OEMAX CONTROLS

Maximum Value for OEMs℠

CSD3 Plus Servo Drive

(CSD3-xxBX2 Rev.B)

User Manual

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation Korea, Ltd. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation Korea, Ltd. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

WARNING 	Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
ATTENTION 	Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence
WARNING 	Labels may be located on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
BURN HAZARD 	Labels may be located on or inside the equipment, for example, a drive or motor, to alert people that surfaces may be at dangerous temperatures.

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Summary of Change

You will see change bars to the left or right of a paragraph throughout this manual to help you quickly indentify revisions.

Manual Revision	Changes	Date
A	N/A	N/A
B	Initial draft	October 2006
C	Correction of typos such as model name or connect name	May 2007
D	Firmware Update V2.4 -> V2.5[1]	November 2007
E	Changes added to CSD3-xxBX2 Rev.B Servo Drive 1. New Parameter • Pr-1.15 (Velocity Response Level) A-21[2] 2. Changed Prameter Values • Pr-0.03 (Autotuning mode) A-2[2] • Pr-0.14 (Protocol, Data Format, Baudrate) A-13[2][3] • Pr-1.00 (System Gain) A-15[2] • Pr-1.07 (Vibration Suppression Filter) A-18[2] 3. Max. Frequency of Pulse Command (Open Collector) is changed to 200kpps (300kpps before). 3-15 4. Contact Input is changed to bi-directional (unidirectional before). 3-8	February 2008

[1] For more information on firmware update, refer to CSD3 Plus Firmware Update Release Note, Ver2.50 (Publication No. CSD3-RN002A).

[2] For more information on each changed parameter, refer to the corresponding page.

[3] For more information on ASCII & Modbus-RTU Protocol, refer to 'CSD3 Servo Drive ASCII & Modbus-RTU Protocol Reference Manual (Publication CSD3-RM001).'

Read this preface to familiarize yourself with the rest of the manual.

About This Publication

This manual provides detailed installation instructions for mounting, wiring, and troubleshooting your CSD3 Plus servo drive drive, and system integration for your drive/motor combination with a Motion Card.

Who Should Use this Manual

This manual is intended for engineers or technicians directly involved in the installation and wiring of the CSD3 Plus servo drive drive, and programmers directly involved in the operation, field maintenance, and integration of the CSD3 Plus servo drive drive with a Motion Card.

If you do not have a basic understanding of the CSD3 Plus servo drive drive, contact your local OE Max sales representative before using this product, for information on available training courses.

Conventions Used in This Manual

The conventions starting below are used throughout this manual.

- Bulleted lists such as this one provide information, not procedural steps
- Numbered lists provide sequential steps or hierarchical information

Additional Resources

The following documents contain additional information concerning related CSD3 Plus servo drive products.

For	Read This Document	Publication Number
Information on the installation of your CSD3 Plus servo drive	CSD3 Plus Servo Drive Installation Instructions	CSD3-IN001
Information on the motors used together with CSD3 Plus servo drive	Servo Motor User Manual	SMOTOR-UM002

You can view or download publications at http://www.oemax.co.kr or http://www.oemax.com To order paper copies of technical documentation, contact your local Rockwell Automation Korea distributor or sales representative.

Before Using the CSD3 Servo Drive

Introduction

This chapter describes the general matters and optional specifications that you should know before using the OEMax CSD3 SERVO DRIVE.

Safety Precautions

This user's manual describes safety matters using the following marks.

Safety marks deals with the important matters. If the following marks and contents of each mark are indicated in the contents of this user's manual, you must be fully aware of them and follow them.

1. The following is a warning mark. This indicates general precautions.

WARNING

When handled incorrectly, dangerous situations or physical damages may happen.

2. The following is a caution mark. This indicates an important precaution against an electric shock.

WARNING

When handled incorrectly, dangerous situation (electrocution) may happen and cause death or severe injury.

3. The following is a caution mark. This indicates precautions against a burn.

WARNING

When handled incorrectly, dangerous situation (burn) may happen and cause death or severe injury.

4. General Precaution

- This user's manual may contain some drawings with the cover or protective shields removed for more detailed and clear explanation. Make sure to reassemble the device before operation.
- Any modification of the product made by the user is not covered by the guarantee of quality.
- Rockwell Samsung Automation is not responsible for all injuries or physical damage caused by any modification of the product made by the user.
- Contact your Rockwell Samsung Automation agent to order a copy of this manual if it has been damaged or lost.

How to Use This Manual

Terminology

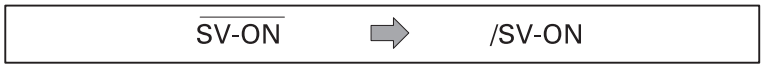
The following describes terminologies used in this manual.

- Servo drive or Drive: Refers to the CSD3 Servo Drive.
- Servo motor or Motor: Refers to the servo motor exclusively for the CSD3 drive.
- Host controller: Refers to a controller or a device that gives command to the drive and controls it.
- Initial value: Refers to the value set at the factory before the shipment.
- Set value: Refers to the initial value or the value changed and set by the users.
- User's manual: Simply indicated as 'manual'.

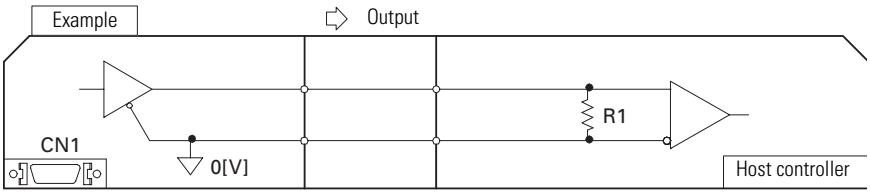
Notation Description

Within the sentences of this manual, the following is expressed as shown below. Be fully aware of them when using the servo drive.

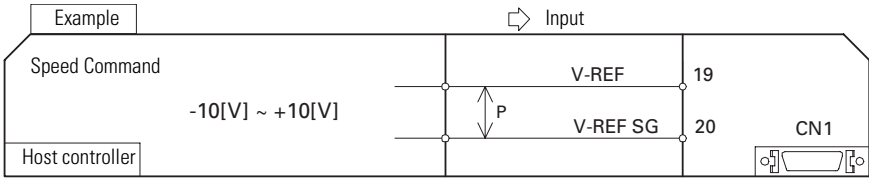
1. Use '/' in front of Active Low signal.



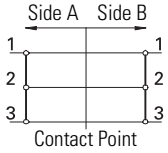
2. A figure box with both the top corners cut off diagonally represents a circuit diagram. If CN1 for I/O signal or a connector attached to the servo driver is on the left, it is the output of CN1 or servo drive.



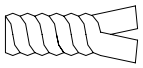
3. If CN1 for I/O signal or a connector attached to servo driver is on the right, it is the input from the host controller to CN1 or servo drive.



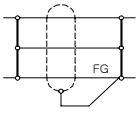
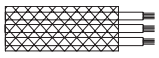
4. The following shows the symbols used on the circuit diagram.

Symbol	Description
	• The figure represents the pin number of the connector, which can be marked with alphabets rather than the numbers. • The contact point is the connection between the side A and side B with the connector.

5. The following figure shows a symbol used to show a twist pair wires to prevent the noise generation.

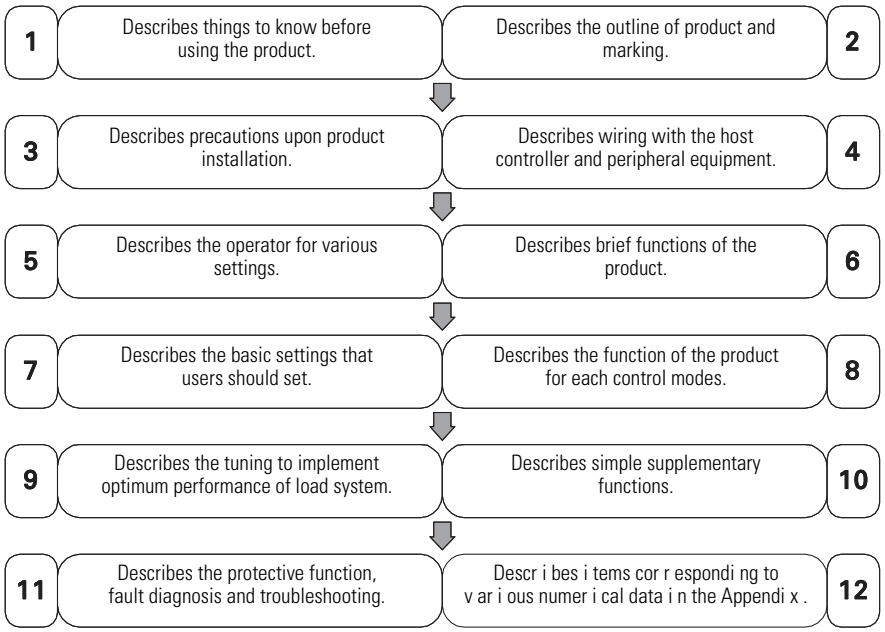
Symbol	Figure	Description
		Twist the wires where this symbol is located for the noise prevention.

6. The following figure shows a symbol used to show a shield pair wire to prevent the noise generation.

Symbol	Figure	Description
		Shield the wires where this symbol is located for the noise prevention.

Manual Description Order

This manual is described in the view of users from the purchase to operation.



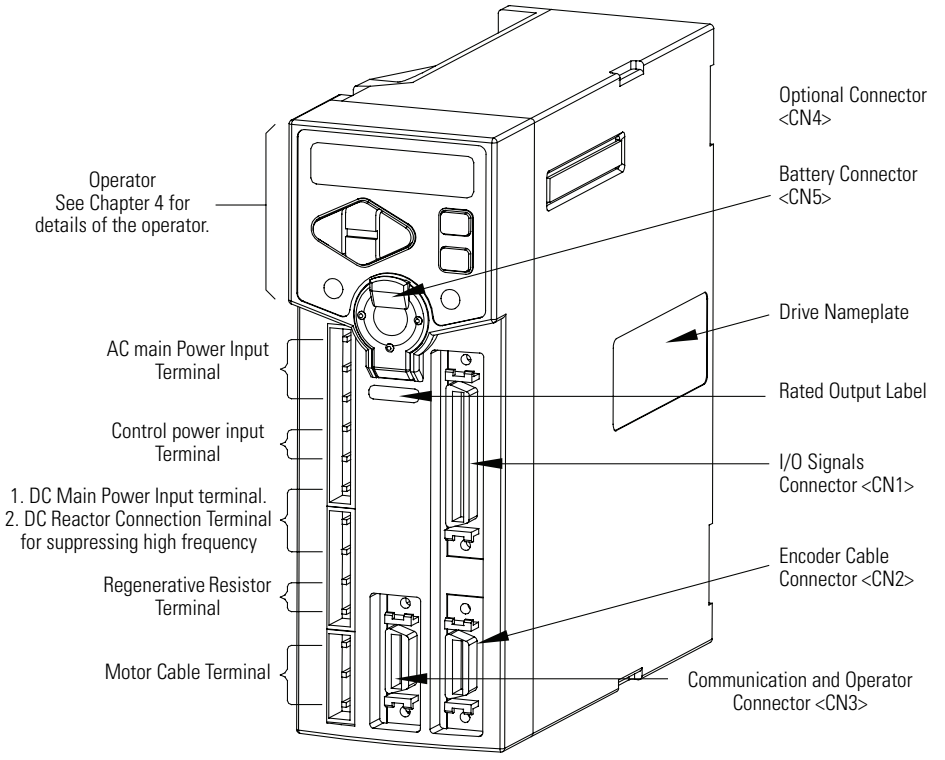
Others

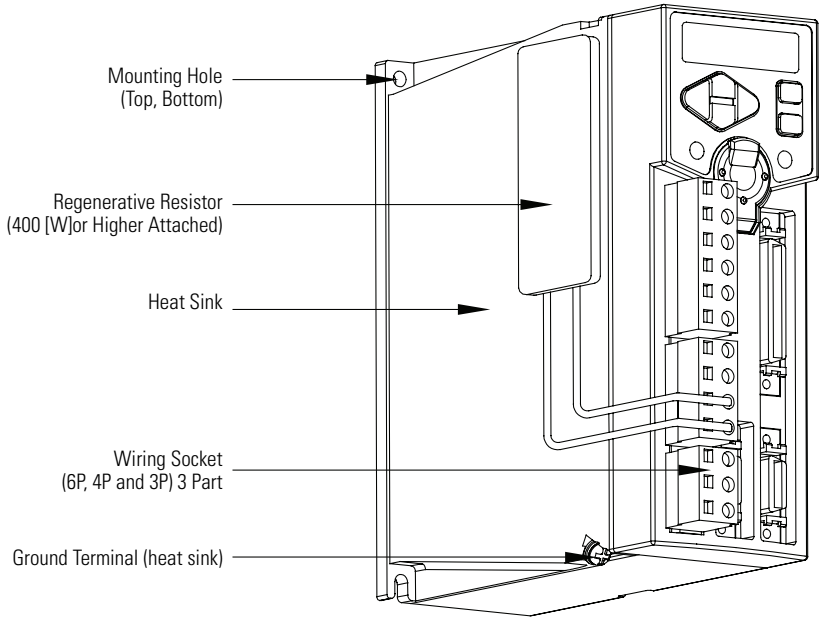
Each chapter or paragraph has a page called Before you begin before description. For easier understanding of this manual, be fully aware of the contents of this page called Before you begin in advance.

Product Type and Each Part Name

Name of Each Part of the Drive

The following figure introduces the name of each part of the servo drive.

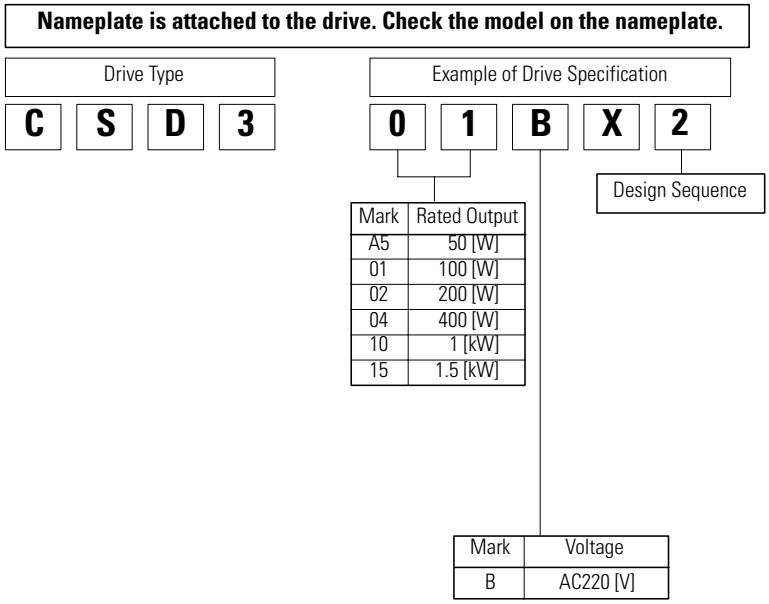




Model Number of the Drive

The following figure describes the model name on the nameplate of the servo drive.

- The nameplate is attached on the side of the drive case.
- Check the model name on the nameplate, and check if it corresponds to the product ordered.
- The drive type is Rockwell Samsung Automation Servo Drive CSD3 Series.
- The serial number is included on the nameplate. Be careful not to erase the serial number during the use.



Drive Type (by capacity)

The table below shows the capacity of drive (rated output) and the capacity of the applied motor.

