WISE Servo Driver

Users' Manual

(9th Edition)

(For WSDV Series)

Weihong Electronic Technology Co., Ltd.

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Preface

About 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 5 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 example of WISE servo driver are offered.
4) Operation and adjustment, including to chapter 3 to 8. Chapter 3 introduces the front panel and operation; chapter 4 gives knowledge of the absolute system; chapter 4.3.3 motor running; chapter 6 gain adjustments and chapter 7 errors and troubleshooting; chapter 8 introduces the registration function of the driver.
5) Parameter, including chapter 9 and chapter 10. The former gives introduction to all parameters in this system, and the later includes the list of parameters.

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 five models, namely, WSDV-1R2 (0.1kW); WSDV-2R8 (0.4kW), WSDV-5R0 (0.75kW), WSDV-6R8 (1.0kW), and WSDV-110 (1.5kW).

Contact Us

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Revision History

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

Date	Edition	Revision Contents
2016.07	R9	1) Styles updated; 2) Company address updated; 3) New model “WSDV-1R2 (0.1kW)” added; 4) Conventions in This Manual added; 5) Section 2.7 and chapter 8 added; 6) Section 1.2, 2.2, 2.3, 2.6, 3.2, 3.5, 3.7, 4.2.3, 4.2.5, 4.3.2, 5.2.1 and 10.1 updated. 7) Chapter 6, 7, and 9 updated.
2015.10	R7	Main revision contents include: 1) Add condition of inertia ratio estimation in chapter 6.2.4; 2) Update contents in chapter 6.3 manual gain adjustment; 3) Update parameters in chapter 9; 4) Other revisions.
2015.03	R6	Compared with R5.06 edition, main revision contents include: 1) Add WSDV-6R8 (1.0kW) model type; 2) Update contents in chapter 1.2.5 specifications of the driver; 3) Add alarm No. A7 in chapter 3.2, 3.5 and 4.2.5; 4) Update parameters in chapter 9; 5) Update the list of parameters in chapter 10.1; 6) Add “Software license agreement” in chapter 10.2; 7) Other revisions.

Conventions in This Manual

In this manual, the P, S and T in column “Related Mode” represents position control mode, Velocity control mode and torque control mode. The letters in grey background represent the corresponding modes are valid while letters in blank background represent the corresponding modes are invalid, as shown below.

Signal Name	Symbol	Default	Related Mode		
Positioning complete	INP	38 (SO4)	P	S	T

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.

: 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 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;
- 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

WARNING

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;
- 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.

Contents

1 Checking Products and Part Names

1.1 On Opening the Product Package

After you open the product package, please check:

- Whether the model number marked on the nameplates of servo driver corresponds to the order. (Refer to the descriptions of model numbers in 1.2.2);
- Whether there is damage or scratch on the appearance;
- Whether screws are loose or fallen;
- Whether all parts are included. A complete configuration includes:
  1) One WISE servo driver
  2) One driver side encoder cable plug (6M-SP)
  3) One users' manual of WISE servo driver

1.2 Basic Information of Driver

1.2.1 Part description

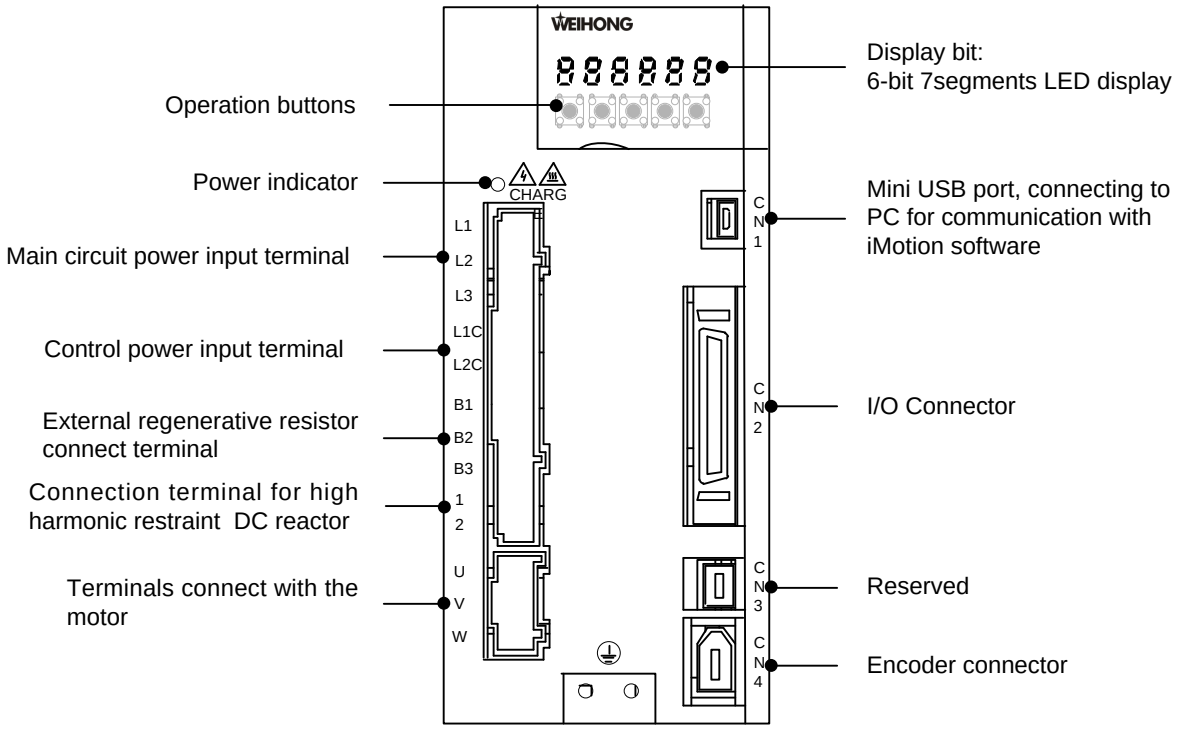


Fig. 1-1 Part description of a non-bus driver

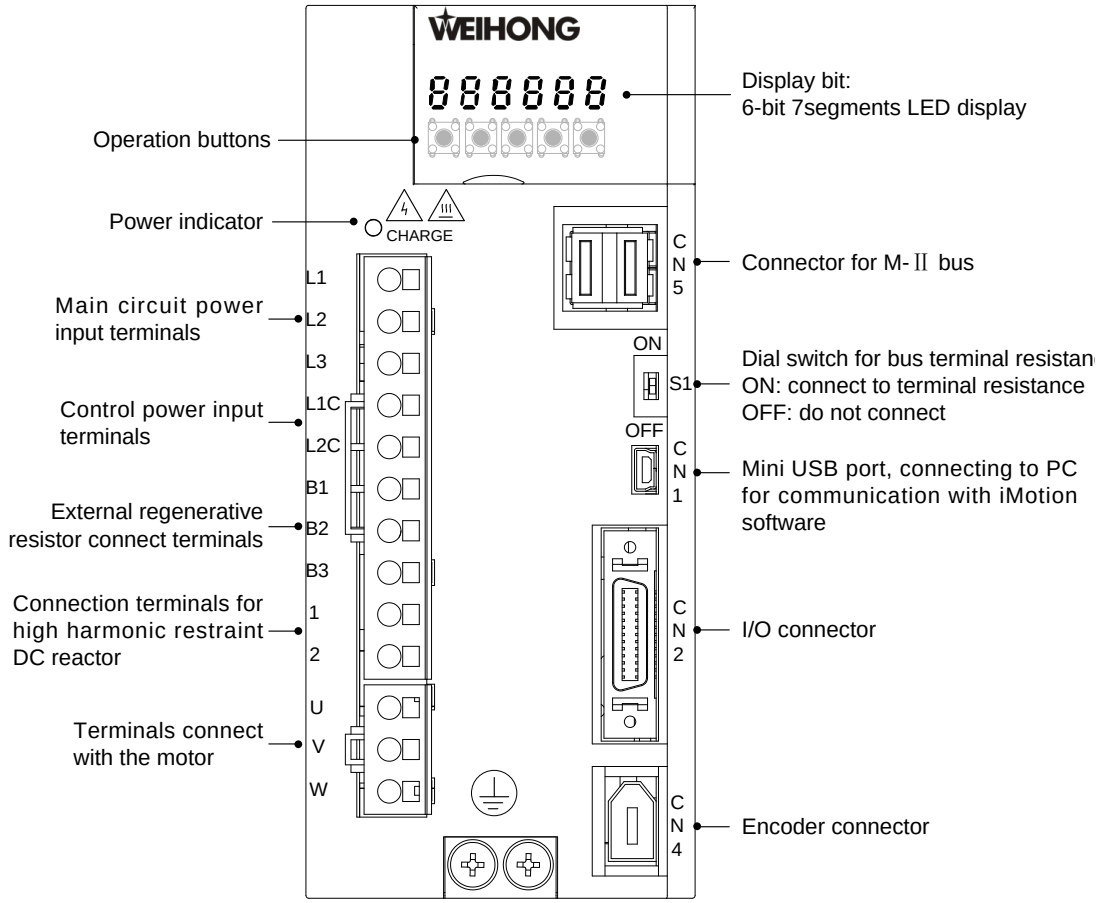
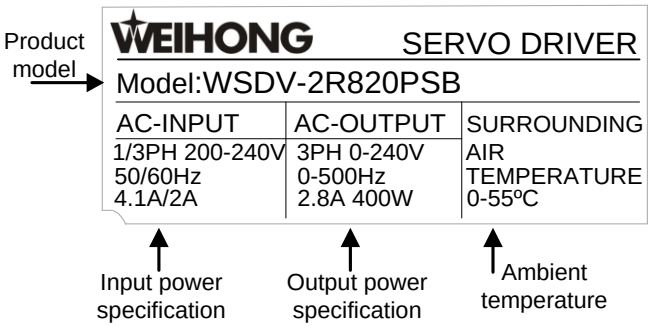


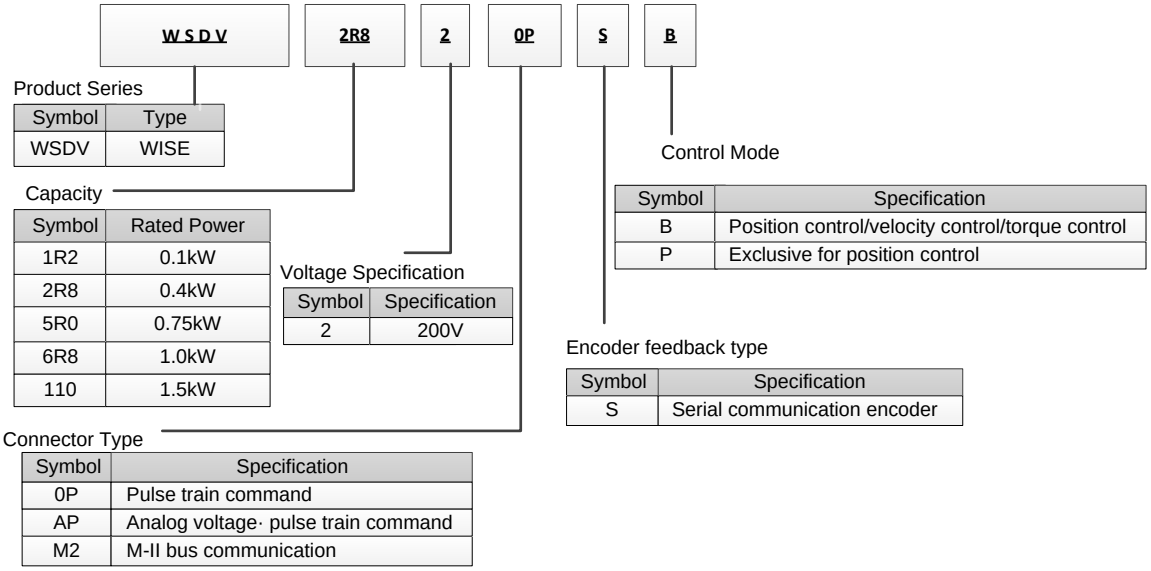
Fig. 1-2 Part description of a bus driver

1.2.2 Nameplate Example



1.2.3 Model Number

WISE series servo driver, with Chinese name “维智”, whose model number consists of product series + capacity indicator + voltage grade + interface type indicator + feedback components + control mode. Please refer to the following chart for details.



1.2.4 Operation Modes of Servo Driver

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

Mode Name	Pr001	Description
Position control	1	The driver receives position command and makes the motor rotate to target position. Position command is input through terminal in the type of pulse.
Velocity control	2	The driver receives velocity command and makes the motor rotate to target rotational speed. Velocity command is provided by 8 groups of internal registers, which can be selected by external control input signal.
Torque control	3	The driver receives torque command and makes the motor rotates to target torque. Torque command is provided by internal register.

1.2.5 Specifications

- **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:	3-phase 200V~240V $^{+10\%}_{-15\%}$, 50/60Hz
Control circuit power supply	Single phase 200V~240V $^{+10\%}_{-15\%}$, 50/60Hz	

Insulation resistance	AC1500V or DC2100V, withstand the voltage for 1 minute, current leak 10mA max.
Ambient temperature (working)	0~+55℃ (Condensation and freezing: None)
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	IGBT PWM control, sinusoidal wave current drive
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	2 groups of differential input signal (one group of pulse differential input, one group of direction differential input), receivable frequency 1M; high-speed bus.
Pulse output	Output encoder pulse via long line driver (A/B/Z-phase)
Communication	Connect with software iMotion in PC via USB interface.
Control input	8 physical input for general purpose are: ① alarm clear (A-CLR); ② internal command velocity selection signal INTSPD1, INTSPD2 and INTSPD3; ③ positive direction inhibition signal POT; ④ negative direction inhibition NOT; ⑤ command pulse inhibition INH; ⑥ SRV-ON; ⑦ zero-speed clamp ZEROSPD; ⑧ Gain switching, etc.
Control output	7 physical output for general purpose (alarm output ALM is fixed allocated to SO3, remaining 6 outputs) are: ① external brake release BRK-OFF; ② servo ready output (S-RDY); ③ position complete (INP); ④ zero-speed clamp detection (ZSP); ⑤ torque limiting (TLC); ⑥ velocity coincidence (V-COIN); ⑦ speed arrival (AT-SPEED); ⑧ warning (WARN1);

	⑨ velocity limiting (V-LIMIT) etc.
Front panel	5 buttons and 6 LED indicators.
Regenerative resistor	WSDV-1R2, WSDV-2R8 with no internal regenerative resistor (can only be external regenerative resistor); WSDV-5R0 WSDV-6R8 WSDV-110 internal regenerative resistor (can be external one as well).
Dynamic brake	WSDV-1R2, WSDV-2R8 without dynamic brake; WSDV-5R0 WSDV-6R8 WSDV-110 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	Max. pulse input frequency	Line drive: 1Mpps Open collector: 200kpps
		Pulse input method	Differential input, command pulse/command direction
		Command pulse division/multiplication (electronic gear setup)	electronic gear used within range of 1/1000~1000
		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.	

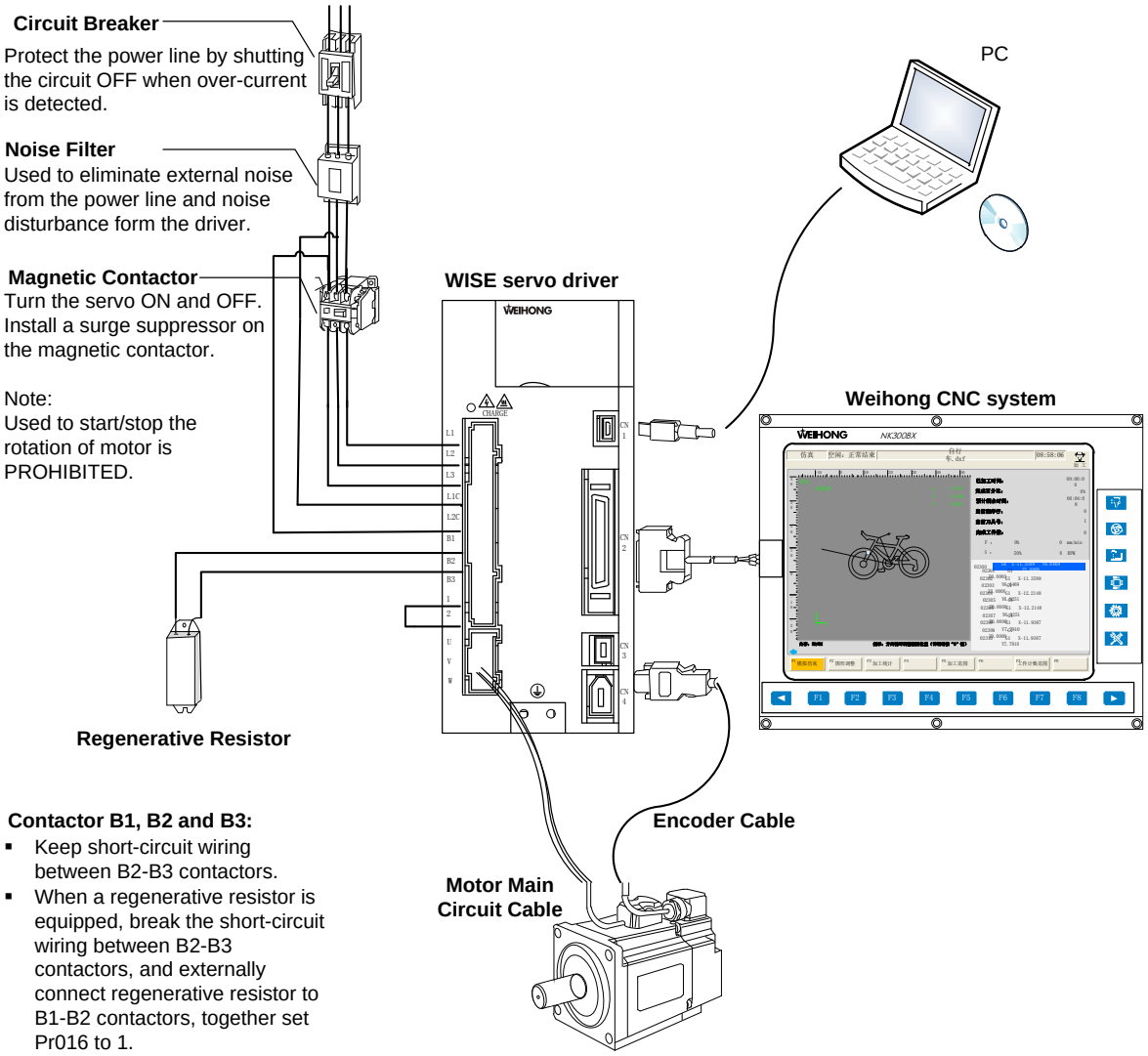
	Control output	Speed arrival
	Internal velocity command	Switch among 8 velocity according to external control input
	Velocity command acceleration/deceleration adjustment	Both individual setup of acceleration/deceleration or sigmoid acceleration/deceleration are enabled.
	Zero-speed clamp	Zero-speed 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 up velocity limiting through parameter setup
	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, 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 traced.

2 Connector and Wiring

2.1 Typical Example of Wiring Diagram



WARNING

When externally wiring to a regenerative resistor, over-temperature protection MUST be provided.

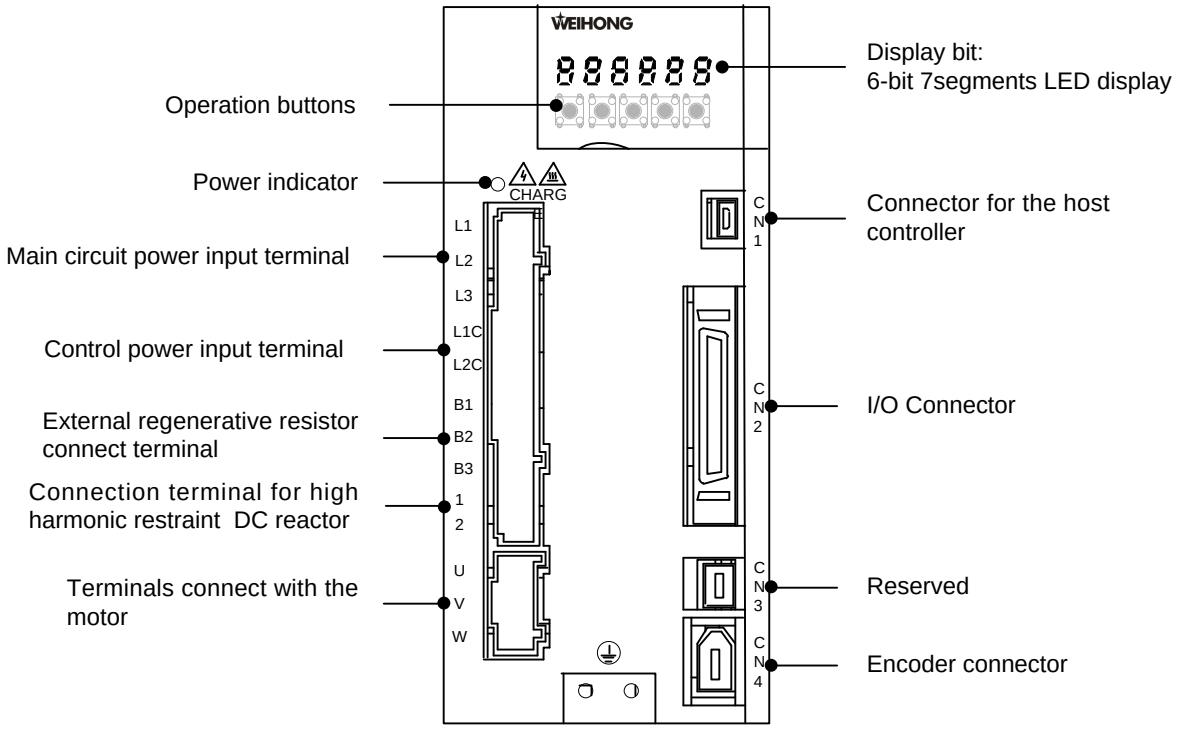
Install over-temperature protection fuse and thermostat in the regenerative resistor. And once fuse action occurs, it cannot restore to previous state.

Please install the regenerative resistor on non-combustion substances such as metal.

2.2 Wiring Diagram of Main Circuit

2.2.1 Terminals of Main Circuit

Terminals and connectors layout of the main circuit of a non-bus driver are shown as below:



Details about terminals of main circuit is as below.

Symbol	Name	Description
L1, L2, L3	Main circuit power input terminal	Any two terminals connected to single phase voltage; All three terminals connected to 3-phase voltage Voltage specification, 200~240V $^{+10\%}_{-15\%}$, 50/60Hz
L1C, L2C	Control power input terminal	Connected to single phase voltage, 200~240V $^{+10\%}_{-15\%}$, 50/60Hz
B1, B2, B3	External regenerative resistor connection terminal	If handling capacity of regenerative power is inadequate, you can connect an external regenerative resistor (optional) between B1-B2. When capacity of internal regenerative resistor is low, make circuit between B2-B3 (*1) open (by removing wire), and connect an external regenerative resistor between B1-B2. B2-B3 is short-circuited by default.
1, 2	Connection terminal for power high harmonic	When high harmonic restraint to the power is required, connect a DC reactor between1-2 (*2). Make sure 1-2 is

Symbol	Name	Description
	restraint DC reactor	short-circuited if no requirement. 1-2 is short-circuited by default.
1	Main circuit front side terminal	When DC power input is used for main circuit.
2	Main circuit side terminal	
U, V, W	Connection terminal for the motor	Used to connect with the servo motor.
⏚	Grounding terminal (2)	Grounding point of AC and motor power line.

2.2.2 Main Circuit Cable Dimension of the Driver

- **Cautions**

1) Allowable temperature: 40℃, which is the specification for rated current flowing through 3 lines.
2) Please use electrical wire of 600V or more withstand voltage for main circuit.
3) When binding wires and put them into PVC tube or metal tube, you need to take the attenuation coefficient of allowable current into consideration.
4) Generally speaking, thermal aging of PVC line is relatively quick, that is, PVC line cannot be used any longer in a short time. When ambient temperature is very high, please use heat resistant wire.

- **Types of cable (use following cables for the main circuit)**

Types		Allowable Temp. 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 table are the maximal specifications in real practice.

AWG Specification	Nominal Cross Sectional Area (mm2)	Constitution (wires/mm2)	Resistance of Conductor (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
14	2.0	7/0.6	9.53	23	20	16

AWG Specification	Nominal Cross Sectional Area (mm2)	Constitution (wires/mm2)	Resistance of Conductor (Ω/Km)	Allowable Current Under Different Ambient Temperature (A)		
				30℃	40℃	50℃
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

CAUTION

Figures in above table are reference specifications in case of 600V PVC wire.

- **Wire and terminal specification in case of 3-phase 200V type**

External Terminal Name	Symbol	WSDV			
		2R8	5R0	6R8	110
Main circuit power input terminal	L1, L2, L3	HIV1.25 (AWG16)		HIV2.0 (AWG14)	
Control power input terminal	L1C, L2C	HIV1.25 (AWG16)			
Motor connection terminal	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			

- **Wire and terminal specification in case of single phase 200V type**

External Terminal Name	Symbol	WSDV			
		2R8	5R0	6R8	110
Main circuit power input terminal	L1, L2, L3 (any two)	HIV1.25		HIV2.0	
Control power input terminal	L1C, L2C	HIV1.25			
Motor connection terminal	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 with business power supply without insulation by transformer, be sure to use circuit breaker (QF) or fuse to prevent the driver from miscontact with peripheral components.

2. No internal grounding protection circuit is enabled for the servo driver. To build up a safe system, please be equipped with an electric leakage circuit breaker with over-load and short protection, or together with wiring circuit breaker, install a short protection electric leakage circuit breaker.
3. Do not turn ON/OFF the 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.

- **Pay attention to following items in wiring:**

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

2.2.4 Power-Control Input Setup

Take following items into consideration in setup of power-control input.

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

WARNING

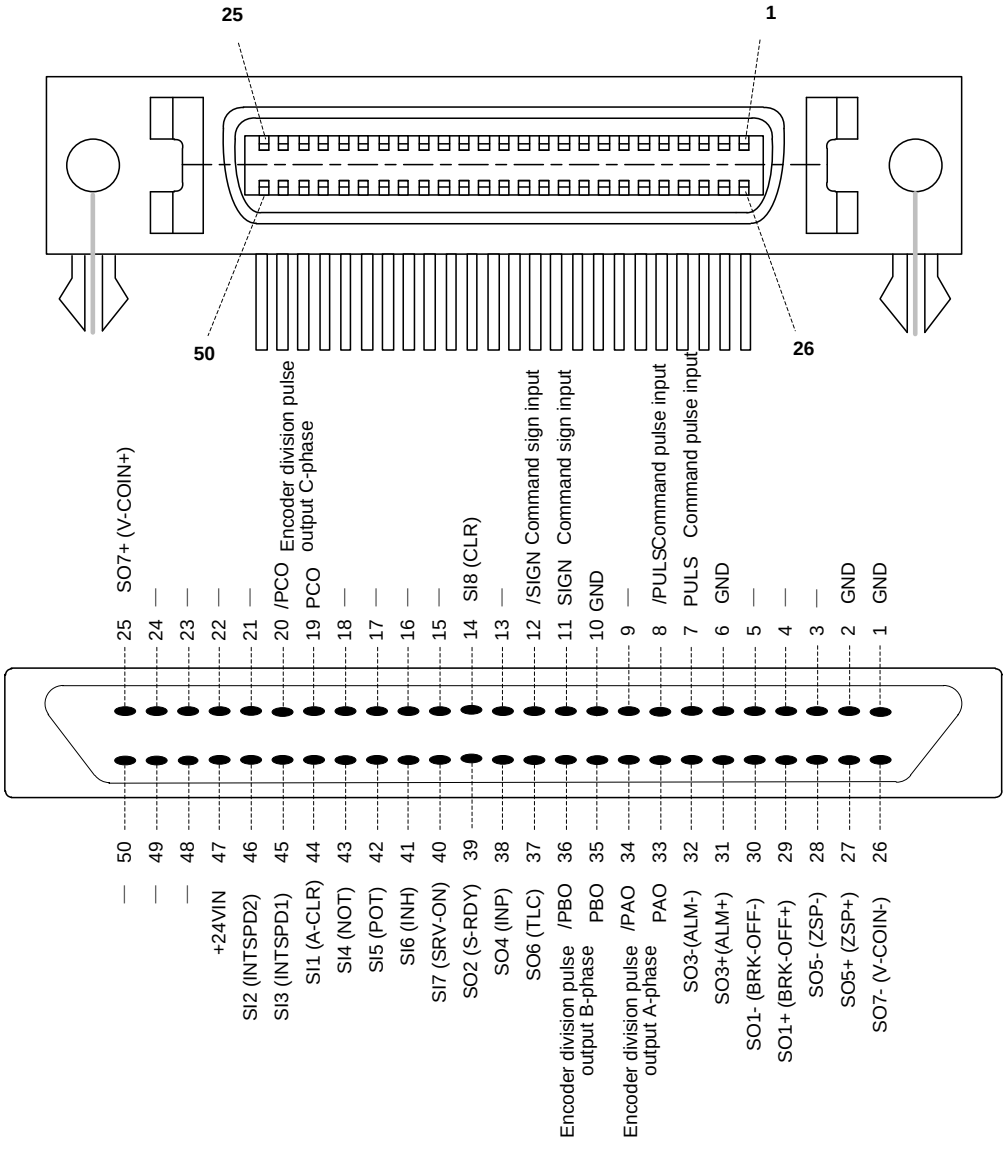
When connecting control power and main circuit power, please turn on main circuit power after control power ON for 1 sec, or turn on two kinds of power at the same time. Similarly, please cut off two powers simultaneously or cut off main circuit power after control power OFF.

2.3 Connection Example of I/O Signal

This section introduces name and function of terminal of I/O signal connector (CN2), terminal arrangement as well as wiring examples in different control mode.

2.3.1 Illustration of I/O Signal Connector (CN2)

Arrangement of terminals of I/O signal connector (CN2) is shown as below:



CAUTION

1) Above figure shows all pins of CN2, and SI1~SI8 and SO1~SO7 are configurable. Signals in brackets are default setup when leaving factory. Do not use any empty terminals.

2) Please connect shield layer of I/O signal cable with case of connector, and make frame grounding (FG) through the connector for driver cable.

3) Following pins can be allocated to different I/O signals. Refer to I/O signal configuration for details.

Input: 46 (SI2), 45 (SI3), 43 (SI4), 42 (SI5), 41 (SI6), 14 (SI8)

Output: 25/26 (SO7), 27/28 (SO5), 29/30 (SO1), 31/32 (SO3), 37 (SO6), 38 (SO4), 39 (SO2).

Names and functions of I/O signals connector (CN2) are shown in following tables.

- **Input signals**

Signal Name	Pin No.	Default signal	Function	
—	7 8 11 12	PULS /PULS SIGN /SIGN	Positional command input signal	
SI1	44	A-CLR	Alarm clear	
SI2	46	—	—	
SI3	45	—	—	
SI4	43	NOT	Negative over-travel inhibition	When machine moves out of limits, stop motor driving (over-travel protection function).
SI5	42	POT	Positive over-travel inhibition	
SI6	41	INH	Command pulse inhibition input	Ignore positional command pulse.
SI7	40	SRV-ON	Control servo-ON/OFF signal.	
SI8	14	CLR	Clear positional deviation pulse when position control is enabled.	
+24VIN	47	+24VIN	Power input: Allowable voltage range: +11V~+25V (+24V power is prepared by the user).	

CAUTION

Input signal for SI1~SI8 are changeable, refer to section 2.4 "I/O Signal Allocation" for details.

