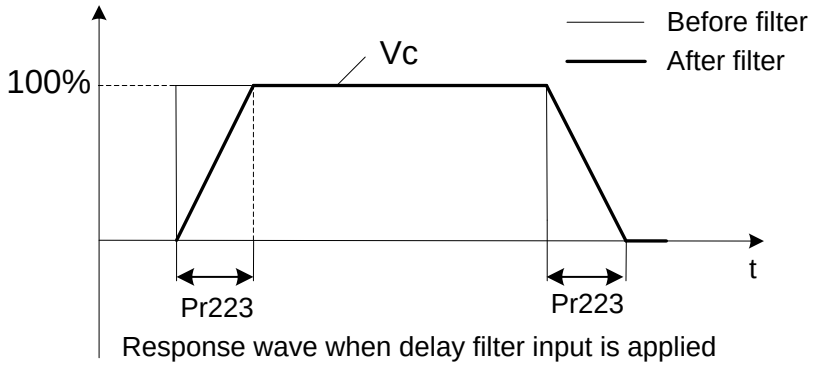
Note: If the time constant is decreased and positioning completer range is increased, and a many number of pulses are accumulated in the filter (the area equivalent of “value of positional command filter-value of positional command after filter” integrated over the time), at the time of switching, these pulses are discharged at a higher rate, causing the motor to return to the previous position-the motor runs at a speed higher than the command speed for a short time.

*3: Even if Pr222 is changed, it is not applied immediately. If the switching as described in *2 occurs during this delay time, the change of Pr222 will be suspended.

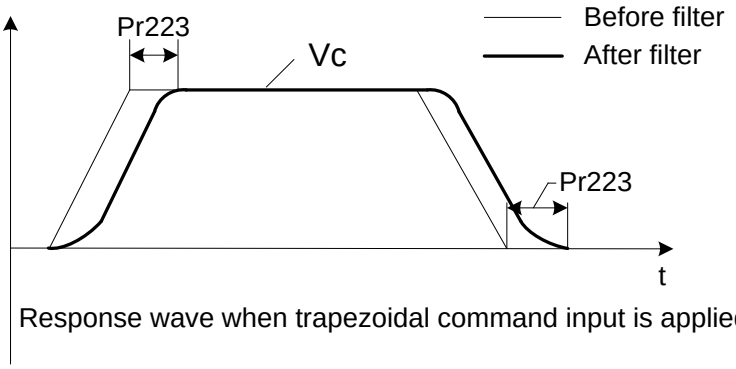
Pr223	Name	Range	Unit	Default	Related Control Mode		
	Positional command FIR filter	0~1000	0.1ms	0	P	S	T

Description

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



Response wave when delay filter input is applied



Response wave when trapezoidal command input is applied

9.4 【Class 3】Velocity/Torque Control

For parameters whose No. have a suffix of "*", changed contents will be validated when you turn on the control power; for parameters whose No. have no suffix of "*", changed contents will be validated immediately.

	Name	Range	Unit	Default	Related Control Mode		
Pr300	Speed setup, Internal/External switching	0~3	—	0	P	S	T

Description

- Please check the driver model because some models do not support analog input.

Set Value	Speed Setting Method
0	Simulate speed command(SPR)
1	Internal speed command 1st~4th speed (Pr304~Pr307)
2	Simulate speed command(SPR) Internal speed command 1st~3rd speed (Pr304~Pr306)
3	Internal speed command 1st~8th speed (Pr304~Pr311)

- ＜Relationship among Pr300, the internal command speed selection 1~3 and speed command to be selected.＞

Set Value	Selection 1 of Internal Command Speed (INTSPD1)	Selection 2 of Internal Command Speed (INTSPD2)	Selection 3 of Internal Command Speed (INTSPD3)	Selection of Speed Command
1	OFF	OFF	No effect	1st
	ON	OFF		2nd
	OFF	ON		3rd
	ON	ON		4th
2	OFF	OFF	No effect	1st
	ON	OFF		2nd
	OFF	ON		3rd
	ON	ON		SPR

Set Value	Selection 1 of Internal Command Speed (INTSPD1)	Selection 2 of Internal Command Speed (INTSPD2)	Selection 3 of Internal Command Speed (INTSPD3)	Selection of Speed Command
3	The same as [Pr300=1]		OFF	1st~4th
	OFF	OFF	ON	5th
	ON	OFF	ON	6th
	OFF	ON	ON	7th
	ON	ON	ON	8th

Pr301	Name	Range	Unit	Default	Related Control Mode		
	Speed command direction selection	0~1	—	0	P	S	T

Description

- Select the positive /negative direction specifying method.

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

	Name	Range	Unit	Default	Related Control Mode		
Pr304	1st speed of speed setup	-20000~20000	r/min	0	P	S	T
Pr305	2nd speed of speed setup	-20000~20000	r/min	0	P	S	T
Pr306	3rd speed of speed setup	-20000~20000	r/min	0	P	S	T
Pr307	4th speed of speed setup	-20000~20000	r/min	0	P	S	T
Pr308	5th speed of speed setup	-20000~20000	r/min	0	P	S	T
Pr309	6th speed of speed setup	-20000~20000	r/min	0	P	S	T
Pr310	7th speed of speed setup	-20000~20000	r/min	0	P	S	T
Pr311	8th speed of speed setup	-20000~20000	r/min	0	P	S	T

Description

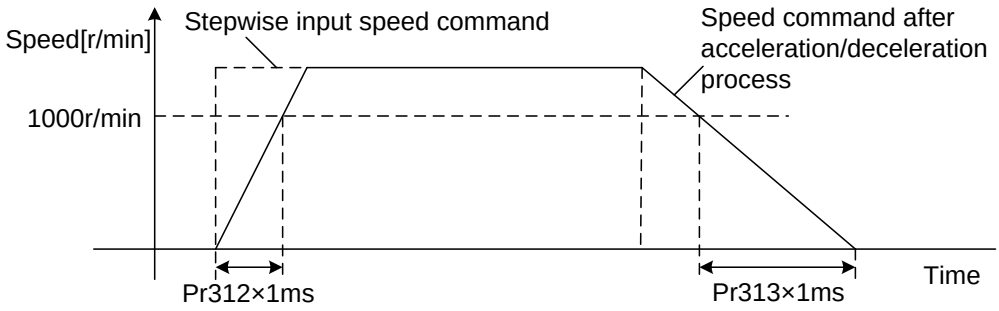
Specify the internal command speeds, 1st to 8th.

	Name	Range	Unit	Default	Related Control Mode		
Pr312	Acceleration time setup	0~10000	ms/(1000r/min)	0	P	**S**	T
Pr313	Deceleration time setup	0~10000	ms/(1000r/min)	0	P	**S**	T

Description

- Specify the acceleration/deceleration processing time in response to the speed command input.
- Set the time required for the speed command (stepwise input) to reach 1000r/min to Pr312. Also set the time required for the speed command to reach from 1000r/min to 0r/min, to Pr313.
- Assuming that the target value of the speed command is Vc［r/min］, the time required for acceleration/deceleration can be computed from the following formula.

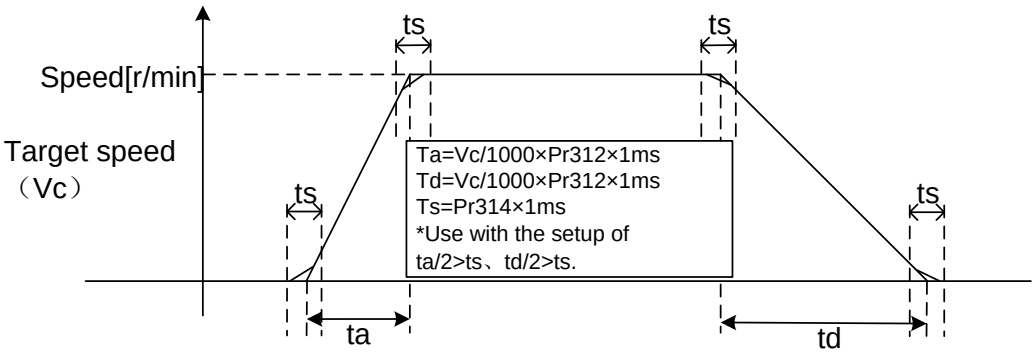
Acceleration time［ms］= Vc/1000×Pr312×1ms
Deceleration time ［ms］= Vc/1000×Pr313×1ms



	Name	Range	Unit	Default	Related Control Mode		
Pr314	Sigmoid acceleration/deceleration time setup	0~1000	ms	0	P	**S**	T

Description

- Specify S-curve time for acceleration/deceleration process when the speed command is applied.
- According to Pr312 and Pr313, set up sigmoid time with time width centering the inflection point of acceleration/deceleration.



Pr315	Name	Range	Unit	Default	Related Control Mode		
	Speed zero-clamp function selection	0~3	—	0	P	S	T

Description

- Specify the function of the speed zero clamp input.

Set Value	ZEROSPD Input Function
0	Invalid: speed zero-clamp input is ignored.
1	Speed command is forced to 0 when the speed zero clamp (ZEROSPD) input signal is turned ON.
2	Speed command is forced to 0 when the speed zero clamp (ZEROSPD) input signal is turned ON. And when the actual motor speed drops to Pr316 or below, the position control is selected and servo lock is activated at this point.
3	When the speed zero clamp (ZEROSPD) input signal is ON, and speed command is below Pr316－10r/min, then the position control is selected and servo lock is activated at that point.

Pr316	Name	Range	Unit	Default	Related Control Mode		
	Speed zero clamp level	10~20000	r/min	30	P	S	T

Description

- Select the timing at which the position control is activated as the Pr315 is set to 2 or 3.
- If Pr315 ＝ 3, then hysteresis of 10r/min is provided for detection.

Pr317	Name	Range	Unit	Default	Related Control Mode		
	Torque command selection	0~2	—	0	P	S	T

Description

- Select the input of the torque command and the speed limit.

Set Value	Torque Command Input	Velocity Limit Input
0	Parameter value (Pr601)	Parameter value (Pr321)
1	—	Parameter value (Pr321)
2	Parameter value (Pr601)	Parameter value (Pr321; Pr322)

CAUTION

If the parameter is set to 1, the torque will always be 0. Therefore, don't set this parameter to 1.

Pr318	Name	Range	Unit	Default	Related Control Mode		
	Torque command direction selection	0~1	—	0	P	S	T

Description

Specify the method to select positive/negative direction for torque command.

Set Value	Specifying Method
0	Specify the direction with the sign of torque command. For example: torque command input 「＋」→positive direction, 「－」→negative direction.
1	Specify the direction with torque command sign (TC-SIGN)

Pr321	Name	Range	Unit	Default	Related Control Mode		
	Speed limit value 1	0~20000	r/min	0	P	S	T

Description

- Specify the speed limit used for torque controlling. During the torque controlling, the speed set by the speed limit value cannot be exceeded.
- When Pr317 = 2, the speed limit is applied upon receiving positive direction command.

Pr322	Name	Range	Unit	Default	Related Control Mode		
	Speed limit value2	0~20000	r/min	0	P	S	T

Description

- Speed limit value of negative direction command when Pr317 = 2.

Pr317	Pr321	Pr322	Pr315	Speed Zero Clamp (ZEROSPD)	Speed Limit Value
0	0~20000	No effect	0	No effect	Pr321 set value
			1~3	OFF	Pr321 set value
				ON	0
2	0~20000	0~20000	0	No effect	Pr321 set value
					Pr322 set value
	0~20000	0~20000	1~3	OFF	Pr321 set value
					Pr322 set value
	0~20000	0~20000	1~3	ON	0

9.5 【Class 4】I/F Monitor Setting

For parameters whose No. have a suffix of "*", changed contents will be validated when you turn on the control power; for parameters whose No. have no suffix of "*", changed contents will be validated immediately.

	Name	Range	Unit	Default	Related Control Mode		
Pr400*	SI1 input selection	0~00FFFFFFh	—	002E2E2Eh (3026478)	P	S	T
Pr401*	SI2 input selection	0~00FFFFFFh	—	00818181h (8487297)	P	S	T
Pr402*	SI3 input selection	0~00FFFFFFh	—	00828282h (8553090)	P	S	T
Pr403*	SI4 input selection	0~00FFFFFFh	—	00222222h (2236962)	P	S	T
Pr404*	SI5 input selection	0~00FFFFFFh	—	00202020h (2105376)	P	S	T
Pr405*	SI6 input selection	0~00FFFFFFh	—	00212121h (2171169)	P	S	T
Pr406*	SI7 input selection	0~00FFFFFFh	—	002B2B2Bh (2829099)	P	S	T

Description

- Allocate functions to SI1~SI7 inputs.
- These parameters are set in hexadecimals while presented in decimals on the display panel.
- Hexadecimal presentation is followed by a specific control mode designation, as shown below. Replace 「★★」with the function number.