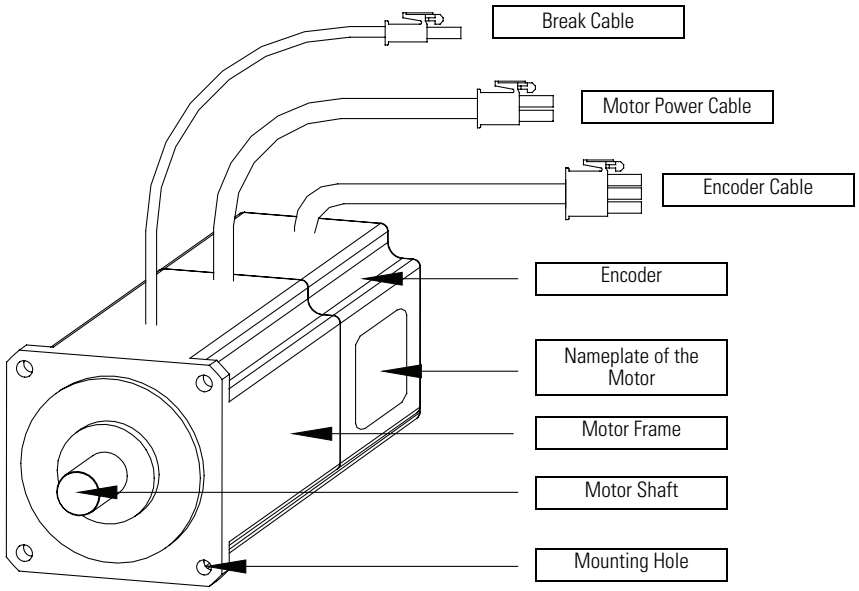
	Drive Model Name	Drive Capacity	Capacity of the Applied Motor
1	CSD3-A3BX1 (P)	30 [W]	30 [W]
2	CSD3-A5BX1 (P)	50 [W]	50 [W]
3	CSD3-01BX1 (P)	100 [W]	100 [W]
4	CSD3-02BX1 (P)	200 [W]	200 [W]

5	CSD3-04BX1 (P)	400 [W]	300 [W] to 400 [W]
6	CSD3-10BX1 (P)	1 [kW]	500 [W] to 1 [kW]
7	CSD3-15BX1 (P)	1.5 [kW]	1.2 [kW] to 1.5 [kW]

Name of Each Motor Part

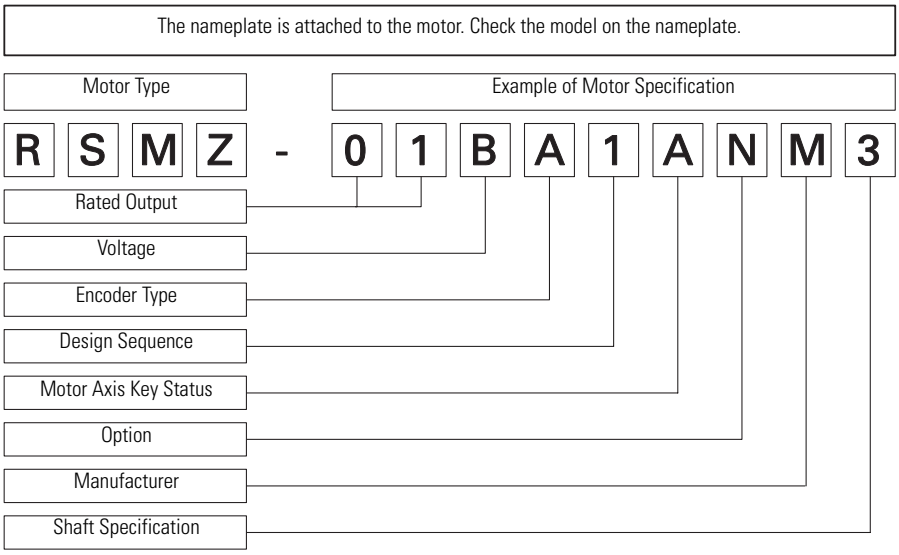
The following figure shows the name of each motor part.

- A motor without a brake does not have a brake cable.
- The name of each motor part may differ from the following figure according to the motor type.



Model Number of the Motor

The following figure describes the model name of the motor on the nameplate.



This is the description of the model on the nameplate of the motor.

Motor Type								
CSM	CSMT	CSMR	CSMQ	CSMZ	CSMD	CSMH	CSMK	CSMS
RSMD	RSMF	RSMS	RSMH	RSMK	RSML	RSMQ	RSMZ	

Rated Output									
A3	A5	01	02	04	~	~	10	~	50
30 [W]	50 [W]	100 [W]	200 [W]	400 [W]	~	~	1 [kW]	~	5 [kW]

Voltage			
A	B	C	D
AC 110 [V]	AC 220 [V]	DC 24 [V]	AC 110/220 [V]

Encoder Type

Motor Model: CSMT/R, RSMS/D/H/F/K/L/Q/Z

Mark	Resolution/1 Rotation	Encoder Type
Q	131072	Serial Absolute Type

Mark	Resolution/1 Rotation	Encoder Type
R	131072	Serial Incremental Type

Motor Type: CSM, CSMT/R		
Mark	**Pulse/1 Rotation**	**Encoder Type**
S	2048	15wire Inc.
B	2048	9wire Inc.
A	2048	Absolute Type
D	2500	15wire Inc.
C	2000	15wire Inc.
K	5000	15wire Inc.

Motor Type		CSMQ/Z/S/D/H/K RSMS/D/H/F/K/L/Q/Z *1)
Mark	Pulse/1 Rotation	Encoder Type
A*1)	2500	11wire Inc.
H	2048	Compact Absolute Type
M*1)	10000	15wire Inc.
K	5000	15wire Inc.
L	6000	15wire Inc.

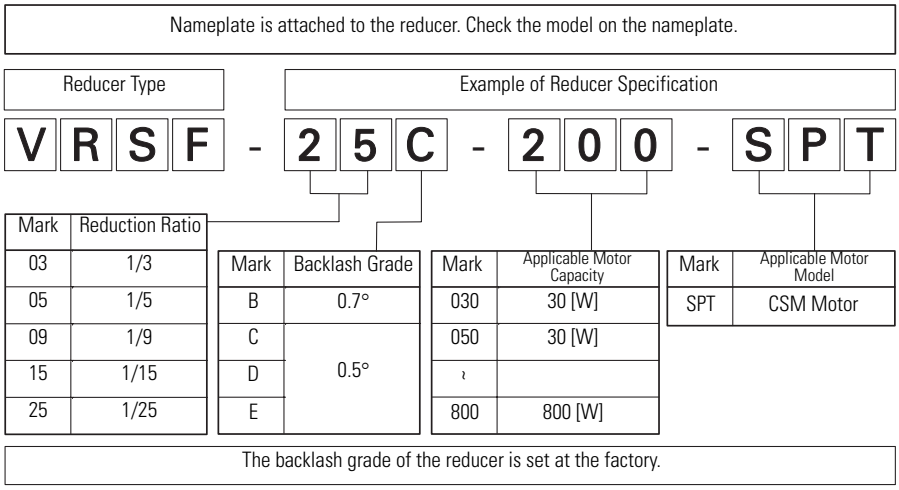
Motor Axis Key Status	
A	B
Key	No Key

Option			
N	B	S	T
No Option	With Brake	With Oil Seal	With Brake & Oil seal

Motor axis specifications					
1	2	3	4	5	6
Circular (Coupling Tightening)	2 Side Slice (Set screw tightening)	Key Tightening	Tapper Tightening	General Reducer	Harmonic Drive Attachment

Reducer

The following figure describes the model name of the reducer on the nameplate.



Type of Reducers Exclusively for CSM Motor

VRSF-					
Reduction Ratio	1/3	1/5	1/9	1/15	1/25
Reducer Type	03B-50-SPT 03B-100-SPT 03B-200-SPT 03B-400-SPT 03C-600-SPT 03C-800-SPT	05B-50-SPT 05B-100-SPT 05B-200-SPT 05C-400-SPT 05C-600-SPT 05C-800-SPT	9B-50-SPT 9B-100-SPT 9C-200-SPT 9C-400-SPT 9B-600-SPT 9B-800-SPT	15B-50-SPT 15B-100-SPT 15C-200-SPT 15C-400-SPT 15D-600-SPT 15D-800-SPT	25B-50-SPT 25C-100-SPT 25C-200-SPT 25D-400-SPT 25E-600-SPT 25E-800-SPT

The reducer is only for CSM motors

Installation

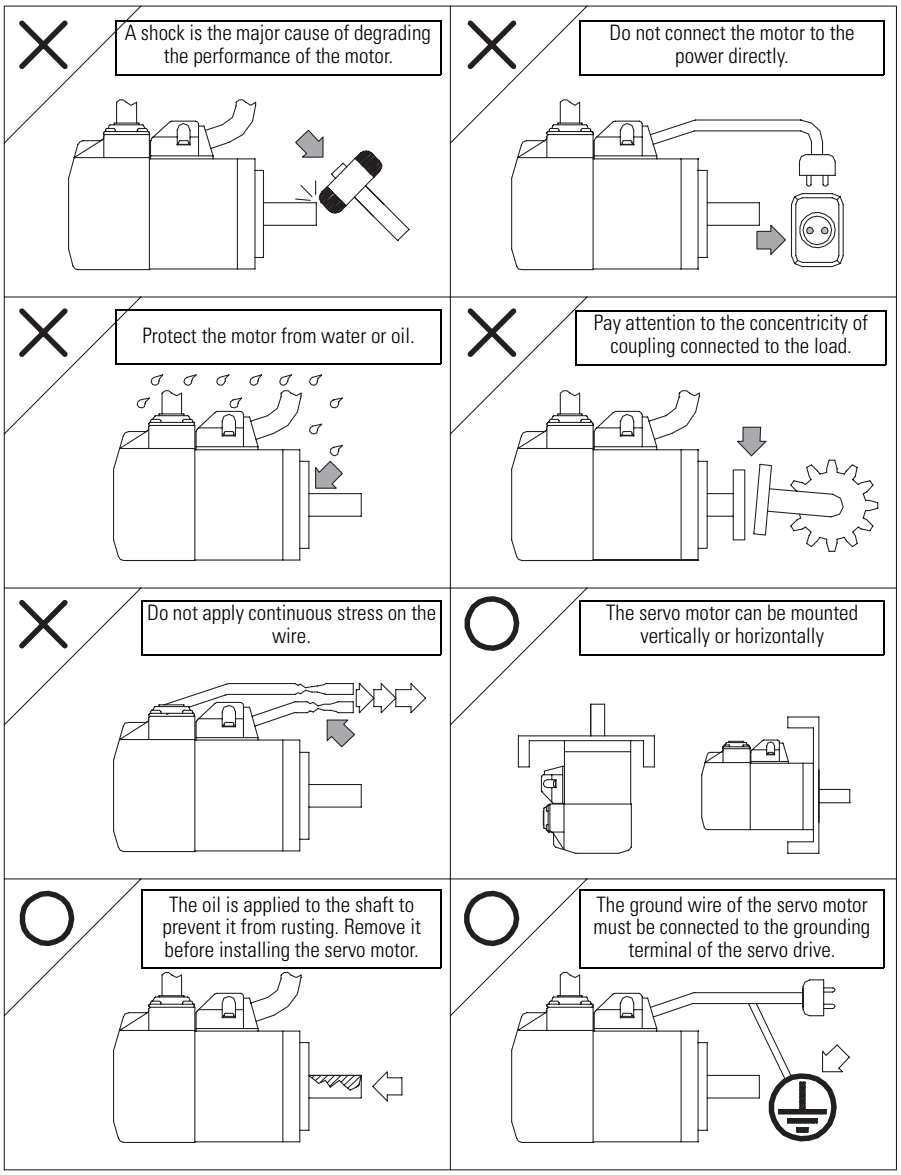
Installation

This chapter describes matters to consider when installing the servo drive and the motor. Refer to the appendix for numerical data on the drive, motor, and various peripheral equipment necessary for the installation.

Servo Motor

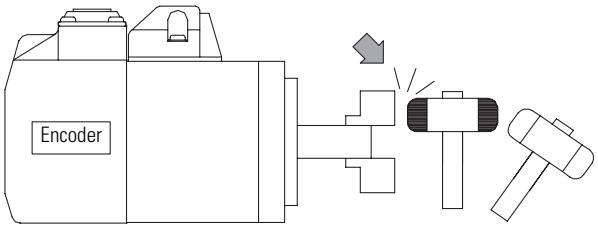
Precautions

Refer to the following figures when installing a motor.
A motor is a precision part. Pay an extra attention to the encoder, motor shaft, and bearing.



Coupling Assembly

Avoid excessive instantaneous shocks.

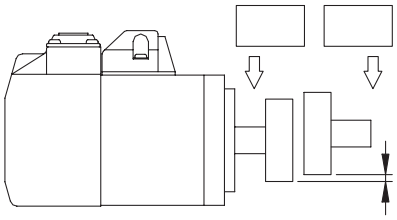


An excessive shock during the coupling assembly damages the encoder.

Use the coupling assembly tools and assemble it properly.

Load Connection

Align the connection shaft of motor and load each other.



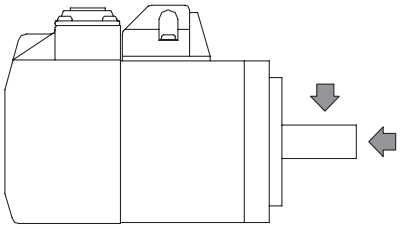
After assembling coupling, measure the concentricity of the motor shaft and the load shaft. By rotating it at intervals of 90 degrees, measure 4 positions and adjust it so that the difference between the maximum and minimum value is less than 0.03 [mm].

If the centers of the axes are different, it leads to the major cause of performance degradation.

Allowable Load on the Shaft

Loads in the motor shaft should be within the specified allowable load.

Refer to the motor specifications in the appendix for allowable load of the motor shaft on each motor type.



(Vertical)Radial Load [kg·f]

(Horizontal) Thrust Load [kg·f]

Installation Environment

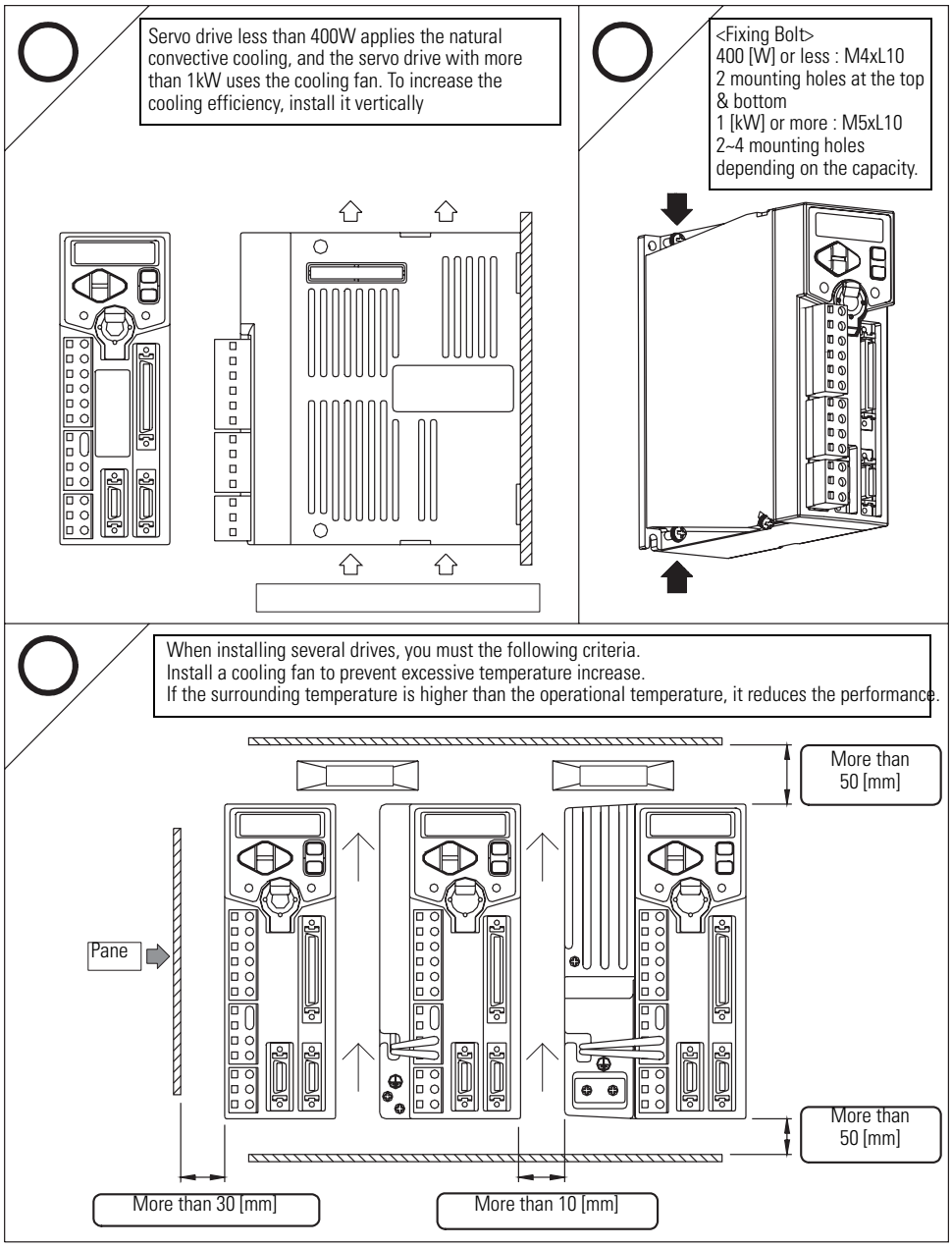
Item	Installation Environment
Storing Temperature	Store it within -20 ~ 60[].
Operating Temperature	Use it within 0 ~ 55[]
Operating Humidity	Use it below 90[%] RH at a place without condensation.
Operating Environment	Use it indoors with well ventilation, at a place for easy checkup and cleaning, and at a place without explosive gas.