- **Output signals**

Signal Name	Pin No.	Default Signal	Function	
—	33 34	PAO /PAO	A-phase signal	Output signal of 90 degree phase-deviation encoder division pulse.
	35 36	PBO /PBO	B-phase signal	

Signal Name	Pin No.	Default Signal	Function	
	19 20	PCO /PCO	C-phase signal	Output signal of origin pulse.
—	Shell	FG	If the shield layer of I/O signal cable has been connected to the case of connector, frame grounding has been made.	
SO1	29/30	BRK-OFF	1) Time sequence signal of electric-magnetic brake action is fed out. 2) Release time sequence of electric-magnetic brake and connect with transistor.	
SO2	39	S-RDY	Output signal in servo-ON status of the driver.	
SO3	31/32	ALM	Output signal in alarm status.	
SO4	38	INP	Output positioning complete signal. Turn transistor ON at positioning complete status.	
SO5	27/28	ZSP	Output zero-speed clamp detection signal. Turn transistor ON at zero-speed clamp detection status.	
SO6	37	TLC	Output torque in- limit signal. Turn transistor ON at torque limiting status.	
SO7	25/26	V-COIN	1) Output velocity coincidence signal. 2) Turn transistor ON at velocity coincidence status.	

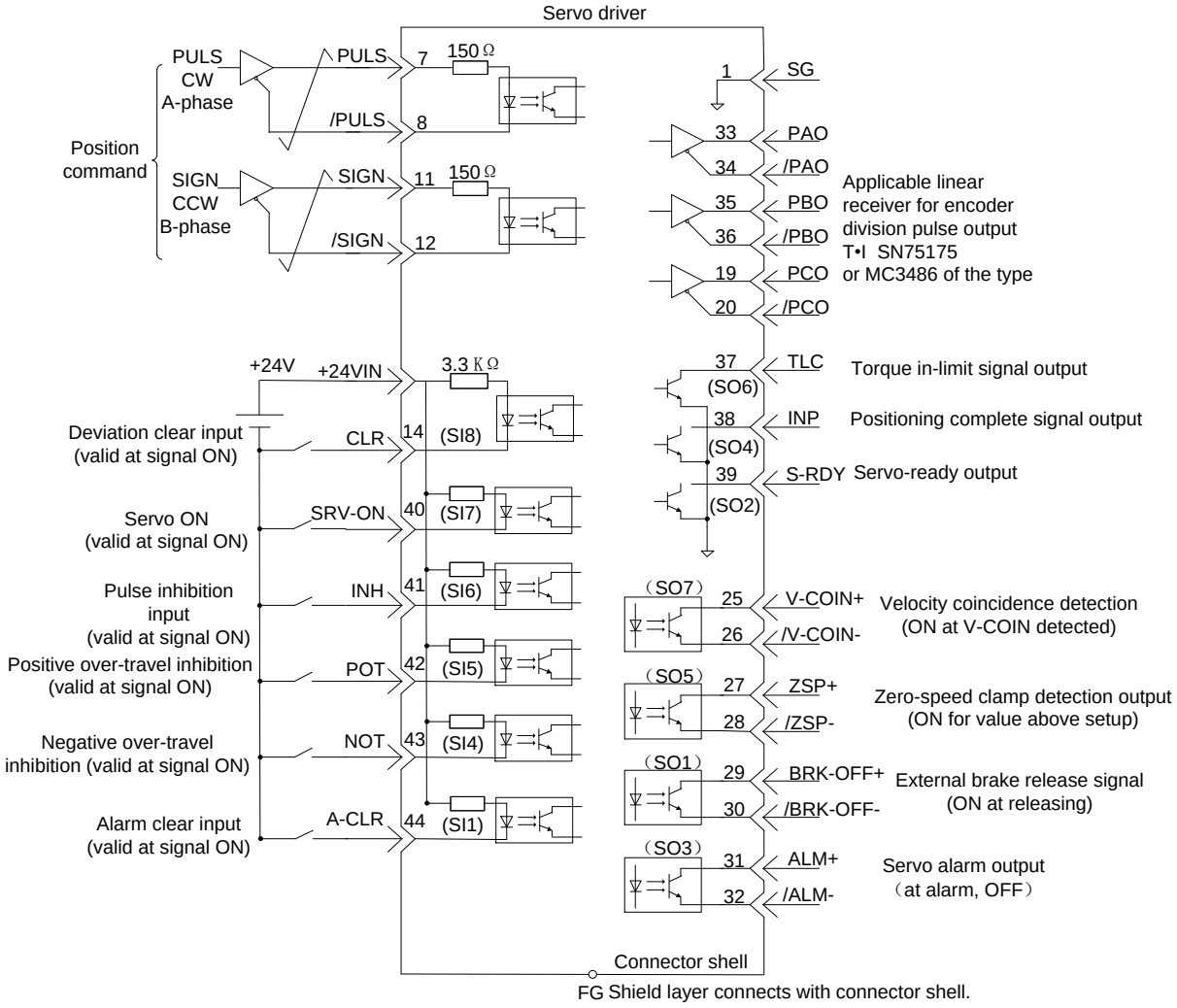
CAUTION

1) Empty pins 3, 4, 5, 9, 13, 15, 16, 17, 18, 21, 22, 23, 24, 48, 49, 50 are not allowed to be used.

2) Output signal allocation for SO1~SO7 can be changeable, refer to section 2.4 “I/O Signal Allocation” for details.

2.3.2 Connection Examples in Three Control Modes

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

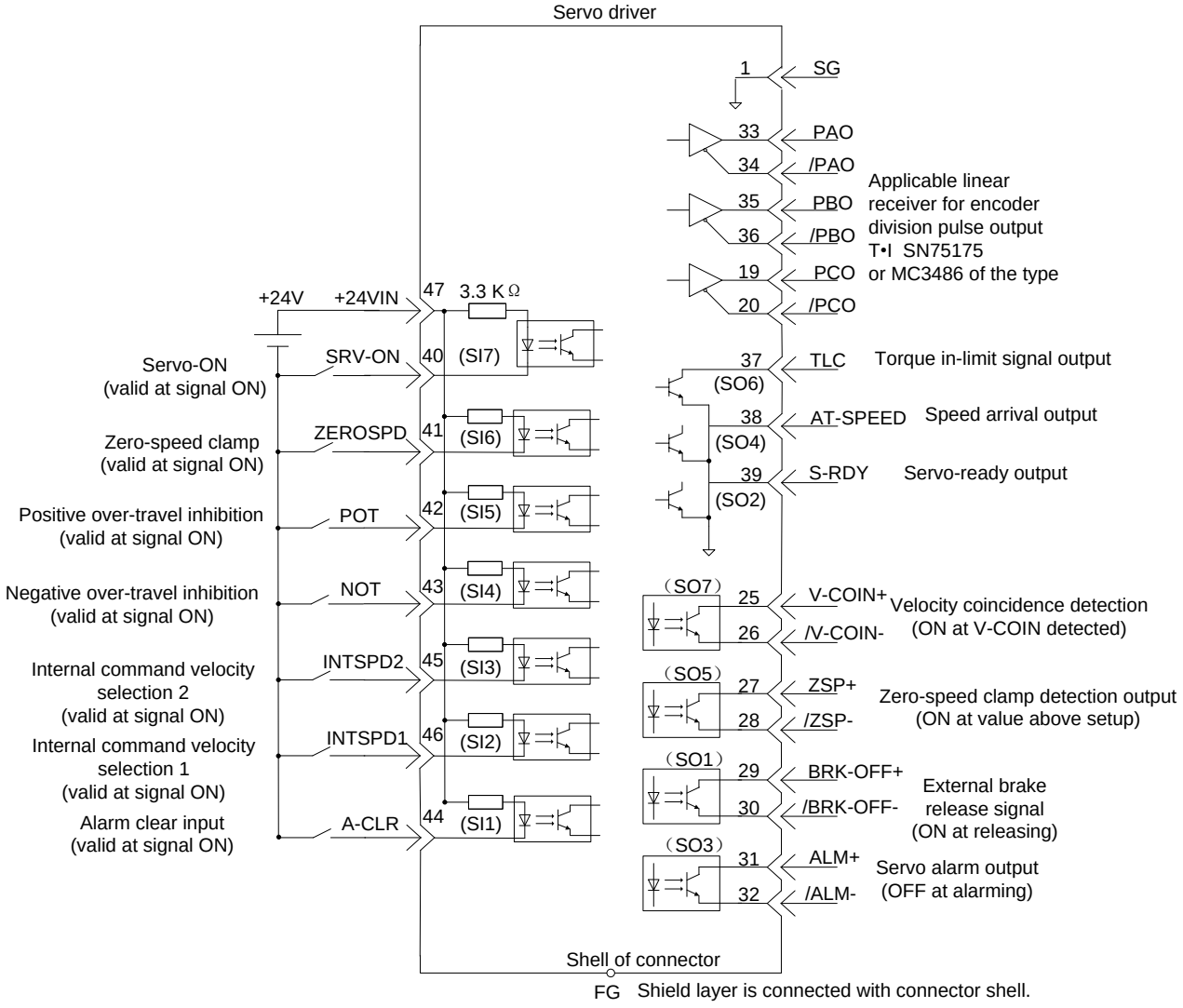


CAUTION

1) ⎍ represents twisted-pair wires.

2) DC24V power supply is prepared by the user.

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



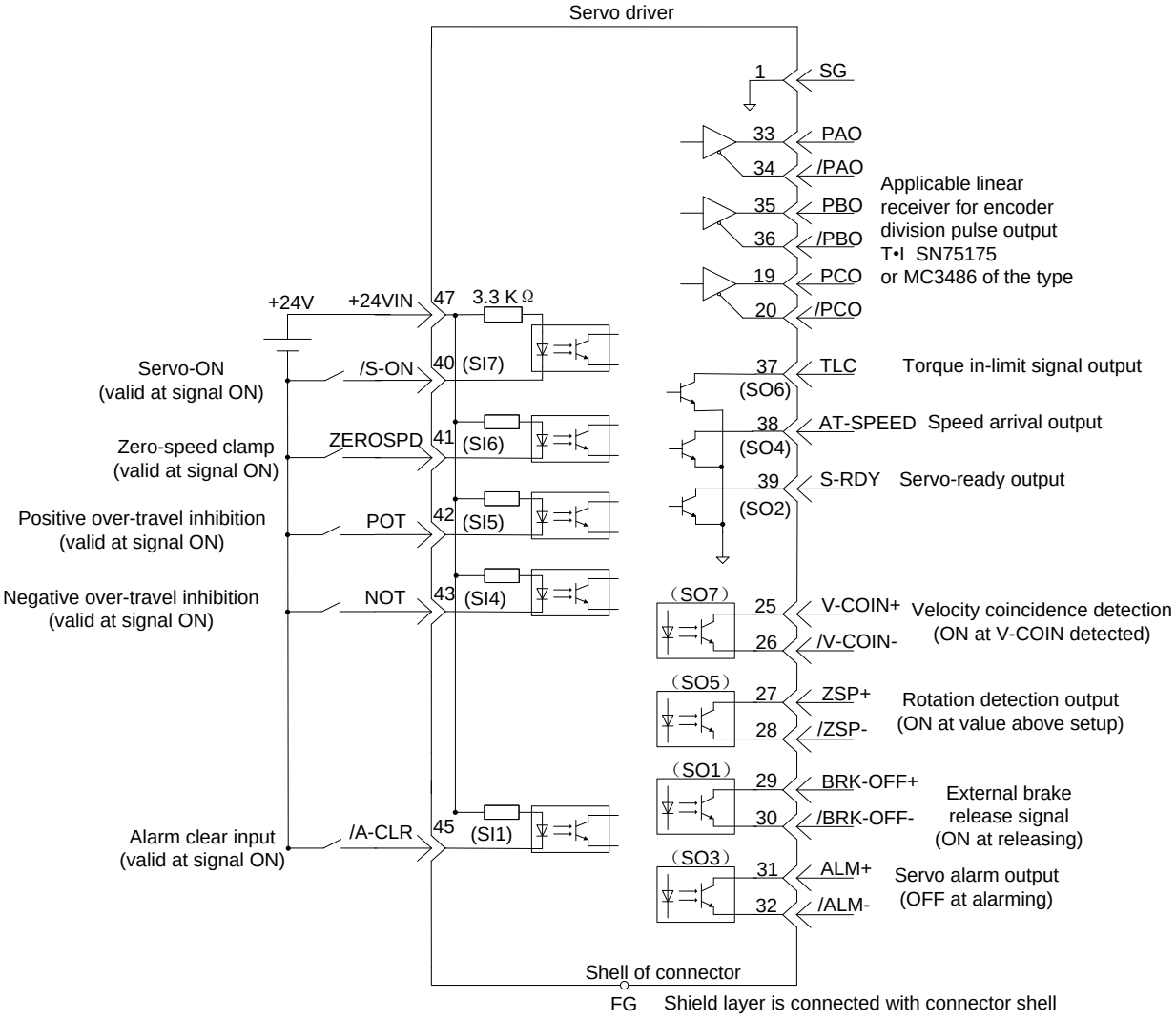
CAUTION

1) DC24V power supply is prepared by the user.

2) Velocity control command is set by 8 internal parameters. You can select one register and make it velocity command by internal command velocity selection input signal INTSPD1, INTSPD2 and INTSPD3.

3) INTSPD1 and INTSPD2 input signal have been allocated to CN2-45 and CN2-46 separately when leaving factory. You can set up according to actual requirement.

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



CAUTION

1) Torque command is set up by Pr601.

2) DC24V power supply is prepared by the user.

2.4 I/O Signal Allocation

2.4.1 Default Allocation Status of Input Signal

Function of pins can be allocated and logically changed.

Pin No.	Port No.	Para.	Default	Factory Setting Layout					
				Position Control		Speed Control		Torque Control	
				Signal Name	Logic	Signal Name	Logic	Signal Name	Logic
44	SI1	Pr400	00040404h (0)	Invalid	-	Invalid	-	Invalid	-
46	SI2	Pr401	000E00h (3584)	—	—	INTSPD1	a-con-tact	—	—
45	SI3	Pr402	00000F00h (3840)	—	—	INTSPD2	a-con-tact	—	—
43	SI4	Pr403	00020202h (131586)	NOT	a-con-tact	NOT	a-con-tact	NOT	a-con-tact
42	SI5	Pr404	00010101h (65793)	POT	a-con-tact	POT	a-con-tact	POT	a-con-tact
41	SI6	Pr405	00111108h (1118472)	INH	a-con-tact	ZEROSP-D	a-con-tact	ZEROSP-D	a-con-tact
40	SI7	Pr406	00030303h (197379)	SRV-ON	a-con-tact	SRV-ON	a-con-tact	SRV-ON	a-con-tact
14	SI8	Pr407	00000007h (7)	CL	a-con-tact	—	—	—	—

CAUTION

1) Functions of pins are changeable by parameter setup.

2) a-contact is active low, while b-contact is active high. Here are specific examples: ("—" stands for status without allocation).

   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 Function Which Can be Allocated to Control Input

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

Description:

Alarm clear status/alarm status.

With this input, only those alarms with clearable attribution can be cleared. For attribution of alarm, refer to section 7 “Alarm Description”.

Signal Name	Symbol	Default	Related Mode		
Internal command velocity selection 1	INTSPD1	46 (SI2)	P	S	T
Internal command velocity selection 2	INTSPD2	45 (SI3)	P	S	T
Internal command velocity selection 3	INTSPD3	—	P	S	T

Description:

Select internal command velocity 1~8.

Relationship among Pr300 “Internal and external switching of velocity setting”, Internal command velocity selection 1~3 and selected velocity command is illustrated in following table:

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	The 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		
Negative direction over-travel inhibition input	NOT	43 (SI4)	P	S	T

Description:

It is negative direction over-travel inhibition input.

Action at this input ON can be set up by parameter Pr504「Over-travel inhibition input setup」.

To enable it, please set up Pr504「Over-travel inhibition input setup」 to 1. If the machine is able to move out of negative movement limit, turn this input signal to ON.

Signal Name	Symbol	Default	Related Mode		
Positive direction over-travel inhibition input	POT	42 (SI5)	P	S	T

Description:

It is positive direction over-travel inhibition input.

Action at this input ON can be set up by parameter Pr504「Over-travel inhibition input setup」.

To enable it, please set up Pr504「Over-travel inhibition input setup」 to 1. If the machine is able to move out of negative movement limit, turn this input signal to ON.

Signal Name	Symbol	Default	Related Mode		
Command pulse inhibition input	INH	41 (SI6)	P	S	T

Description:

Ignore positional command pulse.

Please set Pr518「Command pulse inhibition input validation setup」to 0.

Signal Name	Symbol	Default	Related Mode		
Servo-ON input	SRV-ON	40 (SI7)	P	S	T

Description:

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

Signal Name	Symbol	Default	Related Mode		
Deviation counter clear input	CL	14 (SI8)	P	S	T

Description:

Clear positional deviation counter.

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		
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.

Relationship between DIV1, 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		
Torque limit switching input	TL-SEL	—	P	S	T

Description:

To switch 1st /2nd torque limit. Refer to table below for detailed description.

Pr521	Torque Limit Switching Input	Torque Limit Switching Setup	CW Torque Limit	CCW Torque Limit
1	—	—	Pr013	
2	—	—	Pr013	Pr522
3	OFF	Valid	Pr013	
	ON		Pr522	
6	OFF	—	Pr013	Pr522
	ON		Pr525	Pr526

Signal Name	Symbol	Default	Related Mode		
Zero-speed clamp input	ZEROSPD	41	P	S	T

Description:

Set velocity command to 0.

Please set up Pr315「Zero-speed clamp function selection」≠0.

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

Description:

Velocity command input symbol when velocity control mode is enabled.

You can also refer to Pr301「Specify selection of velocity command direction」.

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

Description:

Torque command input symbol when torque control mode is enabled.

ON: Negative direction; OFF: Positive direction

You can also refer to Pr318「Specify selection of torque command direction」.

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

Description:

Specify the forced alarm input symbol when velocity control mode is enabled.

When input signal is active, Err87.0「Forced alarm input error」 will occur.

Signal Name	Symbol	Default	Related Mode		
Absolute data request signal	SEN	11 (SIGN)	P	S	T

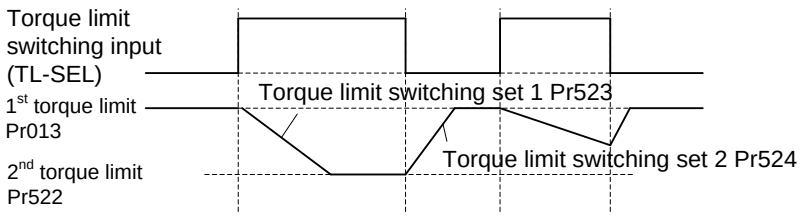
Description:

Initial absolute data request.

- **Changing rate setup during torque limit switching**

When Pr521 「Torque limit selection」is set to 3, torque limit value can be switched in accordance with a certain slope.

1. When switching from the 1st torque limit to 2nd torque limit, changing slope set up by Pr523 「Torque limit switching setup 1」is applicable;
2. When switching from the 2nd to 1st, changing slope set up by Pr524「Torque limit switching setup 2」is applicable;
3. You can set up auto switching according to the relationship between 1st and 2nd torque limit. If Pr523「Torque limit switching setup 1」and Pr524「Torque limit switching setup 2」are set to 0, switch immediately.



CAUTION

If the 1st torque limit (Pr013) and 2nd torque limit have been switched via the front panel or communication, the torque limit value switched to validates, regardless of changing rate. Only when being switched 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 logic cannot be changed.

Pin No.	Port No.	Parameter	Default setup	Leaving Factory Setup Status		
				Position Control	Velocity Control	Torque Control
29/30	SO1	Pr408	00030303 (197379)	BRK-OFF	BRK-OFF	BRK-OFF
39	SO2	Pr409	00020202h(131586)	S-RDY	S-RDY	S-RDY
31/32	SO3	Pr410	00010101h (65793)	ALM	ALM	ALM
38	SO4	Pr411	00050504 (328964)	INP	AT-SPEED	AT-SPEED
27/28	SO5	Pr412	00070707h(460551)	ZSP	ZSP	ZSP
37	SO6	Pr413	00060606 (394758)	TLC	TLC	TLC
25/26	SO7	Pr414	00080808h(526344)	V-COIN	V-COIN	V-COIN

CAUTION

1) Functions change with parameter setup.

2) SO3-ALM is fixed output.

2.4.4 Function Which Can be Allocated to Control Output

Signal Name	Symbol	Default	Related Mode		
External brake release signal	BRK-OFF	29/30 (SO1)	P	S	T

Description:

Feed out time sequence signal which makes electrical magnetic brake operate.

Release time sequence of electrical magnetic brake, and turn output transistor to ON.

Signal Name	Symbol	Default	Related Mode		
Servo ready output	S-RDY	39 (SO2)	P	S	T

Description:

The output signal of driver in power-on.

Display output signal when the driver is power-on.

Specify the control power and main power, and turn output transistor to ON in non-alarm status. 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 completes.

Signal Name	Symbol	Default	Related Mode		
Positioning complete	INP	38 (SO4)	P	S	T

Description:

Output positioning complete signal 1.

After positioning completes, turn output transistor to ON.

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

Description:

Feed out positioning complete signal 2.

After positioning completes, turn output transistor to ON.

INP2 is independent from Pr431「Positioning complete output setup」

Signal Name	Symbol	Default	Related Mode		
Zero-speed clamp detection signal	ZSP	27/28 (SO5)	P	S	T

Description:

Feed out zero-speed clamp detection signal.

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

Signal Name	Symbol	Default	Related Mode		
Torque in-limit signal output	TLC	37 (SO6)	P	S	T

Description:

Feed out 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	25/26 (SO7)	P	S	T

Description:

Feed out velocity coincidence signal.

Under velocity coincidence condition, turn output transistor to ON.

Signal Name	Symbol	Default	Related Mode		
Speed arrival (at-speed) output	AT-SPPED	38 (SO4)	P	S	T

Description:

Feed out speed arrival signal.

Under speed arrival condition, turn output transistor to ON.

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

Description:

Feed out alarm output signal setup by Pr439「Alarm output selection 1」.

Under alarm occurrence condition, turn output transistor to ON.

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

Description:

Feed out alarm output signal setup by Pr440「Alarm output selection 1」.

Under alarm occurrence condition, turn output transistor to ON.

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

Description:

Turn output transistor to ON by positional command.

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 alarm which can be cleared occurs, 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 output, turn output transistor to ON.

2.5 Wiring Example with the Host Controller

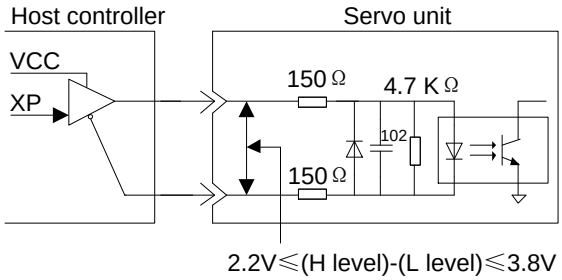
2.5.1 Wiring Example of Command Input Loop and Servo Driver

1. Position command input loop

Here is introduction to terminals 7-8 (Command pulse input) and terminals 11-12 (Command symbol input) of CN2 connector.

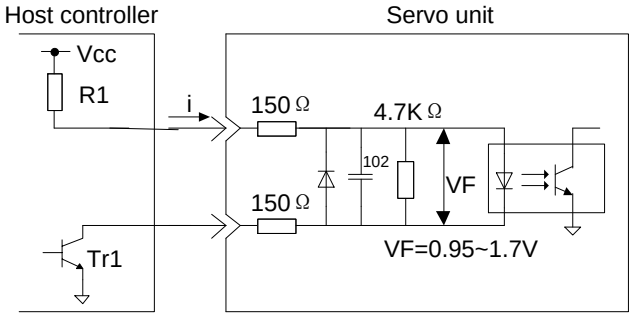
Command pulse output loop of host controller can be fed out through either line drive output or open collector output. Below are two examples. When it is connected with Weihong CNC system, use line drive output loop.

- **Line drive output loop (default output circuit)**



Line drive output circuit

- **Open collector output (the power is prepared by the user)**



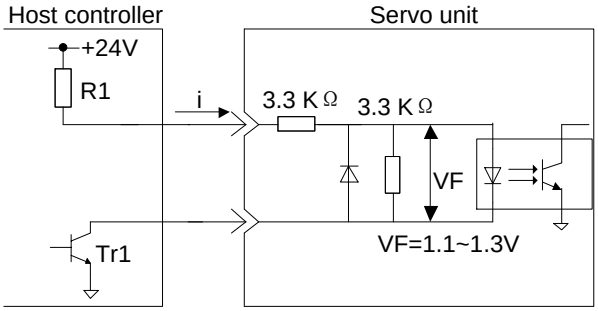
Refer to following application examples to set up the value of R1, in order to restrict current i within range of 3mA~8mA.

Application example		
When Vcc is 24V±5%, R1=4.7KΩ	When Vcc is 12V±5%, R1=2KΩ	When Vcc is 5V±5%, R1=220Ω

Open collector output (the power is prepared by the user)

2. SI1~SI8 input loop

SI1~SI8 input ports can support the open collector loop used for the host controller.



Input current i is within range of 5mA~10mA.
Open collector output (the power is prepared by the user)

2.5.2 Wiring Example of Output Loop and the Servo Driver

Output loop of servo driver signal can be divided into following 3 types:

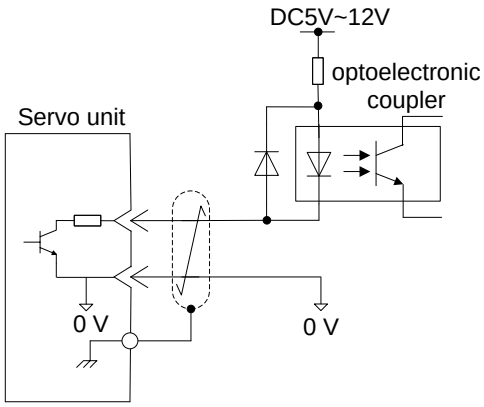
1. Open collector output loop

Pins 37~39 (SO2, SO4, SO6) of CN2 connector use open collector output. Below is an instance.

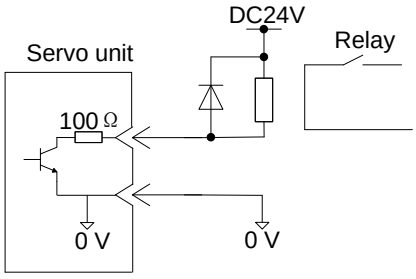
CAUTION

For open collector output loop, maximum allowable voltage is DC30V, and maximum allowable current is DC 20mA.

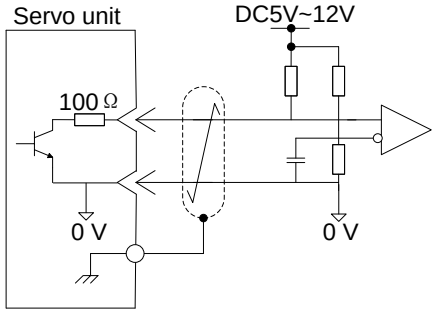
- Example of optoelectronic coupler loop



- Example of relay loop



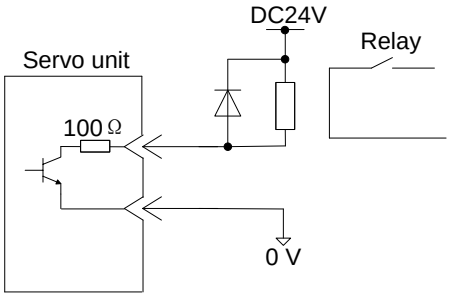
- Example of line receiver loop



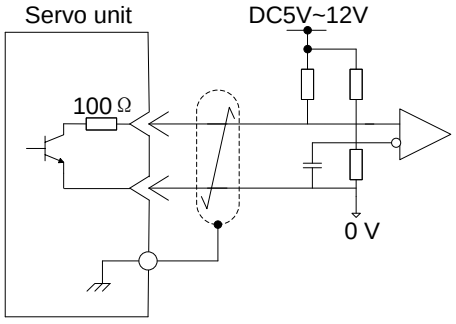
2. Optoelectronic coupler output loop

Pins 25~32 of CN2 connector use optoelectronic coupler output loop, below is an instance.

- Example of relay loop



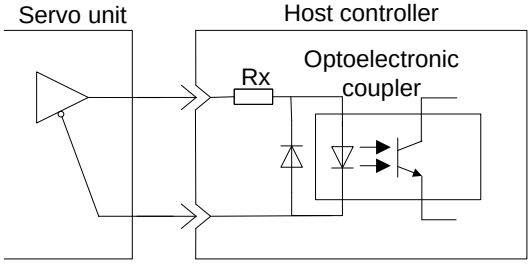
- Example of line receiver loop



3. Line drive output loop

Terminals 33~34 (A-phase signal), 35~36 (B-phase signal) and 19~20 (C-phase signal) of CN2 connector use line drive output loop. Below are instances.

Convert encoder serial data to 2-phase (A/B-phase) pulse signal (PAO/PAO, PBO/PBO) and origin pulse signal (PCO/PCO), and feed them out through line drive output loop.



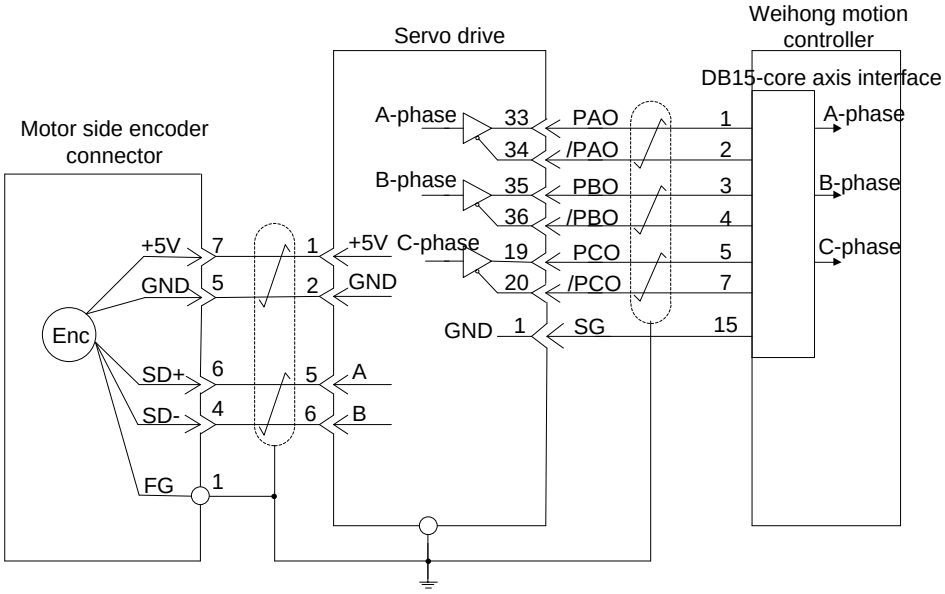
Calculate Rx according to actual situation of the circuit

2.6 Wiring Example of Encoder

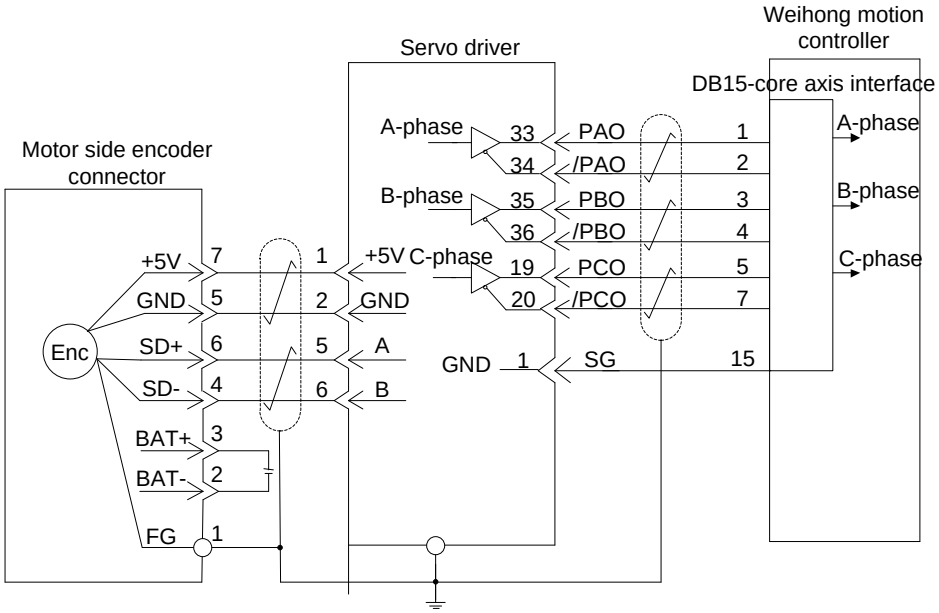
WISE series servo driver supports serial 17-bit and 20-bit communication encoder. Following pages introduce wiring of CN4 connector, position feedback signal and feedback signal of the motor side encoder.