0 0 − − − − ★★ h: position control

0 0 − − ★★ − − h: velocity control

0 0 ★★ − − − − h: torque control

See table below for the signal pin number. Polarity setup of the signal is also shown in set value.

Signal Name	Symbol	Set Value	
		a-contact	b-contact
Invalid	—	00h	Do not setup
Positive direction over-travel inhibition input	POT	01h	81h
Negative direction over-travel inhibition input	NOT	02h	82h
Servo-ON input	SRV-ON	03h	83h
Alarm clear	A-CLR	04h	Do not setup
Gain switching input	GAIN	06h	86h

Signal Name	Symbol	Set Value	
		a-contact	b-contact
Deviation counter clear input	CL	07h	Do not setup
Command pulse inhibition input	INH	08h	88h
Torque limit switching input	TL-SEL	09h	89h
Electronic gear switching input 1	DIV1	0Ch	8Ch
Electronic gear switching input 2	DIV2	0Dh	8Dh
Selection 1 input of internal command speed	INTSPD1	0Eh	8Eh
Selection 2 input of internal command speed	INTSPD2	0Fh	8Fh
Selection 3 input of internal command speed	INTSPD3	10h	90h
Speed zero clamp input	ZEROSPD	11h	91h
Speed command sign input	VC-SIGN	12h	92h
Torque command sign input	TC-SIGN	13h	93h
Forced alarm input	E-STOP	14h	94h
Absolute data request sign	SEN	16h	96h
Deceleration limit switching input	EXT1	20h	A0h
External lock input 1	EXT2	21h	A1h
External lock input 2	EXT3	2Bh	ABh
External lock input 3	GP	2Eh	AEh
Common input	EXT1	20h	A0h

CAUTION

1. Do not set to a value other than that specified in the table.
2. Duplicated assignment will cause Err33.0 “I/F input multiple assignment error 1”.
3. Note that the front panel indicates parameter value in decimal number.

	Name	Range	Unit	Default	Related Control Mode		
Pr408*	SO1 output selection	0~00FFFFFFh	—	00010101h (65793)	P	S	T
Pr409*	SO2 output selection	0~00FFFFFFh	—	00030303h (197379)	P	S	T
Pr410*	SO3 output selection	0~00FFFFFFh	—	00000004h (4)	P	S	T
Pr411*	SO4 output selection	0~00FFFFFFh	—	00070707h (460551)	P	S	T

Description

- Allocate functions to SO1~SO4 inputs.
- These parameters are set in hexadecimals while presented in decimals on the display panel.
- Hexadecimal presentation is followed by a specific control mode designation, as shown below. Replace 「★★」with the function number.

0 0 − − − − ★★ h: position control
0 0 − − ★★ − − h: velocity control
0 0 ★★ − − − − h: torque control

Please refer to the following table for output signal pin number. Polarity of the signal is also shown in set value.

Signal Name	Symbol	Set Value
Invalid	—	00h
Servo alarm output	ALM	01h
Servo ready output	S-RDY	02h
External brake release signal	BRK-OFF	03h
Positioning complete	INP	04h
At-speed output	AT-SPPED	05h
Torque in-limit signal output	TLC	06h
Zero-speed detection output signal	ZSP	07h
Speed coincidence output	V-COIN	08h
Alarm output 1	WARN1	09h
Alarm output 2	WARN2	0Ah
Positional command ON/OFF output	P-CMD	0Bh
Positioning complete 2	INP2	0Ch
Speed in-limit output	V-LIMIT	0Dh
Alarm attribute output	ALM_ATB	0Eh
Speed command ON/OFF output	V-CMD	0Fh

CAUTION

1. Same output signal can be assigned to 2 or more output signals.
2. SO1 output should be fixed set to ALM output, otherwise, Err33.4 will appear.
3. Control output pin set to invalid always has the output transistor turned OFF.
4. Don't change the set value shown in above table.
5. Note that the front panel indicates parameter value in decimal.

	Name	Range	Unit	Default	Related Control Mode		
Pr430	Positioning complete (In-position) range	0~262144	Unit dependent	10	P	S	T

Description

- Specify the timing of positional deviation at which the positioning complete signal (INP1) is output.
- The command unit is used as the default unit but it can be replaced by the encoder unit by using Pr520. Under such circumstance, unit of Pr014 “Positional deviation excess setup” is also changed.

Pr431	Name	Range	Unit	Default	Related Control Mode		
	Positioning complete (In-position) output setup	0~3	—	0	P	S	T

Description

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

Set Value	Action of Positioning Complete Signal
0	The signal will turn on when the positional deviation is smaller than the set value of Pr430.
1	The signal will turn on when there is no position command and the positional deviation is smaller than the set value of Pr430.
2	The signal will turn on when there is no position command, zero speed detection signal is connected and the positional deviation is smaller than the set value of Pr430.
3	The signal will turn on when there is no position command and the positional deviation is smaller than the set value of Pr430. Then holds “ON” status until the next position command is entered. ON state is maintained until Pr432 has elapsed. After the hold time, INP output will be turned ON/OFF according to the coming positional command or condition of the positional deviation.

Pr432	Name	Range	Unit	Default	Related Control Mode		
	INP hold time	0~30000	1ms	0	P	S	T

Description

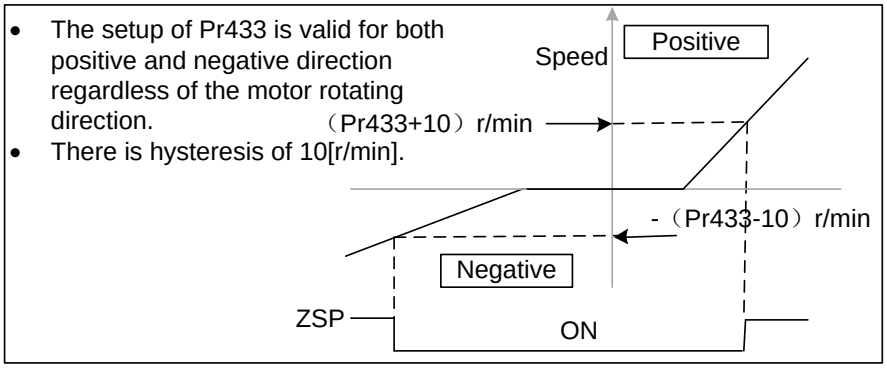
- Specify the hold time when Pr431＝3.

Set Value	Action of Positioning Complete Signal
0	The hold time is maintained definitely, keeping ON state until the next positional command is received.
1~30000	ON state is maintained for setup time value [ms] but switched to OFF state as the positional command is received during hold time.

Pr433	Name	Range	Unit	Default	Related Control Mode		
	Zero speed	10~20000	r/min	50	P	S	T

Description

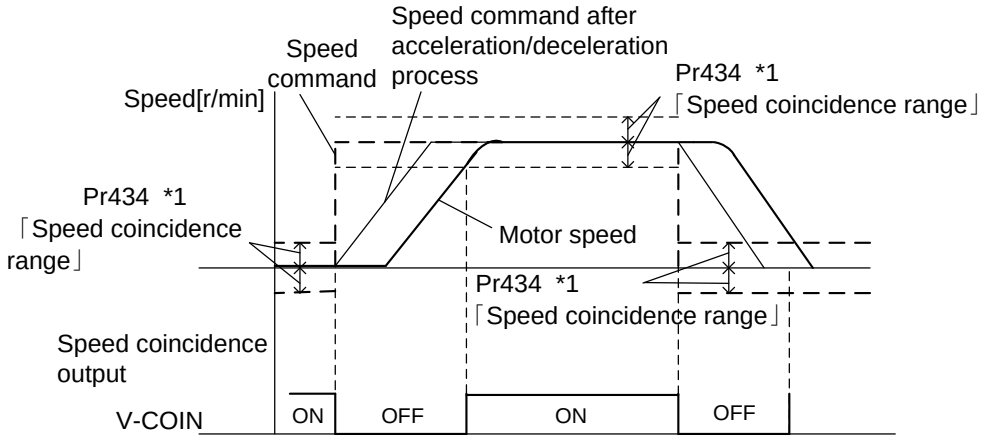
- The zero speed detection signal (ZSP) will be fed out when the motor speed falls below the setup of this parameter, Pr433.



Pr434	Name	Range	Unit	Default	Related Control Mode		
	Speed coincidence range	10~20000	r/min	50	P	S	T

Description

- Specify the speed coincidence (V-COIN) output detection timing.
- 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).

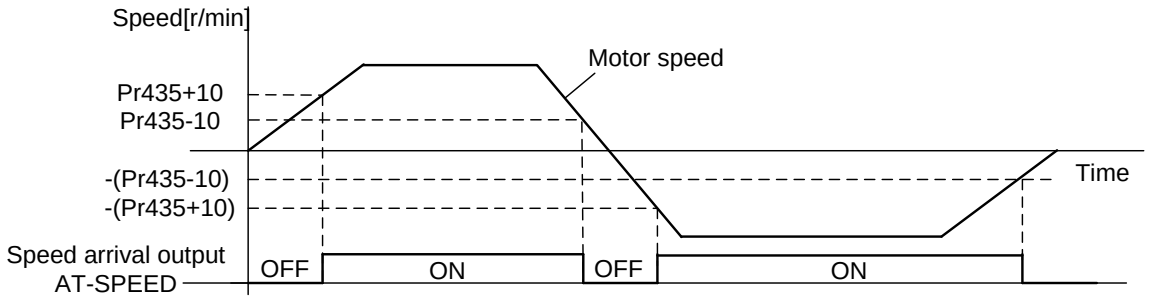


1. *1: Because the speed coincidence detection is associated with 10r/min hysteresis, actual detection range is as shown in the figure above.
2. Speed coincidence output OFF→ON timing: speed deviation below (Pr434－10) r/min.
3. ON →OFF timing: speed deviation higher than (Pr434＋10) r/min.

Pr435	Name	Range	Unit	Default	Related Control Mode		
	At-speed (Speed arrival)	10~20000	r/min	1000	P	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.



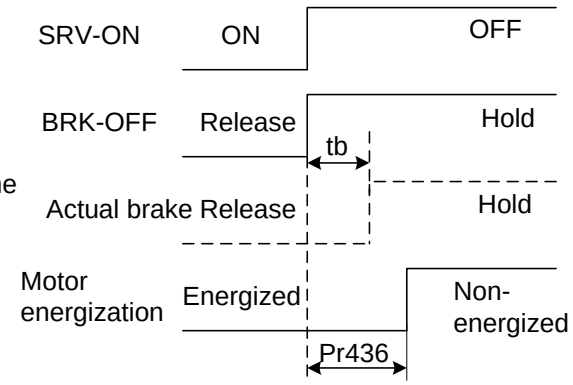
Pr436	Name	Range	Unit	Default	Related Control Mode		
	Mechanical brake action at stalling setup	0~10000	ms	0	P	S	T

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.

  - Set to prevent a minor travel/drop of the motor due to the action delay time(tb) of the brake.
  - Pr436≧tb

  The driver turns to Servo-OFF after the brake is actually activated.

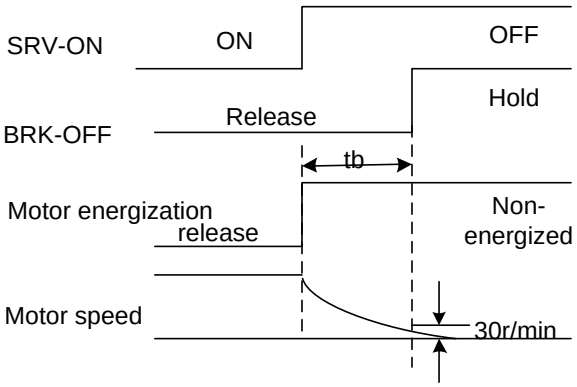


Pr437	Name	Range	Unit	Default	Related Control Mode		
	Mechanical brake action at running setup	0~10000	ms	0	P	S	T

Description

- Specify the time from when detecting the off of SVR-ON input signal (SRV-ON) to when external brake release signal (BRK-OFF) turns off, while the motor turns to servo off during the motor in motion.