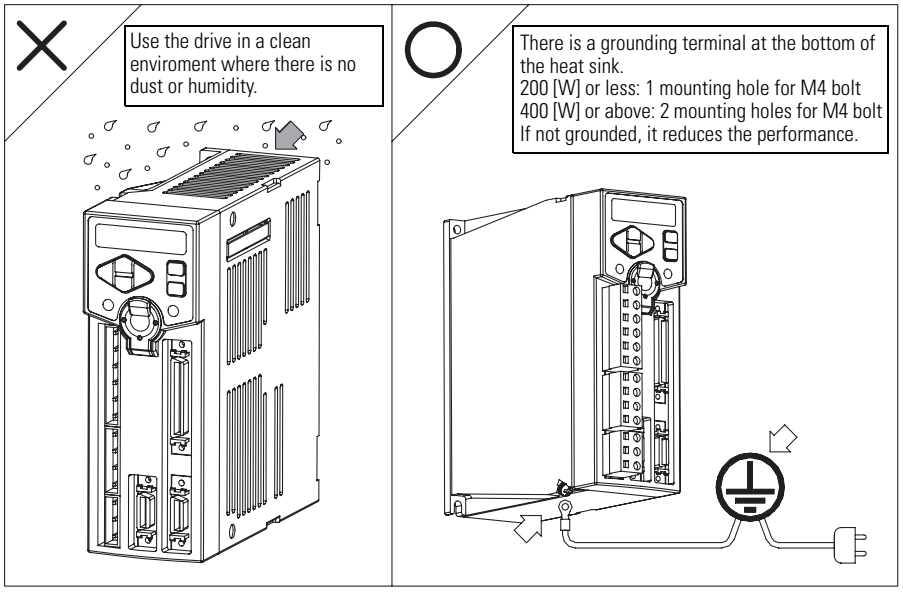
Servo Drive

Precautions

Refer to the following figures when installing the servo drive.

- The most important thing to consider when installing the drive is the ambient temperature.
- Follow the operational temperature and mount the servo drive vertically.





1. Installation Environment

Item	Installation Environment
Storing Temperature	Store it within -20 to 80 [°C].
Operational Temperature	Use it within 0 to 55 [°C].
Operational Humidity	Use it below 90 [%] RH at a place without condensation.
Vibration	Use it below 0.5 [g] (4.9 [m/s^2]).
Operational Location	Install a separate cooling device at a place with high ambient temperature and use it within the operational temperature. Recommendations: To maintain reliability for a long time, use it within 0 to 45 [°C]. Use it indoors with well ventilation, at a place for easy checkup and cleaning, and at a place without explosive gas.

Wiring

Introduction

This chapter describes the information on motor, host controller and other wiring connected to the servo drive, along with the circuit diagram.

Before You Begin

Pay attention to the following precautions when wiring.

WARNING

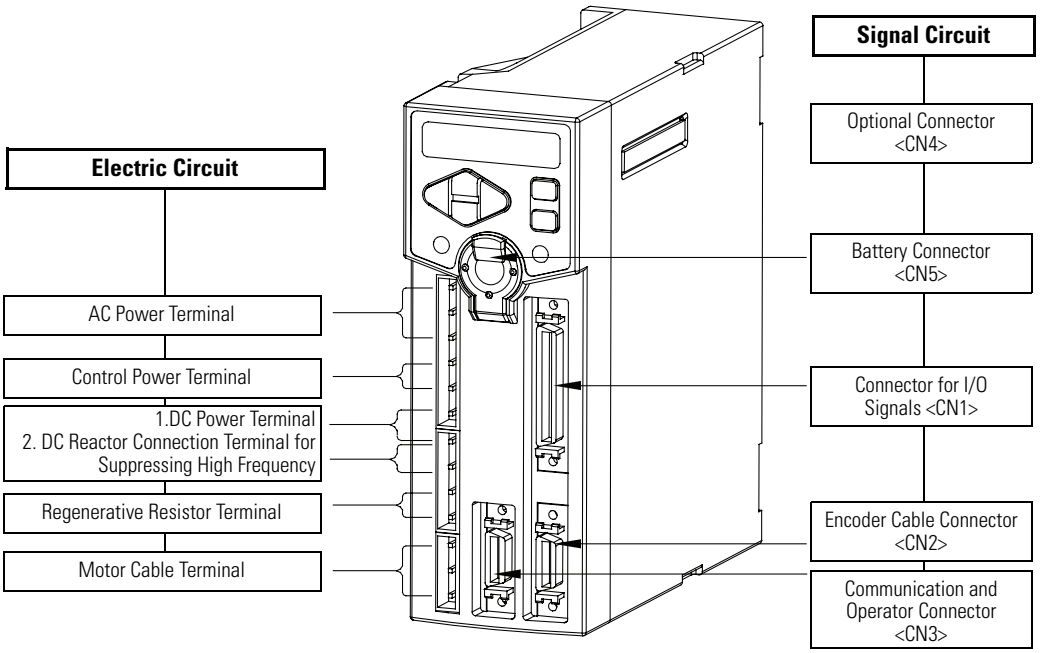
- Wiring should be done only by the qualified personnel.
- High voltage remains in the drive even though the power is off. Therefore, do not inspect components unless inside "Charge" lamp is off.
- Pay attention to the polarity when wiring.

WARNING

- The heat sink of the drive generates high heat.
- Pay attention to the heat sink when wiring.

In this chapter, the circuit is divided into electric circuit and signal circuit for easier and convenient explanation.

Be fully aware of the names of each terminal when reading this user's manual.



NOTE

- The I/O signal connector CN1, encoder cable connector CN2, and battery connector CN5 are included only in the description of the signal circuit.
- The description of other connectors are omitted.

Electric Circuit

Name and Function

The terminal symbol is printed on the wiring socket at the electric circuit terminal of the drive. Observe the drive to identify and understand the terminals on the following table, and then wire accordingly.

Terminal	L1, L2, L3	AC Power Terminal
400 [W] or lower	Single phase 200 to 230 [V] (50/60 [Hz]) L3 port must not be used.	
400 [W] or higher	3 phase 200 to 230 [V] (50/60 [Hz])	

Terminal	L1C, L2C	Control Power Terminal
No output division	Single phase 200 to 230 [V] (50/60 [Hz])	

- The main power and control power can be divided when connecting to the drive. Therefore, the user can configure surrounding circuits when the main power is cut off in an emergency or when the drive itself checks the status and cuts off the power.
- If the drive independently checks the status and only the main power is cut off, but not the control power, the drive can display the cause of cut-off of the main power. The user can take appropriate action after identifying the cause of cut-off of the main power.
- Refer to the Chapter 3 for the Electric Circuit Diagram of the power separation.

Terminal	U, V, W	Motor Cable Terminal
Connect the motor cable.		

NOTE

- The motor cable connectors (U, V, W) are output terminals. Do not connect the input power.
- It causes the fire.

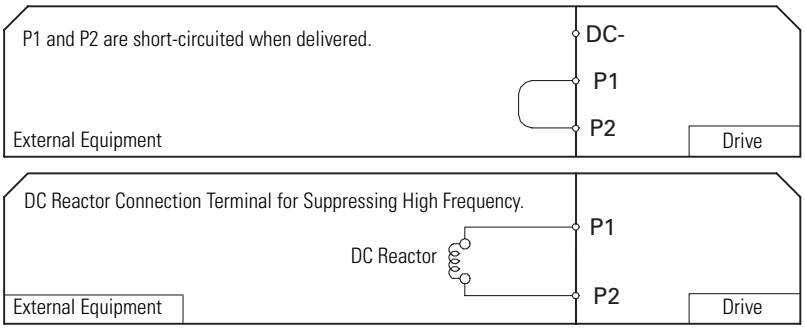
Terminal	⏚	Grounding Terminal (Heat Sink)
Connect the power and motor cable to the grounding terminal.		

Terminal	B1, B2	Regenerative Resistor Connection Port
200 [W] or lower	As the function for regenerative energy consumption is not required, the regenerative resistor does not have to be mounted.	
400 [W] or higher	If the capacity of mounted regenerative resistor is insufficient, remove it or connect it to the mounted regenerative resistor in parallel.	
Refer to the Chapter 7-11 for more information the Regeneration Resistor.		

Terminal	DC-, P1, P2	DC Main Power Terminal or DC Reactor Connection Terminal for Suppressing High Frequency.

The main power can be input by selecting either terminals (L1, L2 and L3) for the AC main power terminal, or the terminals (DC- and P1) for the DC main power terminal.
Refer to the Chapter 4-8 for the selection method.
The initial setting is the AC main power input through the terminals (L1, L2 and L3).

When using the AC main power through terminals (L1, L2, L3), the terminals (P1, P2) can be used to connect the DC reactor for RF control.



WARNING

- The main power can be input by selecting either terminals (L1, L2 and L3) for the AC main power terminal, or the terminals (DC- and P1) for the DC main power terminal.
  Connect only either AC main power terminal or the DC main power terminal.
- When wiring the wiring socket, be careful not to expose the core wire. It may case an electric shock.

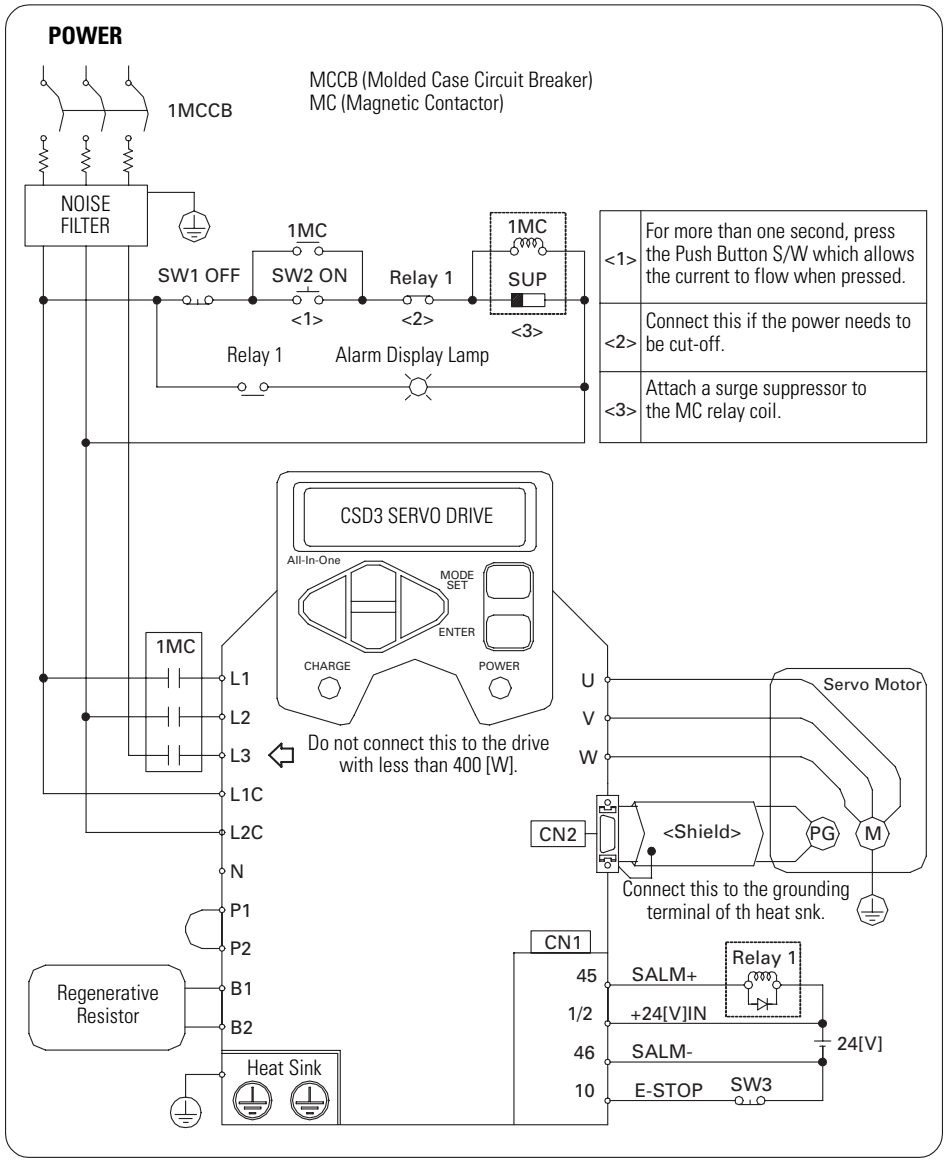
NOTE

- When using the DC main power terminal for the main power supply, refer to the Chapter 4-8 for information on the setting of main power input selection.
- If the terminals DC-, P1 and P2 are not used for 'DC main power input' or 'DC reactor for RF control', do not remove the short circuit wire of the terminals (P1 and P2) which is short circuit when delivered.

Electric Circuit Diagram

This is a circuit diagram where the main power is supplied from AC main power input terminal.

Use single-phase power in servo drive whose rated output (capacity) is 400 [W] or lower. Thus, do not use the terminal L3.



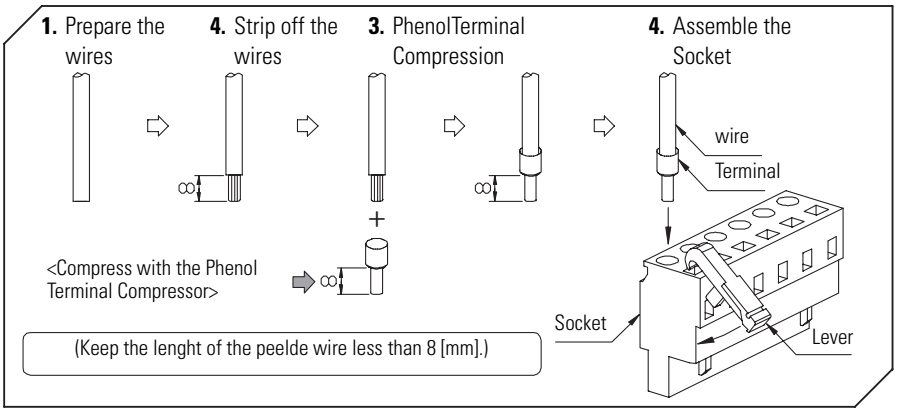
Using the Socket and Lever

This section describes the usage of wiring socket and lever provided with servo drive.

- Connect only one wire at wire inlet of the socket.
- If the wire is pulled accidentally with an excessive force, rewire it properly.
- The peeled wire can be used. (Keep the length of the peeled core wire less than 8 [mm].)
- The use of phenol terminal is recommended for the reliability of wiring.
- Use a lever for wires provided with the product.

The following figure shows the sequence of assembling wire at the socket.

- As shown in the figure, insert lever in the socket and press it.
- Insert wire into socket and release the lever.
- Pull it slightly to check if the connection between the socket and wire is normal.



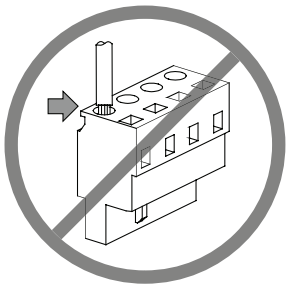
The thickness of wire allowed by the socket is shown below.

	Thickness of Wire
Single	∅0.5 to ∅0.8 [mm]

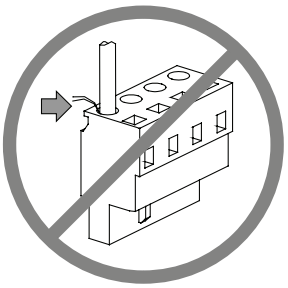
	Thickness of Wire
Twist	AWG28 to AWG12

WARNING

Insert the wire completely.



If peeled core wire is exposed, it may cause an electric shock.