2.6.1 Wiring Example of Encoder with MA&MN Series Motors

Below is the wiring diagram of MA040, MA060, MA080, MN080 and MN130 model with incremental encoder.

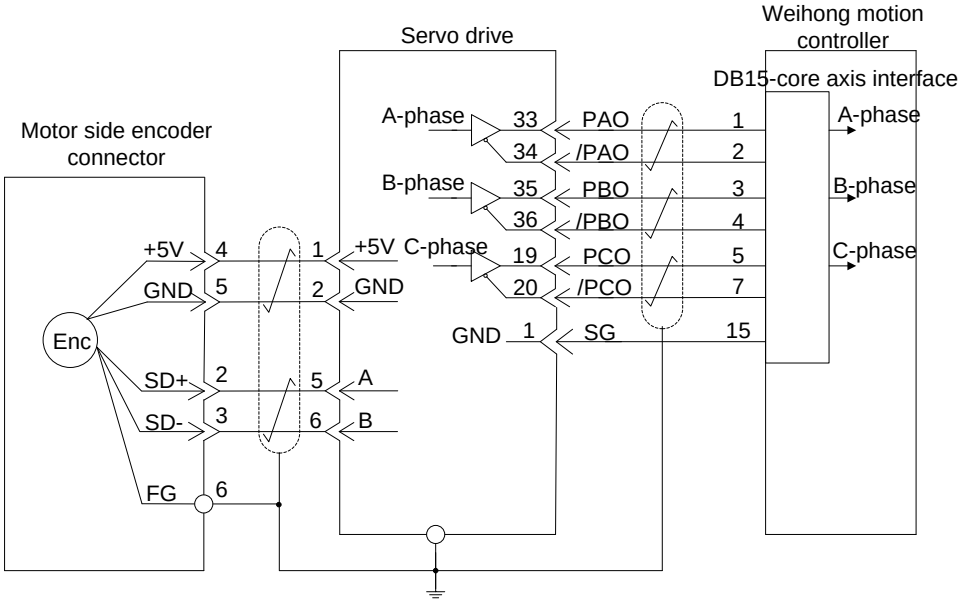


Below is the wiring diagram of MA040, MA060, MA080, MN080 and MN130 model with absolute encoder.

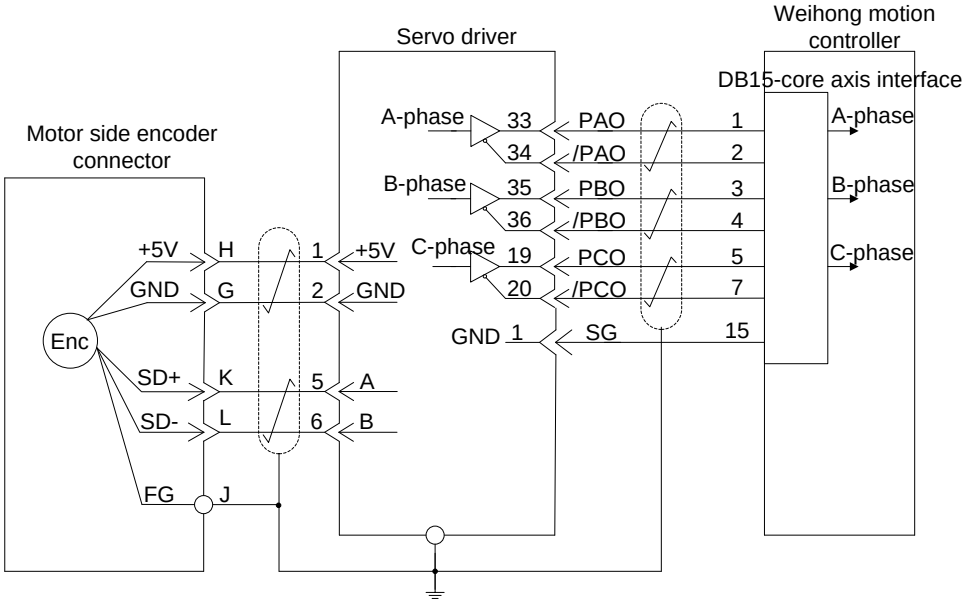


2.6.2 Wiring Example of Incremental Encoder with MHMD, MSMD and MDME Model Motors

Below is the wiring diagram of MHMD/MSMD model motor (400W and 750W) with 20-bit incremental encoder.

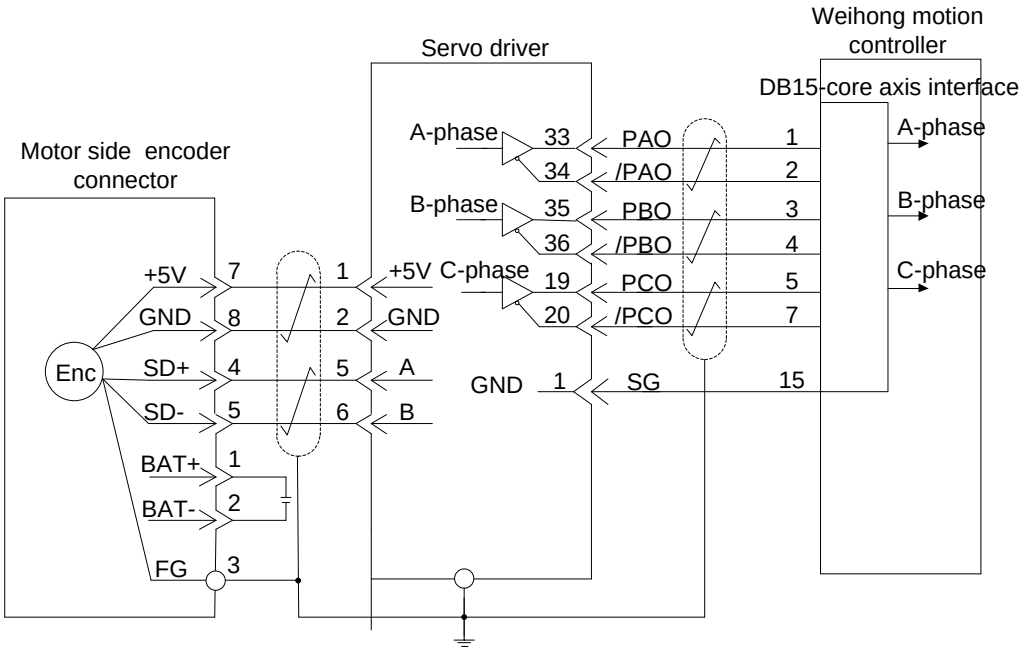


Below is the wiring diagram of MDME model motor (1000W and 1500W) with 20-bit incremental encoder.

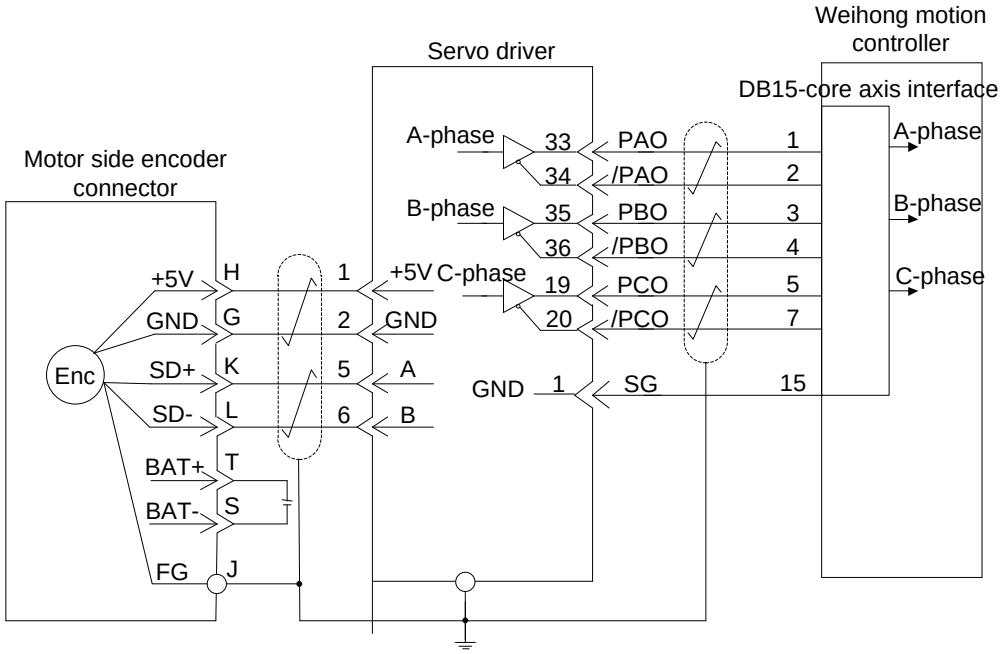


2.6.3 Wiring Example of Multi-turn Absolute Encoder with MHMD,MSMD and MDMW Model Motors

In the following figure, MHMD/MSMD model type of the motor (400W and 750W), and 17-bit absolute encoder are used.

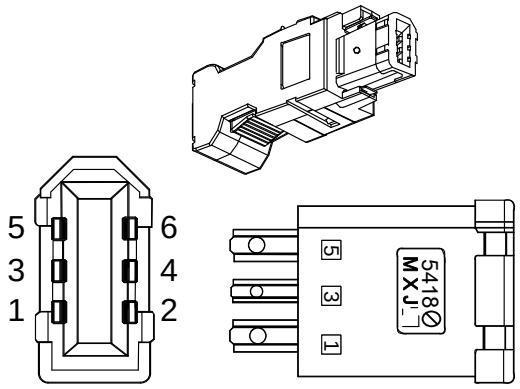


In the following figure, MDME model type of the motor (1000W and 1500W), and 17-bit absolute encoder are used.



2.6.4 Terminal Arrangement of Encoder Cable Connector (CN4) of the Driver

Terminal arrangement of CN4 is shown as below:



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

2.7 Regenerative Resistor

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

2.7.1 Specifications of Regenerative Brake Resistor

Table 2-1 Specifications of regenerative brake resistor in WISE series driver

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

2.7.2 Energy Handled by Single Internal Capacity

Table 2-2 Absorbable energy regenerated in WISE series driver

Power Level (W)	Absorbable Regenerated Energy(J)
100	9
400	18
750	36
1000	36
1500	59

2.7.3 Rotation Energy Calculation of Servo System

Rotation energy (Es) of servo system can be calculated as follows.

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

$J = J_M + J_L$

J_M : Rotational inertia of servo motor (kg? ^{2}

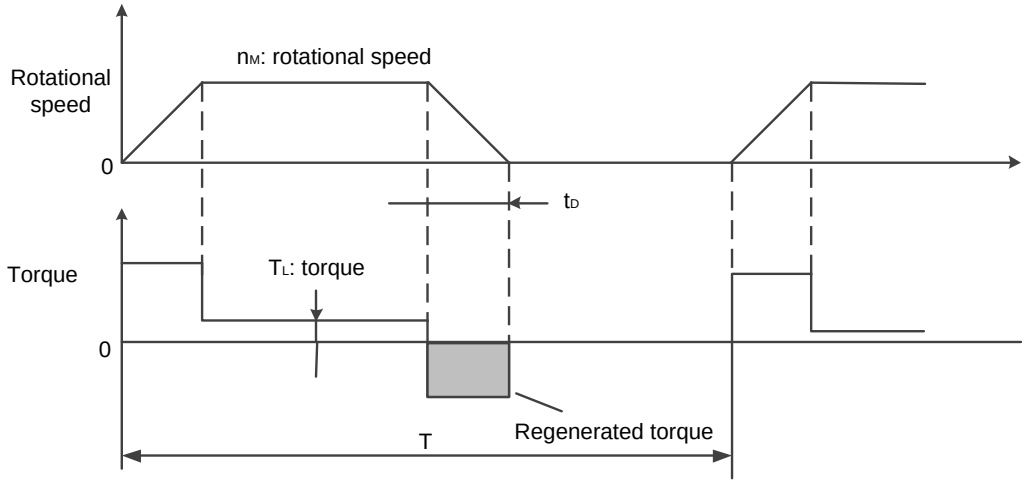
J_L: Rotational inertia of motor axis load (kg?m^2)

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

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

2.7.4 Capacity Calculation of Regenerative Resistor

Below is a sketch of motor run cycle.



When the motor accelerate or decelerate according to the cycle shown above, the capacity 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	Refer to 2.7.2
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 equation calculating W_K, "0.3" is 30%, the load ratio of regenerative resistor.

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 servo motor (s)

In actual calculation, the energy consumed by load system can be neglected. You can calculate the necessary capacity by only 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.

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

In Table 2-2, you can learn that the energy absorbed by internal capacitor is about 36J. Therefore, the capacitor cannot absorb all the energy. And the remaining energy needs to be consumed by external resistor.

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

Assume that the acceleration and deceleration cycle of motor is 1s, the capacity of regenerative resistor is: $W_K = E_K / (0.3 * T) = 1 / 0.3 = 3\text{W}$,

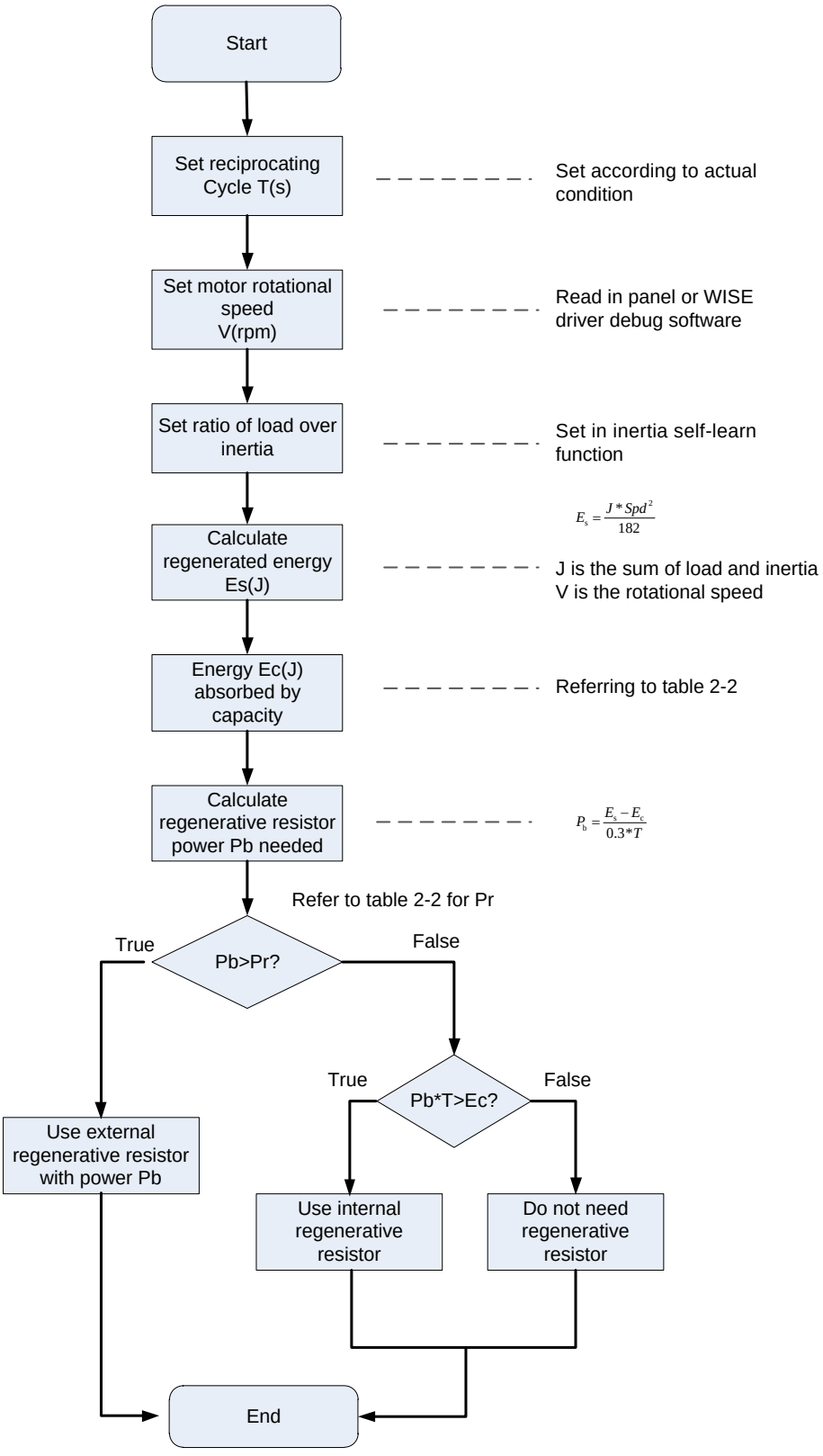
which is less than 40W, the capacity of internal brake resistor. Therefore, using an internal brake resistor is enough.

If the inertia ratio is changed from 400% to 800%, and other conditions do not change, the capacity of regenerative resistor is:

$$W_K = \frac{E_K}{0.3 * T} = \frac{J * Spd^2 / 182 - 36}{0.3 * T} = \frac{9 * 1.51 * 10^{-4} * 3000^2 / 182 - 36}{0.3 * 1} = 103\text{W},$$

which is greater than 40W, the capacity of internal brake resistor. Therefore, an external brake resistor is needed. Suggested power for the external brake resistor is 103W.

2.7.5 Model Selection of Regenerative Resistor



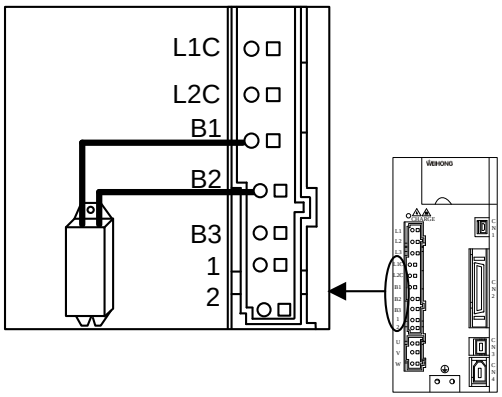
2.7.6 Connection of Regenerative Resistor

Following is the introduction to regenerative resistor connection and its capacity setup.

Set up Pr016 to decide whether an internal or external regenerative resistor is used, and what the active resistance of the resistor is. When Pr016 is set to 0, the internal 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, 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.



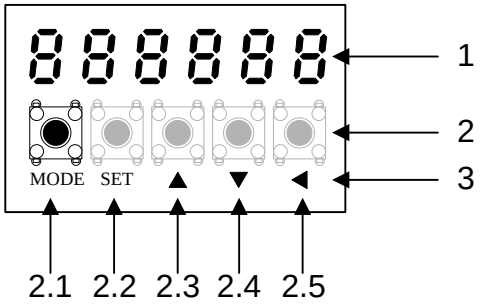
WARNING

1) When an external regenerative resistor is used, be absolutely secure that wire between B2-B3 is removed.
2) Please be absolutely sure that the regenerative resistor is not miswired, or it might result in machine damage or fire hazard.

3 Display and Operation on Front Panel

3.1 About the Front Panel

Below is the front panel, see following table for details about each section.

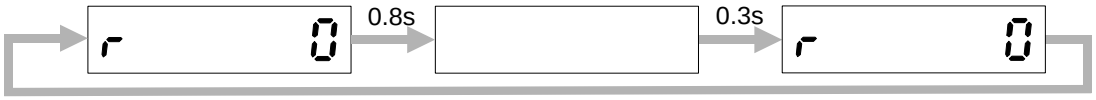


No.	Name	Description
1	Display LED (6-digit)	Switch to error display screen when error occurs, and LED will flash (about 2 HZ).
2	Button	5 buttons
3	Button description	—
2.1	MODE switching button	Valid at selection display. Press this button to switch 4 kinds of mode. 1 Monitor mode 2 Parameter setup mode 3 EEPROM writing mode 4 Auxiliary function mode
2.2	SET 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 valid. Press ▲ to increase the value and ▼ to decrease it.
2.4	DOWN button	
2.5	LEFT button	Shifting of the digit for data changing to higher digit.

3.2 Initial Status of the Front Panel Display LED

After turning on the power, front panel display shows as follows.

If a driver alarm occurs, the front panel display shows the following repeatedly. (0.8s display/0.3s display).



Here are possible causes for the driver alarm.

Alarm No.	Alarm	Content
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 stooped for 1 sec.
A7	Lifetime detection alarm	Registration time of the driver becomes shorter than 24 hours.

3.3 Lock the Front Panel

You can lock the front panel in case of inappropriate operation such as modification to parameters.

Explanation

Limited items in locked status of the front panel are as shown below:

Mode	Limit at Locked Status of The Panel Front
Monitor mode	No limit. All monitor data can be checked.
Parameter setup mode	In this mode, parameter setup is beyond modification except for confirmation.
EEPROM writing mode	Unable neither to execute nor to display.
Auxiliary function mode	Auxiliary functions other than “Release if front panel lock” cannot neither to execute nor to display.

- Related parameter: Pr535.
- **Operation steps to lock the front panel (via operation on the front panel or with the help of support software of the host controller).**

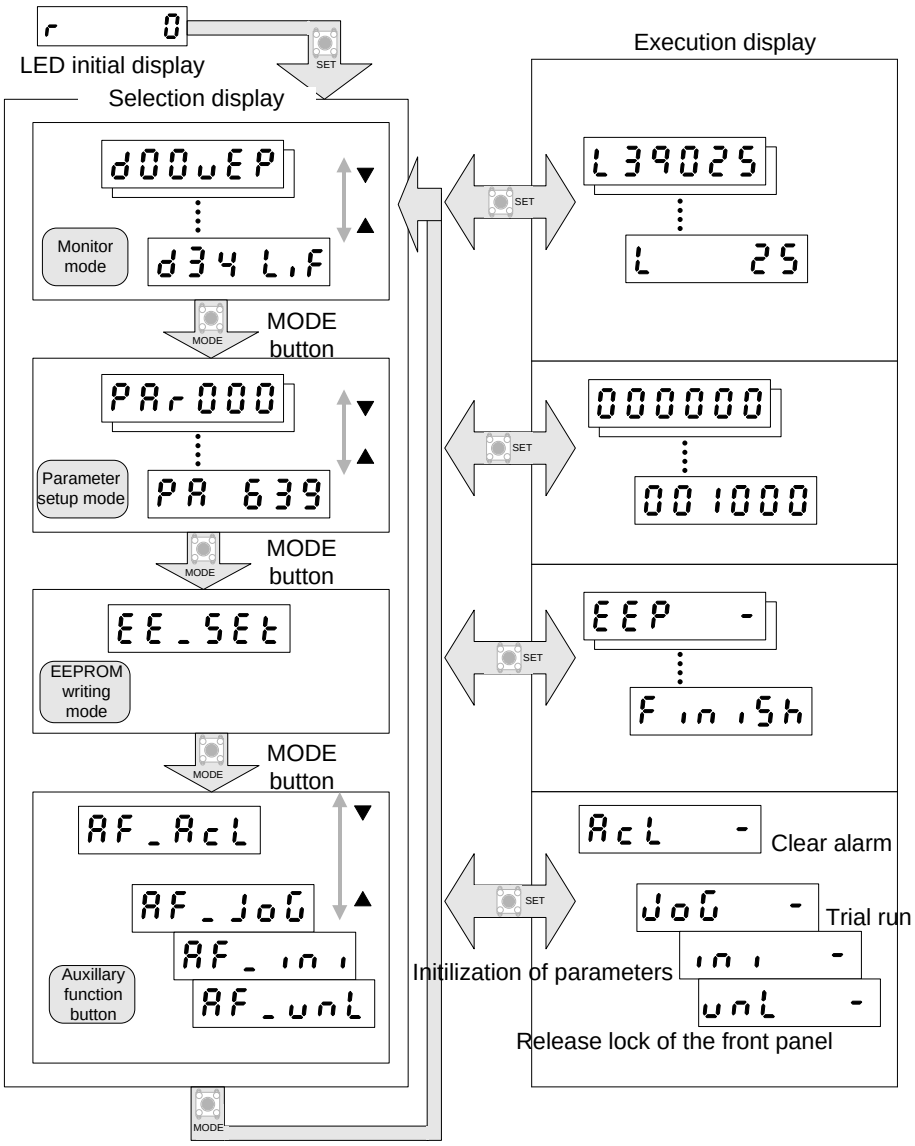
  1) Set up Pr535「Lock setup of the front panel」=1, and it will be written into EEPROM.
  2) Turn off the power of the driver and re-power on.
  3) Lock status of the front panel is activated.

- **Operation steps to release lock of the front panel (via operation on the front panel).**
  1) Enable release function for the front panel lock in auxiliary function mode.
  2) Turn off the power of the driver and re-power on.
  3) Lock status of the front panel is released.
- **Operation steps to release front panel lock setting (via operation on the support software of host controller).**
  1) Set up parameter Pr535「Lock setup of the front panel」=0, and it will be written into EEPROM.
  2) Turn off the power of the driver and re-power on.
  3) Lock status of the front panel is released.

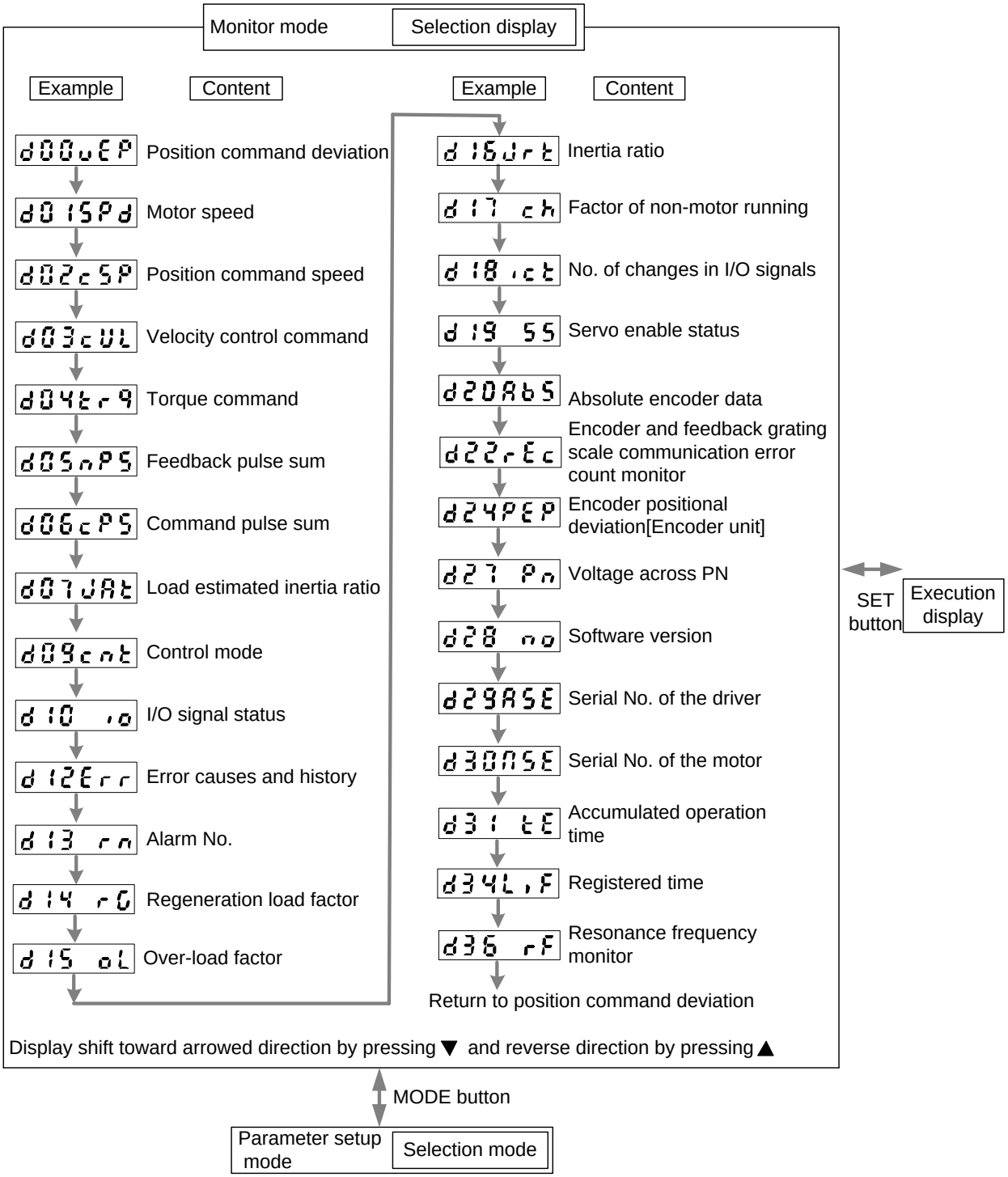
3.4 Structures of Modes

Steps	Operation	Operation Details
First level	Select mode	After power on, press SET button to switch to “Selection display” mode. And then press MODE button to switch among monitor mode, parameter setup mode, EEPROM writing mode and auxiliary function mode.
Second level	Select option	After a certain mode is selected by pressing MODE button, press ▲ ▼ buttons to toggle among offered options.
Third level	Set concrete command	After option is selected by pressing ▲ ▼ buttons, please press SET button to set concrete command.

Illustration of the steps is as below.