- Set up to prevent the brake deterioration due to the motor running.
- At Servo-OFF during the motor is running, If time from when detecting the off of SRV-ON is to when the motor speed is below 30r/min is larger than Pr437 setup, then action of BRK-OFF signal will be done as Pr437 setup; while if the time is smaller than Pr437 setup, action of BRK-OFF signal will be done as time when motor speed is decreased to 30r/min.
- “tb” of the right figure will be a shorter one of either Pr437 setup time or time lapse till the motor speed falls below 30r/min.



Pr438	Name	Range	Unit	Default	Related Control Mode		
	Brake release speed setup	30~3000	r/min	30	P	S	T

Description

- Specify the speed timing of brake output checking during operation.

	Name	Range	Unit	Default	Related Control Mode		
Pr439	Selection of alarm output 1	0~16	—	0	P	S	T
Pr440	Selection of alarm output 2	0~16	—	0	P	S	T

Description

- Select the type of alarm issued as the alarm output 1 or 2.

Set Value	Alarm	Content
0	—	OR output of all alarms.
1	Overload alarm	Load factor is 85% or more the protection level.
2	Over-regeneration alarm	Regenerative load factor is 85% or more the protection level.
3	Battery alarm	The voltage of battery is below 3.2V.
4	Fan alarm	Fan has stopped for 1 second.
5	Encoder communication alarm	Repeated encoder communication error times exceed specified value.
6	Encoder overheat alarm	Encoder overheat is detected.
7	Resonance detection alarm	Resonance is detected.
8	Registered time overdue	The driver has been registered for less than 24 hours.
9	Grating error alarm	The external scale detects the alarm.
10	Grating communication alarm	The number of successive external scale communication errors exceeds the specified value.
11	MECHATROLINK data setting alarm	The parameter number, data range or value is over specified value.
12	MECHATROLINK unsupported alarm	Unsupported command is received.
13	MECHATROLINK not meet the execution condition	Command execution is in unsupported layer, which does not meet the execution condition.
14~16	Internal use only	Internal use only

Pr441	Name	Range	Unit	Default	Related Control Mode		
	2nd positioning complete (In-position)range	0~262144	Command unit	10	P	S	T

Description

- Specify the positional deviation when 2nd positioning complete signal (INP2) turns on.
- The INP2 turns ON whenever the positional deviation is lower than the setup in this parameter, without being affected by Pr431.

CAUTION

The command unit is used as the default unit but can be replaced by the encoder unit by using Pr520. Note that when encoder unit is used, unit of Pr014 is also changed.

9.6 【Class 5】Enhancing Setting

For parameters whose No. have a suffix of "*", changed contents will be validated when you turn on the control power; for parameters whose No. have no suffix of "*", changed contents will be validated immediately.

	Name	Range	Unit	Default	Related Control Mode		
Pr500	2nd numerator of electronic gear	0~1073741824	—	0	**P**	S	T
Pr501	3rd numerator of electronic gear	0~1073741824	—	0	**P**	S	T
Pr502	4th numerator of electronic gear	0~1073741824	—	0	**P**	S	T

Description

- Specify the 2nd to 4th numerator of division/multiplication operation according to the command pulse input.
- This setup is enabled when Pr008＝0.
- When the set value is 0 for positioning controlling, encoder resolution is set as a numerator.

Pr503*	Name	Range	Unit	Default	Related Control Mode		
	Denominator of pulse output division	0~8388608	—	0	**P**	**S**	**T**

Description

- Refer to section 9.1 for details.

Pr504*	Name	Range	Unit	Default	Related Control Mode		
	Over-travel inhibit setup	0~2	—	1	**P**	**S**	**T**

Description

- Specify the operation of the run-inhibition (POT, NOT) inputs.

Set Value	Operation
0	POT: Inhibit positive direction travel NOT: Inhibit negative direction travel
1	POT and NOT invalid.
2	POT or NOT input triggers Err38.0 "Run-inhibition protection".

Pr505*	Name	Range	Unit	Default	Related Control Mode		
	Sequence at over-travel inhibit	0~2	—	0	P	S	T

Description

- When Pr504＝0, specify the status during deceleration and stop after application of the over-travel inhibition (POT and NOT).
- Details of Pr505 are shown as below.

Pr504	Pr505	During Deceleration	After Stalling	Deviation Counter Content
0	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

Pr506	Name	Range	Unit	Default	Related Control Mode		
	Sequence at Servo-off	0~9	—	0	P	S	T

Description

- Specify the status during deceleration and after stop, after servo-off. (DB: Dynamic brake)

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

*1: Emergency stop refers to a controlled immediate stop at servo-on. The torque command value is limited by Pr511 “Emergency stop torque setup”.

*2: Positional deviation is always cleared to 0.

*3: Deceleration process is the time required for the running motor to speed down to 30r/min. Once the motor speed drops below 30r/min, it is treated as in stop state regardless of its speed.

CAUTION

If an error occurs during servo-off, follow Pr510 “Sequence at alarm”. If the main power is turned off during servo-off, follow Pr507 “Sequence at main power interruption”.

Pr507	Name	Range	Unit	Default	Related Control Mode		
	Sequence at main power OFF	0~9	—	0	P	S	T

Description

- Specify the status during deceleration after main power interruption or after stalling.
- The relationship between Pr506 setup and the operation and process at deviation counters is the same as that for Pr507 “Sequence at main power OFF”.

CAUTION

1. If an error occurs when the main power is turned off, follow Pr510 “Sequence at alarm”.
2. If the main power is turned off at servo on, Err13.1 “Main power under voltage error” will occur when Pr508 “LV trip selection with main power off”＝1, and the operation follows Pr510 “Sequence at alarm”.

Pr508	Name	Range	Unit	Default	Related Control Mode		
	LV trip selection at main power OFF	0~1	—	1	P	S	T

Description

- While the main power shutoff continues for the setup of Pr509, select whether or not to activate Err13.1 “Main power under voltage protection” function.

Set Value	Action of Mina Power Under-Voltage Protection
0	When the main power is shut off during servo on, Err13.1 will not be triggered and the driver turns to servo off. The driver returns to servo on again after the main power resumption.
1	When the main power is shut off during servo on, the driver will trip Err13.1 “Main power under-voltage protection”.

CAUTION

1. When Pr509「Detection time of main power OFF」=2000, the parameter is invalid.
2. Err13.0 “Main power under-voltage protection” will be triggered when setup of Pr509 is long and P-N voltage of the main converter falls below the specified value before detecting the main power shutoff, regardless of the set value of Pr508.

Pr509*	Name	Range	Unit	Default	Related Control Mode		
	Detection time of main power off	70~2000	1ms	70	P	S	T

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 you set this parameter to 2000.

Pr510	Name	Range	Unit	Default	Related Control Mode		
	Sequence at alarm	0~7	—	0	P	S	T

Description

- Specify the status during deceleration and after stop when alarm occurs.

Set Value	During Deceleration*3	After Stalling	Positional Deviation
0	Dynamic brake (DB)	Dynamic brake (DB)	Clear*1
1	Free run (DB OFF)	Dynamic brake (DB)	Clear*1
2	Dynamic brake (DB)	Free run (DB OFF)	Clear*1
3	Free run (DB OFF)	Free run (DB OFF)	Clear*1
4	Action A: Emergency stop Action B: DB action*2	Dynamic brake (DB)	Clear*1
5	Action A: Emergency stop Action B: DB OFF*2	Dynamic brake (DB)	Clear*1
6	Action A: Emergency stop Action: DB action*2	Free run (DB OFF)	Clear*1
7	Action A: Emergency stop Action B: DB OFF*2	Free run (DB OFF)	Clear*1

*1: Positional deviation is maintained during alarm condition while be cleared when the alarm is cancelled.

*2: Action A/B: whether the dynamic brake stops immediately when action A or B has a failure. If this parameter is set within the range 4~7, as an alarm requiring emergency stop occurs (see section 7.1), follow action A. When an alarm not requiring emergency stop occurs, it triggers dynamic braking (DB) specified by action B, or BD OFF.

*3: Deceleration period is the time required for the running motor to speed down to 30r/min.

Pr511	Name	Range	Unit	Default	Related Control Mode		
	Torque setup for emergency stop	0~500	%	0	P	S	T

Description

- Specify the torque limit at E-stop

CAUTION

When set value is 0, the torque limit for normal operation is applied.

Pr512	Name	Range	Unit	Default	Related Control Mode		
	Over-load level setup	0~500	%	0	P	S	T

Description

- Specify the overload level. The overload level becomes 115[%] when this parameter is set to 0 or larger than 115.
- Use this with 0 in normal operation. Set up other value only when you need to lower the over-load level.

Pr513	Name	Range	Unit	Default	Related Control Mode		
	Over-speed level setup	0~20000	r/min	0	P	S	T

Description

- When this parameter is set to 0, the over-speed level becomes 1.2 times of the motor max. speed.
- If the motor speed exceeds this set value, Err26.0 “Over-speed protection” will occur.

Pr514	Name	Range	Unit	Default	Related Control Mode		
	Motor working range setup	0~1000	0.1 rev	10	P	S	T

Description

- Specify the moveable range of the motor against the position command input range.
- When the motor movement exceeds the set value, Err34.0 “Motor working range limit protection” will occur.

Pr516*	Name	Range	Unit	Default	Related Control Mode		
	Alarm clear input setup	0~1	—	0	P	S	T

Description

- Select alarm clear input (A-CLR) recognition time.

Set Value	Recognition Time
0	120ms
1	1ms

Pr520*	Name	Range	Unit	Default	Related Control Mode		
	Position setup unit selection	0~1	—	0	P	S	T

Description

- Specify the unit to determine the range of positioning complete and excessive positional deviation.

Set Value	Unit
0	Command unit
1	Encoder unit

Pr521	Name	Range	Unit	Default	Related Control Mode		
	Torque limit selection	0~6	—	1	P	S	T

Description

- Specify the torque limiting method.

Set Value	Positive Direction	Negative Direction
0	Invalid	Invalid
1	1st torque limit (Pr013)	
2	1st torque limit (Pr013)	2nd torque limit (Pr522)
3	TL-SEL OFF →1st torque limit (Pr013) TL-SEL ON → 2nd torque limit (Pr522)	
4	Invalid	Invalid
5	Invalid	
6	TL-SEL OFF	
	1st torque limit (Pr013)	2nd torque limit (Pr522)
	TL-SEL ON	
	External input positive direction torque limit (Pr525)	External input negative direction torque limit (Pr526)

Pr522	Name	Range	Unit	Default	Related Control Mode		
	2nd torque limit (Pr522)	0~500	%	500	P	S	T

Description

- Specify the 2nd limit value of the motor output torque.
- The value is also restricted by the maximal torque of the applicable motor.

Pr523	Name	Range	Unit	Default	Related Control Mode		
	Torque limit switching setup 1	0~4000	ms/100%	0	P	S	T

Description

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

Pr524	Name	Range	Unit	Default	Related Control Mode		
	Torque limit switching setup 2	0~4000	ms/100%	0	P	S	T

Description

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

Pr525	Name	Range	Unit	Default	Related Control Mode		
	External input positive direction torque limit	0~500	%	500	P	S	T

Description

- Specify positive direction torque limit upon receiving TL-SEL with Pr521 “Torque limit selection”＝6.
- The value is also restricted by the maximal torque of the applicable motor.

Pr526	Name	Range	Unit	Default	Related Control Mode		
	External input negative direction torque limit	0~500	%	500	P	S	T

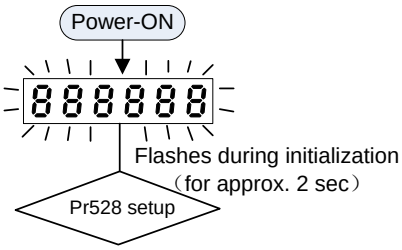
Description

- Specify negative direction torque limit upon receiving TL-SEL with Pr521 “Torque limit selection”＝6.
- The value is also restricted by the maximal torque of the applicable motor.