NOTE

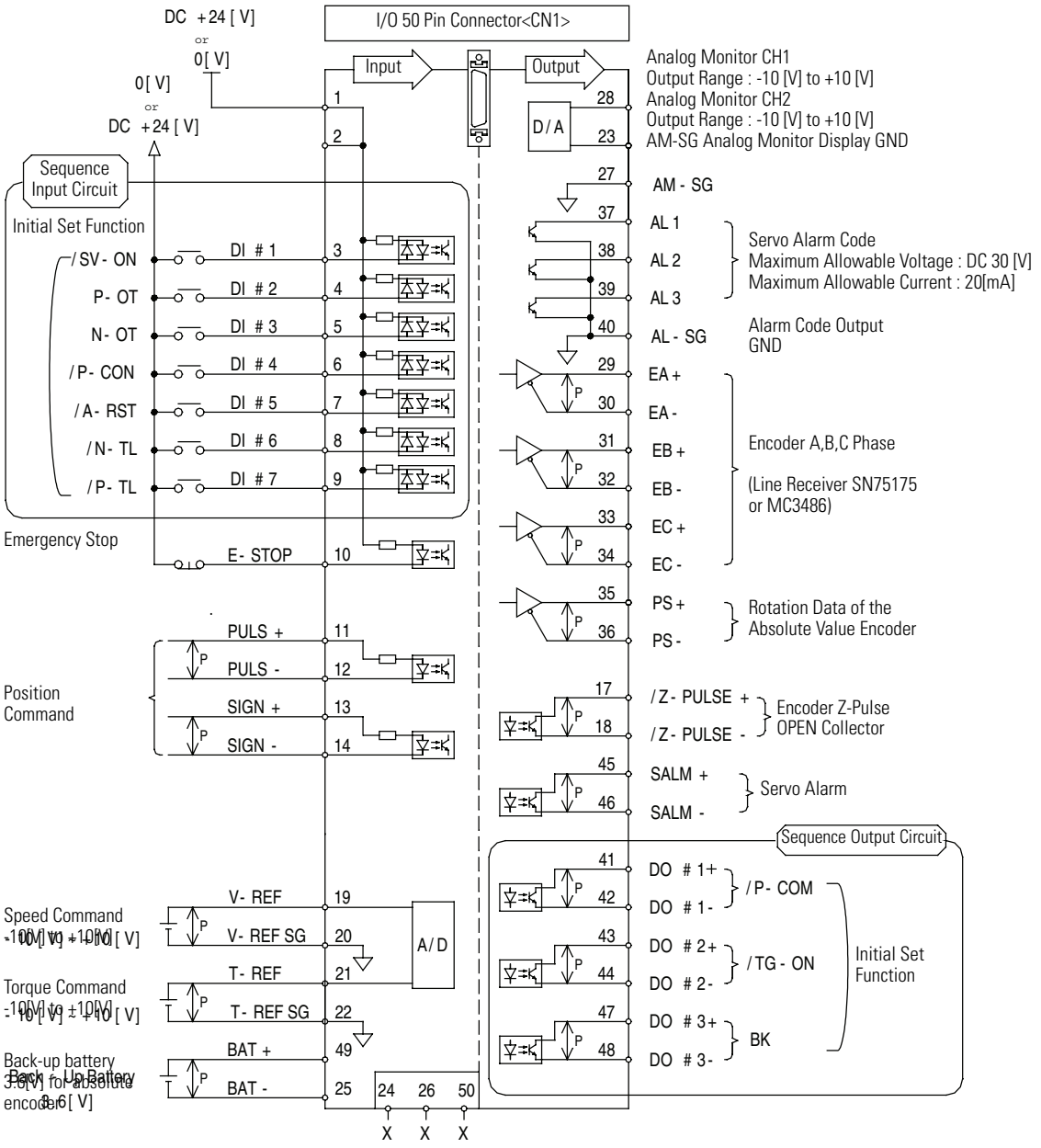
The lever is a small tool, used when wiring. Keep it for other wiring jobs.

I/O Signal (CN1)

I/O Connection Diagram

This is the circuit diagram of a connector for I/O signal. It is divided into input on the left and output on the right.

The Backup battery for absolute value encoder can be connected to (CN5) and (CN1 49, 25). It must be connected to one side only.



(CN1) Pin Arrangement

Pin #	Specifications		
	Symbol	Wire Color	Electrical Features
1	+24 [V] IN	Red	External 24 [V] input for contact point input.
2		Yellow	
3	DI#1	Blue	Pin for sequence input signal. (Terminal input) Refer to the Chapter 5 for details.
4	DI#2	White	
5	DI#3	Pink	
6	DI#4	Orange	
7	DI#5	Gray	
8	DI#6	Red 1 Point	
9	DI#7	Yellow 1 Point	
10	E-STOP	Blue 1 point	Emergency signal input. (Terminal input)
11	PULS+	White 1 point	Signal input for position control mode. (Input of line drive and open collector)
12	PULS-	Pink 1 point	
13	SIGN+	Orange 1 Point	
14	SIGN-	Gray 1 Point	
15	PCLR+	Red 2 Points	
16	PCLR-	Yellow 2 Points	
17	Z-PULSE+	Blue 2 Points	Encoder Z-PULSE output. (Terminal output)
18	Z-PULSE-	White 2 Points	
19	V-REF	Pink 2 Points	Signal input for speed control mode. Analog speed command -10 [V] to +10 [V].
20	V-REF SG	Orange 2 Points	
21	T-REF	Gray 2 Points	Signal input for torque control mode. Analog torque command -10 [V] to +10 [V].
22	T-REF SG	Red 3 Points	
23	AM-CH2	Yellow 3 Points	Analog monitor CH2. -10 [V] to +10 [V].
24	-	-	-
25	BAT-	White 3 Points	Absolute encoder battery GND.
26	-	-	-
27	AM-SG	Orange 3 Points	Analog monitor output GND.
28	AM-CH1	Gray 3 Points	Analog monitor CH1. -10 [V] to +10 [V]
29	EA+	Red 4 Points	Encoder signal output. (line drive output).
30	EA-	Yellow 4 Points	
31	EB+	Blue 4 Points	Encoder signal output. (Line drive output)
32	EB-	White 4 Points	
33	EC+	Pink 4 Points	
34	EC-	Orange 4 Points	
35	PS+	Gray 4 Points	
36	PS-	Red/Line	

37	AL1	Yellow/ Line	Alarm code output. (Open collector output)
38	AL2	Blue/ Line	
39	AL3	White/ Line	
40	AL-SG	Pink/ Line	Alarm code output GND.
41	D0#1+	Orange / Line	Sequence output signal pin. (Terminal input) Refer to the Chapter 5-2 for details.
42	D0#1-	Gray / Line	
43	D0#2+	Red / Line 1	
44	D0#2-	Yellow / Line 1	
45	SALM+	Blue / Line 1	Servo alarm generation signal output. (Terminal output)
46	SALM-	White / Line 1	
47	D0#3+	Pink / Line 1	Sequence output signal pin. (Terminal input) Refer to the Chapter 5-2 for details.
48	D0#3-	Orange / Line 1	
49	BAT+	Gray / Line 1	Absolute encoder battery power. 3.6 [V]
50	-	-	-

(CN1) Input Signal

Sequence Input Signal (allocation)

Refer to the Chapter 5-2 for details of sequence input signal.

Type	Description	Mode	Reference
</SV-ON> Servo-ON	If input is ON, the power is applied to the servo motor, and if OFF, the power is cut off.	All	4-2
</A-RST> Alarm reset	Resets the servo alarm status.	All	7-44
</G-SEL> Gain group conversion	Use 2 group gain where the input is on, and use existing gain where the input is off. Convert 2 types of gain groups.	All	6-27
</P-TL> Limit forward torque	If signal is ON, limit forward torque by the setting of [Pr-4.03].	All	5-41
</N-TL> Limit reverse torque	If signal is ON, limit reverse torque by the setting of [Pr-4.04].	All	
<P-OT> Prohibit forward operation	If load mechanical part reaches the forward limit, this prevents the motor from moving further to that direction.	P S C	7-2
<N-OT> Prohibit reverse operation	If load mechanical part reaches the reverse limit, this prevents the motor from moving further to that direction.	P S C	
</P-CON> P/PI control conversion	Converts the speed controller from PI controller type into P controller type. Used to provide better response performance by prohibiting the overshoot in transient response.	P S C	6-21
</C-SEL> Control mode conversion	Used to convert control mode when used as combinational control mode.	Combinational Control Mode Only Refer to 5.6	
</C-DIR> </C-SP1> </C-SP2> </C-SP3> </C-SP4> Terminal speed command	The rotation direction</C-DIR> and rotation speed </C-SP1 to /C-SP4> of the motor are determined by the above input in terminal speed control mode. Rotation speed of </C-SP1 to /C-SP3> is set in [Pr-2.05 to Pr-2.11]. Rotation speed of </C-SP4> is set by analog speed command voltage. </C-DIR> is used to change motor roatation direction in speed control mode.	C	5-45
</Z-CLP> Zero clamp	Disregard the input value if in speed control, analog command value is smaller than the value set at speed zero clamp level [Pr-5.04].	S	5-31
</INHIB> Inhibit pulse command	Disregard position command pulse where the signal is ON.	P	5-28
</ABS-DT> Absolute Encoder Data Transmission	Transmits absolute encoder data to host controller through EA, EB when the signal is ON.	P	7-32
</PCLR>	Clear position command, position feedback, and position error.	P	5-21
/START	Control motor rotation start or stop by using terminal signal in speed or terminal speed control mode.	S, C	5-33
/GEAR	In position control mode, the 2nd electronic gear parameters [Pr-3.05] and [Pr-3.06] are used when input is ON. The basic electronic gear parameters [Pr-3.01] and [Pr-3.02] are used when input is OFF. Switch between two electronic gear ratios.	P	5-23

General Input Signal (fixed)

Power

Signal Name	Symbol	Function	Mode	Reference
External power input	+24 [V]IN	As control power input for contact point signal, +24 [V] power should be prepared by users.	ALL	

Emergency Stop

Signal Name	Symbol	Function	Mode	Reference
Emergency Stop	E-STOP	Connect and use an extra emergency stop switch to quickly act upon emergency situation,	ALL	3-17

Position Command

Signal Name	Symbol	Function	Mode	Reference
Pulse command	PULS+	Receives position command by pulse input. Can respond to both line drive output and open collector output of host controller.	P	5-9
	PULS-			
	SIGN+			
	SIGN-			
Position error clear	PCLR+	Clears the position error.	P	
	PCLR-			

Signal Name	Symbol	Function	Mode	Reference
Speed command input	V-REF	Receives analog speed command. (-10 [V] to +10 [V])	S	5-28
	V-REF SG			
Torque command input	T-REF	Receives analog torque command. (-10 [V] to +10 [V])	t	5-38
	T-REF SG			

Battery Connection

Signal Name	Symbol	Function	Mode	Reference
Battery input	BAT+	Supplies the external battery power when the absolute encoder is used.	ALL	7-27
	BAT-			

(CN1) Output Signal

Sequence Output Signal (Allocation)

See Chapter 5-2 for details of sequence output signal.

Type	Description	Mode	Details
/P-COM (+, -) (Positioning Completion detection)	It is ON when the position error is within the set value of output width of position completion signal, [Pr-5.00],	P	5-23
/NEAR (+, -) (Position approach detection)	It is ON when the position error is within the setting value of output width of position approach signal, [Pr-5.01].	P	
/V-COM (+, -) (Speed coincidence detection)	It is ON when error between speed command and motor rotation speed is within the set value of output width of speed coincidence signal, [Pr-5.02].	P S C	5-29
/TG-ON (+, -) (Rotation detection)	It is ON when the motor rotates at speeds higher than the set value of rotation detection level, [Pr-5.03].	All	5-35
/T-LMT (+, -) (Torque limit detection)	It is ON when it reaches the set torque limit.	All	5-35
/V-LMT (+, -) (Speed limit detection)	It is ON when it reaches the set speed limit.	All	5-36
BK (+, -) (Breaker control)	Signal for the control of brake mounted internally or externally on the servo motor.	All	7-6
/WARN (+, -) (Warning detection)	It is ON if a servo warning is detected,	All	8-4

NOTE

- In this manual, < > is applied to the names of sequence I/O signal.
- ex) </SV-ON>, </P-COM>

General Output Signal (fixed)

Alarm code

Signal Name	Symbol	Function	Mode	Reference
Alarm code	AL1	Upon servo alarm generation, it outputs the types of the servo alarm with the 3-bit. Maximum rating of open collector : DC 30 [V], 20 [mA]	ALL	8-4
	AL2			
	AL3			
	AL-SG			

Analog Monitor

Signal name	Symbol	Function	Mode	Reference
Analog Monitor Output	AM-CH1	Motor speed and torque, etc. are displayed for monitoring. Output range : -10 [V] to +10 [V].	ALL	7-25
	AM-CH2			
	AM-SG			

Encoder signal

Signal name	Symbol	Function	Mode	Reference
Encoder Signal Output	EA+	Displays multiplied encoder signal A, B, C pulse in the form of line drive. According to the parameter setting, the drive can logically invert output of A, B pulse.	ALL	7-21
	EA-			
	EB+			
	EB-			
	EC+			
	EC-			
Absolute Encoder S-pulse	PS+	Outputs the number of rotation by serial data when the absolute encoder is used.		
	PS-			

Servo alarm

Signal name	Symbol	Function	Mode	Reference
Monitor Output	SALM+	It is displayed if the servo alarm is generated.	ALL	7-25
	SALM-			

Encoder Z-pulse display

Signal name	Symbol	Function	Mode	Reference
Encoder Z-pulse	Z-PULSE +	It is displayed if Z-Pulse of the encoder is detected.	ALL	
	Z-PULSE -			

(CN1) Input Circuit and Interface

Describes the connection circuit for input from the host controller to the servo drive.

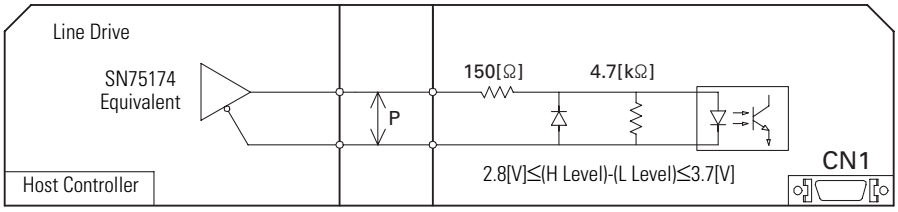
Pulse Command Input Circuit

The drive receives the pulse output of host controller by position command in position control mode.

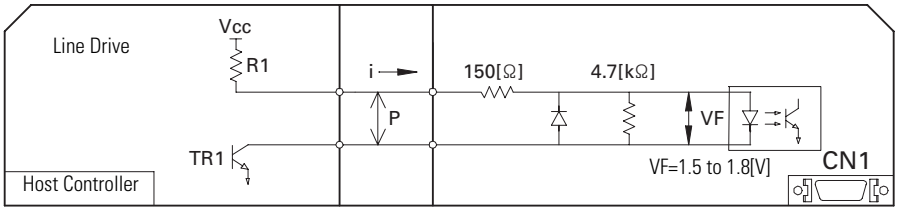
- Host controller can output pulse in line drive or open collector type. Select either of the two for use.
- Refer the Chapter 5-9 for the servo drive setting according to the selection.

Input pin of CN1 that uses line drive and open collector output.		
PULS +, PULS- (11, 12)	SIGN +, SIGN- (13, 14)	PCLR +, PCLR- (15, 16)

Line drive - Maximum allowable frequency 900 [kpps]



Open collector - Maximum allowable frequency 200 [kpps]



By using the example at the bottom, set the value of Pull Up resistor R1 so that the input current i is within 7 [mA] to 15 [mA].

Vcc of the Host Controller	24 [V] ± 5 [%]	12 [V] ± 5 [%]	5 [V] ± 5 [%]
R1	2.2 [kW]	1 [kW]	180 [W]

NOTE

Maximum allowable frequency of host controller's pulse command is

- 900 [kpps] for the line drive,
- 200 [kpps] for the open collector,.

If the maximum allowable frequency is exceeded, "E.OvPUL" servo alarm of position command pulse is generated.

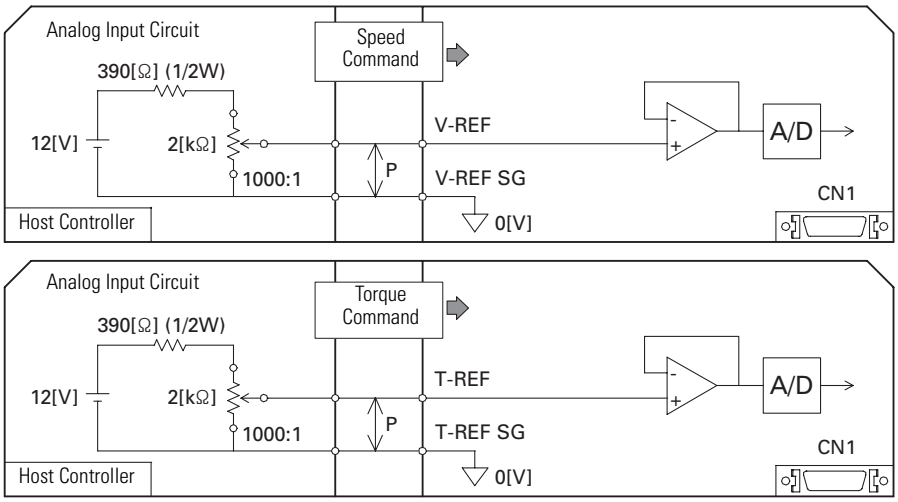
Make sure the output of host controller does not exceed the maximum allowable frequency.

Analog Voltage Input Circuit

The drive receives analog voltage output of the host controller with speed, speed of torque control mode and torque command.

- Input impedance of speed and torque commands is about 5 [M].
- Maximum allowable voltage range of input signal is -10 [V] to +10 [V].