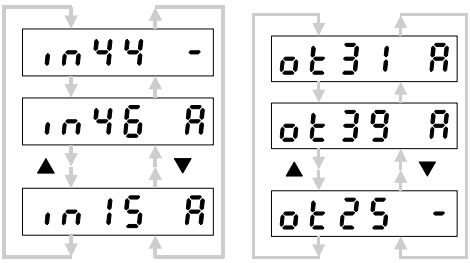


3.5 Monitor Mode

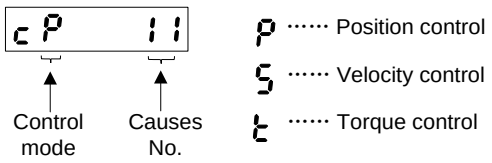
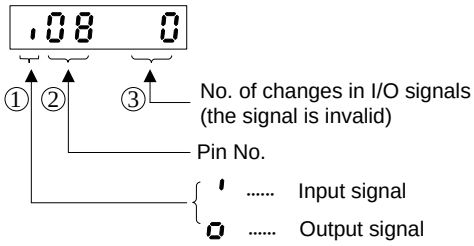
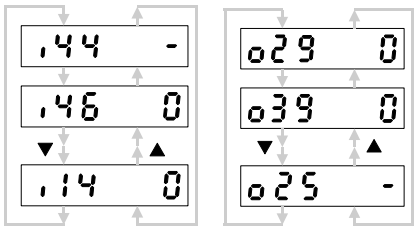
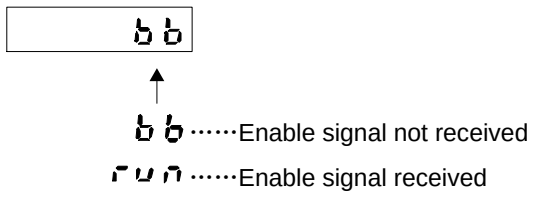


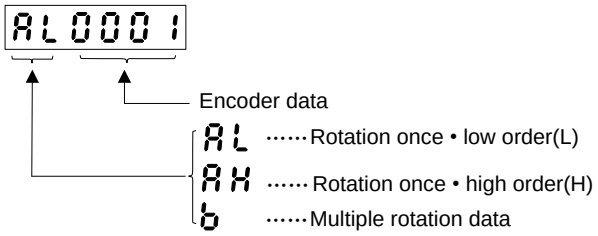
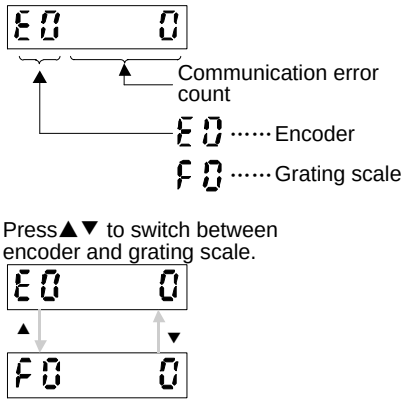
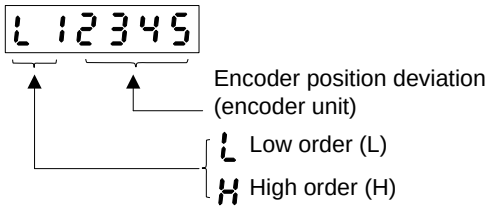
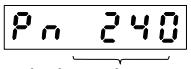
You can press SET button after monitor mode is selected by pressing MODE button, to access following options. When a certain option is accessed, press SET button to view and execute the concrete content; press SET button again to return to “Selection display”.

No.	Item	Display Content	Execution Display
1	Positional command deviation	d00uEP	L 39015 Positional command deviation L ……Low order H ……High order Press ◄ button to switch between low order (L) and high order (H).
2	Motor speed	d01SPd	r 1000 Display active motor speed（r/min）
3	Positional command speed	d02cSP	r 1000 Display positional command speed（r/min）
4	Velocity control command	d03cUL	r 1000 Display velocity control command（r/min）
5	Torque command	d04tr9	t 1000 Display torque command（%）
6	Feedback pulse sum	d05nPS	L 12345 Feedback pulse sum L ……Low order H ……High order Press ◄ button to switch between low orders (L) and high order (H). L 12345 ↔ H 103
7	Command pulse sum	d06cPS	L 12345 Command pulse sum L …… Low order H …… High order Press ◄ button to switch between low orders (L) and high order (H). L 12345 ↔ H 103

No.	Item	Display Content	Execution Display
8	Load estimated inertial ratio	d07JAt	JA 0 Inertio ratio factor Inertio ratio
9	Control mode	d09cnt	PoScnt .....Position control mode SPdcnt .....Velocity control mode trqcnt .....Torque control mode Related parameter is Pr001 [Control mode set up].
10	I/O signals status	d10 io	in44 - ①②③ A .....Active (this signal is valid) - .....Inactive (this signal is invalid) Pin No. in .....Input signal ot ..... Output signal Press ◄ button to switch between ①and②, with decimal point flashing. ① flashes, press ▲ ▼ button to switch status “in” “ot” ② flashes, press ▲ ▼ button to switch the pin No. (8 types, refer to section 2.4 “I/O Signal Allocation”) 

No.	Item	Display Content	Execution Display
11	Error causes and history	d 12 Err	Err - - - Error code No.(_ _ _ appears if no error occurs) Err ..... present error E - 0 ..... history 0 (latest error) E 13 ..... history 13 (oldest error) You can refer to the last 14 error factors (including the present one). Press ▲ ▼ buttons to select the factor to be referred. Refer to chapter 7.1 list of error code for detailed error causes. CAUTION When a history error occurs again, the present one shares the same error code No. with history 0.
12	Alarm No.	d 13 rn	rn - - ..... No alarm is displayed. rn A0 ..... Display prior alarm. Alarm No. Press ▲ ▼ buttons to display alarm occurrence. rnA0 A ▲ ▼ rnA7 - Refer to the list of error code for detailed description.
13	Regeneration load factor	d 14 rG	rG 30 Display occurrence level factor of regeneration over-load protection (%). Enabled when Pr016 (can be external regeneration resistor) is set to 0 or 1.
14	Over-load factor	d 15 oL	oL 28 Display the ratio to rated load. Refer to chapter 7.2.1 Over-load protection characteristics when in trouble.
15	Inertia ratio	d 16 Jrt	J 100 Display value of inertia ratio (%). Directly display setup of Pr004 (Inertia ratio).

No.	Item	Display Content	Execution Display
16	Causes for non-motor running	d17 ch	 Refer to list of non-motor running causes below for detailed description.
17	No. of changes in I/O signals	d18 ict	 Press ◄ button to switch between ①and②. The decimal point flashes. ① flashes, press ▲ ▼ buttons to switch status “i” and “o”. ② flashes, press ▲ ▼ buttons to switch among pin No. (there are 8 types, refer to section2.4 I/O Signal Allocation). Press ▲ ▼ buttons to switch to the pin No. whose No. of changes need to be displayed. 
18	Servo enable status	d19 55	

No.	Item	Display Content	Execution Display
19	Absolute encoder data	d20Ab5	nF ..... It means the driver is connected with an non-absolute encoder motor. When the driver is connected with an absolute encoder motor, following will be displayed: 
20	Encoder and feedback grating scale communication error count monitor	d22rEc	
21	Encoder position deviation [Encoder unit]	d24PEP	 Press ◄ button to switch between high order (H) and low order (L).
22	Voltage across PN	d27 Pn	 Display voltage across PN (not serves as a measuring equipment; the value is for reference only.)

No.	Item	Display Content	Execution Display
23	Software version	d28 no	d-0100 Display the software version of the driver. Software of the driver is divided into two kinds, DSP and FPGA. Press ◄ button to switch over. d10490 ◄ ◄ F20170
24	Serial No. of the driver	d29ASE	L 0001 Serial No. of the driver L ····· SN • Low order n ····· SN • Middle order H ····· SN • High order C ····· Registered times Press ▲ ▼ button to switch among high order, low order, middle order as well as registered times.
25	Serial No. of the motor	d30nSE	nL0001 Serial No. of the motor nL ····· SN • Low order(L) nH ····· SN • High order(H) Press ▲ ▼ button to switch between high order (H) and low order (L).
26	Accumulated operation time	d31 tE	L 25 Display accumulated operation time(h) L Low order(L) H High order(H) Press ◄ button to switch between high order (H) and low order (L).
27	Registered time	d34L.F	L 0 0 ·····Display remaining usage time. Unit:h nF ·····No limit to usage time.
28	Resonance frequency monitor	d36 rF	F 5000 Resonance frequency

- **Alarm list**

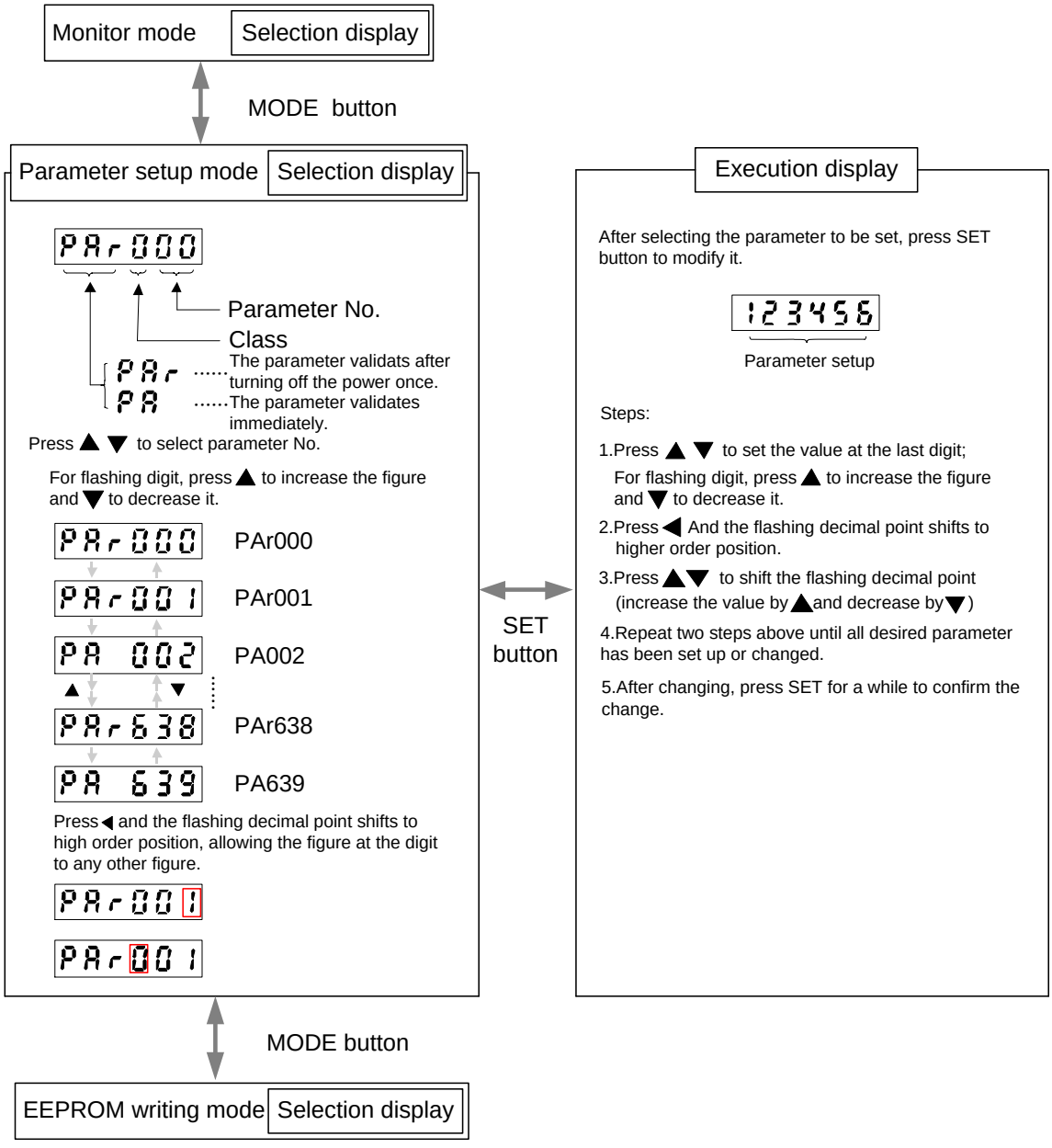
Alarm No.	Alarm	Content	Latch time
A0	Overload alarm	Load factor is 85% or more the protection level.	1~10s or ∞
A1	Over-regeneration alarm	Regenerative load factor is 85% or more the protection level.	1~10s or ∞
A2	Battery alarm	The voltage of battery is below 3.2V.	∞
A3	Fan alarm	Fan has stooped for 1 sec.	1~10s or ∞
A7	Lifetime detection alarm	Registration time of the driver becomes shorter than 24 hours.	∞

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

Error No.	Name	Content	Related Mode		
Flashing	Error and warning occur.	There is active error or warning.	P	S	T
00	No reason	No causes have been found for non-motor running.	P	S	T
01	Main power supply is cut off	Main power supply to the driver is not connected or turned ON.	P	S	T
02	No SRV-ON input	No servo-ON input (SRV-ON) has been connected to COM-.	P	S	T
03	Over-travel inhibition input enabled	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.	P	S	T
04	Torque limit setup is small	Set the valid torque setup of Pr013 (1st) or Pr522 (2nd) to a value lower than 5% of the rated value.	P	S	T
06	INH input enabled	When Pr518=0 (command pulse inhibition input enabled), INH is open circuit.	P	S	T
07	Low input frequency of	1 Command pulse has not been input correctly. 2 Input types selected for Pr006 and Pr007 are	P	S	T

Error No.	Name	Content	Related Mode		
	command pulse	different. Two causes above result in that position command of each control cycle is below 1 pulse.			
08	Invalid CL input	Offset counter reset input CL is connected to COM-.	P	S	T
09	ZEROSPD input enabled	When Pr315=1 (Zero-speed clamp enable), zero-speed clamp input (ZEROSPD) is open circuit.	P	S	T
11	Internal velocity command is 0	When internal velocity command is enabled, its set value is below 30 (r/min).	P	S	T
13	Velocity restriction is small	When Pr317=0, set value of Pr321 is too small. When Pr317=2, set values of Pr321 and Pr322 are too small.	P	S	T
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.	P	S	T

3.6 Parameter Setup Mode



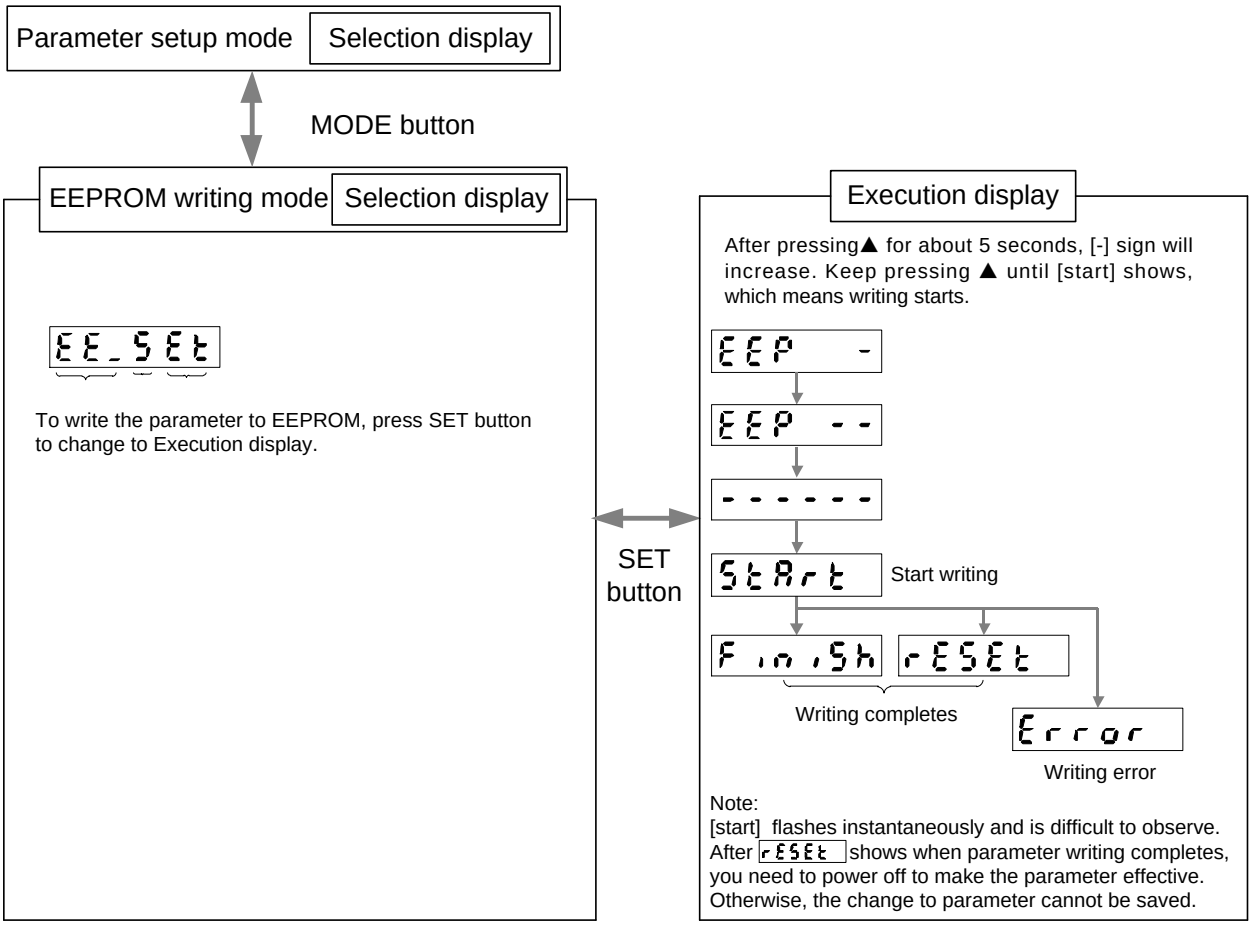
CAUTION

1) After parameter is changed, it won't take effect without prolonged depression of SET button. You can press MODE button to cancel the change and return to parameter No. display.

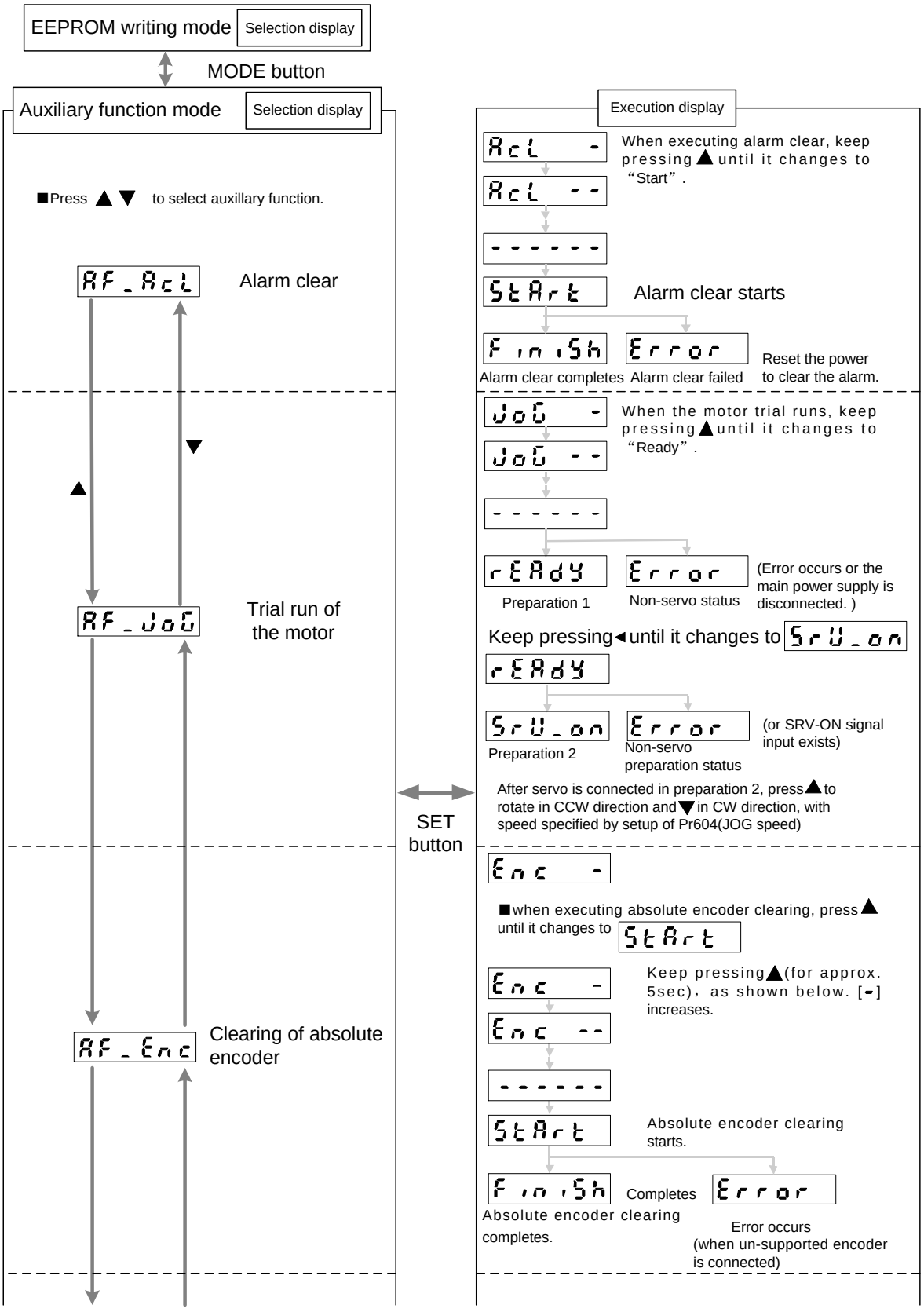
2) Press SET button to conform the parameter value change, whose content will be reflected in the control. Do not extremely change parameters which might affect the motor movement very much, especially the velocity loop or position loop gains. It is recommended to make several changes step by step instead of change to a large value at one time.

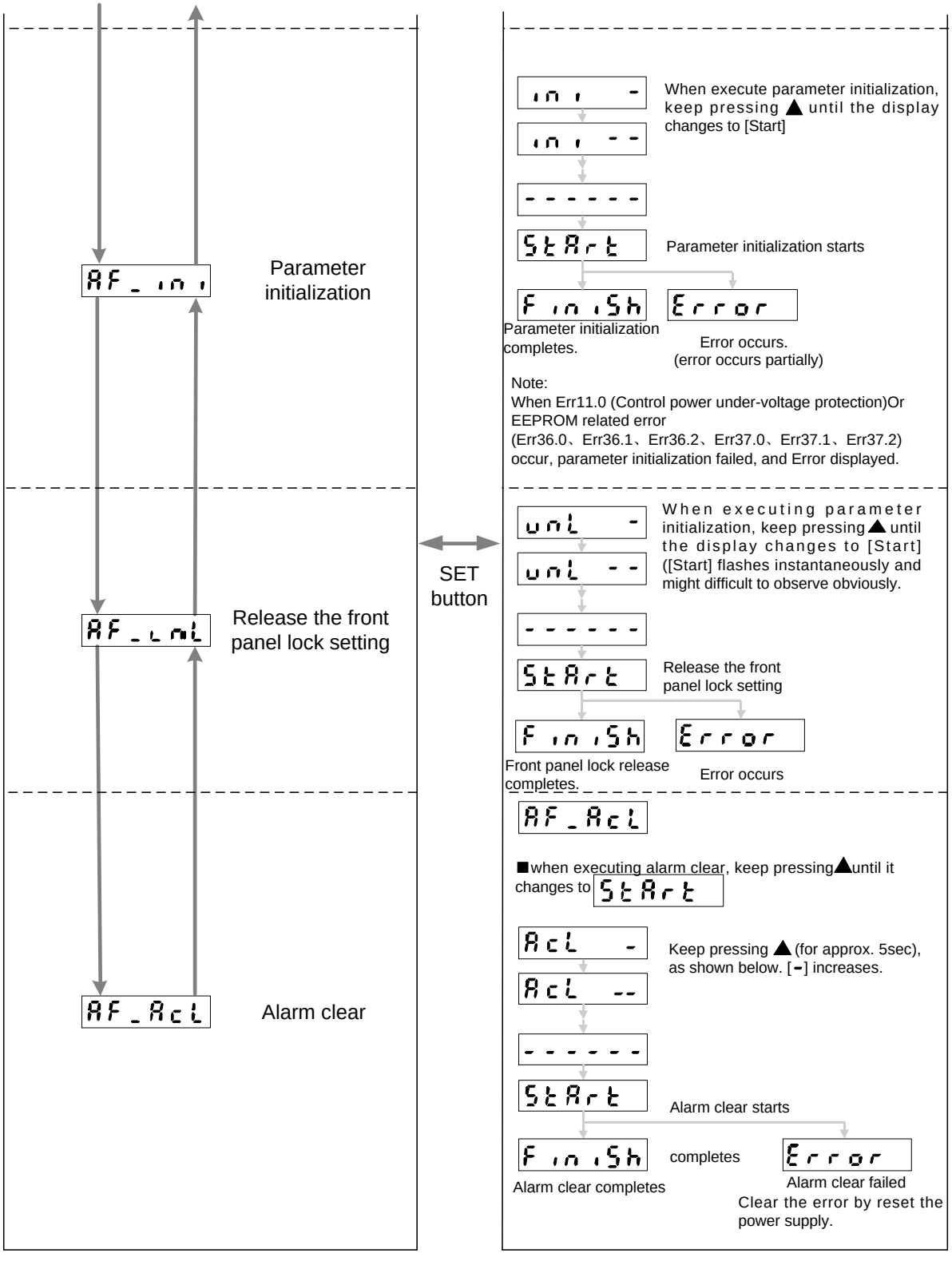
3) For parameters whose validations needs re-power ON, you can return to the parameter display interface and press MODE button to access EEPROM mode.

3.7 EEPROM Writing Mode



3.8 Auxiliary Function Mode





Motor trial run

You can make a trial run without connecting the Connector CN2 to the host controller such as PLC.

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 before using the motor again.
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, operate as that in velocity control mode. Please set parameters to set values according to normal settings in velocity control mode.
5) In trial run, Error will be displayed when EEPROM mode 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 for sure.
7) After trial run completes, refer to introductions to each mode structures to return to “Selection display”.

4 Absolute System

4.1 Abstract

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

Connect the host controller (host • controller) with the battery for absolute encoder via built-in absolute encoder motor, incremental encoder motor or dual specification encoder motor, and set up the parameter Pr015 (Absolute encoder setup) to 0, to compose an absolute system with which you can capture the exact present position information after the power-ON.

After installing the battery, shift the system to origin once, and clear the multi-turn data by clearing the absolute encoder, then you can detect the absolute position without carrying 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-time installation**

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

It is recommended to perform ON/OFF action once a day after installing the battery for refreshing the battery. Due to voltage delay of the battery if you fail to carry out the battery refreshment, a battery error might occur.

- **Replacement**

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, clear the battery alarm.

When you clear the absolute encoder with the front panel or via communication, all error and multi-turn data will be cleared together with alarm, and you are required to execute [Setup (Initialization) of absolute encoder] referring to section 4.2.4.

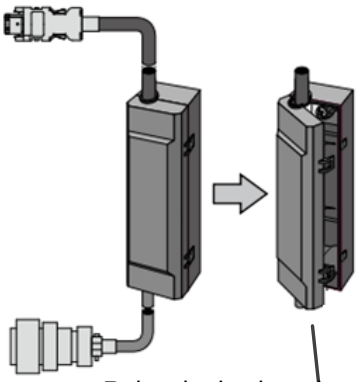
4.2.2 How to Install the Battery

1) Refresh the new battery

Hold connection with connector with lead wire for 5 minutes, and pull out the connector after 5 minutes.

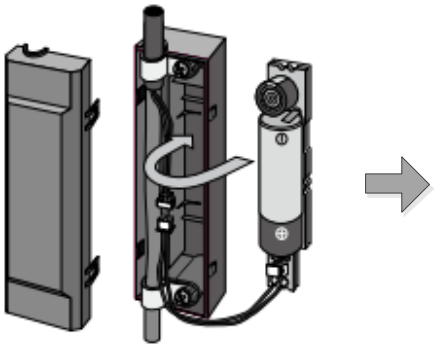
Pull out after 5 - minute connection

2) Take off the cover of the battery box.

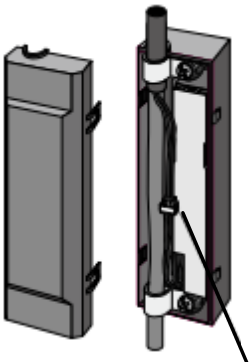


Raise the latch and take off the cover.

3) Install the battery to the battery box.

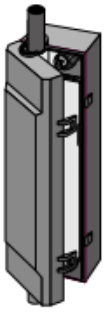


Place the battery from the bottom part.

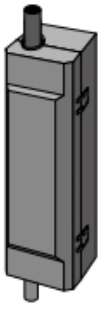


Connect the connector.

4) Close the cover of the battery box.



Close the cover not to pinch the connector cable.



WARNING

Please follow the cautions below when using battery.

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 should leak 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, connect the optional battery for absolute encoder as per the wiring diagram and prepare the connector for the battery of absolute encoder.

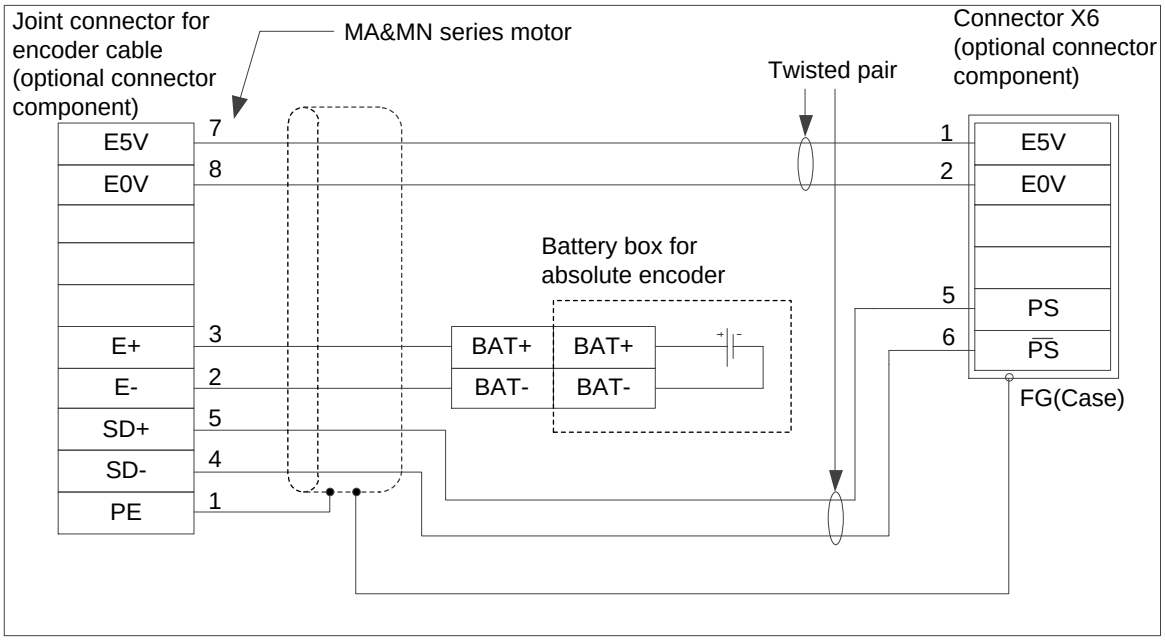


Fig. 4-1 Wiring diagram

- **Installation place requirements**

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

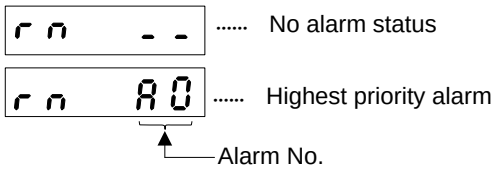
Please install and fix the battery securely. Otherwise, it may cause the wire breakdown or damage of the battery. You can refer to the instruction manual of the battery for battery handling.

4.2.4 Absolute Encoder Setup (Initialization)

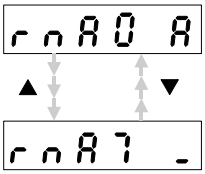
Absolute multi-turn data will be maintained by the absolute encoder battery. Therefore, when operating the machine for the first time after installing the battery to the absolute encoder, clear the encoder data (multi-turn data) to 0 at the origin by operation on the front panel or the support software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

4.2.5 Battery Alarm Display

When the front panel is enabled as the alarm execution mode of monitor mode, following alarm will be displayed.



- **Press ▲ ▼ buttons to scroll alarm conditions.**



- **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	Regenerative load factor is 85% or more	1~10s or ∞

Alarm No.	Alarm	Content	Latched Time
	alarm	the protection level.	
A2	Battery alarm	The voltage of battery is below 3.2V.	∞
A3	Fan alarm	Fan has stopped for 1 sec.	1~10s or ∞
A7	Lifetime detection alarm	Remaining usage time for the driver is shorter than 24 hours.	∞

- **How to clear the battery alarm**

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

1) “Connector X4” connecting alarm clear input (A-CLR) to COM- for more than 120ms.

2) Click the battery alarm clear button after installing support software iMotion.

3) Executing the alarm clear function in auxiliary function mode by using the front panel.