Pr528*	Name	Range	Unit	Default	Related Control Mode		
	LED initial status	0~36	—	1	P	S	T

Description

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



Set Value	Content	Set Value	Content
0	Positional command deviation	17	Cause of no-motor running
1	Motor speed	18	No. of changes in I/O signals
2	Positional command speed	19	Servo-on status
3	Velocity control command	20	Absolute encoder data
4	Torque command	22	No. of encoder/external scale communication errors monitor
5	Feedback pulse sum	23	Slave address of bus-type driver
6	Command pulse sum	24	Encoder positional deviation (encoder unit)
7	Load estimation inertia ratio	27	P-N voltage (voltage across PN)
9	Control mode	28	Software version
10	I/O signal status	29	Driver serial No.
12	Error cause and reference of history	30	Motor serial No.
13	Alarm No.	31	Accumulated operation time
14	Regenerative load factor	34	Driver remaining time
15	Over-load factor	36	Real-time resonance frequency
16	Inertia ratio		

Pr533*	Name	Range	Unit	Default	Related Control Mode		
	Pulse regenerative output limit setup	0~1	—	0	P	S	T

Description

- Enable/disable detection of Err28.0 “Pulse regenerative limit protection”.

Set Value	Content
0	Valid
1	Invalid

Pr535*	Name	Range	Unit	Default	Related Control Mode		
	Front panel lock setup	0~1	—	0	P	S	T

Description

- Lock the operation on the front panel.

Set Value	Content
0	No limit on the front panel operation
1	Lock the operation on the front panel

9.7 【Class 6】Special Setting

For parameters whose No. have a suffix of “*”, changed contents will be validated when you turn on the control power; for parameters whose No. have no suffix of “*”, changed contents will be validated immediately.

Pr601	Name	Range	Unit	Default	Related Control Mode		
	Torque command setup	-500~500	%	0	P	S	T

Description

- Specify input range for torque command.
- Enabled when Pr001 “Control mode setup”=3 (for torque controlling).

Pr602	Name	Range	Unit	Default	Related Control Mode		
	Velocity deviation excess setup	0~100	r/min	0	P	S	T

Description

- When the speed deviation (difference between internal positional command and actual speed) exceeds this value, Err24.1 “Velocity deviation excess protection” will occur.
- When the set value is 0, this protection is not detected.

Pr604	Name	Range	Unit	Default	Related Control Mode		
	JOG trial run command speed	0~500	r/min	300	P	S	T

Description

- Specify the command speed used for JOG trial run (Velocity control).

CAUTION

Before using, please refer to section 5.3 “Trail Run”.

Pr607	Name	Range	Unit	Default	Related Control Mode		
	Torque command additional value	-100~100	%	0	P	S	T

Description

- Specify the offset load compensation value usually added to the torque command in a control mode except for the torque control mode.
- Update this parameter when the vertical axis mode for real time auto-tuning is valid.

Pr608	Name	Range	Unit	Default	Related Control Mode		
	Positive direction torque compensation	-100~100	%	0	P	S	T

Description

- For position controlling, set the dynamic friction compensation value to be added to the torque command when forward positional command is fed.
- Update this parameter when the friction compensation mode for real time auto-tuning is valid.

Pr609	Name	Range	Unit	Default	Related Control Mode		
	Negative torque compensation	-100~100	%	0	P	S	T

Description

- For position controlling, set the dynamic friction compensation value to be added to the torque command when negative direction positional command is fed.
- Update this parameter when the friction compensation mode for real time auto-tuning is valid.

Pr611	Name	Range	Unit	Default	Related Control Mode		
	Current response setup	20~500	%	100	P	S	T

Description

- Fine tune the current response with respect to default setup (100%).

Pr612	Name	Range	Unit	Default	Related Control Mode		
	Positive direction torque compensation filter	0~3000	0.01ms	0	P	S	T

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, which enhances system stability. However, if the set value is too great, the torque compensation effect is affected.

Pr615	Name	Range	Unit	Default	Related Control Mode		
	2nd over-speed level setup	0~20000	r/min	0	P	S	T

Description

- When it is set to 0, the over-speed level becomes 1.2 times of the motor maximal speed.
- When the motor speed exceeds this set value, Err26.1 “2nd over-speed protection” will be activated.

Pr617*	Name	Range	Unit	Default	Related Control Mode		
	Front panel parameter writing selection	0~1	—	0	P	S	T

Description

- Specify the EEPROM writing procedure when parameter is edited from the front panel.

Set Value	Writing
0	Do not write to EEPROM at the same time.
1	Write to EEPROM at the same time.

Pr623	Name	Range	Unit	Default	Related Control Mode		
	Disturbance torque compensation gain	-100~100	%	0	P	S	T

Description

- Set -100~100% compensation gain against disturbance torque.
- After setting up Pr624, increase Pr623 set value.
- Increasing the gain can increase the disturbance suppressing capability, but it is associated with increasing volume of operation noise.
- Please find a balance by adjusting Pr624 and Pr623.

Pr624	Name	Range	Unit	Default	Related Control Mode		
	Disturbance observer filter	0~2500	0.01ms	2000	P	S	T

Description

- Specify the filter time constant to the disturbance torque compensation.
- First, set Pr624 to a greater value and check the operation with Pr623 set to a low value, and then gradually decrease the set value of Pr624. A low filter set value assures disturbance torque estimation with small delay and effectively suppresses effects of disturbance. However, this results in larger operation noise. Therefore, well balance setup is required.

Pr627*	Name	Range	Unit	Default	Related Control Mode		
	Alarm latch time selection	0~10	s	5	P	S	T

Description

- Specify the latch time.

Set Value	Content
0	Latch time is infinite.
1~10	Latch time range: 1~10 (s)

Pr628	Name	Range	Unit	Default	Related Control Mode		
	Auto resonance detection level	30~1000	%	100	P	S	T

Description

- The smaller the set value, more sensitive the resonance detection.

Pr630	Name	Range	Unit	Default	Related Control Mode		
	Anti-vibration filter ON/OFF switch	0~2	—	0	P	S	T

Pr632	Name	Range	Unit	Default	Related Control Mode		
	Real time auto tuning custom setup	-32767~ 32767	—	0	P	S	T

Description

- When the operation mode of real time auto tuning is set to customize (Pr002＝6), set the automatic adjustment function as below.

<table>
<tr><th>Bit</th><th>Content</th><th>Description</th></tr>
<tr><td>1~0</td><td>Load characteristics estimation*</td><td>Enable/disable the load characteristics estimation function.
<table>
<tr><th>Set Value</th><th>Function</th></tr>
<tr><td>0</td><td>Invalid</td></tr>
<tr><td>1</td><td>Valid</td></tr>
</table>
If the load characteristics estimation is disabled, the current setup cannot be changed even if the inertia ratio is updated according to estimated value. When the torque compensation is updated by the estimated value, it is cleared to 0 (invalid).</td></tr>
<tr><td>3~2</td><td>Inertia ratio update</td><td>Set update to be made based on result of the load characteristics estimation of Pr004 “Inertia ratio”.
<table>
<tr><th>Set Value</th><th>Function</th></tr>
<tr><td>0</td><td>Use the current setup</td></tr>
<tr><td>1</td><td>Updated by the estimated value</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Bit</th><th>Content</th><th>Description</th></tr>
<tr><td>6~4</td><td>Torque compensation</td><td>Set the update to be made according to results of load characteristics estimation of Pr607, Pr608 and Pr609.
<table>
<tr><th>Set Value</th><th>Function</th><th colspan="3">Compensation Setup</th></tr>
<tr><td>0</td><td>Use current setup</td><td>Pr607</td><td>Pr608</td><td>Pr609</td></tr>
<tr><td>1</td><td>Torque compensation is invalid</td><td>Clear</td><td>Clear</td><td>Clear</td></tr>
<tr><td>2</td><td>Vertical axis mode</td><td>Update</td><td>Clear</td><td>Clear</td></tr>
<tr><td>3</td><td>Friction compensation (Low)</td><td>Update</td><td>Low</td><td>Low</td></tr>
<tr><td>4</td><td>Friction compensation (Middle)</td><td>Update</td><td>Middle</td><td>Middle</td></tr>
<tr><td>5</td><td>Friction compensation (High)</td><td>Update</td><td>High</td><td>High</td></tr>
</table></td></tr>
<tr><td>7</td><td>Stiffness setup</td><td>Enable/disable Pr003.
<table>
<tr><th>Set Value</th><th>Function</th></tr>
<tr><td>0</td><td>Invalid</td></tr>
<tr><td>1</td><td>Valid</td></tr>
</table></td></tr>
<tr><td>8</td><td>Fixed parameter setup</td><td>Enable/disable the change of parameter that is normally set at a fixed value.
<table>
<tr><th>Set Value</th><th>Function</th></tr>
<tr><td>0</td><td>Use the current setup</td></tr>
<tr><td>1</td><td>Set to a fixed value</td></tr>
</table></td></tr>
<tr><td>10~9</td><td>Gain switching setup</td><td>Select the gain switching related parameters to be used when the real time auto tuning is enabled.
<table>
<tr><th>Set Value</th><th>Function</th></tr>
<tr><td>0</td><td>Use the current setup</td></tr>
<tr><td>1</td><td>Gain switching disabled</td></tr>
<tr><td>2</td><td>Gain switching enabled</td></tr>
</table></td></tr>
</table>

CAUTION

This parameter should be set in unit of bit. To prevent setting error, it is recommended to install software iMotion when editing parameter. Setup method for bit-wise parameter is as below.

1. Confirm the last bit of the setup.

E.g.: LSB of the torque compensation function is 4.

2. Multiply the set value by power of 2 (LSB).

E.g.: to set the torque compensation function to friction compensation (middle):$2^4 \times 4 = 64$.

3. For every setup, perform step 1) and step 2) above, sum up the values which are to be Pr632 set value.

E.g.: Load characteristics measurement＝enable, inertia ratio update＝enable, torque compensation＝friction compensation (middle), stiffness setup＝enable, fixed parameter＝a fixed value, gain switching setup＝enable, then,

$$2^0 \times 1 + 2^2 \times 1 + 2^4 \times 4 + 2^7 \times 1 + 2^8 \times 1 + 2^9 \times 2 = 1477$$

Pr633	Name	Range	Unit	Default	Related Control Mode		
	Speed setting at friction compensation taking effect	0~1000	0.1rpm	0	P	S	T

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 according to actual conditions.

Pr638*	Name	Range	Unit	Default	Related Control Mode		
	Alarm mask setup	-32768~32767	—	0	P	S	T

Description

- Specify the alarm detection mask.
- Placing 1 to the corresponding bit position disables detection of the alarm condition.

Pr640	Name	Range	Unit	Default	Related Control Mode		
	Absolute origin position offset	-1073741823~ -1073741823	Command unit	0	P	S	T

Description

- Specify the position offset between encoder position (external scale position) and machine coordinate position when absolute encoder (absolute external scale) is enabled.

9.8 Parameter List

In the following list, modification to parameters with * will take effect after reboot; while modification to parameters without * will take effect immediately.