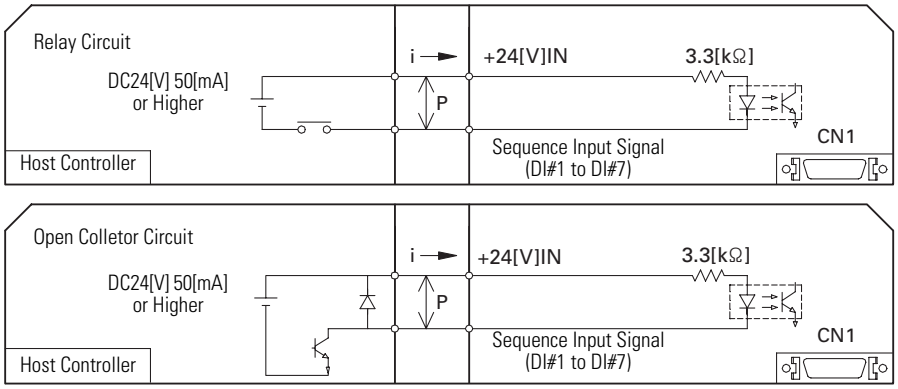
Input pin of CN1 that uses analog voltage output of the host controller	
Speed command V-REF, V-REF SG (19, 20)	Torque command T-REF, T-REF SG (21, 22)



Sequence Input Circuit

Relay or open collector output of the host controller is used for the sequence input circuit.

- Make sure that the input current i is within 7 [mA] to 15 [mA].

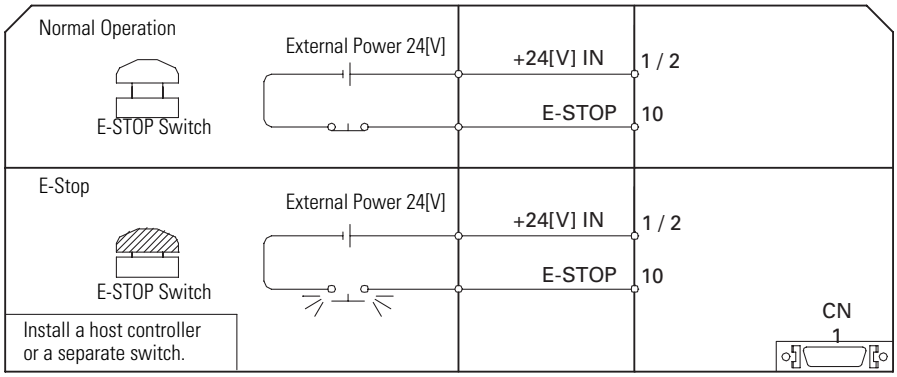


Emergency Stop Signal

This drive has a built-in circuit for the emergency stop situation.

- To quickly respond to the equipment failure or dangerous situation, it receives the emergency stop signal from #10 pin of CN1.
- Emergency stop input can be done by the relay contact output of host controller and installing a separate switch.

#10 pin of CN1 assigned below is used as the input pin only for the emergency stop.



NOTE

- If the emergency stop signal is input, "E.EStoP" servo alarm is generated.
- Refer to the Chapter 8-4 more information on the servo alarm.
- If the emergency stop is released, reset the alarm by referring to the Chapter 7-44.

NOTE

- You can check the status of emergency stop signal through the monitor mode describe in the Chapter 7-50.

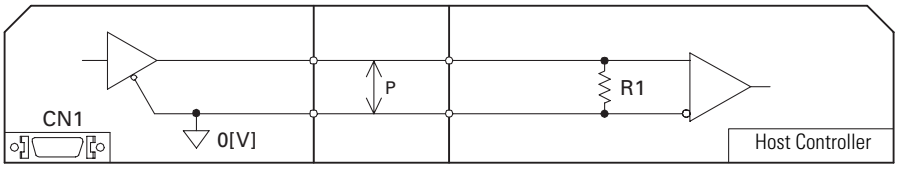
(CN1) Output Circuit and Interface

There are 3 types for the servo drive output circuits. Design the input circuit at the host controller suitable for the each output circuit.

Line Drive Output

Output signal (EA+, EA-, EB+, EB-) that converted the encoder serial data into 2 phase (A phase and B phase) pulse, zero point pulse signal (EC+, EC-) and S phase rotation amount signal (PS+, PS-), are output to line drive circuit. It is used to configure the position control loop from the host controller. Receive the pulse signal with the line receiver circuit in the host controller.

Set R1 value to 330 [Ω].



Open collector output

The servo alarm code output signal is an open collector output circuit. The figure below shows the connection in order of photo coupler, line receiver, and relay circuit.

- The maximum allowable voltage of the open collector output circuit is DC 30 [V], and the allowable current is 20 [mA].

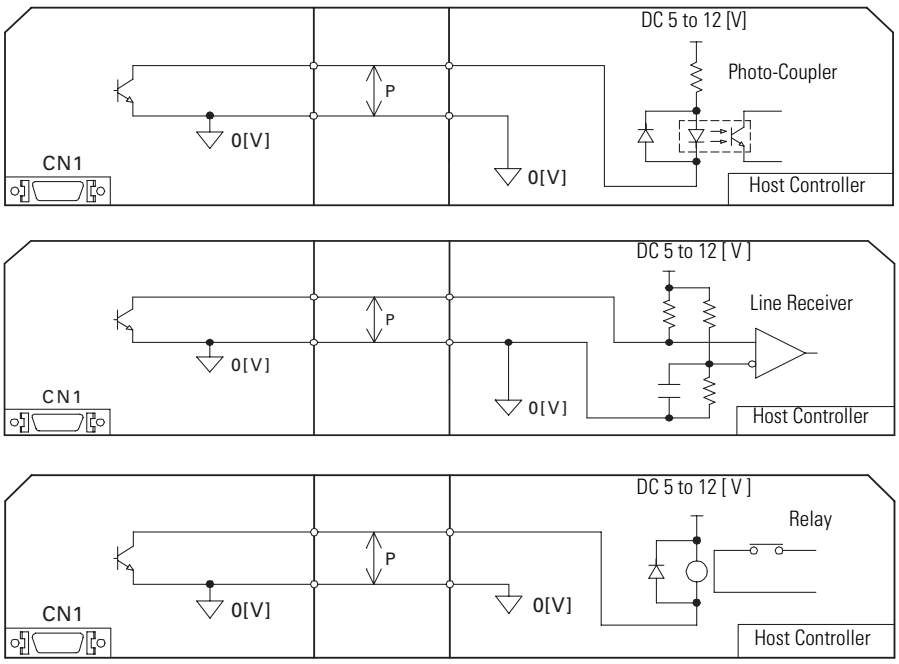
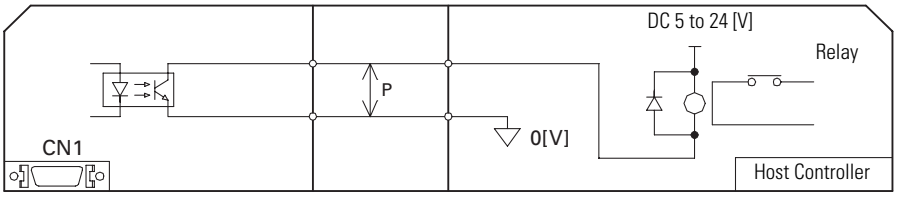


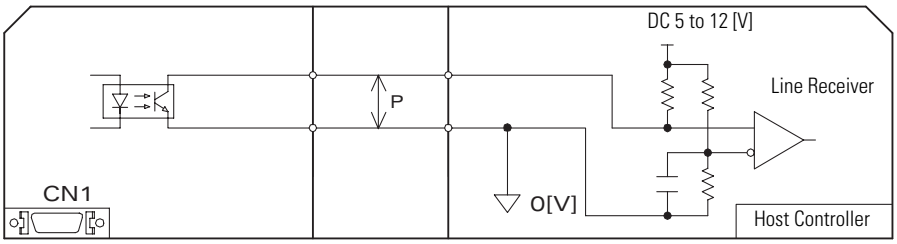
Photo coupler output

Servo alarm, sequence output signal and encoder Z-pulse signal output are the photo coupler output circuits.

Connection to the relay circuit of the host controller.



Connection to the line receiver circuit of the host controller.



Encoder Wiring (CN2)

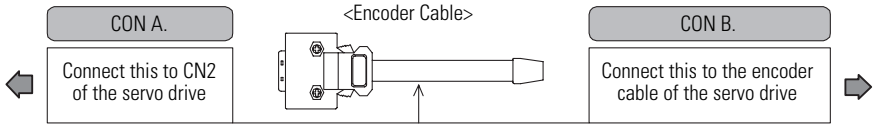
Pin Arrangement of (CN2)

The table below shows the pin arrangement for each encoder.

DRIVE		MOTOR									
PIN NO.	FUNCTION	CSM CSMT CSMR			RSMQ RSMZ		CSMS/D/H/K RSMS/D/H RSMF/K/L			CSMT CSMR RSMQ RSMZ	RSMS/D RSMH/F RSMK/L
		9 wire INC.	15 wire INC.	ABS.	9 wire INC.	ABS.	9 wire INC.	15 wire INC.	ABS.	17bit Serial Abs./Inc.	17bit Serial Abs./Inc.
1	E0 [V]	8	14	14	11	14	G	G	G	8	G
2											
3	A	1	1	1	1	1	A	A	A		
4	/A	2	2	2	2	2	B	B	B		
5	B	3	3	3	3	3	C	C	C		
6	/B	4	4	4	4	4	D	D	D		
7	C	5	5	5	5	5	E	E	E		
8	/C	6	6	6	6	6	F	F	F		
9											
10	U		7	7		11		K	K	4	K
11	RST			9		9			R		
12											
13	/U		8	8		12		L	L	5	L
14	V		9					M			
15	/V		10					N			
16	W		11					P			
17	/W		12					R			
18	BAT+			11		7			T	1	T
19	BAT-			12		8			S	2	S
20	E5 [V]	7	13	13	10	13	H	H	H	7	H
Frame FG		9	15	10 15	12	10 15	J	J	J	3	J

(CN2) Terminal Type

The table below shows the terminal type and specifications of the encoder cable.



Connector CON A for connection to CN2 of servo drive.

	Model Number	Manufacturer
One type regardless of motor model and encoder.	10120-300VE 10320-52A0-008	3M

Connector CON B for connection to the encoder cable of servo motor.

Classification		Model Number	Manufacturer
CSM, CSMT, CSMR	9 wire Inc. Serial Absolute Serial Inc.	172161-1	AMP
	15 wire Inc.	172163-1	
	Absolute Type	172163-1	
RSMZ, RSMQ	9 wire Inc.	171162-1	
	Absolute.	172163-1	
RSMS, RSMD, RSMH, RSMF, RSMK, RSML CSMK CSMT, CSMR	9 wire Inc.	DMS 3108B20-29S or DMS 3106B 20-29S	DDK
	15 wire Inc.		
	Compact Absolute		

NOTE

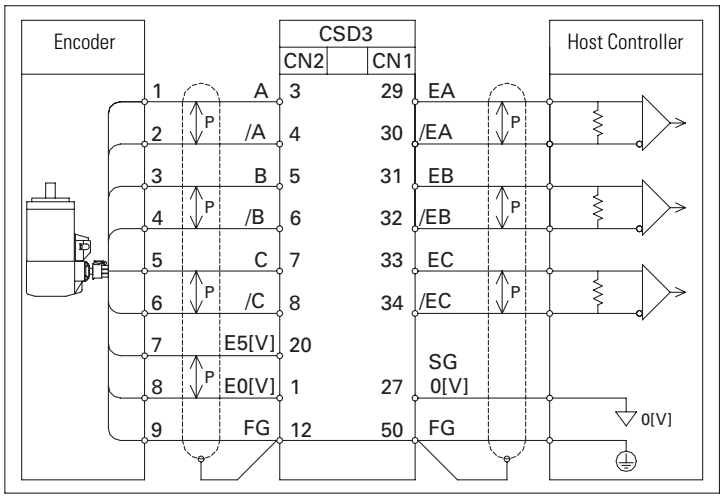
- Do not connect FG of servo drive to host controller if GND and FG are common, or if there is no separate FG,

NOTE

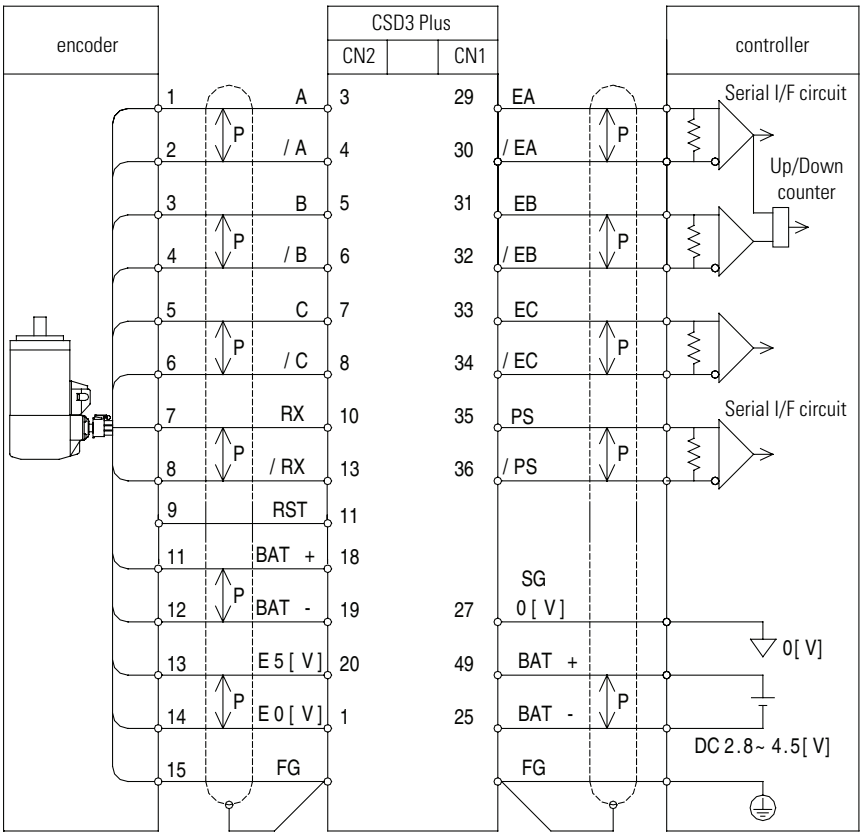
- CSMG motor has a gear attached to CSM motor. Other motor specifications are same.

Encoder Signal Process

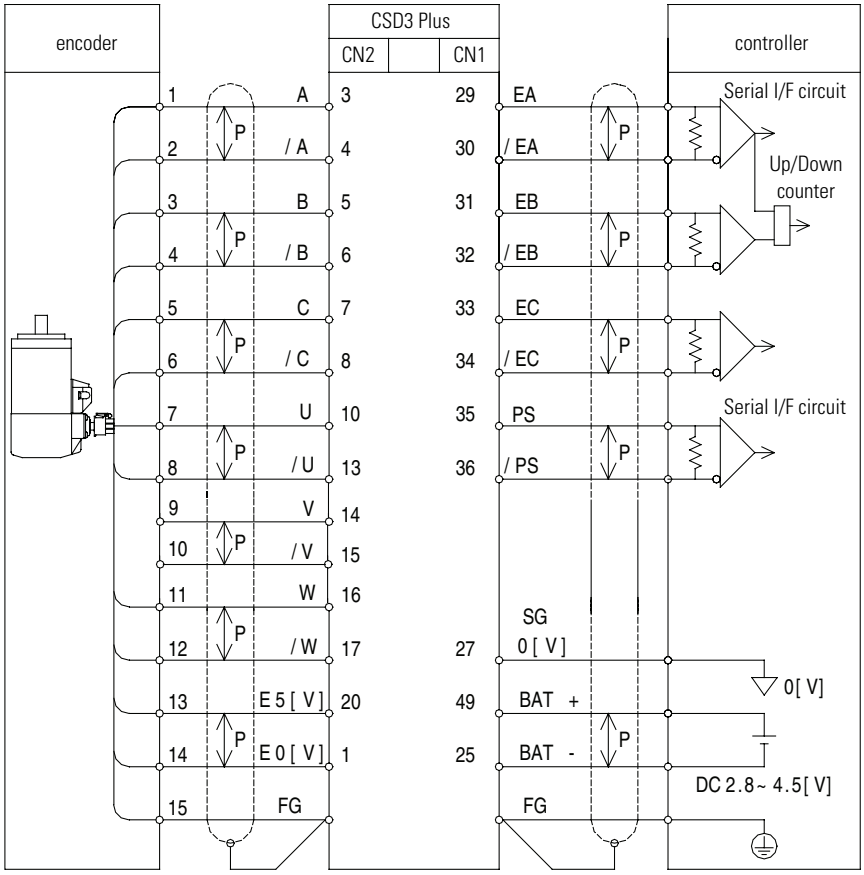
1. Incremental encoder (9 wire Inc.) connection of CSM, CSMT/R motors