4.3 Reception/Transmission Sequence of Absolute Data

Here is the introduction to the sequence from receiving the output signal from absolute encoder to sending it 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.

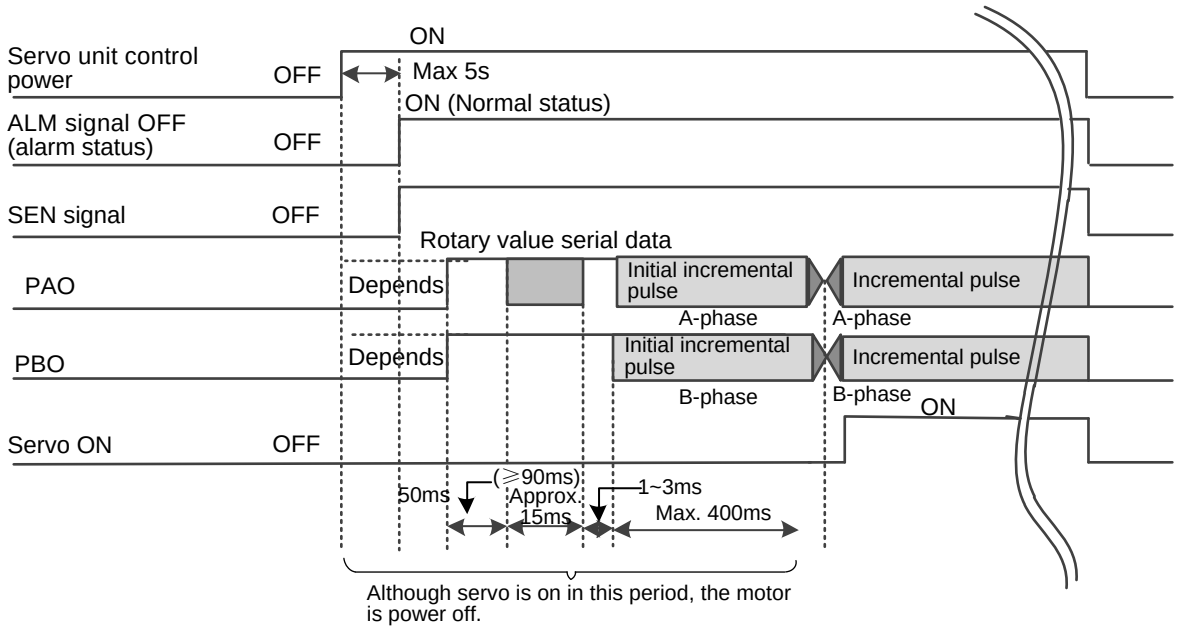
Detailed information of SEN signal is shown as below.

Signal name	Symbol	Default	Related Mode		
Absolute data request data	SEN	11 (SIGN)	P	S	T

Description:

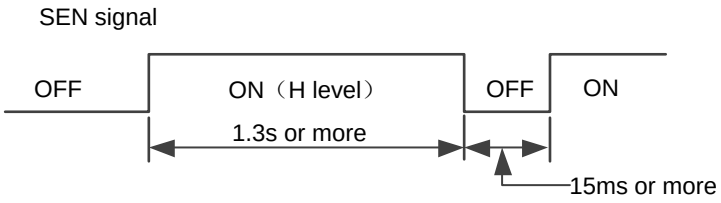
Absolute data initialization request.

Input SEN signal as follows.



When turn off control power, turn SEN off.

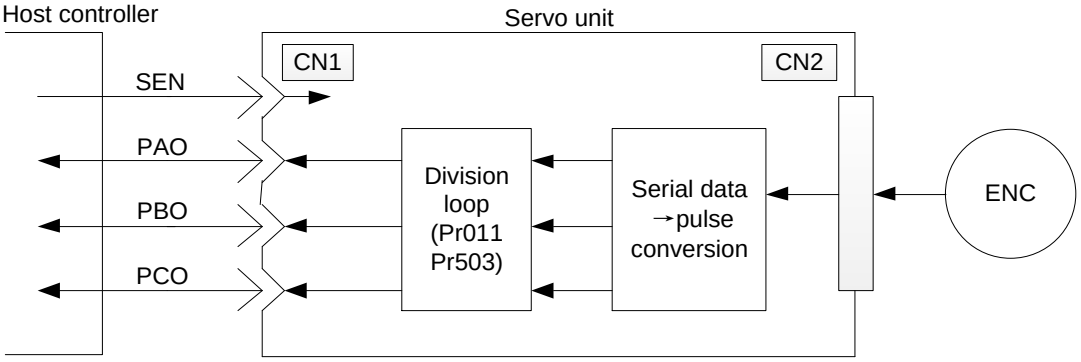
When turn SEN signal to active low again, as shown in below, execute after maintaining previous active low for 1.3 sec.



Servo-ON does not receive SEN signal.

4.3.2 Absolute Data

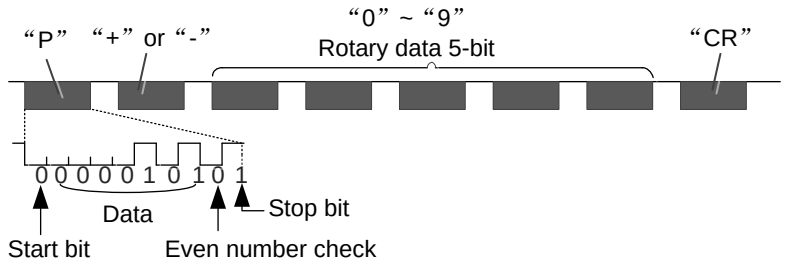
As shown in following figure, rotary serial data and pulse of absolute encoder fed out from the servo unit is output through terminals “PAO PBO PCO”.



Signal Name	Status	Content
PAO	At initialization	Rotary value serial data Initial incremental data
	At most time	Incremental data
PBO	At initialization	Initial incremental pulse
	At most time	Incremental pulse
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.

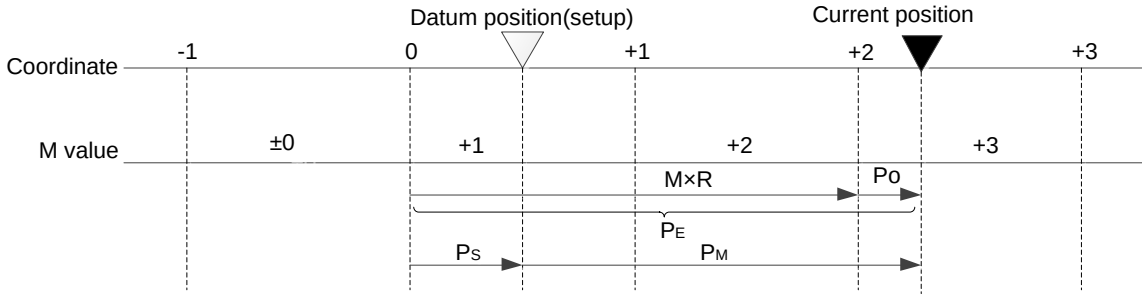
Data Transmission Method	Start-Stop Synchronization (ASYNC)
Baud rate	9600bps
Start bit	1-bit
Stop bit	1-bit
Parity checking	Even
Character	ASCII 7 bits
Data format	8 characters, as shown in below.  Note: 1) Range of non-rotary data will be either "P+00000" (CR) or "P-00000" (CR). 2) Range of rotary 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. Similar with 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

Pr011 Set Value	Pulse Output Speed of Absolute Encoder in 1 Circle	Pulse Output Time of Absolute Encoder in 1 Circle
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 computed according to following formulas.

$P_E = M \times R + P_O$

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

$P_M = P_E - P_S$

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

Note:

In reversal mode, (Pr000=0), formulas are as follows:

$P_E = -M \times R + P_O$

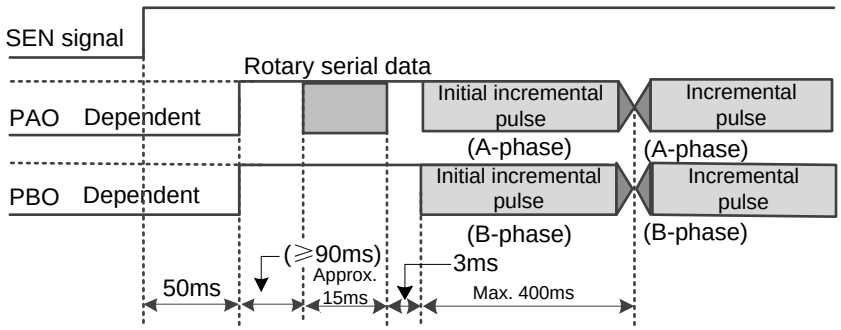
$P_S = M_S \times R + P_S^{'}$

$P_M = P_E - P_S$

4.3.3 Reception and Transmission Sequence of Absolute Data

1) Turn SEN signal to ON (H level).

2) After approx. 100ms, enter into waiting status for receiving rotary serial data, in which reversible counter for incremental pulse will be cleared.
3) Receive rotary serial data of 8-character.
4) In approx. 400ms at receiving the last rotary serial data, enter into normal incremental action status.



5 Motor Running

5.1 Check and Preparation Before Motor Run

You need to check the following before motor running.

Check Item	Content
Check wiring	Miswiring? (Especially power input and motor output). Short or grounded? Loose connection?
Check power supply and voltage	Within the rated voltage?
Fix servo 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	Use pulse series as positional command to control servo motor speed. Specifically, control the position by input pulse number and control the motor speed by input pulse frequency. You can enable it where positioning is needed.
2	Velocity control	The driver receives velocity command and controls the motor to target speed. Velocity command can be provided by internal registeration (altogether 3 groups of register). Select the command by inputting signal INTSPD1, INTSPD2 and INTSPD3.
3	Torque control	The driver receives velocity command and controls the motor to target speed. Torque command is provided by internal register, and external analog input is supported in specific models.

5.2.2 Servo-ON

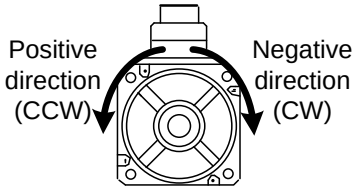
It is used to control the power ON/OFF status of the servo motor. There are following two methods to turn servo-ON:

1) Via input signal. Pin 40 of the connector CN2 is by default set to SRV-ON signal input, refer to section 2) “Connection example in Three Control Modes” for wiring information;

2) Turn servo-ON in trial run (this method can only be used during trial run). Note: when external SRV-ON signal input is active, trial run function is unavailable.

5.2.3 Motor Rotational Direction Selection

You can set up the motor rotational direction by setting Pr000. In this way, you can obtain the same command polarity and rotational direction without changing the polarity of command pulse to the servo. In standard setting, the positive direction is seen like rotation in counter clockwise (CCW) in view of servo motor load.



Ex-factory set value

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

5.2.4 Over-travel Protection Function

With the over-travel protection function, limit switches will be activated when machine moves out of specified safety area (or movable area), forcing the servo motor to stop in order to secure safety.

1. Signal setup

Type	Signal	Pin No. of Connector	Status	Motor Action
Input	POT	CN2-42	ON	Forward rotation side drive inhibition
			OFF	Forward rotation side drive
	NOT	CN2-43	ON	Reversal rotation side drive inhibition
			OFF	Reversal rotation side drive

2. Enable/disable over-travel inhibition function

You can disable the over-travel protection function by setting Pr504. When it is disabled, forward rotation side and reversal rotation side of the servo motor always can run, needless to connect with NOT and POT signal.

Pr504 Set Value	Action
0	POT: Positive direction over-travel inhibition NOT: Negative direction over-travel inhibition
1	POT, NOT invalid
2	With anyone of POT/NOT input, Err38.0「Over-travel inhibition input protection」 will occur.

3. Method selection to stop the motor at over-travel function activation

When Pr504「Over-travel inhibition input setup」=0, status in deceleration or after stoppage can be set up by setting Pr505.

Pr504	Pr505	In Deceleration	After Stopping	Content of Deviation Counter
0	0	Dynamic brake action	Torque command=0 in direction of over-travel inhibition direction	Hold
	1	Torque command=0 in direction of over-travel inhibition direction	Torque command=0 in direction of over-travel inhibition direction	Hold
	2	Emergency stop	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 with built-in servo motor.

A built-in brake is a kind of special and exclusive brake without magnetic excitation, and cannot be used for braking purpose. Please enable it only when the motor stops. While enabling the brake, turn off power supply for the servo unit or make it SRV-OFF.

5.2.6 Method to Stop the Motor at Servo-OFF or at Alarm

1) You can set up status in deceleration and after stoppage at servo-OFF by setting Pr506.

Set Value	In Deceleration	After Stopping	Positional Deviation
0	Dynamic brake (DB) action	Dynamic brake (DB)action	Clear
1	Free run (DB OFF)	Dynamic brake (DB)action	Clear

Set Value	In Deceleration	After Stopping	Positional Deviation
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	Hold
5	Free run (DB OFF)	Dynamic brake (DB) action	Hold
6	Dynamic brake (DB) action	Free run (DB OFF)	Hold
7	Free run (DB OFF)	Free run (DB OFF)	Hold
8	Emergency stop	Dynamic brake (DB) action	Clear
9	Emergency stop	Free run (DB OFF)	Clear

2) You can set up status in deceleration and after stoppage at alarm by setting Pr510.

Set Value	In Deceleration	After Stopping	Positional Deviation
0	Dynamic brake (DB) action	Dynamic brake (DB) action	Clear
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	Engaged A: Emergency stop Engaged B: DB	Dynamic brake (DB) action	Clear
5	Engaged A: Emergency stop Engaged B: DB	Dynamic brake (DB) action	Clear
6	Engaged A: Emergency stop Engaged B: DB	Free run (DB OFF)	Clear
7	Engaged A: Emergency stop Engaged B: DB	Free run (DB OFF)	Clear

CAUTION

1) Dynamic brake (DB): One way to make the motor stop immediately. The servo motor can be emergently stopped through short circuiting the motor electrical loop. Dynamic brake is built in the servo unit.
2) Emergency stop: At servo-ON, general control function makes the motor stop immediately.
3) Clear: Positional deviation always is zero.
4) Hold: Positional deviation is held at alarm while cleared at alarm clear.
5) Decelerating: the interval of motor rotational speed decelerates from current speed to below 30r/min.

5.2.7 Overload Setup of the Motor

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.

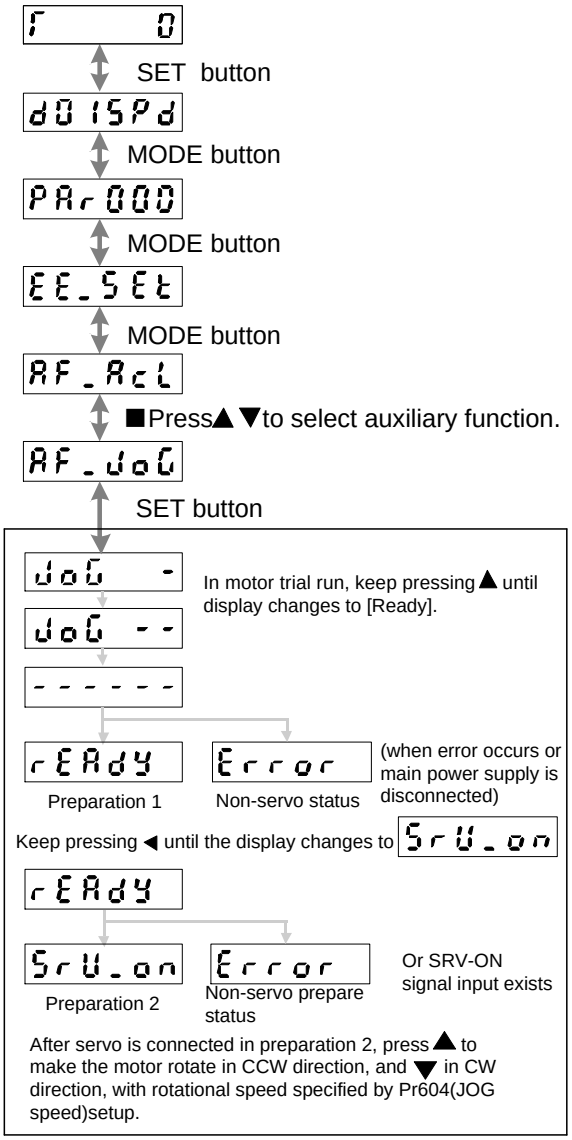
5.3 Trial Run

When you get the driver for the first time, you can be acquainted with operation methods of the servo driver by using trial run function.

Please well connect the main power, control power, motor power cable and encoder cable by referring to section 2.1. Do not connect mechanical load in first-time trial running. Below are two ways to trial run.

- **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 of 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 main functional display.
  5) After trial run window is opened, refer to *Operating Manual of 「iMotion」* to run the motor.
- **Trial run with the front panel of the driver**

You can enable the servo-ON and make the motor run as steps in following figure. Set up Pr604 (JOG speed) to control the motor speed, with acceleration/deceleration time fixed at 1 (r/min)/ms. You can refer to section 3.8 “Auxiliary Function Mode” for explanation of JOG mode.



5.4 Position Control

When position control is enabled for the driver, make sure Pr001 is set to 1.

5.4.1 Pulse Command Input Signal Setup

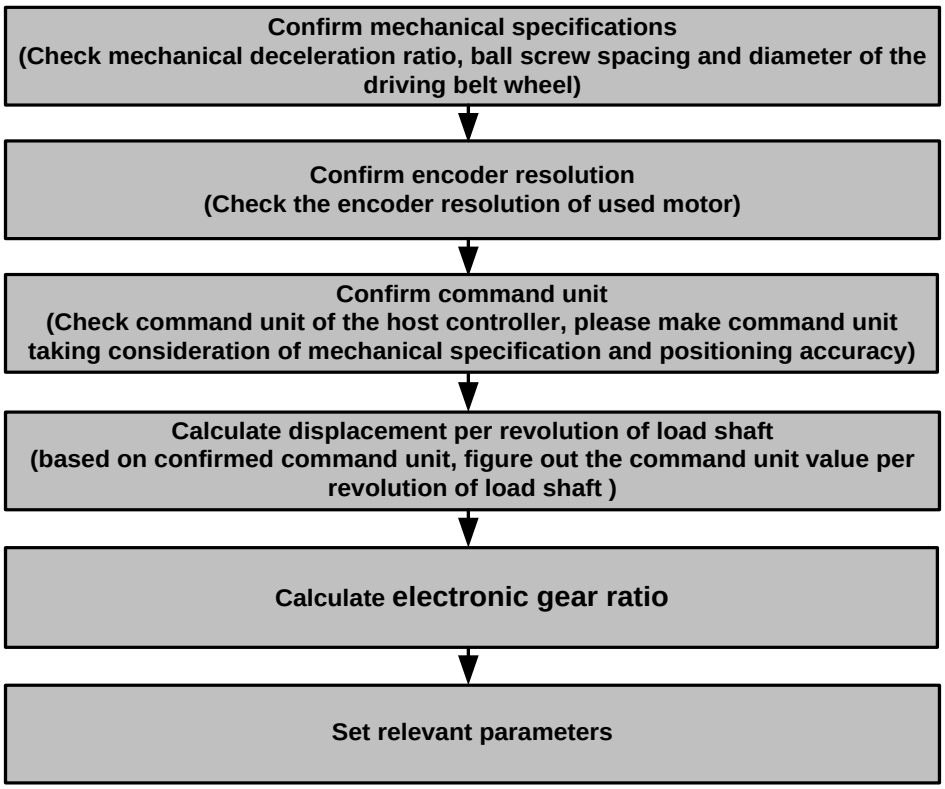
As shown in table below. Refer to section 2) “Connection Example in Three Control Modes”.

Type	Signal	Pin No. of Connector	Name
Input	PULSE	CN2-7	Command pulse input
	/PULSE	CN2-8	Command pulse input
	SIGN	CN2-11	Command direction input
	/SIGN	CN2-12	Command direction input

Pulse command input is determined by setup of Pr006 and Pr007, refer to section 9.1 for details.

5.4.2 Electronic Gear Setup

Set up the electronic gear as following steps:



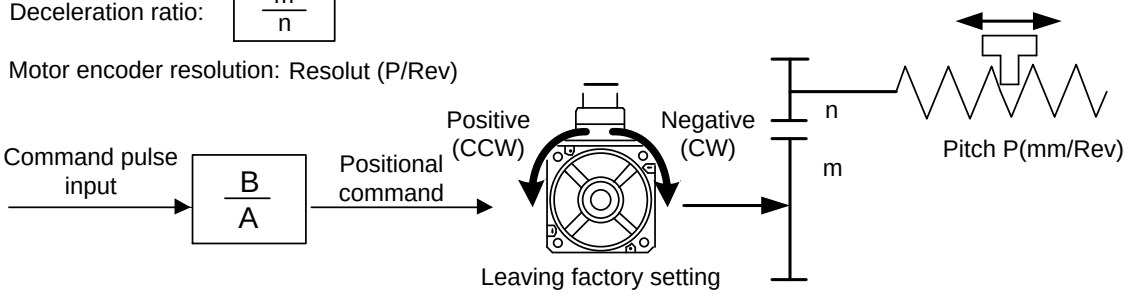
Calculation formula for the electronic gear ratio is as below:

Command pulse of Weihong driver

Command unit: K(mm/P) Equivalent parameter

Deceleration ratio: $\frac{m}{n}$

Motor encoder resolution: Resolut (P/Rev)



Formula derivation :

$$\frac{n \times P}{K} \times \frac{B}{A} = Resolut \times m$$

$$\frac{B}{A} = \frac{Resolut \times m \times K}{n \times P}$$

When Pr008 is set to 0, set B result to Pr009, A result to Pr010.

Or you can directly set Pr008 to $\frac{n \times P}{m \times K}$

5.4.3 Driver Feedback Pulse Output Setup

If driver feedback pulse output signal is used, you need to set up Pr011, Pr503 and Pr012. Refer to section 9.1 for details.

5.5 Velocity Control

When velocity control is enabled for the driver, make sure that Pr001 is set to 2.

Velocity command input signal setup

Velocity control command is determined by set values of 8 (Pr304~Pr311). Validation of parameters is decided by set value of Pr300. Select among internal command velocity signals INTSPD1, INTSPD2 and INTSPD3 to decide the active velocity command. Refer to section 9.4 for content and setup method of Pr300~Pr311. INTSPD1 and INTSPD2 have been set to CN2-45 and CN2-46 pin separately by default, while INTSPD3 hasn't allocated when leaving factory. Refer to section 0 for details about I/O signal allocation and setup method of Pr400~Pr414. Polarity of velocity command can be changed by setting Pr301.

5.6 Torque Control

When torque control mode is enabled for the driver, make sure that Pr001 is set to 3.

Torque command input signal setup

Torque control command is determined by internal parameter setup (Pr601), whose unit is %. For instance, if Pr601=10, it means that the torque command is 10% of rated torque of the motor.

6 Gain Adjustment

It is required for the servo driver to run the motor in least time delay and as faithful as possible against the commands from the host controller. You can make a gain adjustment so that you can run the motor as closely as possible to the commands and obtain the optimum performance of the machine.

6.1 Preparation for Gain Adjustment

6.1.1 Install Host Controller Support Software iMotion

You can make gain adjustment through operations on the front panel or through operations on support software of the host controller, and execute analog measurement and monitoring with the help of the software.

Connect computer with the driver via USB cable by connecting one end to the PC and the other end to CN1 connector of the driver.

After the support software has been successfully installed, double click it and select “Connect with the driver” to make proper communication between the computer and driver. Then you can begin adjustment.

Refer to section 5.3 for details of the support software of the host controller.

6.1.2 Set Basic Protective Function

Before gain adjustment, you can make appropriate parameter setting according to following conditions.

1. Set over-travel inhibition input

Collision to the machine end can be avoided by sending limit switch sensor signal to the driver. Refer to details of positive direction/negative direction over-travel inhibition input (POT/NOT). Besides, please set Pr504 “Over-travel inhibition input setup” and Pr505 “Sequence setup at over-travel inhibition”, referring to section 9.6.

2. Set torque limit

Damage to machine caused by errors such as clutch or collision can be reduced by limiting the max. torque of the motor. Please set Pr013「1st torque limit」to make this restriction referring to section 9.1.

However, please note that limit the torque below actual requirement level, over-speed protection due to overshoot or positional deviation protection due to command reception delay may be triggered. In addition, torque status can be externally detected by feeding out torque in-limit output to output signal.

3. Set Over-speed protection

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

Default setting: auto set up it to 1.2 times of the value of the max. speed [r/min] of the applicable motor. If the maximal speed has not been reached, set Pr513「Over-speed level setup」.

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

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

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

In addition, you can run the motor at a low speed at the primary adjustment phase, or add safety coefficient to the velocity, in order to trigger protection when oscillation occurs.

Refer to section 9.6 for setting of Pr513.

4. Positional deviation excess protection setup

In position control mode, with this function, once difference between detected positional command and motor position is large, Err24.0「Positional deviation excess protection」.

Set up positional deviation excess level by setting Pr014「Positional deviation excess setup」. Apart from that, you can make choice between command position deviation ［Pulse (command unit)］ and encoder positional deviation［Pulse (encoder unit)］ by setting Pr520「Unit selection of position setup」. Default value of parameter Pr014 is 100000［Pulse (command unit)］.

Positional deviation in normal operation is changing with setup of active velocity and gain. For this reason, set following calculation result to Pr014 in accordance with running condition.

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

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

Vc represents to max. frequency (pulse/s) of positional command pulse.

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

"1.2~2.0" is 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.

Position command filter: Vc× time constant of filter［s］

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

Pr014「Positional deviation excess setup」= Ve/Kp× (1.2~2.0)

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

Kp represents 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.

5. Software limit function setup

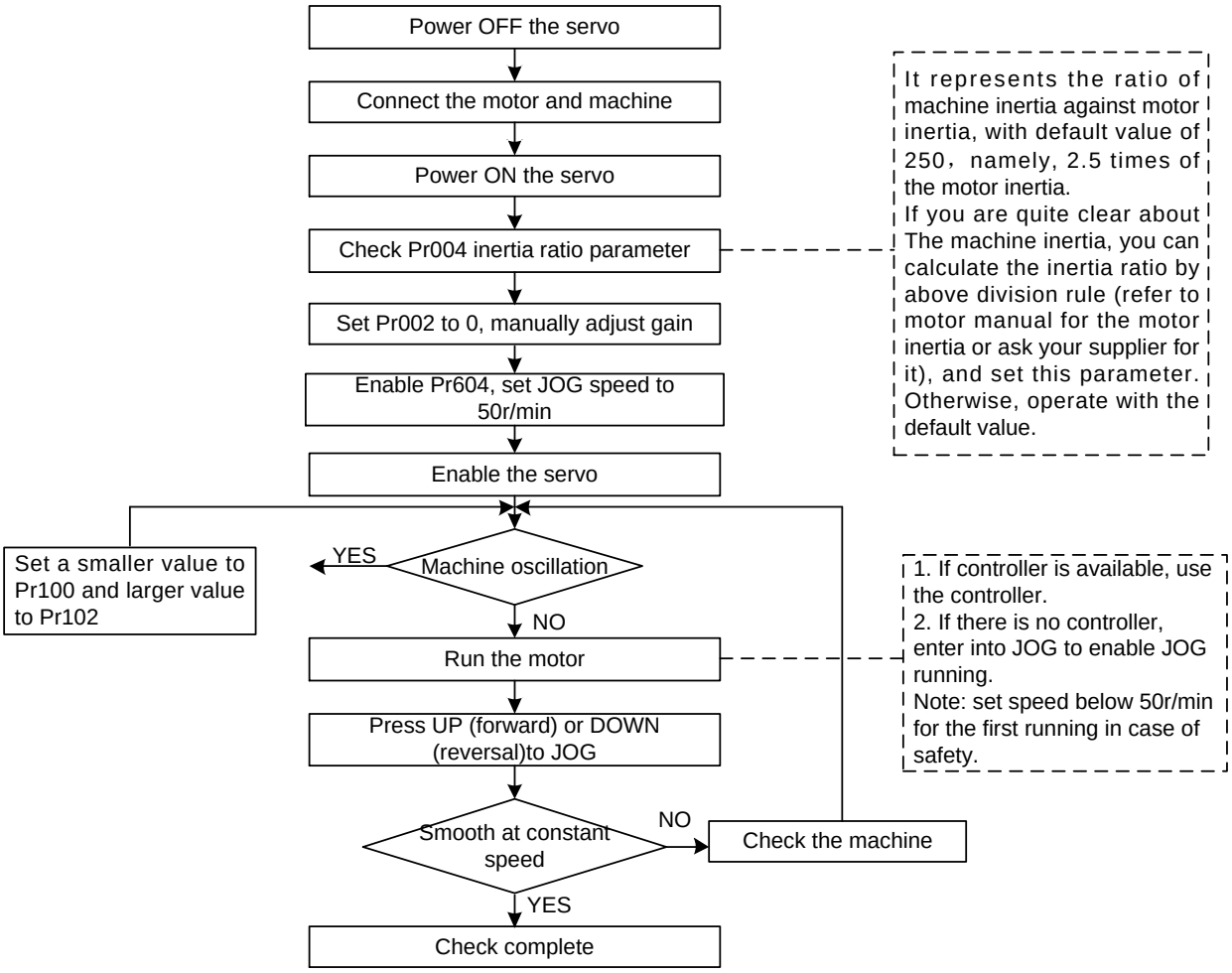
In position control mode, among all positional commands which have been input, once value is detected larger than the rotary value set up by Pr514「Motor movable range setup」 or the motor position is exceeded, Err34.0「Motor movable range protection」will occur. Refer to section 9.6 for setting of Pr514.

6.2 Automatic Gain Adjustment

Following conditions should be secured in order to enable automatic gain adjustment.

1) Should be Servo ON;
2) Input signals such as the deviation counter clear and command input inhibit, and parameter except for controls such as torque limit setup, are correctly set, assuring that the motor can run smoothly.