Para. No.	Name	Range	Unit	Default
Pr000*	Rotational direction setup	0~1	—	1
Pr001*	Control mode setup	0~3	—	1
Pr002	Real-time auto-gain tuning setup	0~6	—	0
Pr003	Real-time auto tuning mechanical stiffness setup	0~31	—	13
Pr004	Inertia ratio	0~10000	%	250
Pr008*	Command pulse counts per one motor revolution	0~8388608	pulse	0
Pr009	1st numerator of electronic gear ratio	0~1073741824	—	1
Pr010	Denominator of electronic gear ratio	1~1073741824	—	1
Pr011*	Output pulse counts per one motor revolution	1~2097152	pulse	2500
Pr012*	Reversal of pulse output logic	0~1	—	0
Pr013	1st torque limit	0~500	%	300
Pr014	Position deviation excess setup	0~1073741824	Unit-dependent	35000000
Pr015*	Absolute encoder setup	0~2	—	0
Pr016*	External regenerative resistor setup	0~3	—	0
Pr017*	Load factor of external regenerative resistor selection	0~4	—	0
Pr100	1st gain of position loop	0~30000	0.1/s	480
Pr101	1st gain of velocity loop	1~32767	0.1Hz	270
Pr102	1st time constant of velocity loop integration	1~10000	0.1ms	210
Pr103	1st filter of speed detection	0~10000	0.01ms	0

Para. No.	Name	Range	Unit	Default
Pr104	1st torque filter	0~2500	0.01ms	84
Pr105	2nd gain of position loop	0~30000	0.1/s	570
Pr106	2nd gain of velocity loop	1~32767	0.1Hz	270
Pr107	2nd time constant of velocity loop integration	1~10000	0.1ms	10000
Pr108	2nd filter of speed detection	0~10000	0.01ms	0
Pr109	2nd torque filter	0~2500	0.01ms	84
Pr110	Velocity feed forward gain	0~1000	0.001	300
Pr111	Velocity feed forward filter	0~6400	0.01ms	200
Pr112	Torque feed forward gain	0~1000	0.001	0
Pr113	Torque feed forward filter	0~6400	0.01ms	0
Pr114	2nd gain setup	0~1	—	1
Pr115	Position control switching mode	0~10	—	0
Pr116	Position control switching delay time	0~10000	0.1ms	50
Pr117	Position control switching level	0~20000	Mode-dependent	50
Pr118	Position control switching hysteresis	0~20000	Mode-dependent	33
Pr119	Position gain switching time	0~10000	0.1ms	33
Pr120	Velocity control switching mode	0~5	—	0
Pr121	Velocity control switching delay time	0~10000	0.1ms	0
Pr122	Velocity control switching level	0~20000	Mode-dependent	0
Pr123	Velocity control switching hysteresis	0~20000	Mode-dependent	0
Pr124	Torque control switching mode	0~3	—	0
Pr125	Torque control switching delay time	0~10000	0.1ms	0
Pr126	Torque control switching level	0~20000	Mode-dependent	0

Para. No.	Name	Range	Unit	Default
Pr127	Torque control switching hysteresis	0~20000	Mode-dependent	0
Pr200	Adaptive filter mode setup	0~4	—	0
Pr201	1st notch frequency	50~5000	Hz	5000
Pr202	1st notch width selection	0~20	—	2
Pr203	1st notch depth selection	0~99	—	0
Pr204	2nd notch frequency	50~5000	Hz	5000
Pr205	2nd notch width selection	0~20	—	2
Pr206	2nd notch depth selection	0~99	—	0
Pr207	3rd notch frequency	50~5000	Hz	5000
Pr208	3rd notch width selection	0~20	—	2
Pr209	3rd notch depth selection	0~99	—	0
Pr210	4th notch frequency	50~5000	Hz	5000
Pr211	4th notch width selection	0~20	—	2
Pr212	4th notch depth selection	0~99	—	0
Pr214	1st damping frequency	0~2000	0.1Hz	0
Pr215	1st damping ratio	0~500	0.001	0
Pr216	2nd damping frequency	0~2000	0.1Hz	0
Pr217	2nd damping ratio	0~500	0.001	0
Pr218	3rd damping frequency	0~2000	0.1Hz	0
Pr219	3rd damping ratio	0~500	0.001	0
Pr220	4th damping frequency	0~2000	0.1Hz	0
Pr221	4th damping ratio	0~500	0.001	0
Pr222	Positional command smoothing filter	0~32767	0.1ms	0
Pr223	Positional command FIR filter	0~1000	0.1ms	0
Pr300	Switching between internal and external speed setup	0~3	—	1
Pr301	Speed command direction selection	0~1	—	0
Pr304	1st speed of speed setup	-20000~20000	r/min	0
Pr305	2nd speed of speed setup	-20000~20000	r/min	0
Pr306	3rd speed of speed setup	-20000~20000	r/min	0
Pr307	4th speed of speed setup	-20000~20000	r/min	0
Pr308	5th speed of speed setup	-20000~20000	r/min	0

Para. No.	Name	Range	Unit	Default
Pr309	6th speed of speed setup	-20000~20000	r/min	0
Pr310	7th speed of speed setup	-20000~20000	r/min	0
Pr311	8th speed of speed setup	-20000~20000	r/min	0
Pr312	Acceleration time setup	0~10000	ms/(1000r/min)	0
Pr313	Deceleration time setup	0~10000	ms/(1000r/min)	0
Pr314	Sigmoid acceleration/deceleration time setup	0~1000	ms	0
Pr315	Speed-zero clamp function selection	0~3	—	0
Pr316	Speed-zero clamp level	10~20000	r/min	30
Pr317	Torque command selection	0~2	—	0
Pr318	Torque command direction selection	0~1	—	0
Pr321	Speed limit value 1	0~20000	r/min	0
Pr322	Speed limit value 2	0~20000	r/min	0
Pr400*	SI1 input selection	0~00FFFFFFh	—	002E2E2Eh (3026478)
Pr401*	SI2 input selection	0~00FFFFFFh	—	00818181h (8487297)
Pr402*	SI3 input selection	0~00FFFFFFh	—	00828282h (8553090)
Pr403*	SI4 input selection	0~00FFFFFFh	—	00222222h (2236962)
Pr404*	SI5 input selection	0~00FFFFFFh	—	00202020h (2105376)
Pr405*	SI6 input selection	0~00FFFFFFh	—	00212121h (2171169)
Pr406*	SI7 input selection	0~00FFFFFFh	—	002B2B2Bh (2829099)
Pr408*	SO1 output selection	0~00FFFFFFh	—	00010101h (65793)
Pr409*	SO2 output selection	0~00FFFFFFh	—	00030303h (197379)
Pr410*	SO3 output selection	0~00FFFFFFh	—	00000004h (4)

Para. No.	Name	Range	Unit	Default
Pr411*	SO4 output selection	0~00FFFFFFh	—	00070707h (460551)
Pr430	Positioning complete (In-position) range	0~262144	Unit-dependent	10
Pr431	Positioning complete (In-position) output setup	0~3	—	0
Pr432	INP hold time	0~30000	ms	0
Pr433	Zero-speed	10~20000	r/min	50
Pr434	Speed coincidence range	10~20000	r/min	50
Pr435	At-speed (speed arrival)	10~20000	r/min	1000
Pr436	Mechanical brake action at stalling setup	0~10000	ms	0
Pr437	Mechanical brake action at running setup	0~10000	ms	0
Pr438	Brake release speed setup	30~3000	r/min	30
Pr439	Selection 1 of alarm output	0~16	—	0
Pr440	Selection 2 of alarm output	0~16	—	0
Pr441	2nd positioning complete (In-position) range	0~262144	Command unit	10
Pr500	Numerator of 2nd electronic gear ratio	0~1073741824	—	0
Pr501	Numerator of 3rd electronic gear ratio	0~1073741824	—	0
Pr502	Numerator of 4th electronic gear ratio	0~1073741824	—	0
Pr503*	Denominator of pulse output division	0~8388608	—	0
Pr504*	Over-travel inhibit input setup	0~2	—	1
Pr505*	Sequence of over-travel inhibit	0~2	—	0
Pr506	Sequence at Servo-OFF	0~9	—	0
Pr507	Sequence of main power OFF	0~9	—	0
Pr508	LV trip selection at main power OFF	0~1	—	1

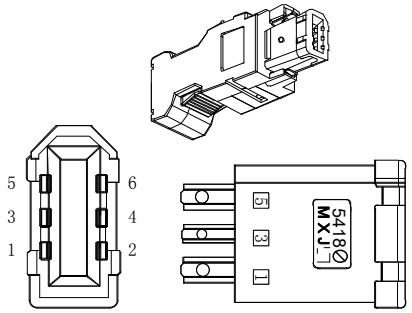
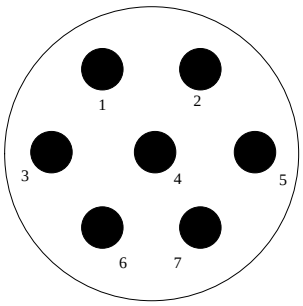
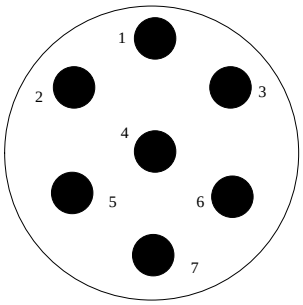
Para. No.	Name	Range	Unit	Default
Pr509*	Detection time of main power OFF	70~2000	ms	70
Pr510	Sequence at alarm	0~7	—	0
Pr511	Torque setup for emergency stop	0~500	%	0
Pr512	Over-load level setup	0~500	%	0
Pr513	Over-speed level setup	0~20000	r/min	0
Pr514	Motor working range setup	0~1000	0.1 revolution	10
Pr516*	Alarm clear input setup	0~1	—	0
Pr520*	Position setup unit selection	0~1	—	0
Pr521	Selection of torque limit	0~6	—	1
Pr522	2nd torque limit	0~500	%	500
Pr523	Torque limit switching setup 1	0~4000	ms/100%	0
Pr524	Torque limit switching setup 2	0~4000	ms/100%	0
Pr525	Positive direction torque limit at external input	0~500	%	500
Pr526	Negative direction torque limit at external input	0~500	%	500
Pr528*	LED initial status	0~36	—	1
Pr533*	Pulse regenerative output limit setup	0~1	—	0
Pr535*	Lock front panel setup	0~1	—	0
Pr601	Torque command setup	-500~500	%	0
Pr602	Velocity deviation excess setup	0~100	r/min	0
Pr604	JOG trial run command speed	0~500	r/min	300
Pr607	Torque command additional value	-100~100	%	0
Pr608	Positive direction torque compensation value	-100~100	%	0
Pr609	Negative direction torque compensation value	-100~100	%	0
Pr611	Current response setup	20~500	%	100

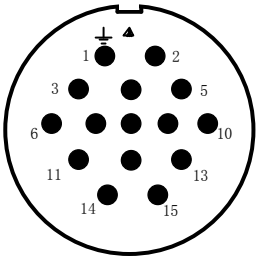
Para. No.	Name	Range	Unit	Default
Pr612	Positive/negative torque compensation filter	0~30000	0.01ms	0
Pr615	2nd over-speed level setup	0~20000	r/min	0
Pr617*	Front panel parameter write selection	0~1	—	0
Pr623	Disturbance torque compensating gain	-100~100	%	0
Pr624	Disturbance observer filter	0~2500	0.01ms	2000
Pr627*	Alarm latch time selection	0~10	s	5
Pr628	Auto resonance detection level	30~1000	%	100
Pr630	Damping filter ON/OFF switch	0~2	—	0
Pr632	Real-time auto-tuning customer setup	-32767~32767	—	0
Pr633	Friction compensation valid speed setup	0~1000	0.1r/min	0
Pr638*	Alarm mask setup	-32768~32767	—	0
Pr640	Absolute origin position offset	-1073741823~ 1073741823	Command unit	

10 Wiring of Connector

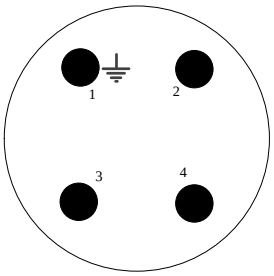
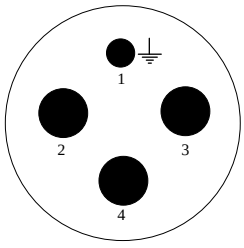
10.1 Driver-MA/MB/MN/ME Motor

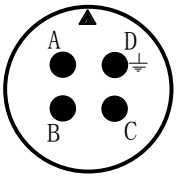
10.1.1 Encoder Connector

Part Name	Pin No.	Signal	Part Illustration
SM-6P (Lateral encoder connector of the driver)	1	+5V	
	2	0V	
	3	—	
	4	—	
	5	PS	
	6	/PS	
7-pin directly inserted XS16K7P	1	FG (shield ground)	
	2	BAT-	
	3	BAT+	
	4	/PS	
	5	0V	
	6	PS	
	7	+5V	
7-pin aviation connector YD28K7TSL	1	FG (shield ground)	
	2	BAT-	
	3	BAT+	
	4	/PS	
	5	0V	
	6	PS	
	7	+5V	

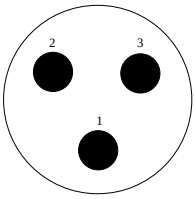
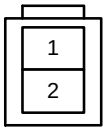
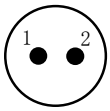
Part Name	Pin No.	Signal	Part Illustration
15-pin military aviation connector (please don't connect anything to NC)	1	FG (shield ground)	
	2	BAT-	
	3	BAT+	
	4	/PS	
	5	0V	
	6	PS	
	7	+5V	
	8	NC	
	9	NC	
	10	NC	
	11	NC	
	12	NC	
	13	NC	
	14	NC	
	15	NC	