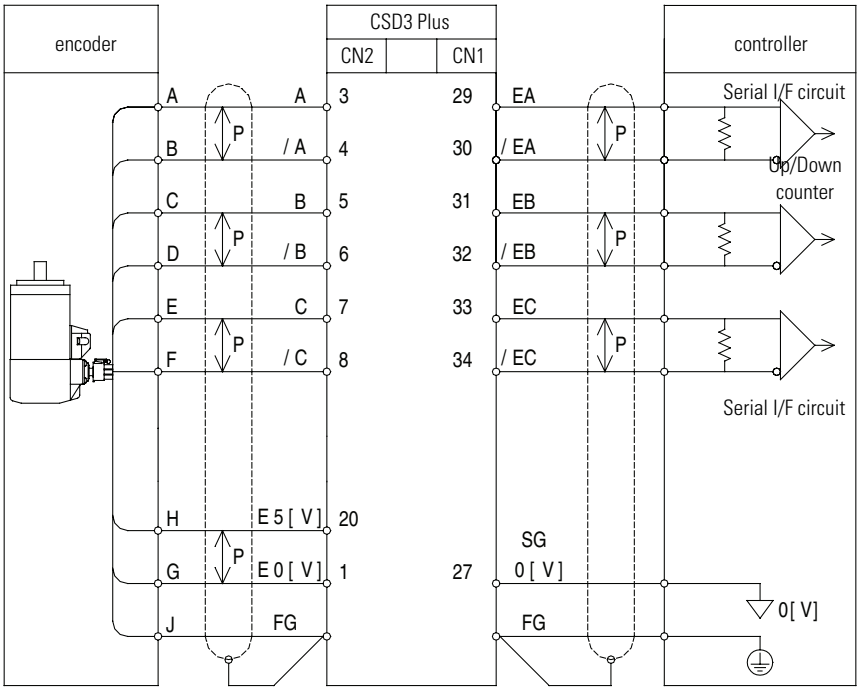
2. Absolute encoder connection of CSM, CSMT/R motoers



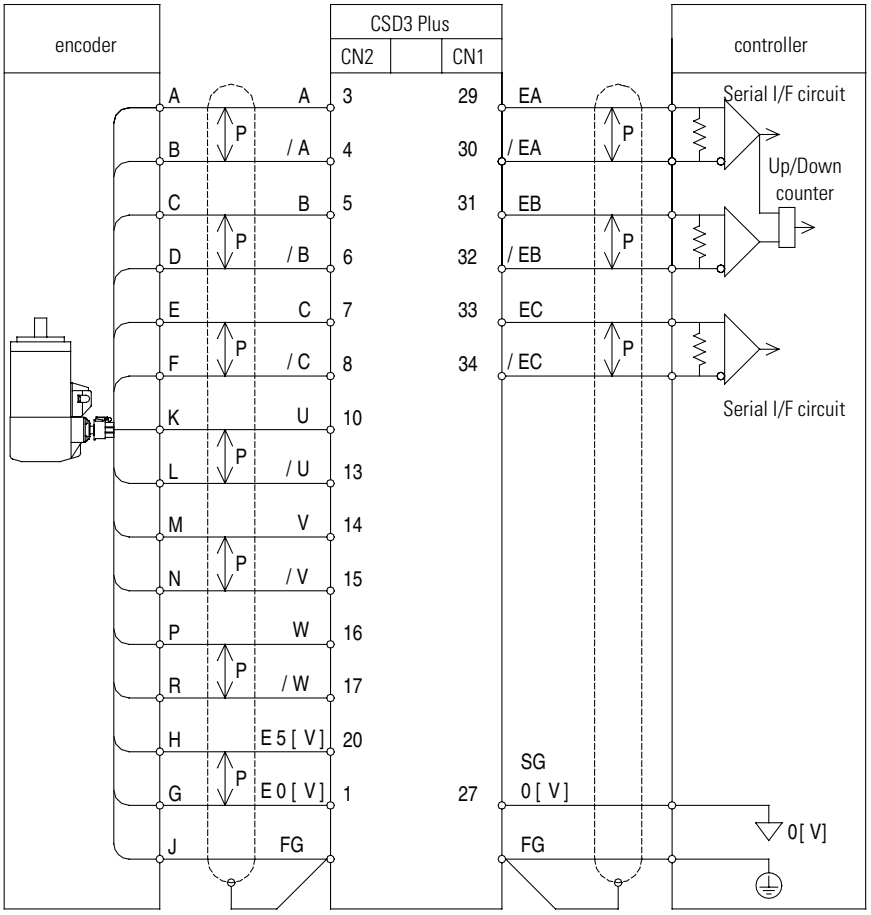
3. Incremental encoder (15-wire Inc.) connection of CSM, CSMT/R motoers



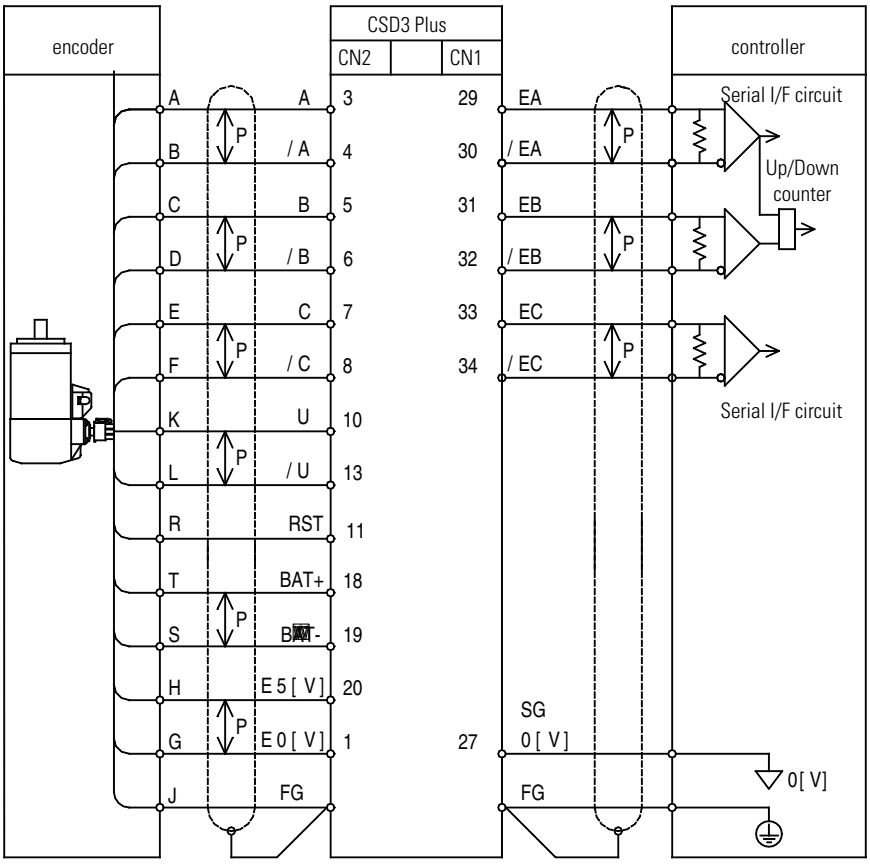
4. Incremental encoder (9 wire Inc.) connection of RSMS/D/F/H/K/L motors



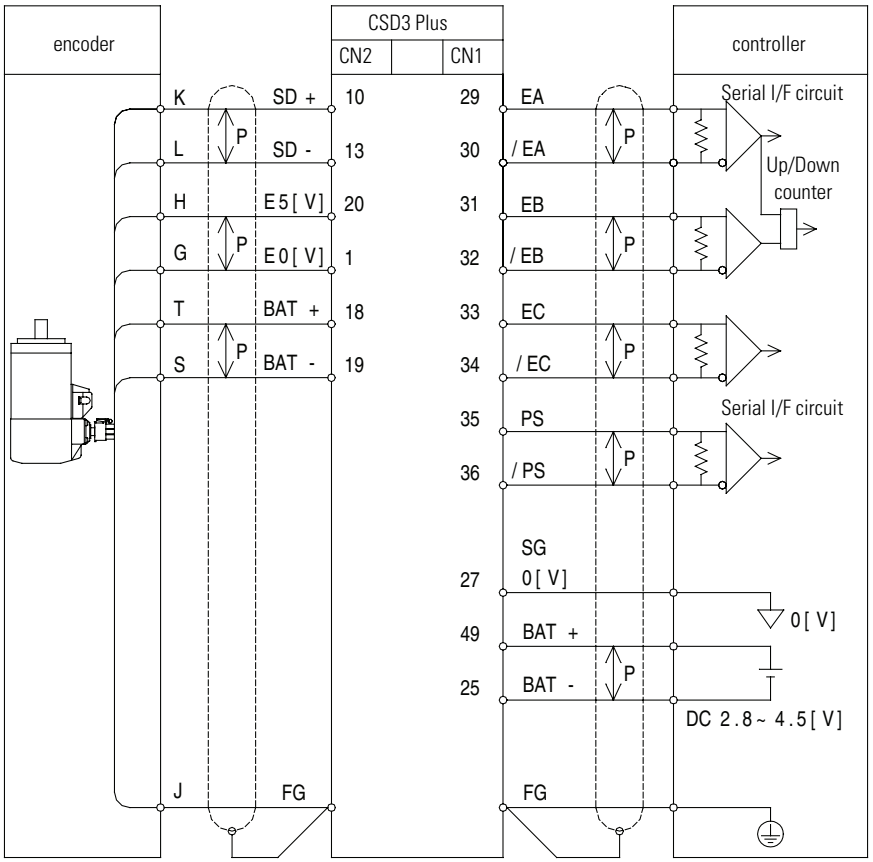
5. Incremental encoder (15 wire Inc.) connection of RSMS/D/F/H/K/L motors



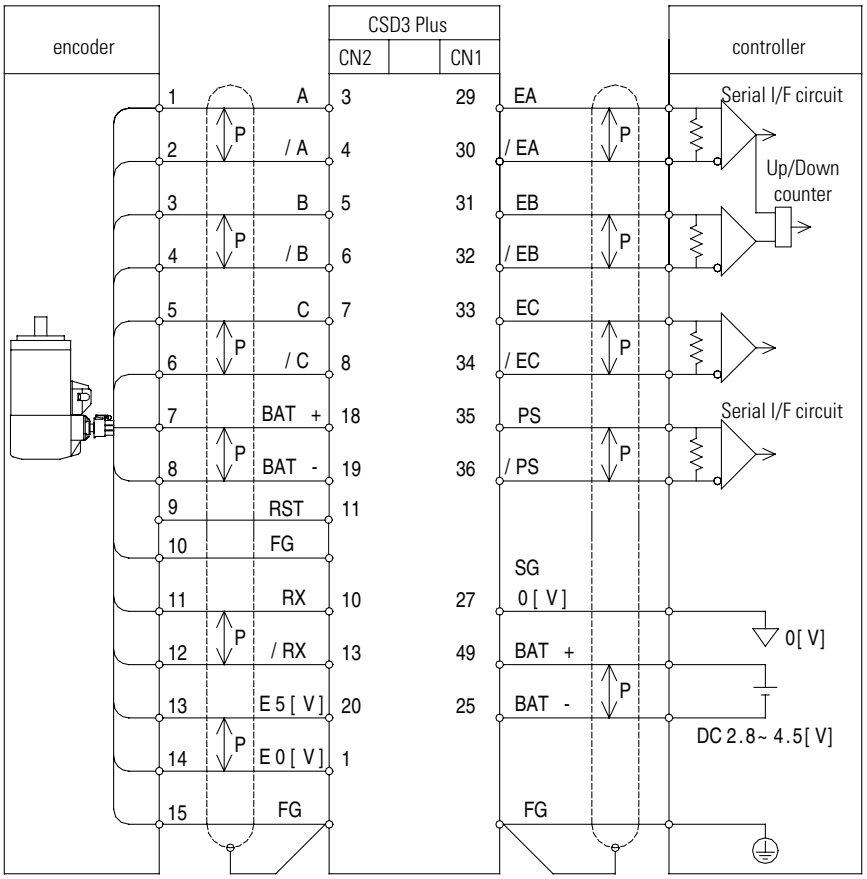
6. Absolute encoder connection of RSMS/D/F/H/K/L motors



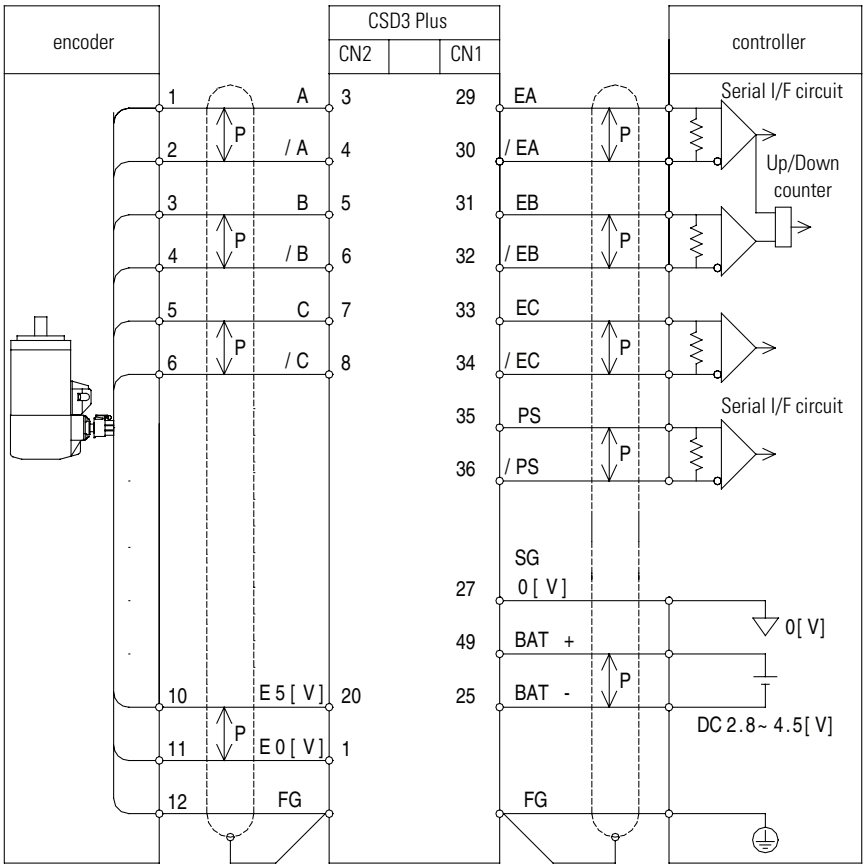
7. Serial encoder connection of RSMS/D/F/H/K/L motors



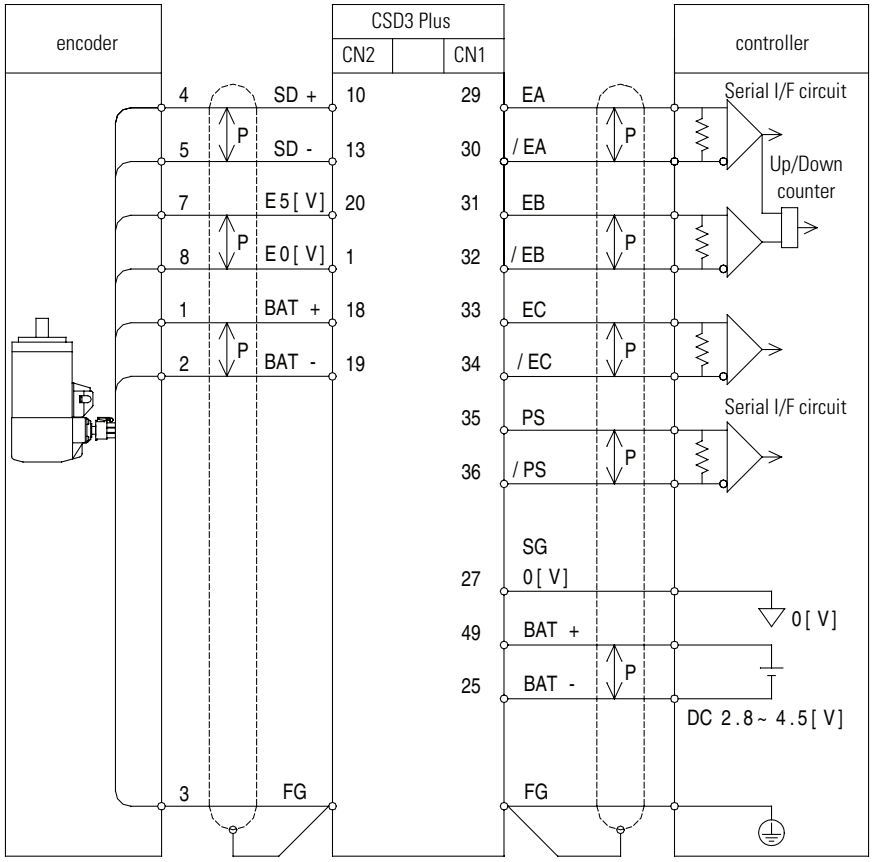
8. Absolute encoder connection of RSMQ/Z motors



9. Incremental encoder (9-wire Inc.) connection of RSMQ/Z motors



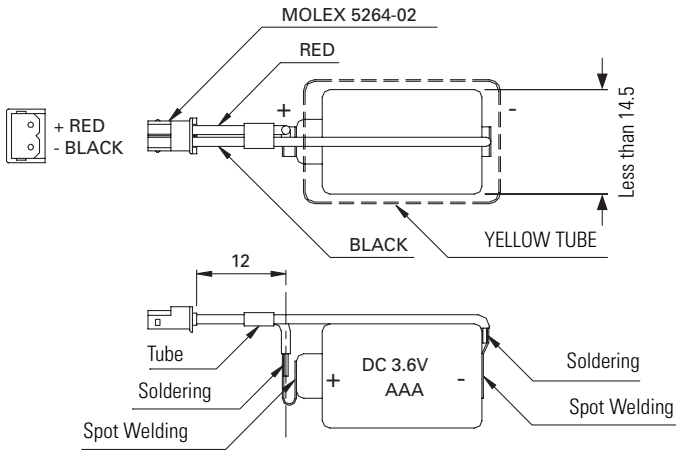
10. Serial encoder connection of RSMQ/Z motors (Absolute, Incremental) (18 and 19 not necessary for Incremental)



Wiringthe Battery (BATT)

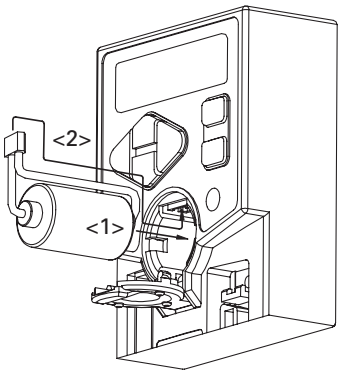
Battery Specifications

The figure below shows the specifications of battery connected to BATT of servo drive.