6.2.1 Flowchart of Primary Estimation of Inertia



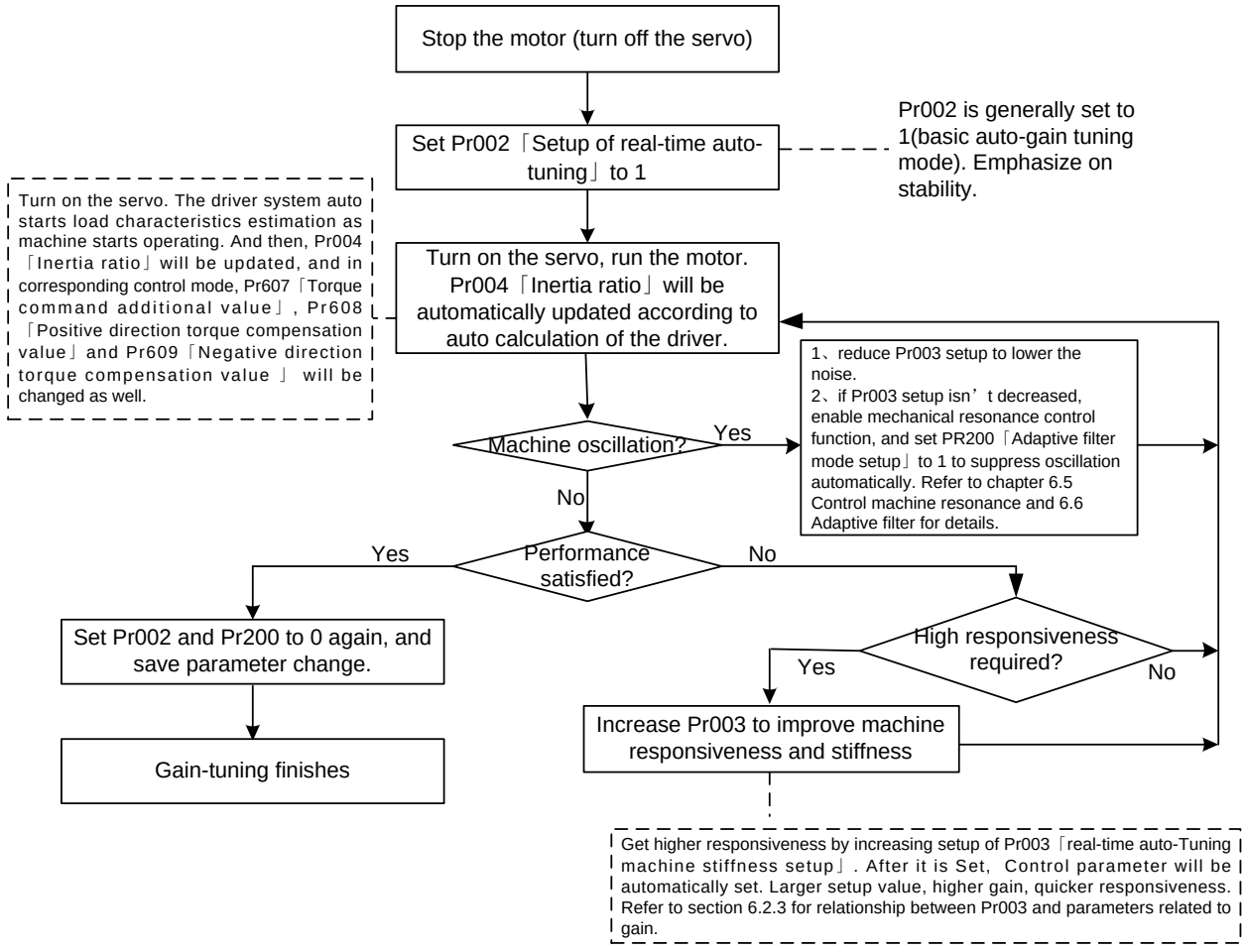
CAUTION

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

1) Too large actual inertia of the machine. e.g., for some machines, the inertia is 15 times or above of the motor inertia, while default set value of the driver of this ratio is 2.5. For this reason, problem can be fixed by increasing parameter Pr004 inertia ratio to an appropriate value.

2) Too large set value of parameters related with velocity gain. Machine oscillation may be removed by reducing value of Pr101 and increase time constant of velocity loop integration.

6.2.2 Automatic 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. If the result is not saved, manually write parameter to EEPROM and then turn off the power.

6.2.3 Related Parameters

- **Parameters which will be updated**

According to set values of 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 following parameters.

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

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

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

Param No.	Parameter Name	Function
Pr100	1st gain of position loop	When stiffness setup is valid, update the parameter based on the set value. Refer to section 6.2.4 “Basic Gain Setup Parameter”.
Pr101	1st gain of velocity loop	
Pr102	1st time constant of velocity loop integration	
Pr104	1st time constant of torque filter	
Pr105	1st gain position loop	
Pr106	2nd gain velocity loop	
Pr107	2nd time constant velocity loop integration	
Pr109	2nd time constant of torque filter	

- **Parameters which will be set to fixed value**

Real time auto-tuning function sets the following parameters to the fixed values.

Param No.	Parameter Name	Function
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	50 (0.5ms)
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.

Param No.	Parameter 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	Delay time of position control switching	Set to 50 if the current setting is not maintained.
Pr117	Level of position control switching	
Pr118	Hysteresis at position control switching	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	Delay time of velocity control switching	
Pr122	Level of velocity control switching	
Pr123	Hysteresis at velocity control switching	
Pr124	Torque control switching mode	
Pr125	Delay time of torque control switching	
Pr126	Level of torque control switching	
Pr127	Hysteresis at torque control switching	

6.2.4 Cautions for Automatic Gain Adjustment

1. Cautions

1) Immediately after the first servo-on upon start-up, or after increasing Pr003「Real time auto-tuning stiffness setup」, abnormal sound or oscillation may be generated until the load characteristics estimation is stabilized. If such abnormality lasts or repeats for 3 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 calculated value of 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 noise and oscillation occur, Pr004「Inertia ratio」, Pr607「Torque command additional value」, Pr608 「Positive direction torque compensation value」 and Pr609

「Negative direction torque compensation value」might have changed to extreme values. Take same measures as the above in these cases.

3) Among the results of real time auto-tuning, Pr004「Inertia ratio」, Pr607「Torque command additional value」, Pr608 「Positive direction torque compensation value」and Pr609 「Negative direction torque compensation value」will be written into EEPROM every 30 minutes. When you turn on the power again, the auto-gain tuning will be enabled using the latest data as initial values.

2. Real time auto-gain tuning invalidation

You can stop the automatic calculation of Pr004 「Inertia ratio」 and invalidate the real time auto-gain tuning by setting Pr002「Real time auto-gain tuning setup」to 0. Since the estimation result of Pr004 「Inertia ratio」remains, and if the parameter becomes clearly abnormal value, manually set to the appropriate value which is obtained from suitable formula or calculation.

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. If the result is not saved, manually write parameters to EEPROM and then turn off the power.

3. Conditions for inertia ratio estimation (calculation)

1) Load inertia: The 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.

4. Relationship between gain adjustment and stiffness

You can enhance the machine stiffness through following measures:

1) Well mount the equipment on the ground base, securing no vibration.
2) Use 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.
   a) The inherent vibration (resonance frequency) of mechanical system will greatly affect gain adjustment of the servo machine.
   b) For machines with low resonance frequency (low machine stiffness), response setup of the servo machine cannot be set too high.
   c)

- **Basic Gain Setup Parameter Table**

Sti-ffn-ess	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

WISE series driver is equipped with auto-gain tuning function as introduced before, while in situation where with auto-gain tuning function, best gain cannot be obtained or best response and stability are required at each load, manual gain adjustment is needed.

When oscillation occurs in servo system or its control characteristics is far from satisfactory, 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.

1) 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, higher set value of this parameter, higher response speed.
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.
Torque command filter	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 responsiveness 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 is larger than gain of position loop. When gain of position loop exceeds gain of velocity loop largely, 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.

2) 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) and set Pr102 time constant of velocity loop integration to 10000.

Step	Content	Adjustment Description
		2) Then gradually increase set value of Pr101, at the same time, observe oscillation at motor stopping. Besides, manually adjust 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 increase, you need to decrease the set value to remove the oscillation and obtain smooth rotational speed. This value can be the initial setup for Pr101.
2	Adjust the time constant of velocity integration	1) You can gradually decrease setup of Pr102 to display integration effect. 2) As described in step on, when Pr102 is decreased, oscillation and instability may occur. For this reason, you need to increase the set value of Pr101 to remove oscillation and obtain smooth speed. This value can be the initial setup for Pr102.
3	Adjust set value of Pr100	If 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 mean reduced 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):**

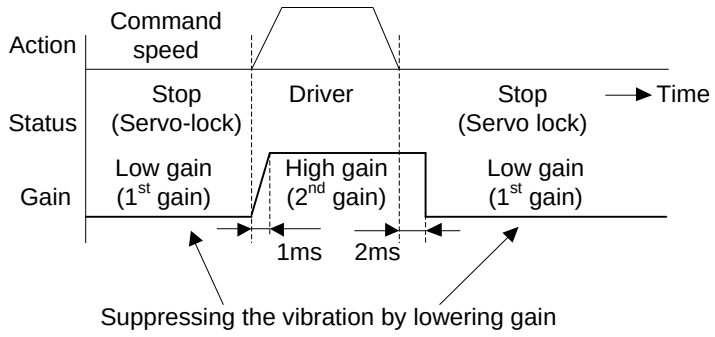
Typical Examples	Description
Appropriate parameter setting	In this situation, parameter setting isproper, where motor speed is in accordance with the positional command, velocity is within allowable range and positioning time is short.
Time constant of velocity loop integration is relatively small	Velocity loop of the servo driver should be quickly responded. Waving velocity curve means that time of velocity loop integration is too short, destabilizing the velocity loop and causing 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.
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

Typical Examples	Description
	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.



In example below, you can reduce the noise at motor at stalling (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 gain switching condition

In the following three tables, "●" represents "Enabled", and "—" represents "Disabled".

- Position control mode

Gain Switching Condition Setting			Parameters at Position Control Mode		
Pr115	Switching 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	Positional deviation	D	●	●*3(pulse)	●*3(pulse)
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)

➢ Velocity control mode

Gain Switching Condition Setup			Parameters at Velocity Control Mode		
Pr120	Switching to 2nd gain	Fig.	Delay time*1	Level	Hysteresis*2
			Pr116 121	Pr117 122	Pr118 123
0	Fixed to 1st gain		—	—	—
1	Fixed to 2nd gain		—	—	—
2	Gain switching input		—	—	—
3	Torque command	A	●	● [%]	● [%]
4	Velocity command variation	B	—	●*4[10[r/min)/s]]	●*4[10[r/min)/s]]
5	Speed command	C	●	● (r/min)	● (r/min)

➢ Torque control mode

Gain Switching Condition Setup			Parameters at Torque Control Mode		
Pr124	Switching to 2nd gain	Fig.	Delay time*1	Level	Hysteresis*2
			Pr116 125	Pr117 126	Pr118 127
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 through control mode.

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

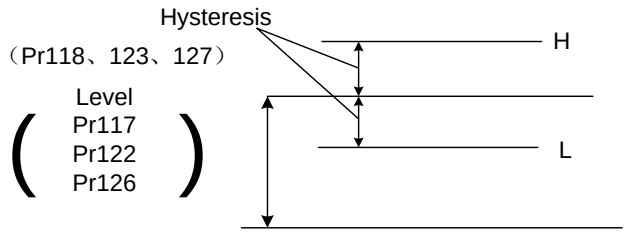
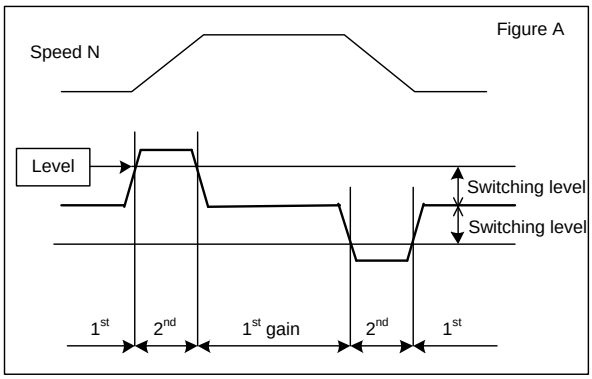
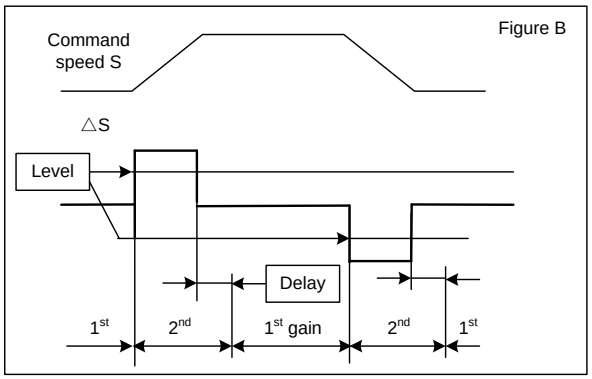
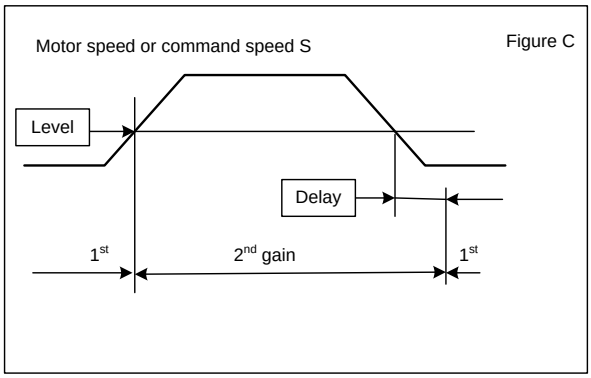
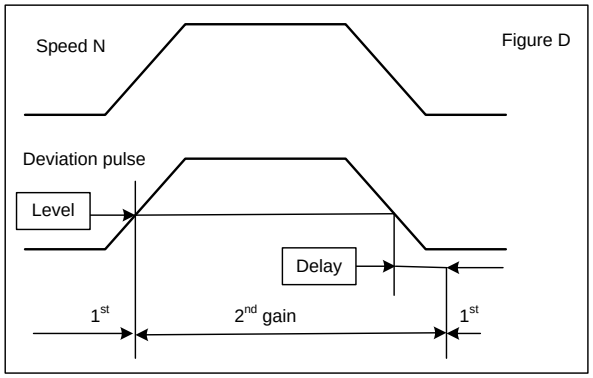


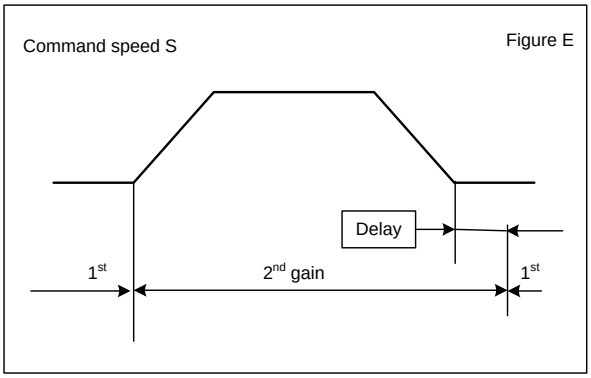
Fig. 6-1 Definition of Hysteresis

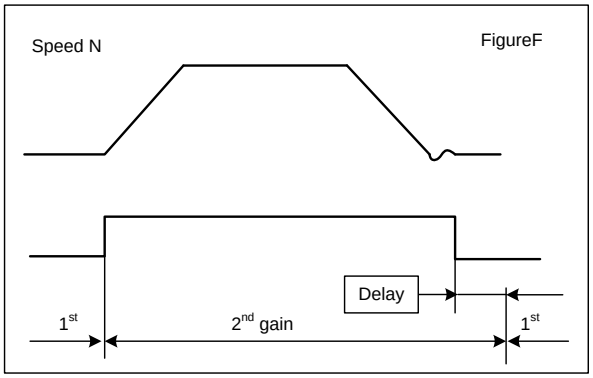












CAUTION

Figures above 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 reduced.

1. 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)

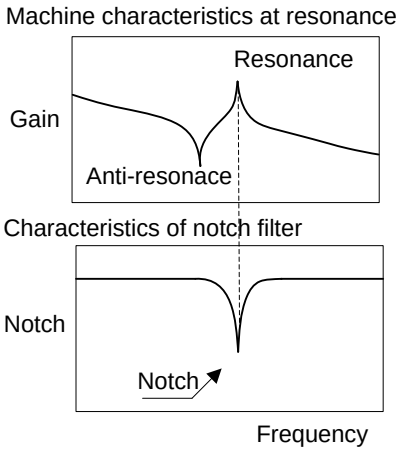
2. Notch filter (Pr201~212)

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

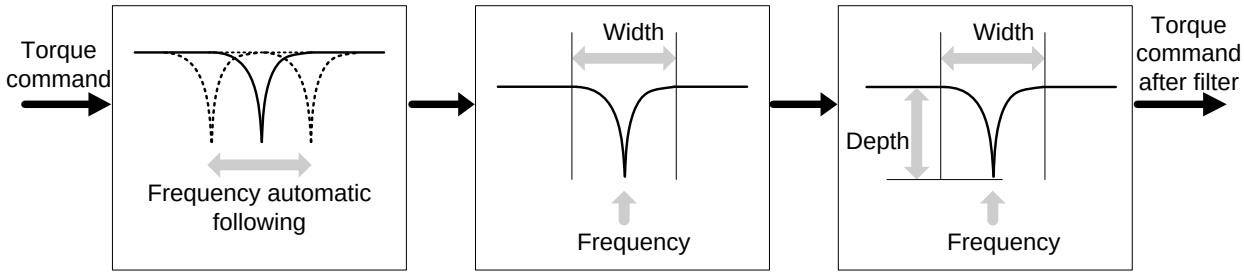
No.	Parameter name	Function
Pr201*[1]	1st notch frequency	Set the frequency of the 1st notch filter.
Pr202	1st notch width selection	Set the width of notch at the center frequency of the 1st notch filter.
Pr203	1st notch depth selection	Set the depth of notch at the center frequency of the 1st notch 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.
Pr208	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.

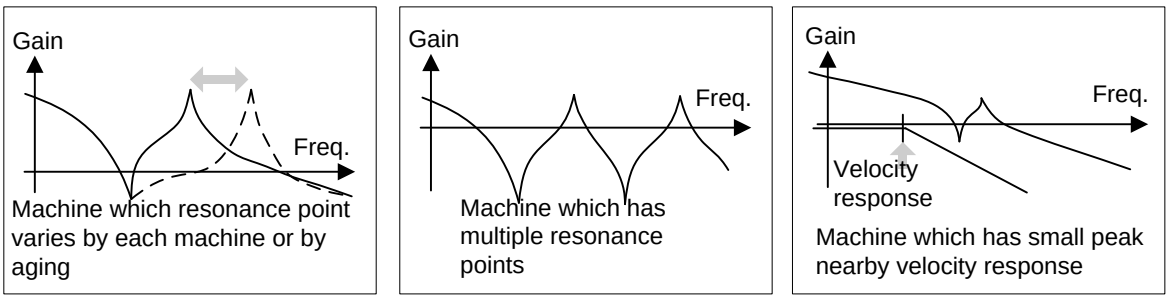


Adjust the frequency, width and depth of the notch filter:



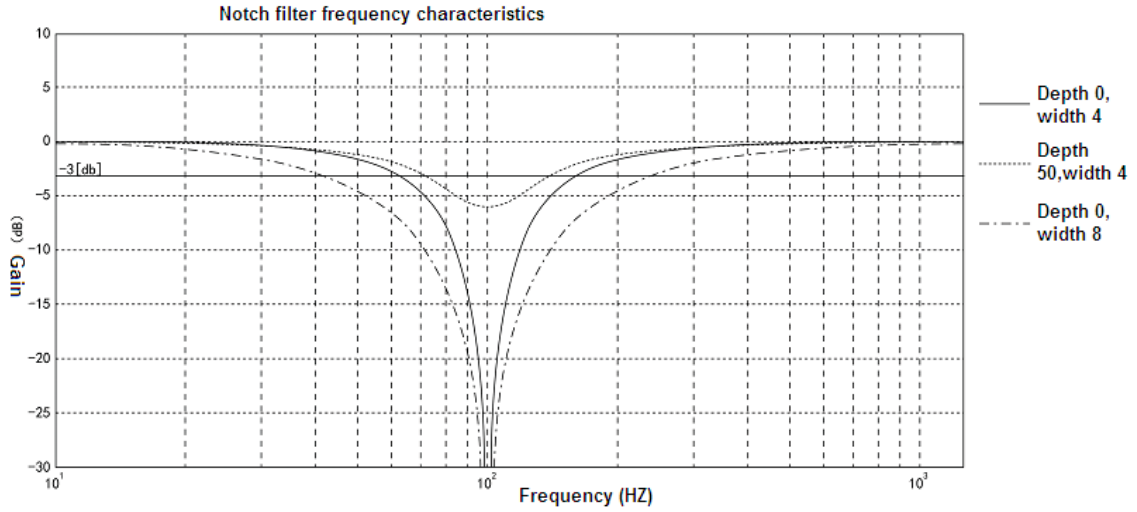
Adaptive filter | 1st notch filter | 2nd ~4th notch filter

Examples:



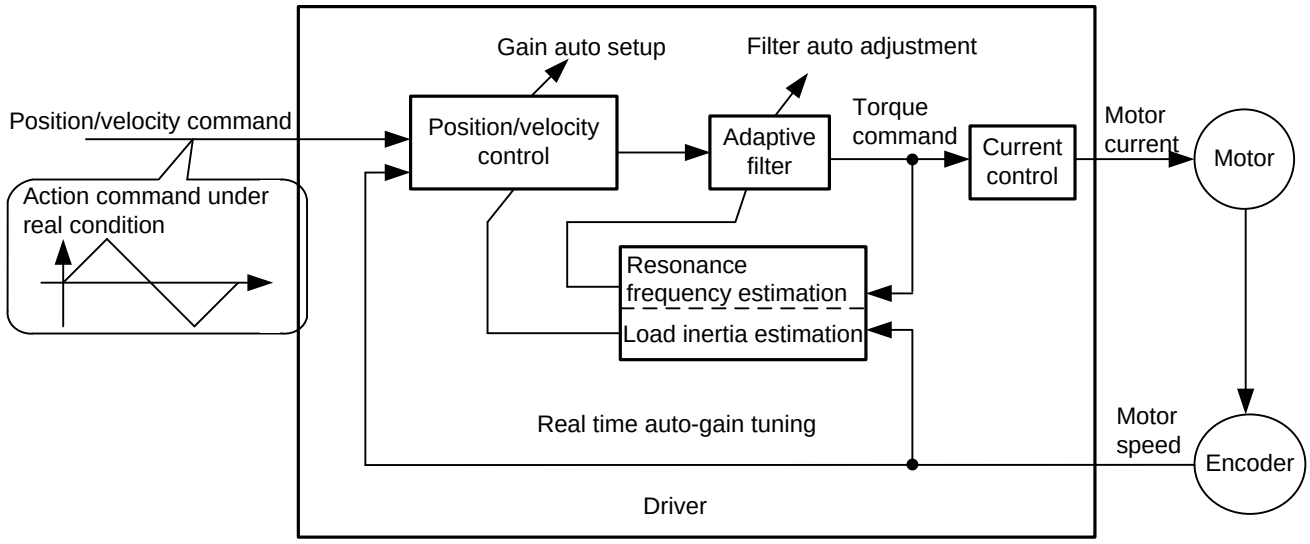
Adaptive filter enabled | Adaptive filter and notch filter enabled | Depth adjustment enabled

Characteristics of notch filter frequency:



6.4 Adaptive Filter

In real practice, the adaptive filter estimates the resonance frequency out of vibration component presented in the motor speed in motion, and then removes the resonance component from the torque command by setting the notch filter coefficient automatically, hence reduces the resonance vibration.



1. Applicable conditions

The function works under the following conditions.

	Conditions under Which the Adaptive Filter is Activated
Control Mode	Applies to other control modes 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 following conditions, normal operation may not be expected. In this case, 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 resonances of 3 or more points exist.
Load	Motor speed variation with high harmonic component is generated due to non-linear factors such as backlash.
Command Mode	Acceleration/deceleration is rapid such as 30000r/min per 1s.

2. Operation methods

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

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

Param No.	Parameter 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 filter hold the current set value.
		1	1 adaptive filter is valid	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 and 4th notch filters will be updated based on adaptive performance.
		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.

Param No.	Parameter 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.
2Pr12	4th notch depth selection	

3. Cautions

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 actions.

   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.

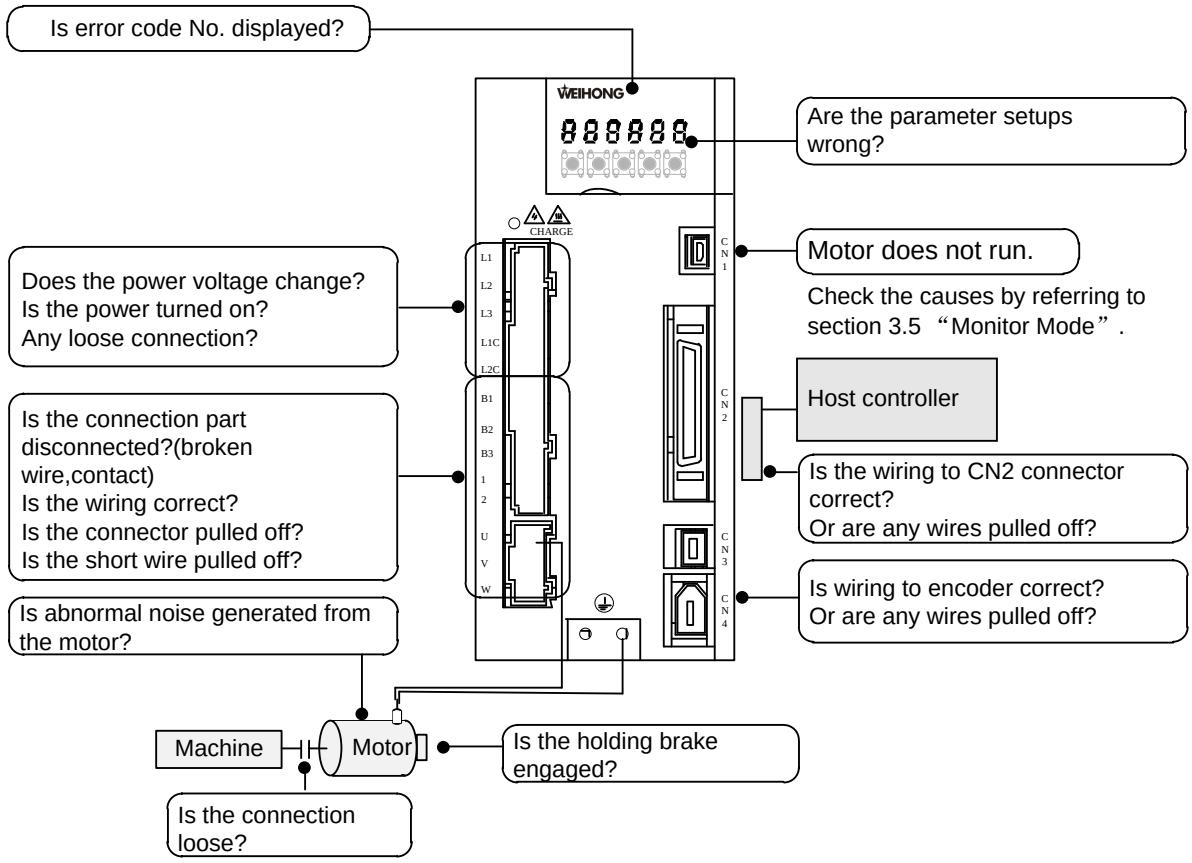
   d) Manually set the notch filter.

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 filters (Pr207~Pr209) and 4th notch filters (Pr210~Pr212) are written to EEPROM every 30 minutes. Upon power up, these data are used as default values during adaptive process.

7 Error and Troubleshooting

In case of driver failure, you can debug and troubleshoot as shown in figure below.



7.1 List of Error Code

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 stop after removing the cause of the error and securing safety.

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 as below. ● represents the attribute of the relevant error code.

Table 7-1 Overall list of error code

Error code	Content	Attribute		
		History	Can be cleared	Immediate stop
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 27.1	Command pulse input frequency error protection	●	●	●
Err 28.0	Limit of pulse replay error protection	●	●	●
Err 33.0	IF overlap allocation error 1	●		
Err 33.2	IF input function number error 1	●		
Err 33.4	IF output function number error 1	●		
Err 34.0	Software limit protection	●	●	●
Err 36.0~36.2	EEPROM parameter error protection			
Err 37.0~37.2	EEPROM code error protection			
Err 38.0	Over-travel inhibit input protection		●	

Error code	Content	Attribute		
		History	Can be cleared	Immediate stop
Err 39.0	Current offset excess protection	●	●	
Err 40.0	Absolute system down error protection	●	●	
Err 41.0	Absolute counter over error protection	●		
Err 42.0	Absolute over-speed error protection	●	●	
Err 43.0	Encoder Initialization error failure	●		
Err 44.0	Absolute single turn counter error protection	●		
Err 45.0	Absolute multi-turn counter error protection	●		
Err 46.0	Absolute 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	Version does not match.	●		
Err 87.0	Forced alarm input protection		●	
Err 95.0~95.4	Motor automatic recognition error protection			
Other error code	Other error protection	●		

7.2 Introduction to Error Codes (Causes and Remedy)

1) When protective function marked with ★ in the protection function table is activated, it cannot be disabled by the alarm clear input (A-CLR). To return to the normal operation, turn off power, remove the cause, and then turn on power again.

2) Refer to section 2.2 “Wiring Diagram of Main Circuit” and chapter 9 “Parameter”.

Error Code	Name	Causes	Remedy
Err 12.0	Over-voltage protection	Voltage between P-N of the converter portion has exceeded the specified value. ① Voltage of the power supply has exceeded the permissible input voltage. Voltage surge due to the phase-advancing capacitor or UPS (uninterruptible power supply) have occurred. ② Disconnection of the regeneration discharge resistor. ③ External regeneration discharge resistor is not appropriate and could not absorb the regeneration energy. ④ Failure of servo driver (failure of the circuit).	Measure the voltage between lines of connector (L1 L2 L3). ① Input correct voltage. Remove a phase-advancing capacitor. Measure resistance of the external resistor for P-B of the driver. ② If the value is ∞, replace the external resistor. ③ Change to the one with specified resistance and wattage. ④ Replace the driver with a new one.
Err 13.0	Main power supply under-voltage protection (PN)	When Pr508「LV trip selection at the main power-OFF」=1, instantaneous power failure has occurred between L1 and L3 for longer period than the preset time with Pr509「Detection time at main power-OFF」; or the voltage between P and N of the converter portion of the main power supply has fallen below the specified value during Servo-On. ① Power supply voltage is low. Instantaneous power failure has occurred. ② Instantaneous power failure has occurred. Lack of power	Measure the voltage between lines of connectors (L1 L2 L3). ① Increase the power capacity. Change the power supply. Rule out the causes of the shutdown of the magnetic contactor of the main power supply, then re-enter the power. ② Set up a longer time to Pr509「Main power-OFF detecting time」. Set up each phase of the power correctly. ③ Increase the power capacity. ④ Connect each phase of the power supply (L1 L2 L3). For single phase, use any two of the three terminals. ⑤ Replace the driver with a new one.
Err 13.1	Main power supply under-voltage protection (AC)		

Error Code	Name	Causes	Remedy
		capacity…Power supply voltage has fallen down due to inrush current at the main power-on. ③ Phase lack …3-phase input driver has been operated with single phase input. ④ Failure of servo driver (failure of the circuit).	
Err 14.0	★ Over-current protection	Current through the converter portion has exceeded the specified value. ① Failure of servo driver (failure of the circuit, IGBT or other components). ② Short of the motor wire (U, V and W). ③ Earth fault of the motor wire. ④ Burnout of the motor. ⑤ Poor contact of the motor wire. ⑥T iming of pulse input is same as or earlier than Servo-ON.	① Turn to Servo-On, while disconnecting the motor. If error occurs immediately, replace with a new driver. ② Check that the motor wire (U, V and W) is not short-circuited, and check the branched out wire out of the connector. Make a correct wiring connection. ③ Measure the insulation resistance between motor wires, U, V and W and earth wire. In case of poor insulation, replace the motor. ④ Check the balance of resistor between each motor line, and if unbalance is found, replace the motor. ⑤ Check the loose connectors. If they are loose or fall off, fix them securely. ⑥ Enter the pulse 100ms or longer after Servo-ON.
Err 14.1	★IPM error protection		
Err 15.0	★Over-heat protection	Temperature of the heat sink or power device has been risen over the specified temperature. ① Ambient temperature has risen over the specified temperature. ② Over-load.	① Improve the ambient temperature and cooling condition. ② Increase the capacity of the driver and motor. Set up longer acceleration/deceleration time. Lower the load.