10.1.2 Connector for Motor Cable

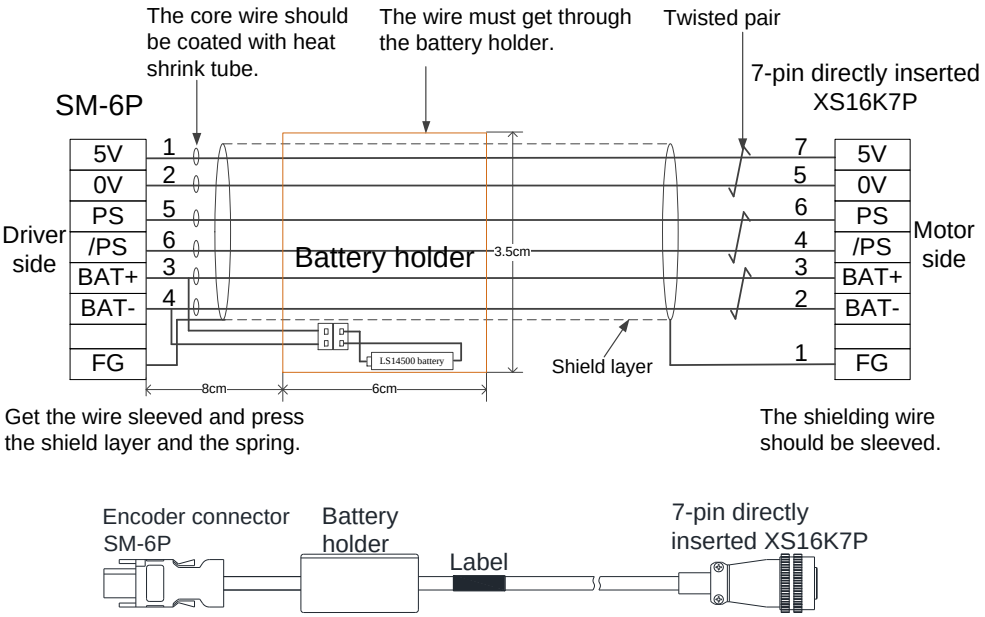
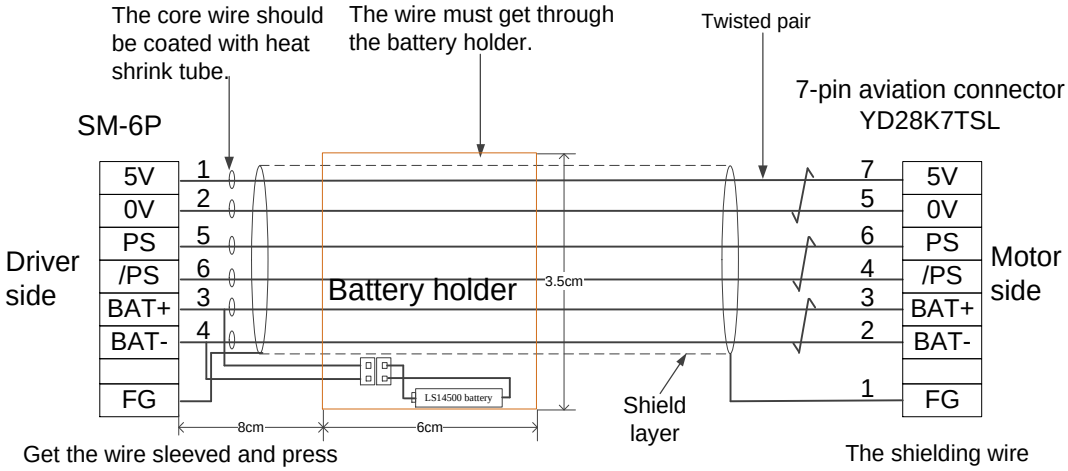
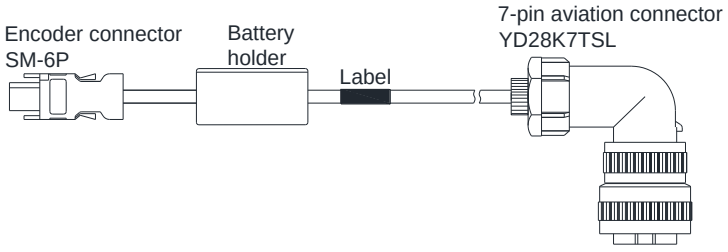
Part Name	Pin No.	Signal	Part Illustration
4-pin directly inserted motor cable connector XS16K4aP	1	⏚	
	2	U	
	3	V	
	4	W	
4-pin aviation motor cable connector YD28K4TSL	1	⏚	
	2	U	
	3	V	
	4	W	

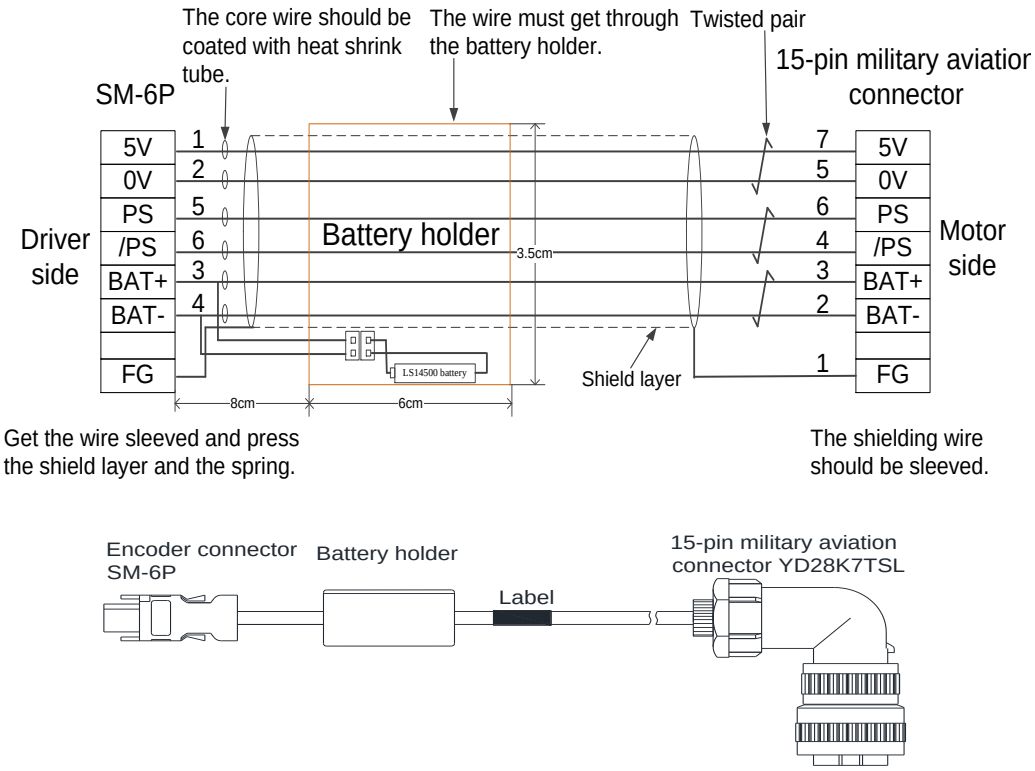
Part Name	Pin No.	Signal	Part Illustration
4-pin aviation motor cable connector CMS3108A18-10SI	A	U	
	B	V	
	C	W	
	D	⏚	

10.1.3 Connector for Brake Cable

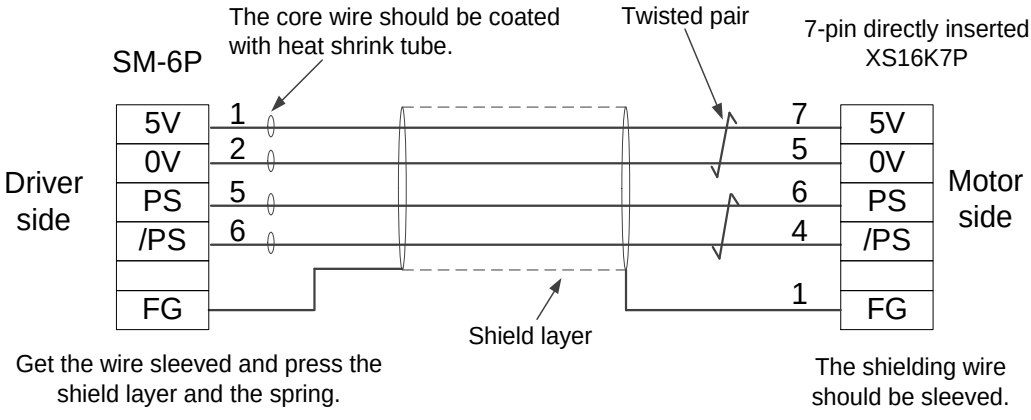
Part Name	Pin No.	Signal	Part Illustration
3-pin brake aviation connector XS12K3P	1	Brake +	
	2	Brake -	
	3	NC	
2-pin brake connector 172157-1	1	Brake +	
	2	Brake -	
2-pin brake connector SC-CMV1-AP02C	1	Brake +	
	2	Brake -	

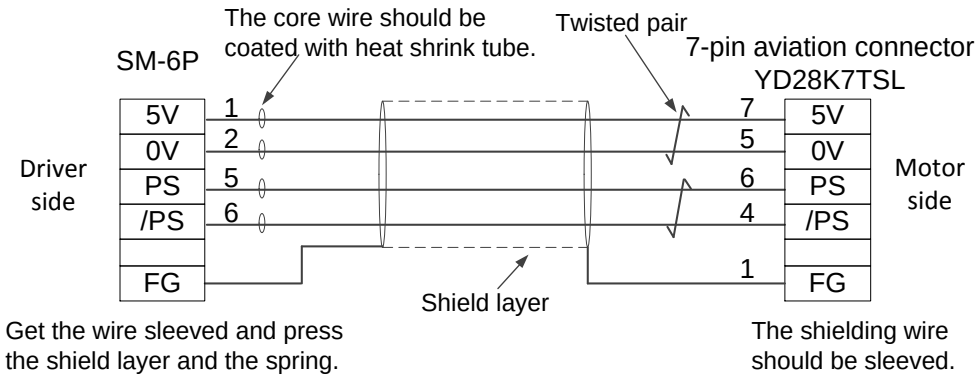
10.1.4 Wiring Diagram of Encoder Cable

Motor Rated Power	Wiring Diagram
Wiring diagram of 17/23-bit absolute encoder	
100W~750W 1kW (MN080-DA4035F-F□ Series)	
1kW~2.3kW	 

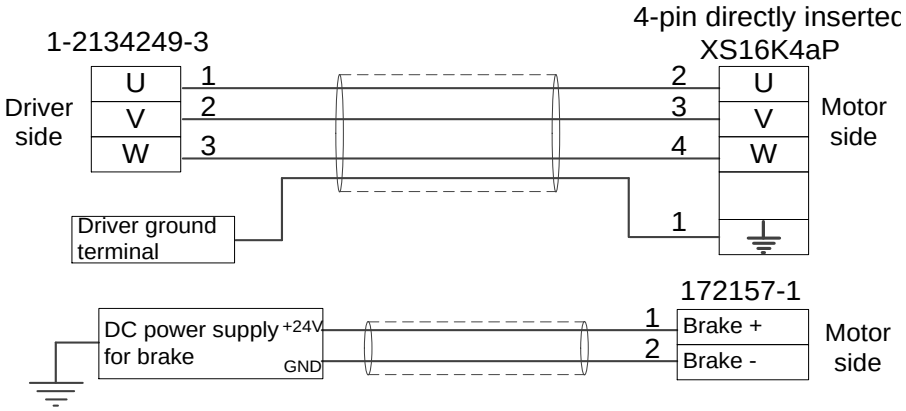
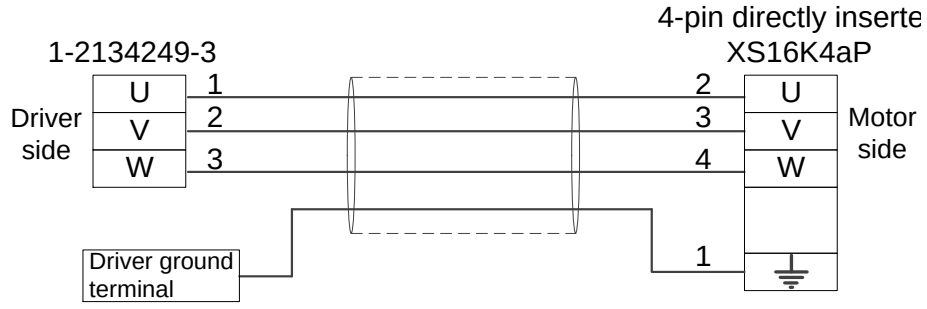
Motor Rated Power	Wiring Diagram
850W& 1.3kW (MB130 series)	