Wiring the Battery (BATT)

The figure below shows how to connect the battery to BATT of the servo drive.



Procedure

1. Prepare a battery according to the specifications.
2. Open the battery cover.
3. Push it to the end in the direction of <1>.
4. Connect the connector in the direction of <2>.
5. Close the battery cover.
6. If you follow the battery specifications, the polarity coincides.

General Articles Wiring

This part describes wiring to implement optimum performance of the servo drive in wiring and noise.

Precautions

Electric Circuit

- Use a thick wire as earth wire if possible.
- Class 3 grounding is recommended. (Recommendation: grounding resistance lower than 100Ω).
- Only 1 point must be grounded.
- Select ground phase and ground point considering the power conditions of installation area. If the power is supplied by the ground phase, wire it so that L2 of AC main power input terminal (L1, L2, L3) becomes the ground phase.
- Use noise filter for the main power and control power.
- Electric circuit wiring and signal circuit wiring should be apart as much as possible. (30 [cm] or more)
- Do not use same power with the electric ARC welding machine or discharge processor equipment.
- The earth wire of the servo motor must be connected to the grounding terminal of the drive. In addition, ground the grounding terminal of the drive.
- If the wiring is inside the metal pipe, ground the pipe with class 1 grounding.

Signal Circuit

- The host controller should be installed as closely as possible to the drive, and the noise filter must be used.
- CN1 (I/O signal connector) and CN2 (encoder cable) should be twist pair wire and batch shield wire. (Refer to the appendix for the Samsung's standardized parts.)
- Note that the signal circuit wire is very thin, thus pay attention when handling it.
- If the noise is generated at command input cable, ground 0 [V] line (SG) of the input line before the usage.

Others

- Use the breaker or fuse for wiring to protect the servo drive.
- Make sure there is no continuous bending and stress to the wire.
- Use noise filter in radio noise.
- If used around residential area or the radio disturbance is concerned, install a noise filter on the input side of power line.
- As the drive is for industrial use, there are no measures for radio disturbance.
- Attach a surge absorption circuit to the relay, solenoid, and coil of the magnetic contactor.

Capacity of the Drive and Fuse

The table below shows the capacity of servo drive and fuse.

Power	Drive type		Power Capacity per 1 Drive [kVA]	MCCB or Fuse Power Capacity [Arms]
	Capacity	CSD3-		
Single phase 220V	50 [W]	A5BX2	0.25	4
	100 [W]	01BX2	0.40	
	200 [W]	02BX2	0.75	
	400 [W]	04BX2	1.2	8
3 phase 220V	1 [KW]	10BX2	2.3	7
	1.5 [KW]	15BX2	3.2	10

The fuse capacity is the value when 100 [%] load is applied. When selecting the MCCB (breaker for wiring) or fuse capacity, select the fuse capacity considering the load ratio.

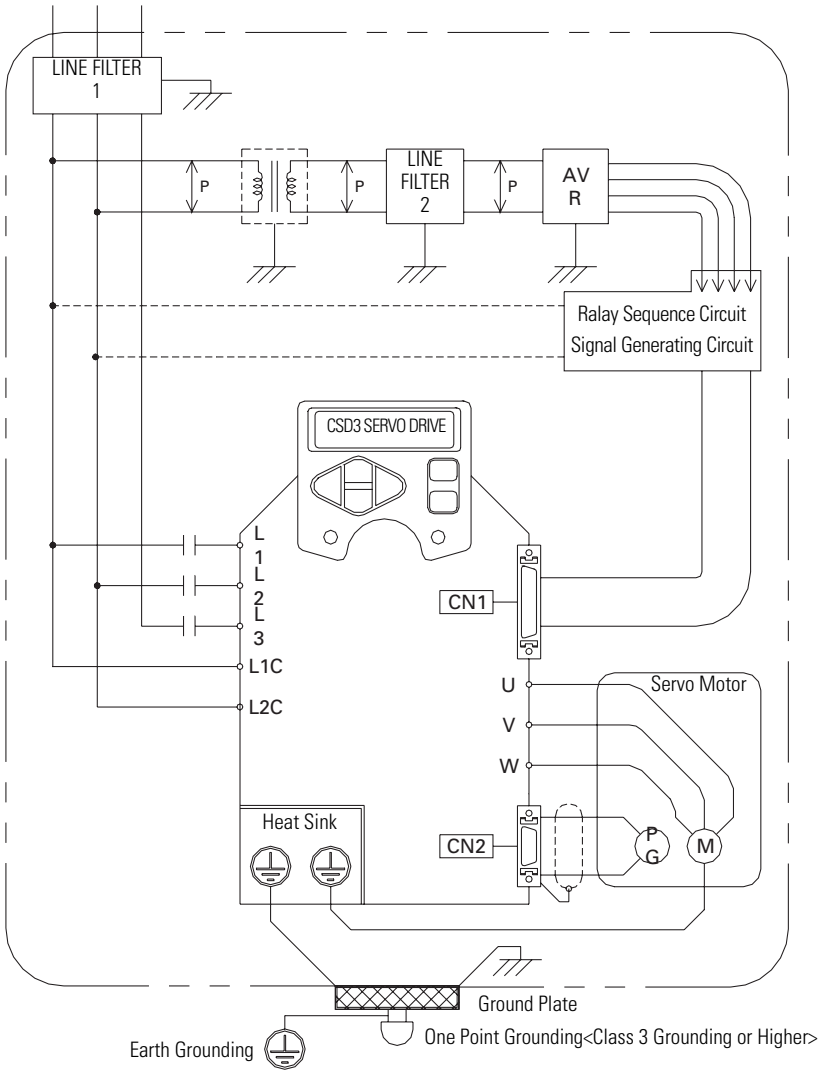
Cut-off features : 200 [%]-2 seconds or more. 700 [%]- 0.01 second or more.

NOTE The high -speed cut-off fuse can not be used. As the power of the drive is condenser input type, the fuse may be blown even during a normal situation if the high-speed cut-off fuse is used

Noise Protection

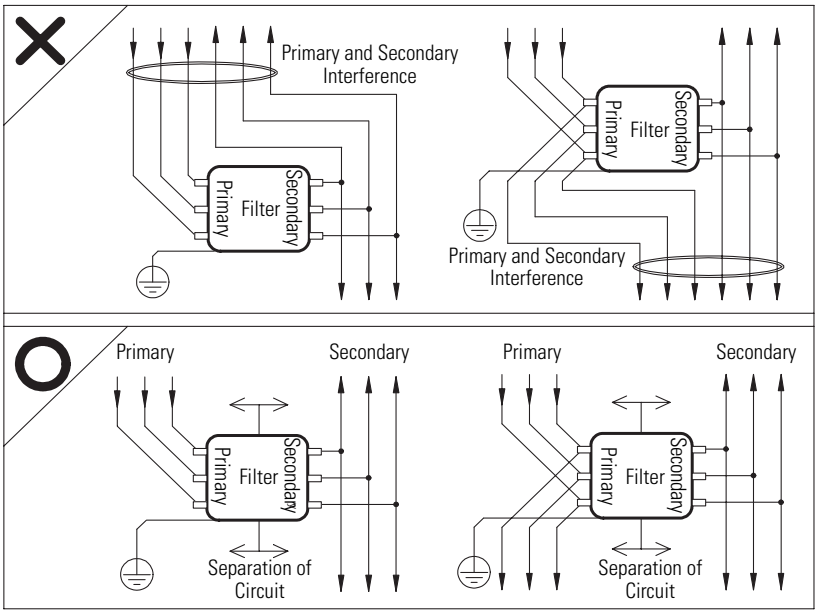
The high-speed switching device and microprocessor are used at the main circuit of the servo drive. Thus, switching noise is affected by the connection and grounding methods. Use the proper wiring and grounding method to prevent any affects from the noise.

Use a wire of 3.5 [mm^2] or thicker for the earth wire.

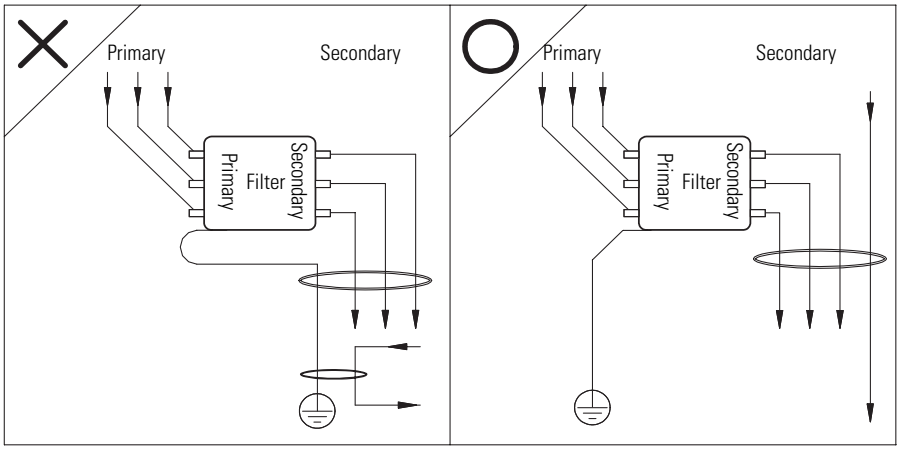


Extra caution is required when wiring the noise filter. The following figure describes precautions when wiring the noise filter. If the wiring is wrong, the performance of the noise filter falls.

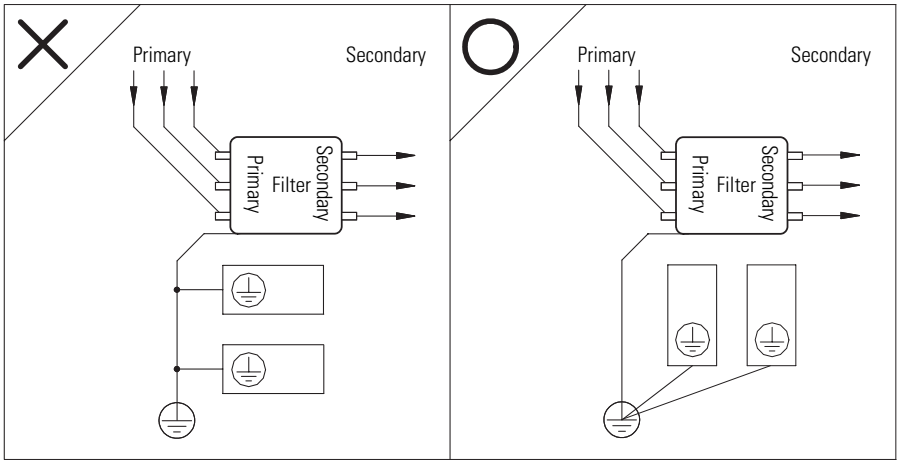
- Separate the input and output wiring of the noise filter and do not tie up them together.



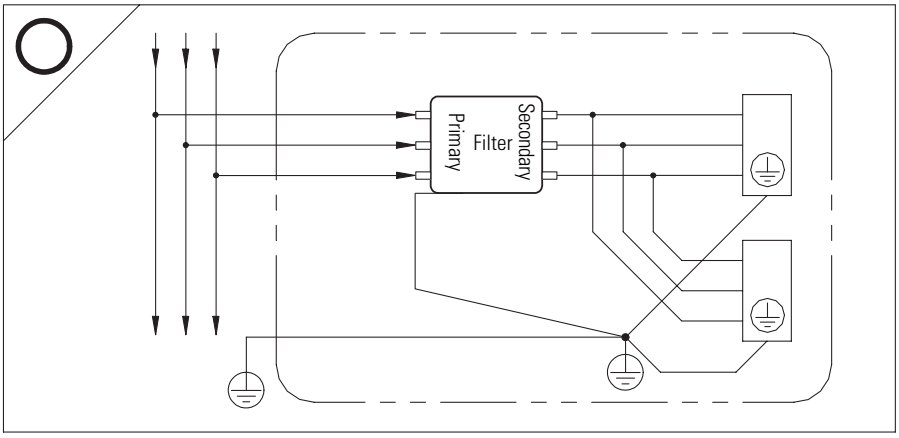
- Earth wire of the noise filter should be wired in distance to the output wire and do not put other signal lines and earth wire in a same duct and tie up them together.



- Earth wire of noise filter should be solely attached in the earth plate. Do not connect the earth wire of the noise filter to other earth wire together.



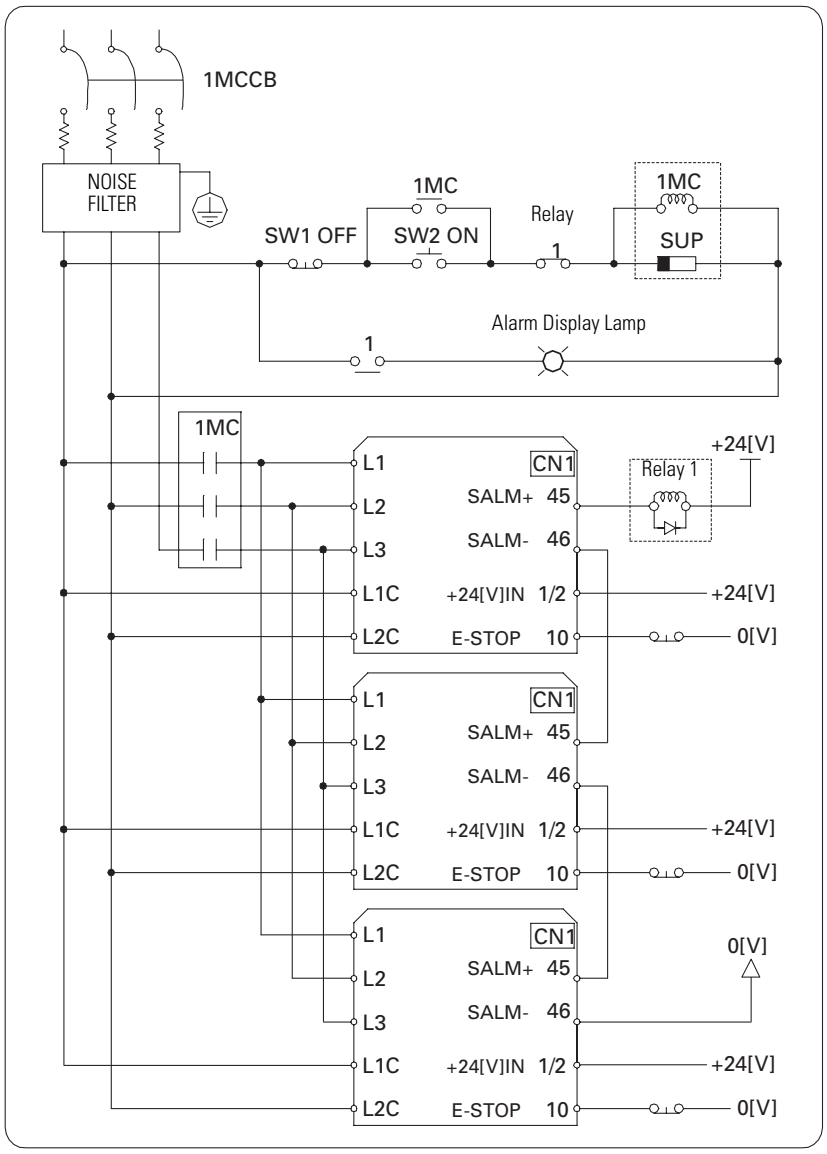
- If there is noise filter inside the case (panel), connect all of the earth wires and earth wires of other equipment inside of the case to the grounding plate. And then, ground them.