Error Code	Name	Causes	Remedy
Err 16.0	Over-load protection	Torque command value has exceeded the over-load level set with Pr512 「Setup of over-load level」 and resulted in overload protection according to the time characteristics. ① Load was heavy and actual torque has exceeded the rated torque and kept running for a long time. ② Oscillation and hunching action due poor adjustment. Set value of Pr004 is wrong. ③ Miswiring, disconnection of the motor. ④ Machine has collided or the load has gotten heavy. Machine has been distorted. ⑤ Electromagnetic brake has been kept engaged. ⑥ While wiring multiple axes, miswiring has occurred by connecting the motor cable to the other axis.	Check that the torque (current) does not oscillate nor fluctuate up and down very much on the analog output and via communication. Check the over-load alarm display and load factor with the analog output and via communication. ① Increase the capacity of the driver and motor. Set up longer acceleration/deceleration time. Lower the load. ② Make a re-adjustment of gain. ③ Wire correctly as wiring diagram. Replace the cables. ④ Remove the cause of distortion. Lower the load. ⑤ Release the brake, and measure the voltage between brake terminals. ⑥ Make a correct wiring by matching the correct motor and encoder wires.
		CAUTION 1) Refer to section 7.2.1 for details about over-load protection time characteristics. 2) Once the error occurs, it cannot be cleared at lease for 10 seconds.	
Err 18.0	★ Regeneration over-load protection	Regenerative energy has exceeded the capacity of regenerative resistor. ① Due to the regenerative energy during deceleration caused by a large load inertia, converter voltage has risen, and the voltage is risen further due to the lack of capacity of absorbing this	Check the load factor of the regenerative resistor from the front panel or via communication. ① Check the running pattern (velocity monitor). Check the load factor of the regenerative resistor and over-regeneration warning display. Increase the capacity of the driver and the motor, and loosen the deceleration time. Use the external

Error Code	Name	Causes	Remedy
		energy of the regeneration discharge resistor. ② Regenerative energy has not been absorbed in the specified time due to a high motor rotational speed. ③ Active limit of the external regenerative resistor has been limited to 10% duty.	regenerative resistor. ② Check the running pattern (velocity monitor). Check the load factor of the regenerative resistor. Increase the capacity of the driver and the motor, and loosen the deceleration time. Lower the motor rotational speed. Use an external regenerative resistor. ③ Set Pr016 to 2.
		WARNING When you set Pr016 to 2, install an external protection such as thermal fuse without fail. Otherwise, regenerative resistor loses the protection and it may be heated up extremely and may burn out.	
Err 18.1	★ Regenerative transistor error protection	Regenerative driver transistor on the servo driver is detective.	Replace the driver.
Err 19.0	★ DB(Dynamic brake) over-load protection	① The motor is driven by external power. ② Rotating energy when DB is stopping exceeds the resistor capacity of DB. ③ Failure of the driver. ④ too much power consumption of dynamic brake has been detected.)	① Don't drive the motor with external power or force. ② Decrease the command velocity of the driver. Decrease load inertia ratio. Reduce times of DB stalling. ③ 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-. Make a wiring connection of the encoder as per the wiring diagram. Correct the miswiring of the connector pins.
Err 21.1	★Encoder communication error	Mainly data error due to noise. Encoder cables are connected, but	① Secure the power supply for the encoder of DC5V±5% (4.75~5.25V). Pay special attention

Error Code	Name	Causes	Remedy
	protection	communication data has some errors.	when the encoder cables are long. ② Please check whether the signal of encoder cable is twisted pair, SD+ and SD-. ③ Separate the encoder cable and the motor cable if they are bound together. ④ Connect the shield to FG.
Err 23.0	★Encoder communication data error protection	① Data communication between the encoder is normal, but contents of data are not correct. ② Mainly data error due to noise. ③ Encoder cables are connected, but communication data has some error.	
Err 24.0	Positional deviation excess protection	Deviation pulse has exceeded the set value of Pr014. ① The motor movement has not followed the command. ② Set value of Pr014 is too small.	① 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. ② Set a larger value for Pr014.
Err 24.1	Velocity deviation excess protection	The difference between the internal positional command speed and actual speed (speed deviation) exceeds the set value of Pr602. **CAUTION** If the internal positional command speed is forcibly set to 0 due to instantaneous stop caused by the command pulse inhibit input (INH) or CW.CCW over-travel inhibition input, the speed deviation rapidly increases at this moment. The speed deviation also largely increases on the	① Increase the set value of Pr602. ② Make the acceleration/deceleration time of internal positional command speed longer, or improve the follow-up characteristic by adjusting the gain. ③ Disable the excess speed deviation detection (Pr602 ＝ 0).

Error Code	Name	Causes	Remedy
		rising edge of the internal positional command speed. Therefore, Pr602 set value should have sufficient margin.	
Err 26.0	Over-speed protection	The motor rotational speed has exceeded the set value of Pr513.	① Avoid an excessive speed command. ② Check the command pulse input frequency and division/multiplication ratio. ③ Make a gain adjustment when an overshoot has occurred due to a poor gain adjustment. ④ Make a wiring connection of the encoder as the wiring diagram.
Err 26.1	2nd over-speed protection	The motor rotational speed has exceeded the set value of Pr615.	
Err 27.1	Command pulse input frequency error protection	Division and multiplication ratio which are set up with the command pulse counts per single turn and the 1st and the 4th numerator/denominator of the electronic gear are not appropriate.	Check set values of division and multiplication ratio of the electronic gear.
Err 28.0	Pulse regeneration limit protection	The output frequency of pulse regeneration has exceeded the limit.	① Check the set value of Pr011 and Pr503. ② To disable the detection, set Pr533 to 0.
Err 33.0	★I/F input duplicated allocation error1 protection	Input signals (SI1, SI1, SI2, SI3, SI4, SI5, SI6, SI7, and SI8) are assigned with two functions.	Please allocate correct function to each connector pin.
Err 33.2	★I/F input function number error1 protection	Input signals (SI1, SI1, SI2, SI3, SI4, SI5, SI6, SI7, and SI8) are assigned with undefined number.	
Err 33.4	★I/F output function number	Output signals (SO1, SO2, SO3, SO4, SO5, SO6, and SO7) are assigned with	

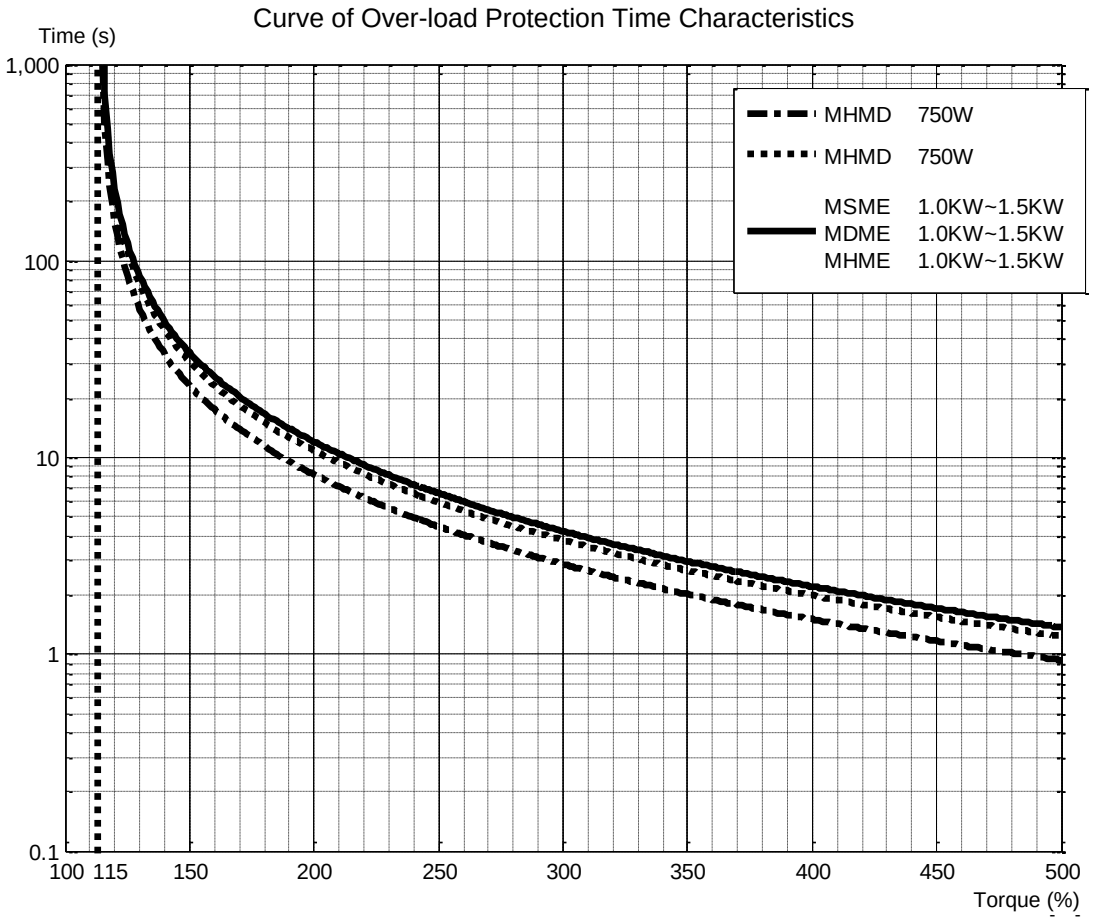
Error Code	Name	Causes	Remedy
	error1	undefined number.	
Err 34.0	Software limit protection	When a position command within the specified input range is given, the motor operates outside its working range specified in Pr514. ① Gain is not appropriate. ② Pr514 set value is low.	① Check the gain (balance between position loop gain and speed loop gain) and inertia ratio. ② Increase the set value of Pr514, or set Pr514 to 0 to disable the protective function.
Err 36.0	★EEPROM parameter error protection	Data in parameter storage area has been damaged when reading the data from EEPPOM at power-on.	① Set up all parameters again. ② If the error persists, replace the driver (it may be a failure). And return the problem product to the manufacturer.
Err 36.1			
Err 36.2			
Err 37.0	★EEPROM check code error protection	Operating to EEPROM failed when reading data from EEPROM at power-on.	
Err 37.1			
Err 37.2			
Err 38.0	★Over-travel inhibit protection	① When Pr504「Over-travel inhibit input setup」＝0, both positive and negative over-travel inhibit inputs (POT ／NOT) have been ON. ② 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. Check that the rising time of the control power supply (DC12 ～ 24V)is not slow.
Err 39.0	Current offset excess protection	Chip circuit working error in current sampling.	① Cut off the power supply and re-power ON. If error display persists, stop using and replace with a new motor. Return to the manufacturer. ② Check the connection status of connector X4.
Err 40.0	Absolute system down error protection	Voltage of the built-in capacitor has fallen below the specified value because the power suppl or battery for the absolute encoder has been down.	After connecting the power supply for the battery, clear the absolute encoder.

Error Code	Name	Causes	Remedy
		CAUTION Once this error occurs, the alarm cannot be cleared until the absolute encoder is reset.	
Err 41.0	Absolute encoder count error protection	Multi-turn counter of the absolute encoder has exceeded the specified value.	Set Pr015 to 2 to ignore the multi-turn counter over. Limit the travel from machine origin with 32767 revolutions.
Err 42.0	Absolute over-speed error protection	The motor speed has exceeded the specified value when only the supply from the battery has been supplied during the 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 failure	Error detected during initializing of encoder.	Replace the motor.
Err 44.0	Absolute single turn counter error protection	Absolute: single turn counter error protection; increment: single turn counter error protection;	Replace the motor.
Err 45.0	Absolute multi-turn counter error protection	Absolute: multi-turn counter error protection; increment encoder: single turn counter error protection;	Replace the motor.
Err 46.0	Absolute overheat protection	Encoder temperature is too high.	Cool down the temperature of the environment of motor.
Err 47.0	Absolute status error protection	Encoder has been running at faster speed than the specified value at power-on.	Avoid the motor to rotate when power is connected.
Err 48.0	Encoder Z-phase error	Missing pulses of Z-phase serial incremental encoder has been detected. The	Replace the motor.

Error Code	Name	Causes	Remedy
	protection	encoder might be a failure.	
Err 49.0	Encoder CS signal error protection	CS signal logic error of serial incremental encoder has been detected. The encoder might be a failure.	Replace the motor.
Err 57.0	Current sampling offset excess protection	Driver failure.	Return the driver to factory for repair.
Err 57.1	★Current gain diagnosis error protection	Power circuit error, or motor cables U, V and W wires are disconnected.	① Cut off the power supply and re-power ON. If error display persists, stop using and replace with a new motor. Return to the manufacturer. ② Check U, V and W wires connection of the motor cable.
Err 58.0	★Chip working error protection	Error caused by power supply for the chip or noise.	Cut off the power supply and re-power ON. If error display persists, stop using and replace with a new motor. Return to the manufacturer.
Err 56.0	ABZ incremental encoder protection	ABZ incremental encoder over-speed protection	① Check if there is miswiring for encoder cable. ② Check if there is any strong disturbance source in the vicinity of encoder.
Err 56.1		ABZ incremental encoder UVW error protection	
Err 56.2		ABZ incremental encoder ABZ error protection	
Err 59.0		Registered time expired	
Err 59.1		Version does not match.	
Err 87.0	Forced alarm input protection	Forced alarm input (E-STOP) is applied.	Check the wiring of forced alarm input (E-STOP).
Err 95.0	Motor automatic recognition error protection	The motor and voltage specification of the driver does not match.	Replace the motor which matches to the driver.
Err 95.1		The motor and encoder connector of the driver does	

Error Code	Name	Causes	Remedy
		not match.	
Err 95.2		The motor and power rate of the driver does not match.	
Err 95.3		Write to encoder EEPROM error.	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.
Err 95.4		Reading from encoder EEPROM error.	
Other error code	★Other error	Control circuit has malfunctioned due to excess noise or other causes. Some error has occurred inside of the driver while triggering self-diagnosis function of the driver.	① Turn off the power once, then re-power ON. ② Stop using the products, and replace the motor and the driver. Return the products to the manufacturer.

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



For WISE series driver 750W and 1500W, their curves of over-load protection time characteristics are the same. As shown in above figure, curve in grey color are over-load protection for driver 750W and 1500W, while curve in black color is the curve for the driver 400W.

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 with 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.

1. Applicable conditions

- Position control mode.
- Should be servo-ON condition.

- Input signals such as the deviation counter clear and command input inhibit, and correctly set up parameters excepts for controls such as torque limit setup, assuring that the motor can run smoothly.

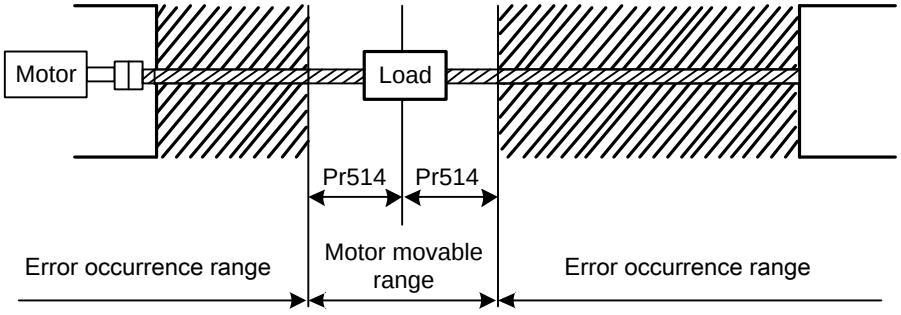
2. Cautions

- 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.

3. Example of movement

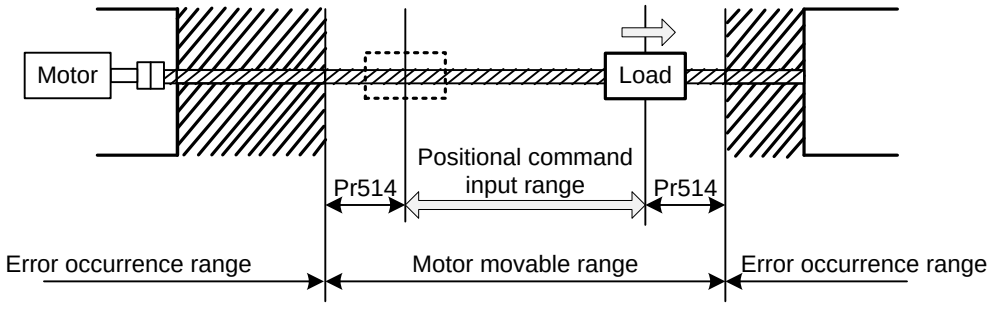
1) When no position command is entered (Servo-ON status)

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 to Err34.0 occurrence range (oblique line range), software limit protection will be activated.



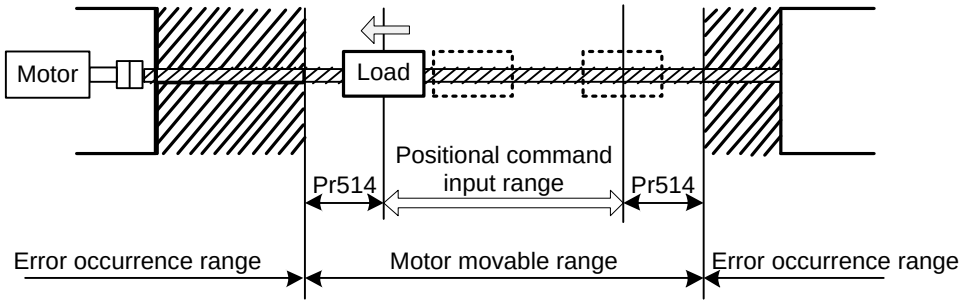
2) When the load moves to the right (at Servo-ON)

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.



3) 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.



4. 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 Abstract of Driver Registration Function

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.

8.2 Basic Configuration

The basic configuration for driver registration is as follows.

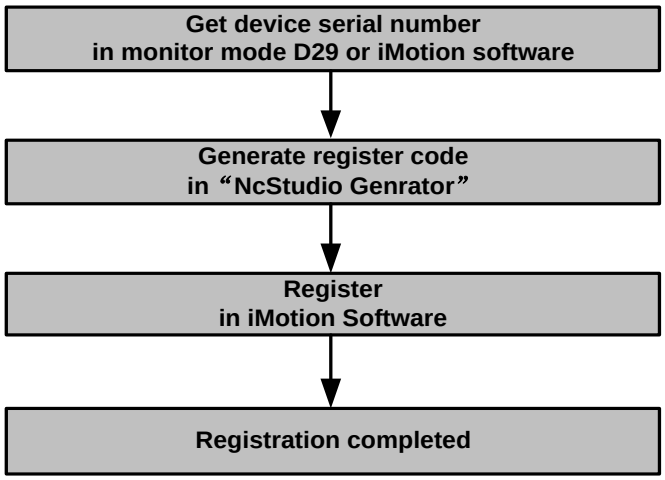
1) WISE driver
2) USB cable
3) Mobile APP “NcStudio Generator”*1
4) PC with iMotion software installed*2

CAUTION

*1: Search theApple APP store for “NcStudio Generator” or “Weihong”, and you can find the APP “NcStudio Generator”. Download and install it. You need to register 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 V1.19 or higher version.

8.3 Registration Steps



8.3.1 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

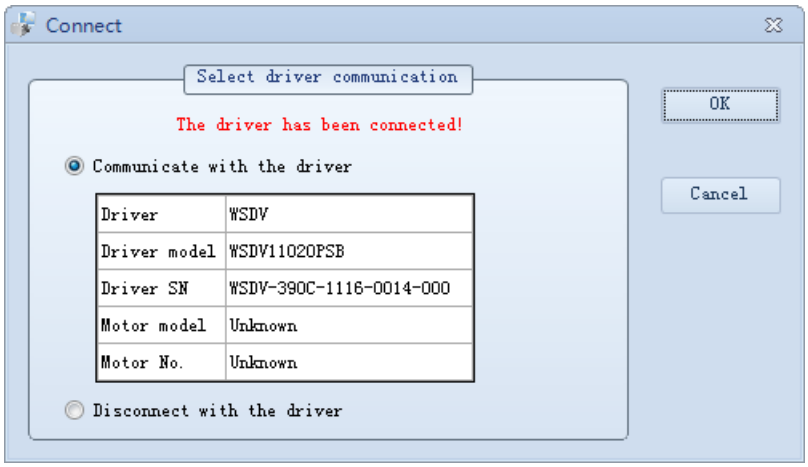
CAUTION

Decimal value is displayed in high order “H” of the panel. In order to be entered in 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.

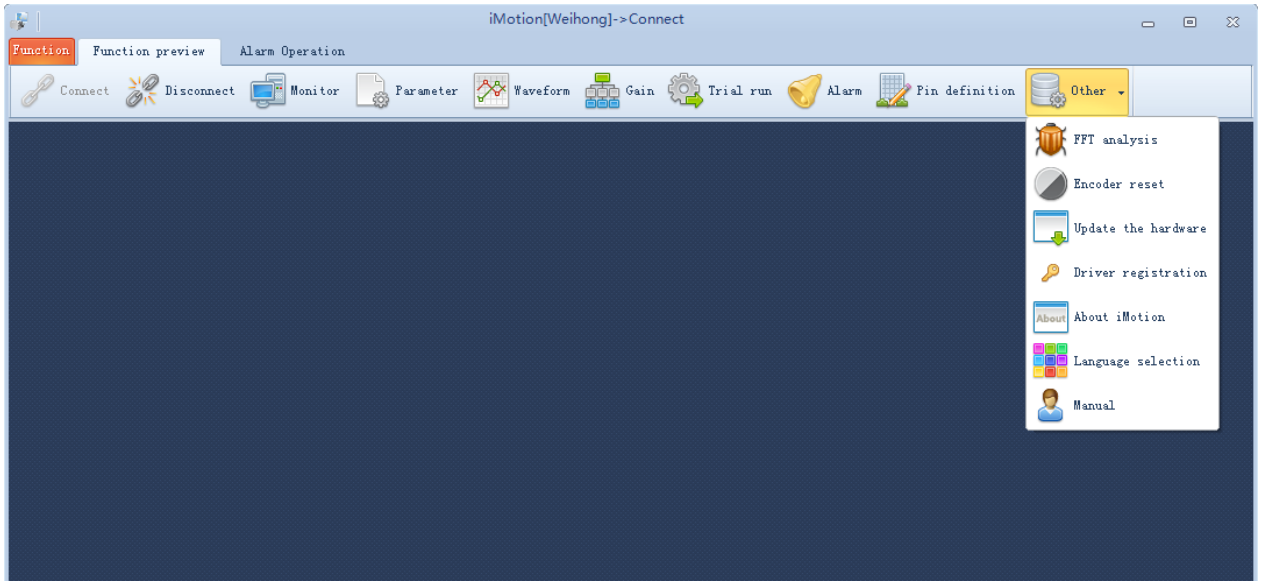
- **Read in iMotion software**

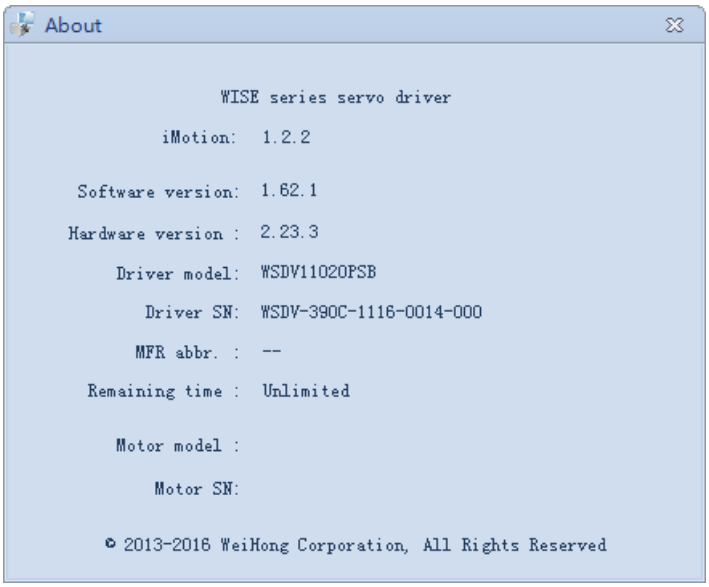
Connect the driver to PC with a USB cable, and then open iMotion software for communication connection.

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



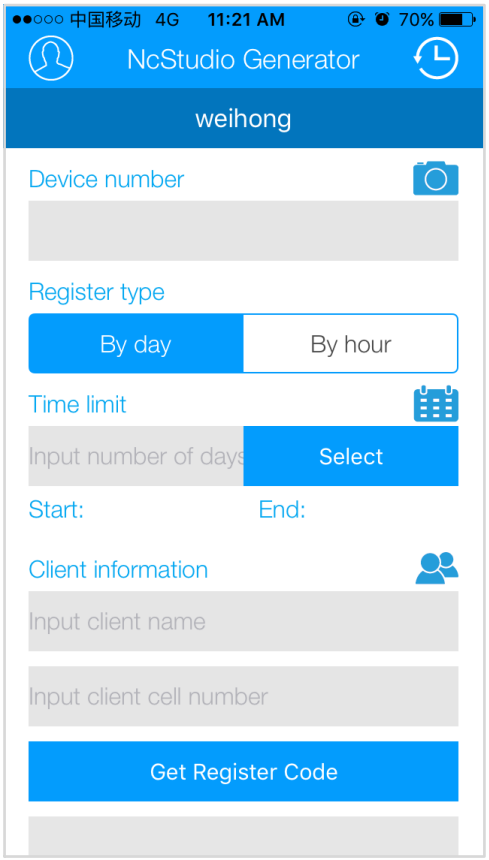
2) Under function tab “Function preview”, select sub-menu “About iMotion” of menu “Other”, and you can read the “Driver SN”, which is the device serial number.





8.3.2 Generate Register Code

1) Open APP “NcStudio Generator” as shown below.



3) Input the device serial number into “Device number”, for example, input “WSDV–2B67–1111–1111–000”. Please make sure you input the number in English input method.

4) Select a Register type. The actual registered time in register type “By day” is calculated as per the equation: Registered time (hour) = Registered day count * 24.

5) Input client name and client cell number in “Client information” part.

6) Click “Get Register Code” to generate a register code, which will be shown below later.

8.3.3 Register

Connect the driver to PC with a USB cable, and then open iMotion software for communication connection. Under function tab “Function preview”, select sub-menu “Driver Registration” of menu “Other”, and the driver registration dialog box is shown as below.

Enter the register code you generated in APP into “Register code”, and click “Register” button to finish registration.

WISE driver registration function is currently supported in part of the Lambda controllers and NcStudio instead of iMotion software. Please contact us for detailed product model of the software if you need to register in the software.

9 Parameters

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.

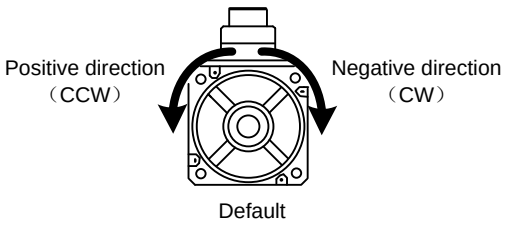
Pr000*	Name	Range	Unit	Default	Related Control Mode		
	Rotational direction setup	0~1	—	1	P	S	T

Description:

Specify the relationship between the direction of command and direction of motor rotation.

0: Motor turns CW in response to positive direction command (CW when viewed from load side shaft end);

1: Motor turns CCW in response to positive direction command (CCW when viewed from load side shaft end).



Set Value	Command Direction	Motor Rotational Direction	Positive Direction Drive Inhibit Input	Negative Direction Drive Inhibit Input
0	Positive direction	CW	Valid	—
	Negative direction	CCW	—	Valid
1	Positive direction	CCW	Valid	—
	Negative direction	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

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

Description:

Specify the action mode of the real-time auto-gain tuning.

Set Value	Mode	Vary Degree of Load Inertia in Motion
0	Invalid	Real-time auto-gain tuning function is disabled.
1	Standard	Basic mode. Do not use unbalanced load, friction compensation or gain switching.
2	Positioning *1	Main application is 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 features 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 features 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.

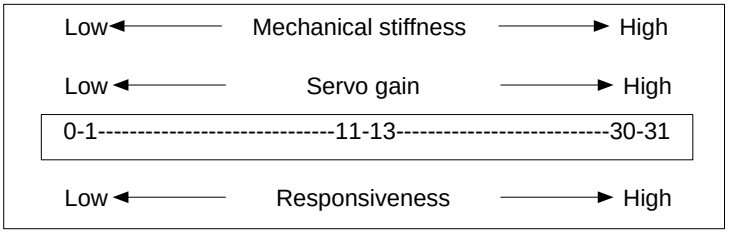
*2: Torque control is the same as in the standard mode.

*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.

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

Mechanical stiffness setup with real time auto-gain tuning enabled



CAUTION

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

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

Description:

Specify 1st inertia ratio.

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

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

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

1) If the inertia ratio is correctly set, the setup unit of Pr101 and Pr106 becomes Hz.
2) 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.

Pr006*	Name	Range	Unit	Default	Related Control Mode		
	Command pulse rotational direction setup	0~1	—	0	P	S	T

Description:

Specify the rotational direction against the command pulse input, and the command pulse input format.

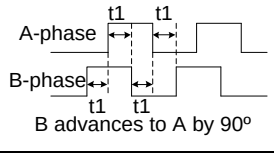
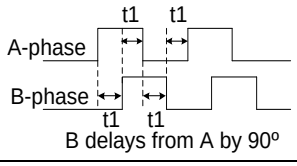
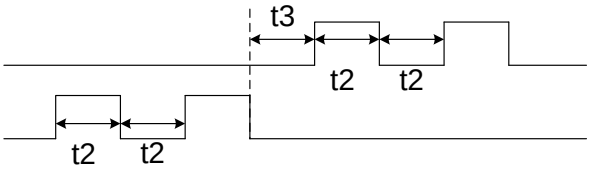
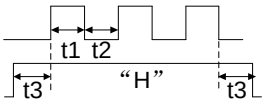
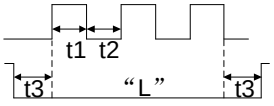
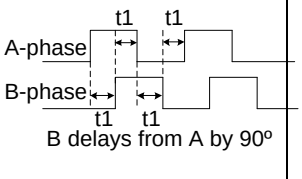
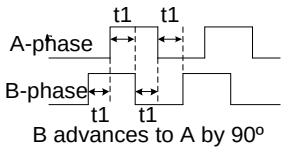
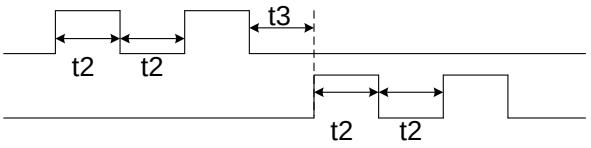
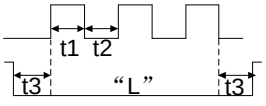
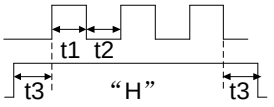
Please refer to the parameter specification of Pr007 for detailed setting of command pulse rotational direction.

	Name	Range	Unit	Default	Related Control Mode		
Pr007*	Command pulse input mode setup	0~3	—	3	P	S	T

Description:

Specify the rotational direction against the command pulse input, and the command pulse input format.

Table below shows combinations of Pr006 and Pr007:

Pr006	Pr007	Command Pulse Format	Signal Name	Positive Direction Command	Negative Direction Command
0	0 or 2	90° phase difference 2-phase pulse (A +B-phase)	PULS SIGN		
	1	Positive direction pulse train + Negative direction pulse train	PULS SIGN		
	3	Pulse train + Signal	PULS SIGN		
1	0 or 2	90° phase difference 2-phase pulse (A+B-phase)	PULS SIGN		
	1	Positive direction pulse train + Negative direction pulse train	PULS SIGN		
	3	Pulse train + Signal	PULS SIGN		

Permissible maximal input frequency and minimal necessary time width of command pulse input signal.

Permissible maximal input frequency of pulse train interface and line driver interface is 1Mpps; permissible maximal input frequency of open collector interface is 200kpps; min. necessary time width (us) is as shown in table below:

Interface Type	t1	t2	t3
Line driver interface	0.5	0.5	0.5
Open collector interface	2.5	2.5	2.5

	Name	Range	Unit	Default	Related Control Mode		
Pr008*	Command pulse counts per one motor revolution	0~8388608	pulse	10000	P	S	T

Description:

Specify the command pulse that causes single turn of the motor shaft.