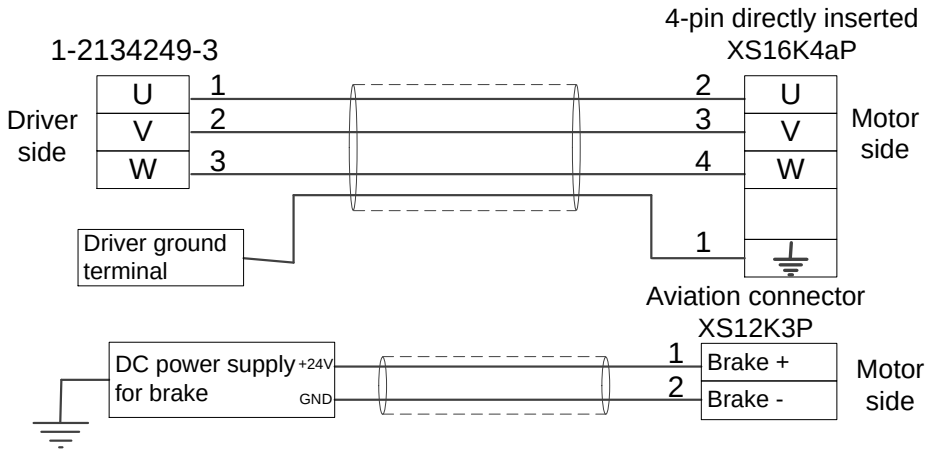
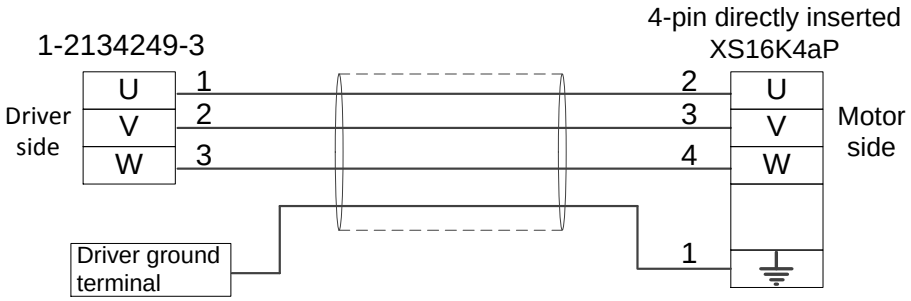
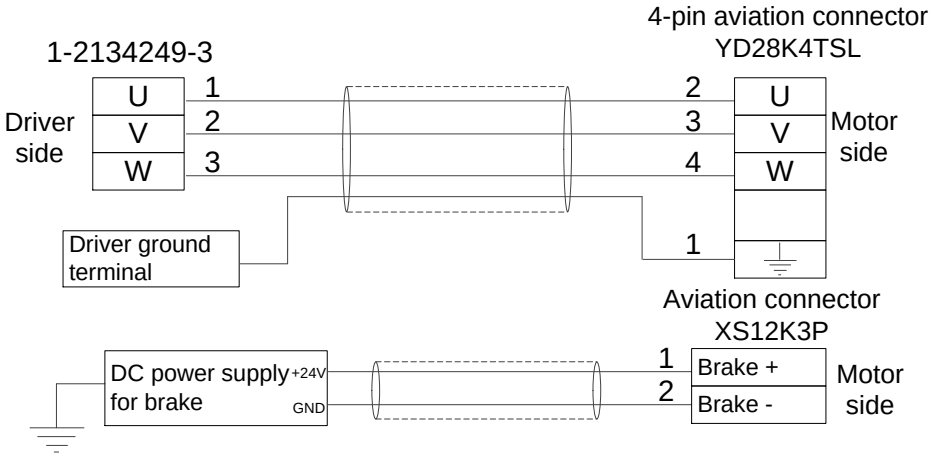
Wiring diagram of 17-digit incremental encoder

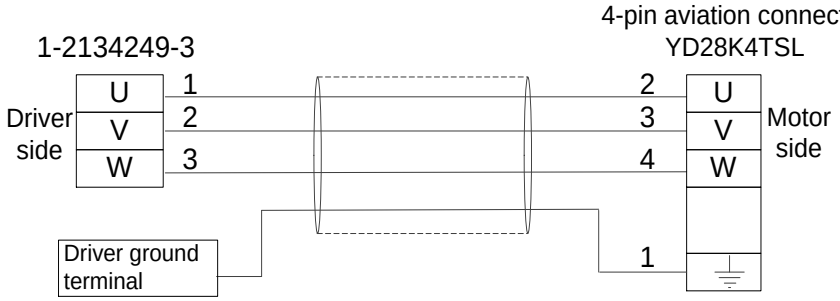
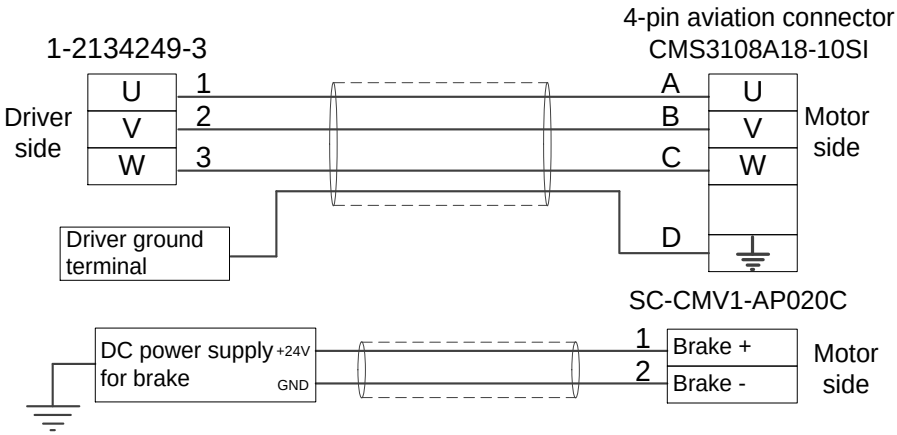
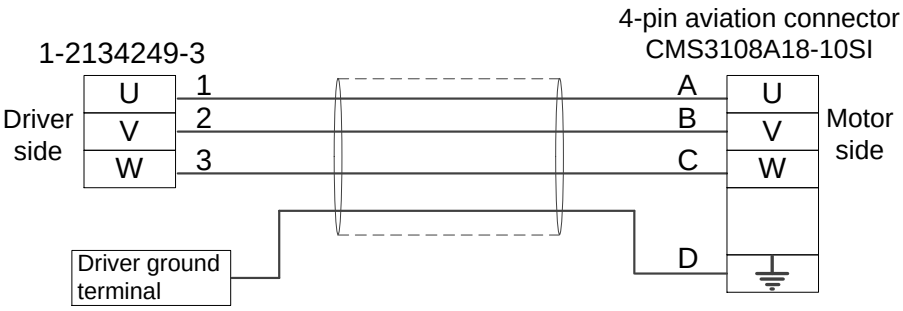
100W~ 750W 1kW (MN080-DA4035F-F□ series)	

Motor Rated Power	Wiring Diagram
1kW~ 2.3kW	

10.1.5 Wiring Diagram of Motor Cable

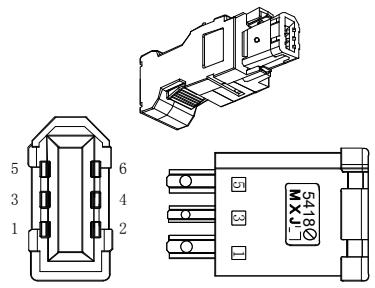
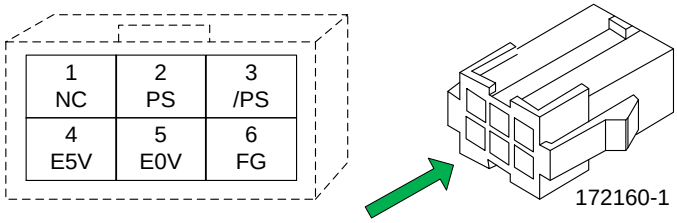
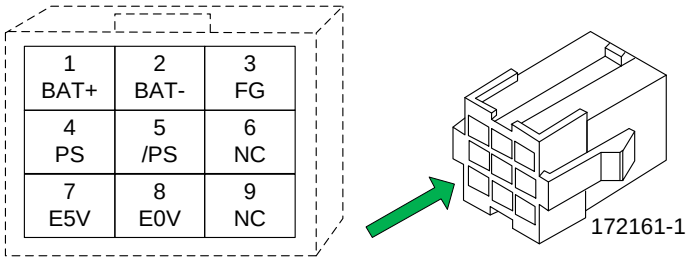
Motor Rated Power	Wiring Diagram
100~400W (with brake)	
100~400W (without brake)	

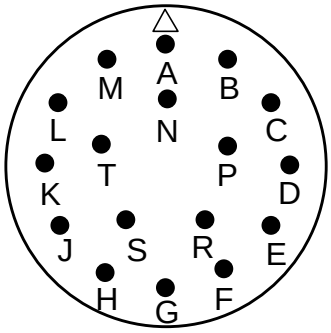
Motor Rated Power	Wiring Diagram
750W (with brake)	
750W (without brake)	
1.0kW~ 2.3kW (with brake)	

Motor Rated Power	Wiring Diagram
1.0kW~ 2.3kW (without brake)	
850W & 1.3kW (MB130 series) (with brake)	
850W& 1.3kW (MB130 series) (without brake)	

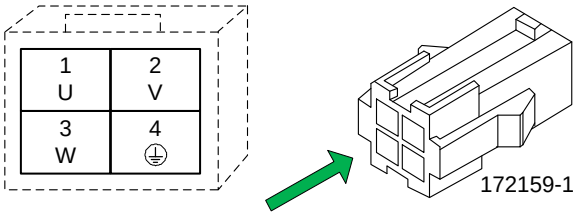
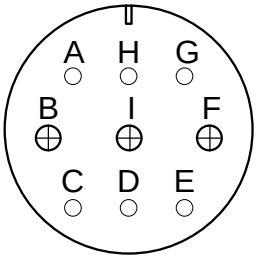
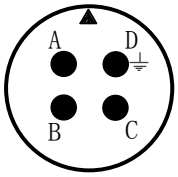
10.2 Driver- Panasonic A5/A5-Ⅱ Motor

10.2.1 Encoder Connector

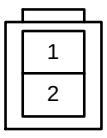
Part Name	Pin No.	Signal	Part Illustration
SM-6P (Lateral encoder connector of the driver)	1	+5V	
	2	0V	
	3	—	
	4	—	
	5	PS	
	6	/PS	
6-pin incremental encoder connector 172160-1 (please don't connect anything to NC)	1	NC	
	2	PS	
	3	/PS	
	4	+5V	
	5	0V	
	6	FG (shield ground)	
9-pin bus type encoder connector 172161-1 (please don't connect anything to NC)	1	BAT+	
	2	BAT-	
	3	FG	
	4	PS	
	5	/PS	
	6	NC	
	7	+5V	
	8	0V	
	9	NC	

Part Name	Pin No.	Signal	Part Illustration
17-pin bus type aviation connector 3108B20-29S (please don't connect anything to NC)	A	NC	
	B	NC	
	C	NC	
	D	NC	
	E	NC	
	F	NC	
	G	0V	
	H	+5V	
	J	FG (shield ground)	
	K	PS	
	L	/PS	
	M	NC	
	N	NC	
	P	NC	
	R	NC	
	S	BAT-	
	T	BAT+	

10.2.2 Connector for Motor Cable

Part Name	Pin No.	Signal	Part Illustration
4-pin motor cable connector 172159-1	1	U	
	2	V	
	3	W	
	4	⏚	
9-pin aviation motor cable connector with brake 3108B20-18S (please don't connect anything to NC)	1	⏚	
	2	U	
	3	V	
	4	W	
4-pin aviation motor cable connector CMS3108A 18-10SI	A	U	
	B	V	
	C	W	
	D	⏚	