When the parameter is set to 0, Pr009「1st numerator of electronic gear」and Pr010 「Denominator of electronic gear」become valid.

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

Description:

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

This setup is valid when Pr008 [Command pulse counts per one motor revolution] =0.

When the parameter is set to 0, the encoder resolution is set as the numerator.

	Name	Range	Unit	Default	Related Control Mode		
Pr010	Denominator of electronic gear	1~1073741824	—	10000	P	S	T

Description:

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

This parameter is valid when Pr008「Command pulse counts per one motor revolution」=0.

Interrelationship among Pr008, Pr009 and Pr010

Pr008	Pr009	Pr010	Comment
$1\sim2^{20}$	— (No effect)	— (No effect)	Command pulse input → Encoder resolution 【Pr008*setup value】 → Positional command Regardless of setup of Pr009 and Pr010, this operation is processed according to set value of Pr008.

Pr008	Pr009	Pr010	Comment
0	0	$1\sim2^{30}$	Command pulse input → Encoder resolution 【Pr010 setup value】 → Positional command When both Pr008 and Pr009 are set to 0, this operation is processed according to set value of Pr010.
	$1\sim2^{30}$	$1\sim2^{30}$	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 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:

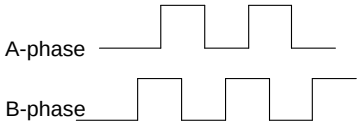
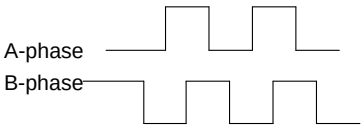
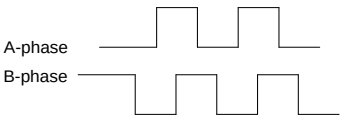
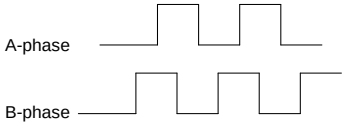
For an application where the number of output pulses per one motor revolution is not an integer, set this parameter to a value other than 0; and the dividing ratio can be set by using Pr011 as the numerator and Pr503 as the denominator. Therefore, the upper end counts the pulse number by 4 times, as 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	100000	P	S	T

Description:

Specify excess range of positional deviation by the command unit (default).

Parameter unit can be changed to encoder unit through 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	—	1	P	S	T

Description:

Specify the using method of 17-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 counter over.

Pr016*	Name	Range	Unit	Default	Related Control Mode		
	External regenerative resistor setup	0~3	—	3	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. 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 acoording 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 1000W model)
3	Set when external resistor is about 20 Ω and 800W(for 1500W model)
4	Set when external resistor is about 20 Ω and 1000W(for 2000W model)

9.2 【Class 1】Gain Adjustment

Pr100	Name	Range	Unit	Default	Related Control Mode		
	1st gain of position loop	0~30000	0.1/S	480	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	270	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	210	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”.

Pr103	Name	Range	Unit	Default	Related Control Mode		
	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.

Pr104	Name	Range	Unit	Default	Related Control Mode		
	1st time constant of torque filter	0~2500	0.01ms	84	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.

Param	Name	Range	Unit	Default	Related Control Mode		
Pr105	2nd gain of position loop	0~30000	0.1/s	570	P	S	T
Pr106	2nd gain of velocity loop	1~32767	0.1Hz	270	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	84	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. 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	0.10%	300	P	S	T

Description:

Multiplies the velocity control command which is calculated according to the internal positional command by the ratio of this parameter and adds 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:

Multiplies the torque command calculated according to the velocity control command by the ratio of this parameter and adds 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

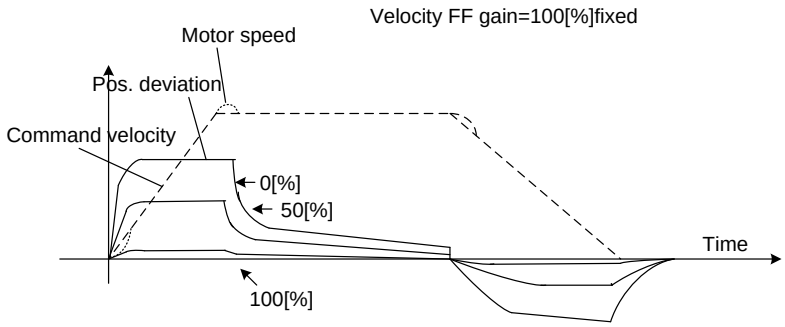
Description:

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).

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	1st gain when the gain switching input (GAIN) is open. 2nd gain when the gain switching input (GAIN) is connected to COM-. If no input signal is allocated to the gain switching input (GAIN), the 1st gain is fixed.
3	Torque command is large	Shift to the 2nd gain when the absolute value of the torque command exceeded (level+hysteresis) [%] previously with the 1st gain. 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	Only valid for velocity control. Shift to the 2nd gain when the absolute value of the speed command exceeded (level+hysteresis) [10r/min/s] previously with the 1st gain. 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. For others except velocity control, fixed at 1st Gain.
5	Speed command is large	Valid for position and velocity control. Shift to the 2nd gain when the absolute value of the speed command exceeded (level+hysteresis) [r/min] previously with the 1st gain. Return to the 1st gain when the absolute value of the speed

Set Value	Switching Condition	Gain Switching Condition
		command kept below (level+hysteresis) [r/min] previously during delay time with the 2nd gain.
6	Positional deviation is large	Valid for position control. Shift to the 2nd gain when absolute value of the positional deviation exceeded (level+hysteresis) [pulse] previously with the 1st gain. 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. Unit of level and hysteresis [pulse] is set as the encoder resolution for positional control.
7	With position command	Valid for position control. Shift to the 2nd gain when the positional command was not 0 previously with the 1st gain. Return to the 1st gain when the positional command was kept 0 previously during delay time with the 2nd gain.
8	Positioning not completed	Valid for position control. Shift to the 2nd gain when the positioning was not completed previously with the 1st gain. Return to the 1st gain when the positioning was kept in completed condition previously during delay time with the 2nd gain.
9	Actual speed is large	Valid for position control. Shift to the 2nd gain when the absolute value of the actual speed exceeded (level+hysteresis) [r/min] previously with the 1st gain. Return to the 1st gain when the absolute value of the actual speed was kept below (level+hysteresis) [r/min] previously during delay time with the 2nd gain.
10	Position command exists+Actual speed	Valid for position control. Shift to the 2nd gain when the positional command was not 0 previously with the 1st gain. 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「Position control switching mode」 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「Position control gain switching mode」 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「Position control switching mode」 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	0.1ms	33	P	S	T

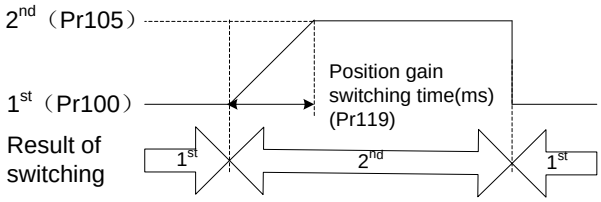
Description:

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 controlling, 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 controlling, when shifting from the 2nd gain to the 1st gain with Pr120「Velocity control switching mode」 set at 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「Velocity control gain switching mode」 is set at 3, 4 or 5. Unit of setting varies with switching mode.

CAUTION

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

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

Description:

For velocity controlling, set up triggering hysteresis when Pr120「Velocity control gain switching mode」is set at 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.

	Name	Range	Unit	Default	Related Control Mode		
Pr124	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

	Name	Range	Unit	Default	Related Control Mode		
Pr125	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「Torque control switching mode」 set at 3, set up the delay time from trigger detection to the switching operation.

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

Description:

For torque controlling, set up triggering level when Pr124 (Torque control gain switching mode) is set at 3. Unit varies depending on the setup of mode of control switching.

CAUTION

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

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

Description:

For torque controlling, set up triggering hysteresis when Pr124 (Torque control gain switching mode) is set at 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

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 and 4th notch filter will be updated based on adaptive performance.
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:

Speicify the frequency of the 1st notch filter.

CAUTION

The notch filter function will be invalid by setting up this parameter 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 by setting up this parameter 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 the 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

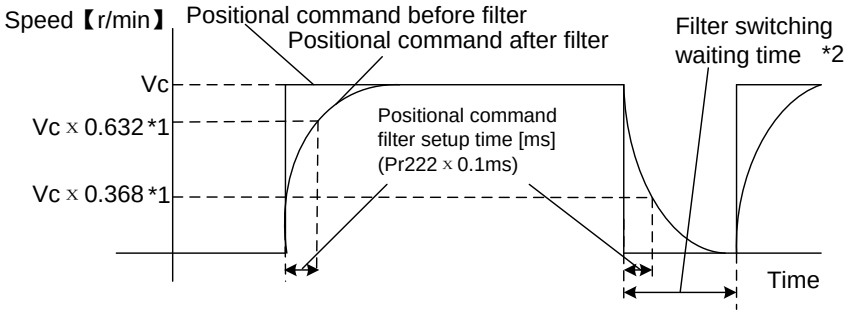
The greater the set value, the shallower the notch depth and smaller the phase delay you can obtain.

Param	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「Positional command smoothing filter」is performed, the command pulse within each control cycle is changed from 0 to a value other than 0 while the positioning complete is being output.

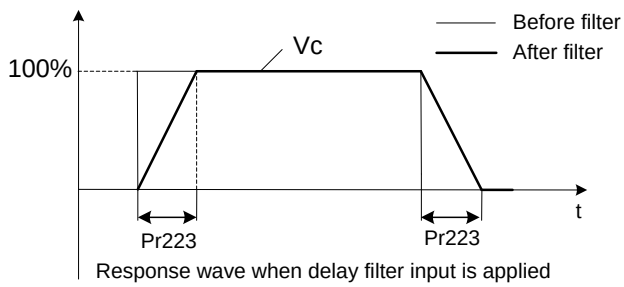
If the time constant is decreased and positioning completer range is increased, and a many number of pulses are accumulated in the filter (the area equivalent of "value of positional command filter-value of positional command after filter" integrated over the time), at the time of switching, these pulses 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「Position command smoothing filter」 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.

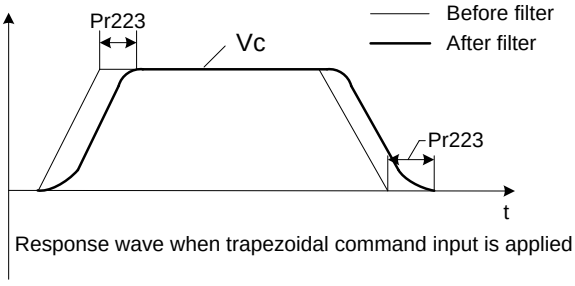
Pr223	Name	Range	Unit	Default	Related Control Mode		
	Positional command FIR filter	0~1000	0.1ms	0	P	S	T

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

	Name	Range	Unit	Default	Related Control Mode		
Pr300	Speed setup, Internal/External switching	0~3	—	1	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 between Pr300「Internal/External switching speed setup」 and 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 speed
	ON	OFF		2nd speed
	OFF	ON		3rd speed
	ON	ON		4th speed
2	OFF	OFF	No effect	1st speed
	ON	OFF		2nd speed
	OFF	ON		3rd speed
	ON	ON		SPR
3	The same as [Pr300=1]		OFF	1st ~ 4th speed
	OFF	OFF	ON	5th speed
	ON	OFF	ON	6th speed
	OFF	ON	ON	7th speed
	ON	ON	ON	8th speed

	Name	Range	Unit	Default	Related Control Mode		
Pr301	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

Param	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.

Param	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:

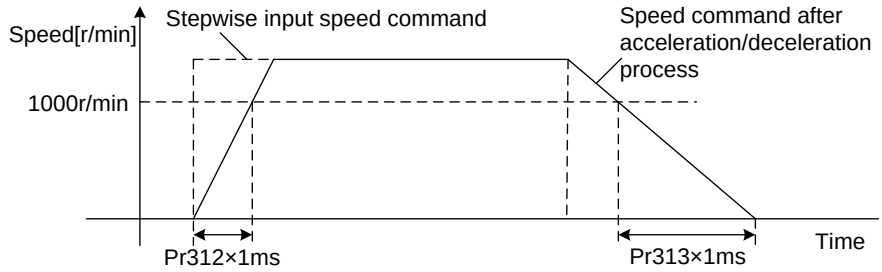
Specify the acceleration/deceleration processing time in response to the speed command input.

Set the time required for the speed command (stepwise input) to reach 1000r/min to Pr312「Acceleration time setup」. Also set the time required for the speed command to reach from 1000r/min to 0r/min, to Pr313「Deceleration time setup」.

Assuming that the target value of the speed command is Vc［r/min］, the time required for acceleration/deceleration can be computed from the following formula.

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

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

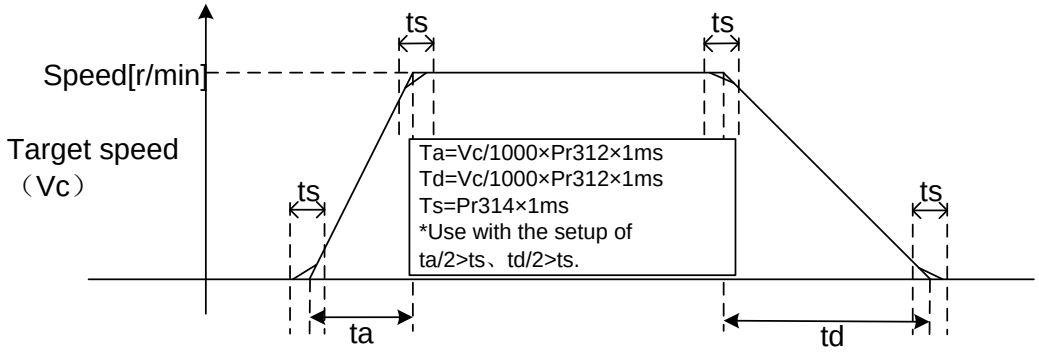


	Name	Range	Unit	Default	Related Control Mode		
Pr314	Sigmoid acceleration/deceleration time setup	0~1000	ms	0	P	S	T

Description:

Specify S-curve time for acceleration/deceleration process when the speed command is applied.

According to Pr312「Acceleration time setup」 and Pr313「Deceleration time setup」, set up sigmoid time with time width centering the inflection point of acceleration/deceleration.



	Name	Range	Unit	Default	Related Control Mode		
Pr315	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.

Set Value	ZEROSPD Input Function
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「Speed zero clamp level」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「Speed zero clamp level」－ 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「Speed zero clamp function selection」 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

Param	Name	Range	Unit	Default	Related Control Mode		
Pr400*	SI1 input selection	0~00FFFFFFh	—	00000000h (0)	P	S	T
Pr401*	SI2 input selection	0~00FFFFFFh	—	00000E00h (3584)	P	S	T
Pr402*	SI3 input selection	0~00FFFFFFh	—	00000F00h (3840)	P	S	T
Pr403*	SI4 input selection	0~00FFFFFFh	—	00020202h (131586)	P	S	T
Pr404*	SI5 input selection	0~00FFFFFFh	—	00010101h (65793)	P	S	T
Pr405*	SI6 input selection	0~00FFFFFFh	—	00111108h (1118472)	P	S	T
Pr406*	SI7 input selection	0~00FFFFFFh	—	00030303h (197379)	P	S	T
Pr407*	SI8 input selection	0~00FFFFFFh	—	00000007h (7)	P	S	T

Description:

Assign functions to SI1 ~ SI8 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	**b**
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
Deviation counter clear input	CL	07h	Do not setup

Signal Name	Symbol	Set Value	
		a	b
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

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) Servo-ON (SRV-ON) input must be assigned; otherwise, servo cannot be enabled.

4) Note that the front panel indicates parameter value in decimal number.=

Param	Name	Range	Unit	Default	Related Control Mode		
Pr408*	SO1 output selection	0~00FFFFFFh	—	00030303h (197379)	P	S	T
Pr409*	SO2 output selection	0~00FFFFFFh	—	00020202h (131586)	P	S	T
Pr410*	SO3 output selection	0~00FFFFFFh	—	00010101h (65793)	P	S	T
Pr411*	SO4 output selection	0~00FFFFFFh	—	00050504h (328964)	P	S	T
Pr412*	SO5 output selection	0~00FFFFFFh	—	00070707h (460551)	P	S	T
Pr413*	SO6 output selection	0~00FFFFFFh	—	00060606h (394758)	P	S	T
Pr414*	SO7 output selection	0~00FFFFFFh	—	00080808h (526344)	P	S	T

Assign functions to SO1~SO7 outputs. These parameters are presented in hexadecimals.
Hexadecimal presentation is followed by a specific control mode designation, as shown below.

0 0 − − − − ★★ h: position control
0 0 − − ★★ − − h: velocity control
0 0 ★★ − − − − h: torque control
Replace 「★★」 with the function number.
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 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) SO3 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.

Pr430	Name	Range	Unit	Default	Related Control Mode		
	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 can be replaced by the encoder unit by using Pr520 「Positioning unit selection」. 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 Pr430「Positioning complete range」.
1	The signal will turn on when there is no position command and the positional deviation is smaller than Pr430「Positioning complete range」.
2	The signal will turn on when there is no position command and the positional deviation is smaller than Pr430「Positioning complete range」.
3	The signal will turn on when there is no position command and the positional deviation is smaller than Pr430 「Positioning complete range」. Then holds "ON" status until the next position command is entered. ON state is maintained until Pr432 「INP hold time」 has elapsed. After the hold time, INP output will be turned ON/OFF according to the coming positional command or condition of the positional deviation.

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

Description:

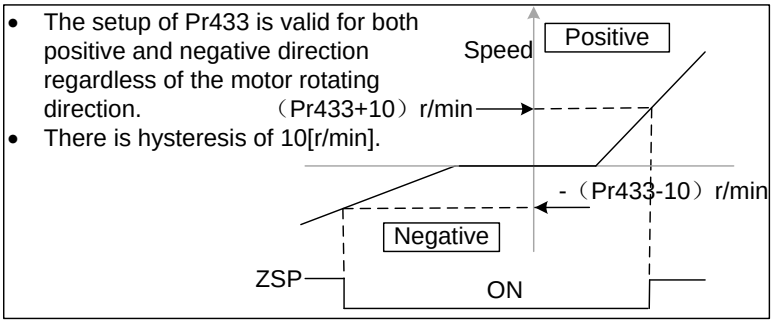
Specify the hold time when Pr431「Positioning complete output setup」＝3.

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.

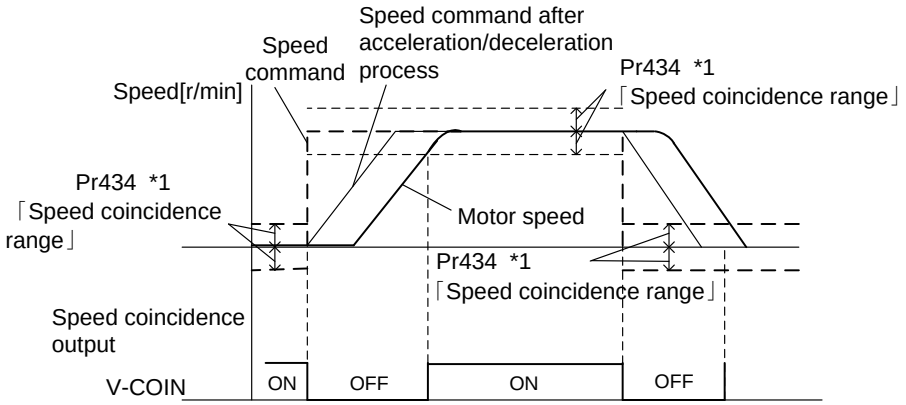


Pr434	Name	Range	Unit	Default	Related Control Mode		
	Speed coincidence range	10~20000	r/min	50	P	S	T

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.



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

Speed coincidence output OFF →ON timing: speed deviation below (Pr434－10) r/min.

ON →OFF timing: speed deviation higher than (Pr434＋10) r/min.

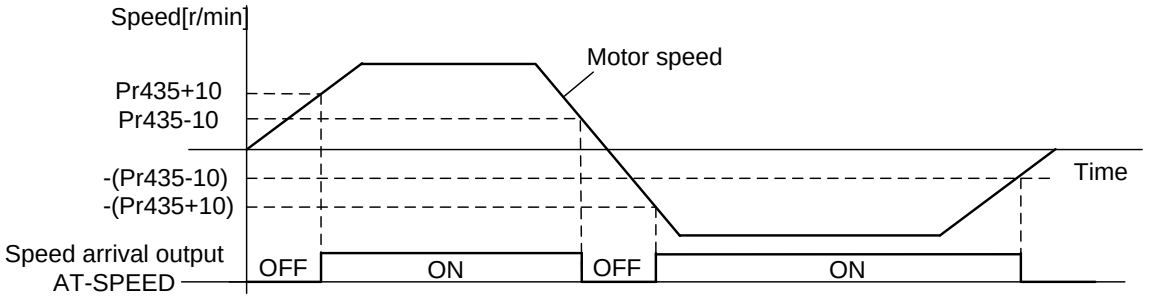
Pr435	Name	Range	Unit	Default	Related Control Mode		
	At-speed (Speed arrival)	10~20000	r/min	1000	P	S	T

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.



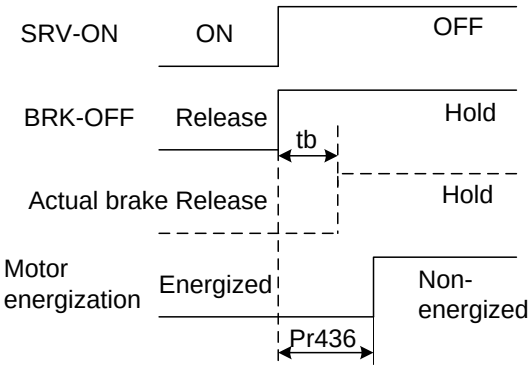
Pr436	Name	Range	Unit	Default	Related Control Mode		
	Mechanical brake action at stalling setup	0~10000	1ms	0	P	S	T

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.

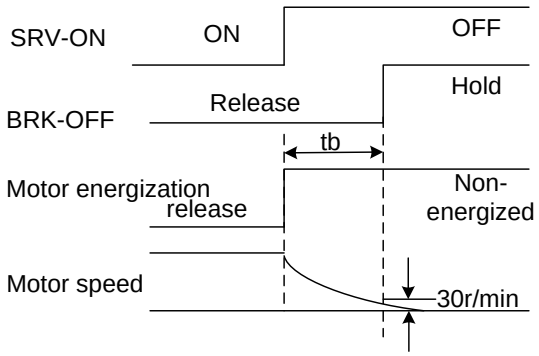


Pr437	Name	Range	Unit	Default	Related Control Mode		
	Mechanical brake action at running setup	0~10000	1ms	0	P	S	T

Description:

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

- 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. That is, 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.

Param	Name	Range	Unit	Default	Related Control Mode		
Pr439	Selection of alarm output 1	0~10	—	0	P	S	T
Pr440	Selection of alarm output 2	0~10	—	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	For internal use	—
10	For internal use	—

	Name	Range	Unit	Default	Related Control Mode		
Pr441	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「Position complete output setup」.

CAUTION

The command unit is used as the default unit but can be replaced by the encoder unit by using Pr520「Position unit selection」. Note that when encoder unit is used, unit of Pr014「Position deviation excess setup」 is also changed.

9.6 【Class 5】Enhancing Setting

Param	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 made according to the command pulse input.

This setup is enabled when Pr008「Command pulse counts per one motor revolution」= 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 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「Over-travel inhibition」= 0, specify the status during deceleration and stop after application of the over-travel inhibition (POT NOT).

Details of Pr505「Sequence at over-travel inhibit」 is 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.

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

*1: Emergency stop refers to a controlled immediate stop with servo-on. The torque command value is limited during this process by Pr511「Emergency stop torque setup」.

*2: If the positional command is kept applied or the motor is kept running with servo-off condition, positional deviation is accumulated, causing Err24.0 [Positional deviation excess protection]. In addition, if the servo is turned ON while the position is significantly deviating, the motor may rapidly operate to reduce the deviation to 0. Remember these requirements if you want to maintain the positional deviation.

*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.
*4: Positional deviation is always cleared to 0.

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 with servo on, Err13.1「Main power under voltage error」 occurs if 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「Main power OFF detection time」,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 due to 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 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: when an alarm requiring emergency stop occurs, the action A is selected when the set value in the table is set within the range 4~7, causing emergency stop of operation. 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.
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:

If the motor speed exceeds this set value, Err26.0「Over-speed protection」 occurs.
When this parameter is set to 0, the over-speed level becomes 1.2 times of the motor max. speed.

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.

Pr518	Name	Range	Unit	Default	Related Control Mode		
	Invalidation of command pulse inhibit input	0~1	—	1	P	S	T

Description:

Select command pulse inhibition input enable/disable.

Set Value	INH Input
0	Valid
1	Invalid

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	INH Input
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	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 1st to 2nd 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:

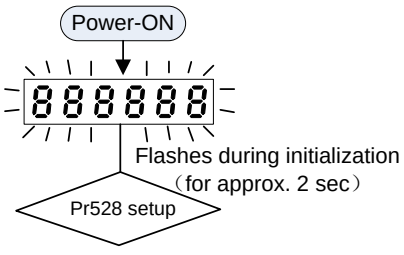
Specify negative direction torque limit upon receiving TL-SEL with Pr521「Torque limit selection」=6.

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	15	Over-load factor
1	Motor speed	16	Inertia ratio
2	Positional command speed	17	Cause of no-motor running
3	Velocity control command	18	No. of changes in I/O signals

Set Value	Content	Set Value	Content
4	Torque command	20	Absolute encoder data
5	Feedback pulse sum	24	Encoder positional deviation (encoder unit)
6	Command pulse sum	27	P-N voltage (voltage across PN)
7	Load estimation inertia ratio	28	Software version
9	Control mode	29	Driver serial No.
10	I/O signal status	30	Motor serial No.
12	Error cause and reference of history	31	Accumulated operation time
13	Alarm No.	34	Driver remaining time
14	Regenerative load factor	36	Real-time resonance frequency

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	INH Input
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

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」 occurs.

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.

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	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 the motor speed exceeds this set value, Err26.1「2nd over-speed protection 」will be activated.

When it is set to 0, the over-speed level becomes 1.2 times of the motor maximal speed.

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「Disturbance observer filter」 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 according 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	—	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.
<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>
<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>0 clear</td><td>0 clear</td><td>0 clear</td></tr>
<tr><td>2</td><td>Vertical axis mode</td><td>Update</td><td>Update</td><td>Update</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>
</table>

<table>
<tr><th>Bit</th><th>Content</th><th>Description</th></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,

$$2^0 \times 1 + 2^2 \times 1 + 2^4 \times 4 + 2^7 \times 1 + 2^8 \times 1 + 2^9 \times 2 = 1477$$

	Name	Range	Unit	Default	Related Control Mode		
Pr633	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.

	Name	Range	Unit	Default	Related Control Mode		
Pr638*	Alarm mask setup	-32767~ 32767	—	0	P	S	T

Description:

Specify the alarm detection mask.

Placing 1 to the corresponding bit position disables detection of the alarm condition.

Pr639	Name	Range	Unit	Default	Related Control Mode		
	Lambda communication ON/OFF signal	0~1	—	1	P	S	T

Description:

Default is 1, which means communication with lambda controller is ON.

Please set the parameter to 0, which means communication with lambda controller is OFF, if you need to set the pin signal of SO1.

10 Appendix

10.1 Parameter List

Param	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
Pr006*	Command pulse rotation direction setup	0~1	—	0
Pr007*	Command pulse input mode setup	0~3	—	3
Pr008*	Command pulse counts per one motor revolution	0~8388608	pulse	10000
Pr009	1st numerator of electronic gear	0~1073741824	—	0
Pr010	Denominator of electronic gear	0~1073741824	—	10000
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	100000
Pr015*	Absolute encoder setup	0~2	—	1
Pr016*	External regenerative resistor setup	0~3	—	3
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
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

Param	Name	Range	Unit	Default
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	0.10%	300
Pr111	Velocity feed forward filter	0~6400	0.01ms	50
Pr112	Torque feed forward gain	0~1000	0.1%	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
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	2 notch depth selection	0~99	—	0
Pr207	3rd notch frequency	50~5000	Hz	5000

Param	Name	Range	Unit	Default
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 filter setup	0~500	0.001	0
Pr216	2nd damping frequency	0~2000	0.1Hz	0
Pr217	2nd damping filter setup	0~500	0.001	0
Pr218	3rd damping frequency	0~2000	0.1Hz	0
Pr219	3rd damping filter setup	0~500	0.001	0
Pr220	4th damping frequency	0~2000	0.1Hz	0
Pr221	4th damping filter setup	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	Speed setup internal/external switching	0~3	—	1
Pr301	Speed command rotational direction selection	0~1	—	0
Pr304	1st speed setup	-20000~20000	r/min	0
Pr305	2nd speed setup	-20000~20000	r/min	0
Pr306	3rd speed setup	-20000~20000	r/min	0
Pr307	4th speed setup	-20000~20000	r/min	0
Pr308	5th speed setup	-20000~20000	r/min	0
Pr309	6th speed setup	-20000~20000	r/min	0
Pr310	7th speed setup	-20000~20000	r/min	0
Pr311	8th 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	0~10000	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

Param	Name	Range	Unit	Default
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	—	00000000h (0)
Pr401*	SI2 input selection	0~00FFFFFFh	—	00000E00h (3584)
Pr402*	SI3 input selection	0~00FFFFFFh	—	00000F00h (3840)
Pr403*	SI4 input selection	0~00FFFFFFh	—	00020202h (131586)
Pr404*	SI5 input selection	0~00FFFFFFh	—	00010101h (65793)
Pr405*	SI6 input selection	0~00FFFFFFh	—	00111108h (1118472)
Pr406*	SI7 input selection	0~00FFFFFFh	—	00030303h (197379)
Pr407*	SI8 input selection	0~00FFFFFFh	—	00000007h (7)
Pr408*	SO1 output selection	0~00FFFFFFh	—	00030303h (197379)
Pr409*	SO2 output selection	0~00FFFFFFh	—	00020202h (131586)
Pr410*	SO3 output selection	0~00FFFFFFh	—	00010101h (65793)
Pr411*	SO4 output selection	0~00FFFFFFh	—	00050504h (328964)
Pr412*	SO5 output selection	0~00FFFFFFh	—	00070707h (460551)
Pr413*	SO6 output selection	0~00FFFFFFh	—	00060606h (394758)
Pr414*	SO7 output selection	0~00FFFFFFh	—	00080808h (526344)
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

Param	Name	Range	Unit	Default
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	0~10	—	0
Pr440	Selection 2 of alarm output	0~10	—	0
Pr441	2nd positioning complete (In-position) range	0~262144	Command unit	10
Pr500	Numerator of 2nd electronic gear	0~1073741824	—	0
Pr501	Numerator of 3rd numerator electronic gear	0~1073741824	—	0
Pr502	Numerator of 4th numerator electronic gear	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
Pr509*	Detection time of main power OFF	70~2000	1ms	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
Pr518	Invalidation setup of command pulse input	0~1	—	1
Pr520*	Position setup unit selection	0~1	—	0
Pr521	Selection of torque limit	0~6	—	1
Pr522	2nd torque limit	0~500	%	500

Param	Name	Range	Unit	Default
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
Pr612	Positive direction torque compensation filter	0~3000	0.01ms	0
Pr615	2nd over-speed level setup	0~20000	r/min	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	Anti-vibration filter ON/OFF switch	0~2	—	0
Pr632	Real time auto-tuning custom setup	-32767~32767	—	0
Pr633	Speed setting at friction compensation taking effect	0~1000	0.1rpm	0
Pr638*	Alarm mask setup	-32767~32767	—	0
Pr639	Lambda communication ON/OFF signal	0~1	—	1

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