10.2.3 Connector for Brake Cable

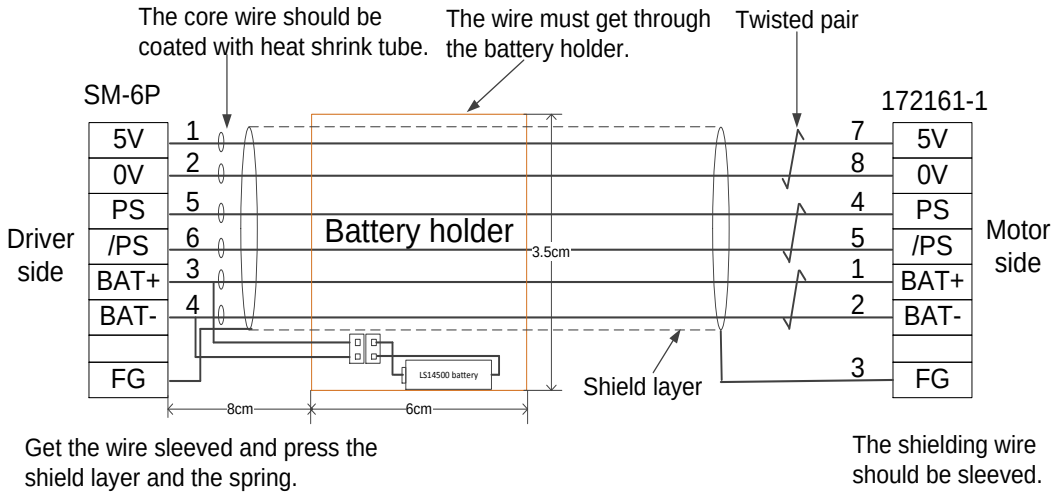
Part Name	Pin No.	Signal	Part Illustration
2-pin power-off brake connector 172157-1	1	Brake +	
	2	Brake -	

10.2.4 Wiring Diagram of Encoder Cable

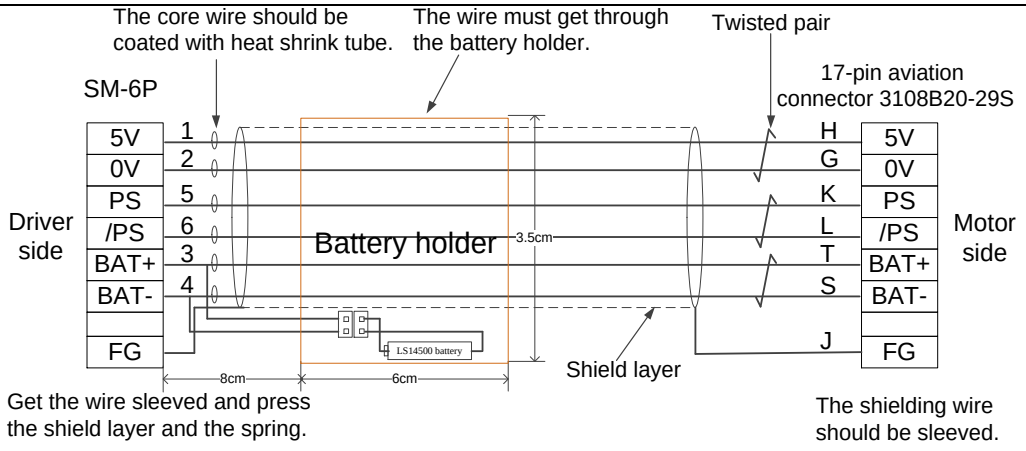
Motor rated power	Wiring diagram

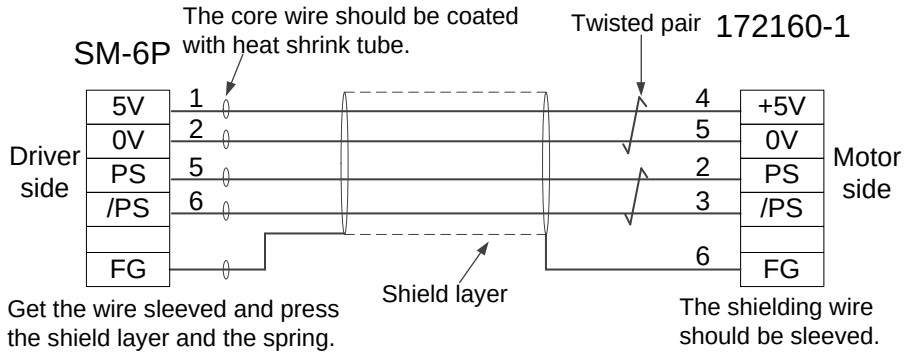
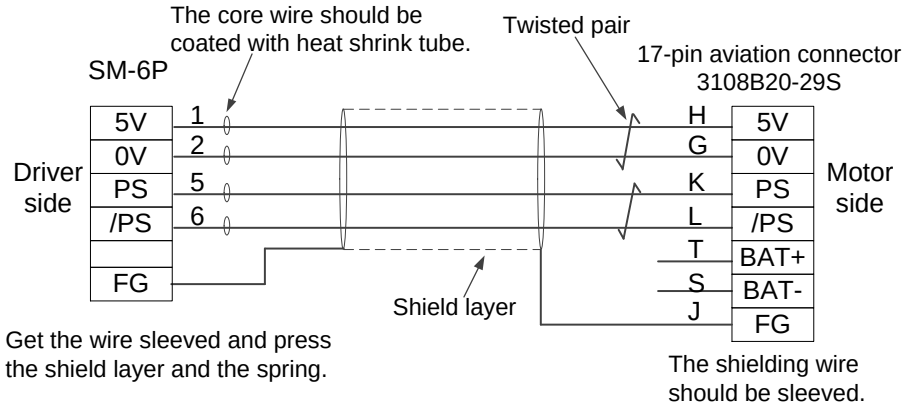
17-bit absolute encoder wiring diagram

400W~ 750W

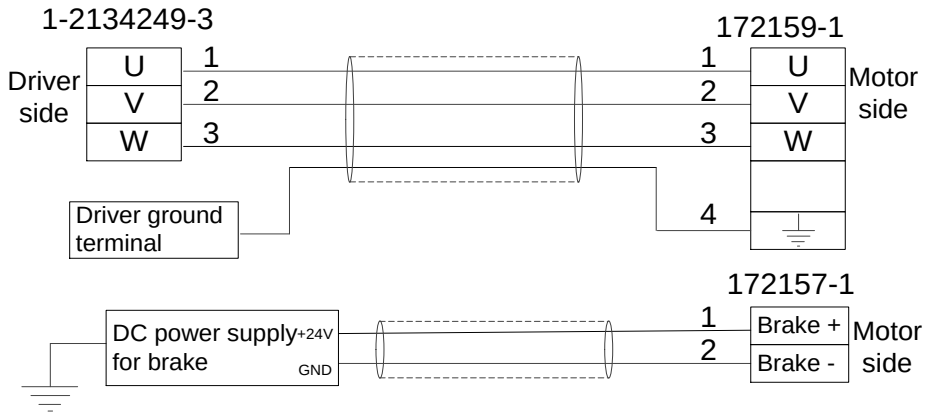
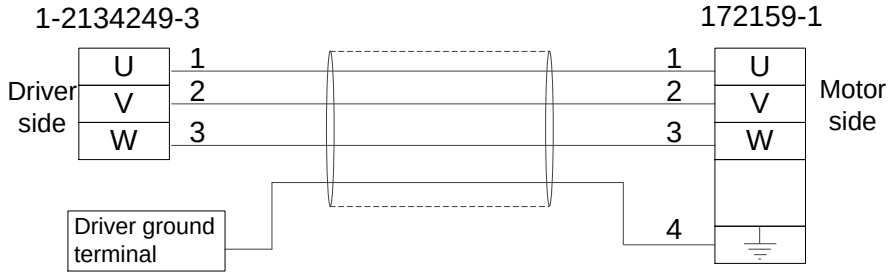
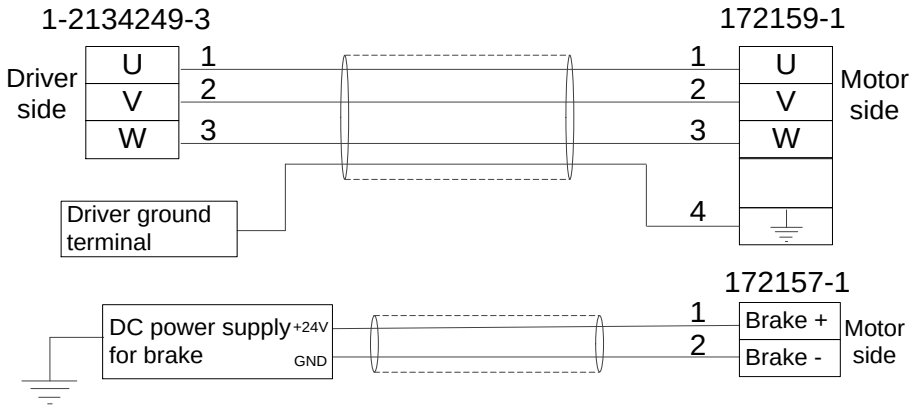
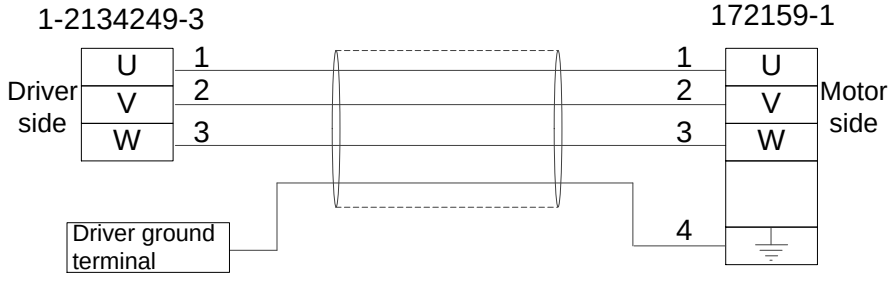


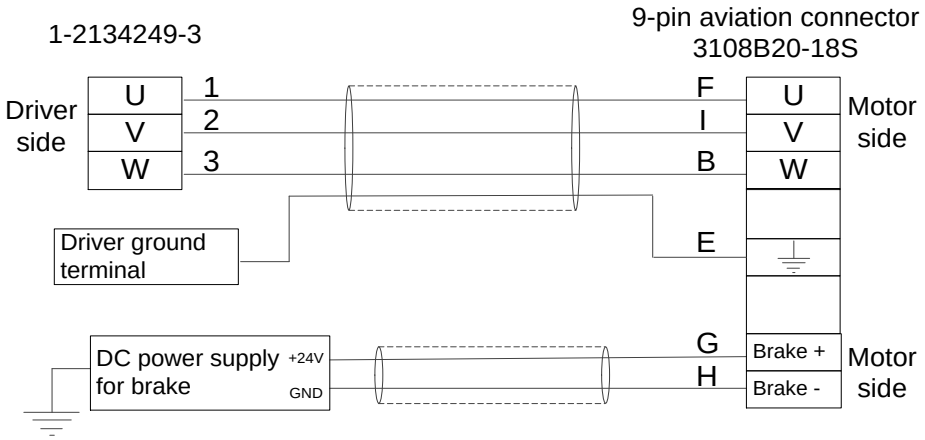
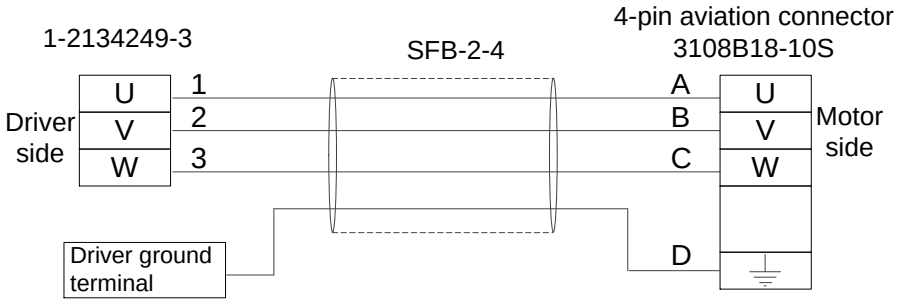
1.0kW~ 1.5kW



Motor rated power	Wiring diagram
20-bit incremental encoder wiring diagram	
400W~ 750W	
1.0kW~ 1.5kW	

10.2.5 Wiring Diagram of Motor Cable

Motor rated power	Wiring diagram
400W (with brake)	
400W (without brake)	
750W (with brake)	
750W (without brake)	

Motor rated power	Wiring diagram
1000W &1500W (with brake)	
1000W & 1500W (without brake)	

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