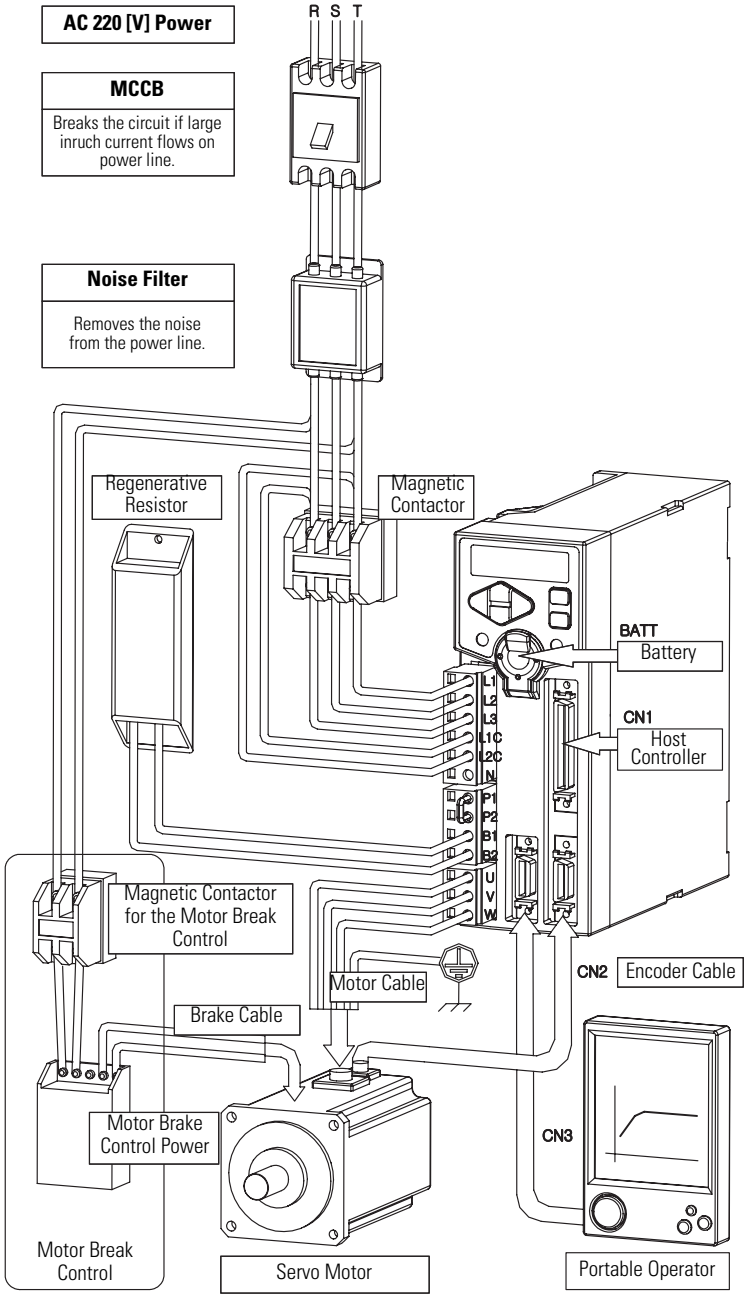
Wiring when Using Several Drives

This is an example of wiring when connecting several drives.

- Connect the alarm output (SALM) signal of each servo drive in a series and run Relay 1 to detect the alarm. Normally, SALM+ and SALM- are interconnected, and with 24 [V] supplied to Relay1, the servo drive runs normally.
- If the servo alarm is generated, 24 [V] supplied to Relay1 is cut off.



Connection to Peripheral Equipment



Operator, Basic Setting and Startup

Introduction

This chapter introduces the operator mounted on the servo drive. In addition, it describes the basic setting of servo drive, and also an example for simple startup.

Before You Begin

About Servo-ON Signal

This part describes Servo-ON signal for the control of the servo drive.

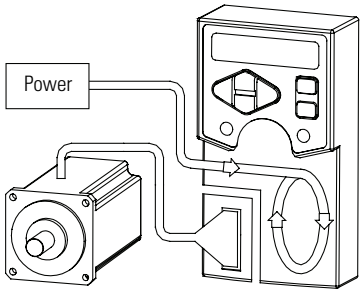
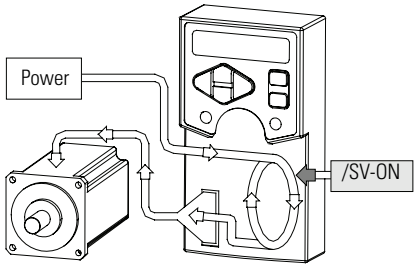
What is Servo-ON?

Audio or TV can select and play music and display channel that the users want from the moment the power switch is on.

However, the servo drive cannot run servo motor by simple applying the power. To complete load the system and use the servo drive, Servo-ON signal from the host controller is required.

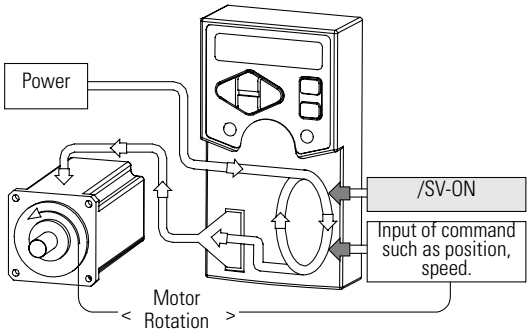
Servo-ON signal should be applied and maintained from the host controller for the servo drive to run the motor. In servo -OFF status, it cannot run the motor.

Servo-OFF and Servo-ON

Servo-OFF Status	Servo-ON Status
• If the servo-ON signal is not applied after the power application, it is same as the servo driver and motor being separated completely. • This is a ready status to run the motor.	• If the servo-ON signal is applied from the host controller, the drive starts to apply voltage to the motor. At this time, if there is no motor run command, the drive maintains the motor stopped.
	

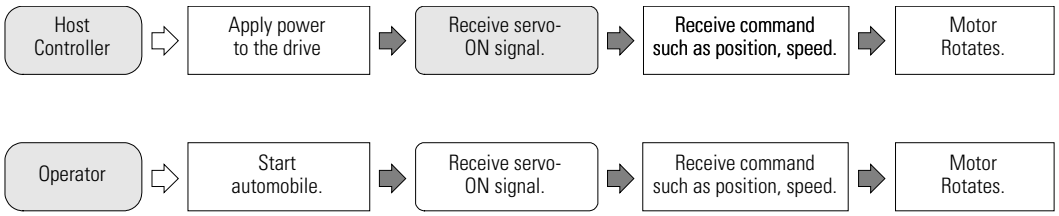
Input of commands such as position, speed regarding servo-ON status and motor run.

- If the motor run command is input while the servo-ON signal of the host controller is maintained, the drive can run the motor according to the command.



Servo-ON signal of the host controller and running the automobile

The following describes the servo drive in relation to the transmission of the automobile.



- As the transmission of the automobile should be positioned at 'D' to start the automobile, the drive can be run only when the servo-ON of the host controller is maintained.
- Commands to run the motor such as the position, speed of host controller are invalid in Servo-OFF status.

In this manual, the Servo-ON signal is indicated as shown below.

Servo-ON, </SV-ON>	Servo -OFF

Servo-ON signal input

Servo-ON signal from host controller is received through the sequence input signal of CN1. Refer to the Chapter 5-2 for the sequence I/O signals.

Servo drive's own Servo-ON

If the servo drive runs the motor without a command from the host controller as in the operation mode (run-00), (run-01), the drive make itself Servo-ON for the operation.

- Refer to the Chapter 7-35 for the operation mode (run-00) to (run-02).
- In addition, the operation mode (run-00) is described in the Chapter 4-22 Startup.
- (run-00),(run-01),(run-07),(run-08),(run-10),(run-12) are not operated in Servo-ON status.

Alarm occurrence and Servo-ON status

If servo alarm is occurred by the self-diagnosis function of the drive while the Servo-ON signal is applied to the drive, the drive make itself Servo-OFF to stop the motor and displays the contents of servo alarm. Users should inspect the contents of servo alarm, take necessary action, and reset the alarm (Refer to the Chapter 7-44). At this time, if an appropriate action against the servo alarm is taken and the servo-ON signal of host controller is maintained, the drive returns to servo-ON status at the moment that alarm is reset.

- Refer to the Chapter 8-6 for the information of the servo alarm.

NOTE

- All parameter setting after Chapter 4-1 should be done for the Servo-ON status and Servo-OFF status.
- In this manual, 'the servo drive status' means whether the servo drive is in servo-ON status or servo-OFF status.

Table for Parameter Setting

This manual uses the following table for parameter description.

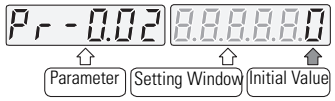
			Parameter Name
Setting Value	0		
	1		
Applicable Mode	ALL	Others	Servo-OFF > Setting > Power Off & On > End

Table Description

- Parameter at the top-left side shows the parameter being described.
- The setting window on the right of the parameter, is entered when the ENTER key is pressed. The parameter must be set from the digit in black color and the initial value shows the initial value of the parameter.
- It is classified into a parameter selected among already set values ("selected parameter") and a parameter, which the users give appropriate values. The selected parameter, as shown in the example above, displays both parameter and setting window, and the latter parameter displays only the parameter and not the setting window.
- **<Setting value>** Describes the value selectable by the user and the selected value.
- **<Applicable mode>** Alphabetically displays the corresponding control mode in setting parameter, and displays (ALL) if all are included.

Alphabets display each mode

Mode	Position mode	Speed mode	Torque mode	Multi-step speed mode
Display	P	S	t	C

- Combinational control mode indicates the alphabets of two modes, combined in a row.

- ex) speed + position mode (SP), torque-speed mode (tS).

- **<Others>** Normally, as described in an example of automobile in the Chapter 4-2, the driver cannot manipulate parking brake of a running automobile, and the servo drive also should be divided into Servo-ON status and Servo-OFF status when setting the parameter.

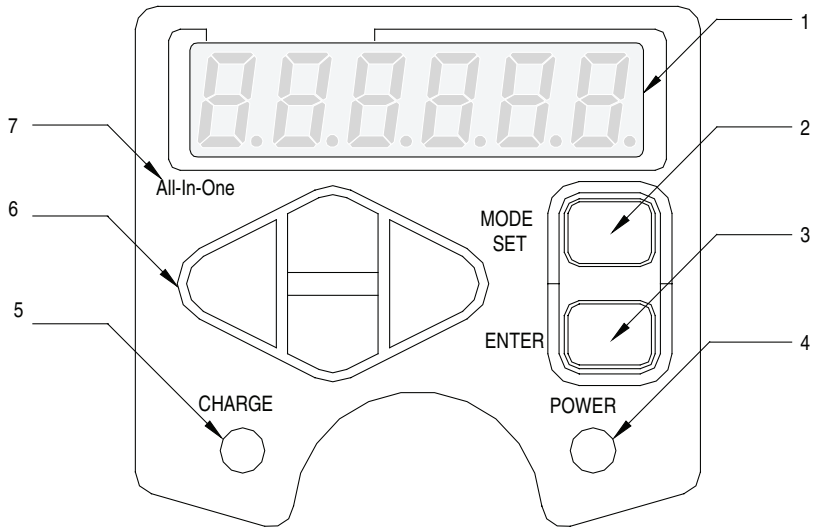
Others	Description
Setting > End	Set regardless of the drive status.
Servo-OFF > Setting > End	Set it in Servo–OFF status.
Servo-OFF > Setting > Power Off & On > Completion	Set it in Servo-OFF status, and apply the power again.

Operator

Name and Function of Each Part

The servo drive has a built-in operator for various status displays, parameter setting, operation command, and monitoring.

- Displays various contents with six 7-segment LED display.
- Distinguish the type of the servo drive according to the front design of the operator.
- Provides all key manipulation function without a separate external operator.
- The following figure shows the front side of the operator on the servo drive.

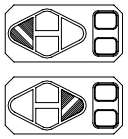


No.	Name	Function
1	7-Segment LED Display	Displays the status with 6-digit 7-segment LED display, sets parameter, commands operation and displays monitoring.
2	MODE/SET Key	Enters display mode shift and parameter setting value.
3	ENTER key	Enters into each window after changes the display mode. Completes setting and exits from it.
4	Control Power Check Lamp	Checks if the control power is applied.
5	Main Power Check and Discharge Check Lamp	Checks if the main power is applied, and if the capacitor of the main circuit is discharged after the main power cut-off
6	Top, Bottom, Left/Right Key	Moves the digit of 7-segment LED display and functions as the UP/DOWN of the number.
7	Drive Type	There are two types: All-In-One and Position-Control-Only.

Icons for the Key Buttons

Describes the functions and icons of the key buttons.

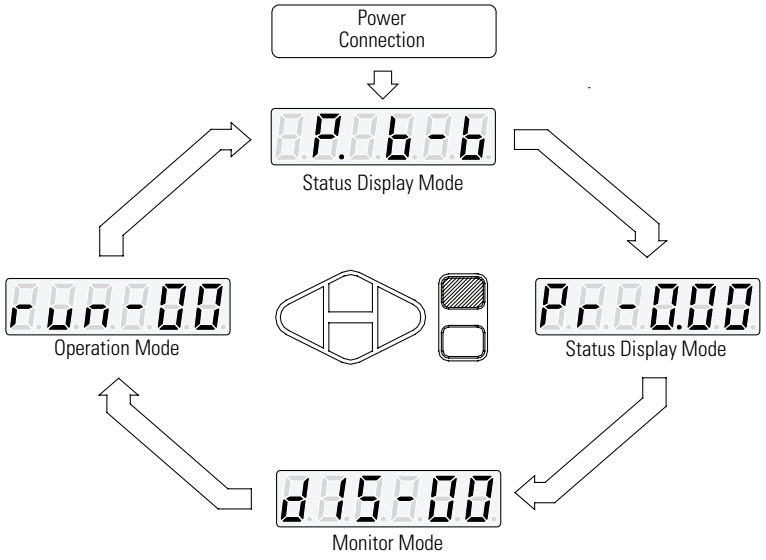
- Icon is used in description throughout the manual. Thus, be fully aware of the shape, name and function of icons.

Icon	Name	Function	Icon	Name	Function
	Up	Increases and decreases the value. Press and hold this icon to continuously increase/decrease the value. Use this when setting the value.		Direction Key	Used to indicate up, down, left, right keys altogether.
	Down			MODE/ SET Key	Changes the mode. Saves the setting value.
	Left/ Right	Shifts the digits.		ENTER Key	To enter/exit each setting window after changing the mode.
			Black key button represents that it is pressed.		

Structure of the Entire Mode

As shown in the figure below, the servo drive is divided into 4 types of control modes:

- The mode displayed after the power ON is the status display mode.
- Mode is changed whenever the MODE/SET key is pressed.
- Be fully aware of the following 4 mode types and read the following.



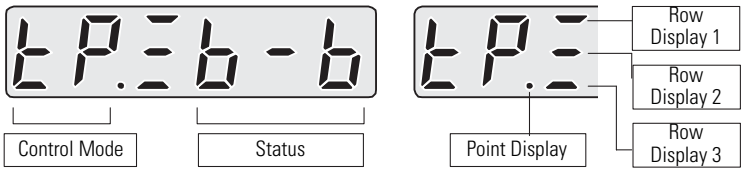
NOTE

- All parameter setting after Chapter 4-1 should be done for the Servo-ON status and Servo-OFF status.
- In this manual, 'the servo drive status' means whether the servo drive is in servo-ON status or servo-OFF status.

Status Display Mode

This section describes contents of the status display mode.

- The figure below is an example of display for the description of the status mode.
- The display on the right is separated for the convenience of description.
- Refer to the table below for the meaning of each display.



	Basic Control Mode		Combinational Control Mode	
	Display	**Description**	**Display**	**Description**
Control Mode	---P	Position mode	--SP	Speed + position mode
	--S-	Speed mode	-tS-	Torque + speed mode
	-t--	Torque mode	-t-P	Torque + position mode
	C---	Multi-step speed mode	C--P	Multi-step speed + position mode
			C-S-	Multi-step speed + speed mode
			Ct--	Multi-step speed + torque mode

- Displays control mode in use. In Servo-ON status (in operation), the display of the control mode flickers.
- In combinational control mode, it performs two types of selected mode simultaneously for the operation. And at this time, the display of the current mode is flickered. If the mode is changed, the display of new mode flickers, and the previous mode does not.

	Display	Description	
Status	 SERCOS Network option	 DeviceNet Network option	Displays corresponding option upon the use of the network option. Refer to the Chapter 1-6 for the network option.
		BASE-BLOCK means the preparation for the operation in Servo-OFF status.	
		Displays that it is running.	
		Displayed when forward operation prohibiting signal is input.	
		Displayed when reverse operation prohibiting signal is input.	

- Displays corresponding character upon servo warning.
- Refer to the chapter 8 for details of the servo warning.

	Description
Point Display	It is on if the power is applied.

Refer to the reference pages on the right for more information on the row display.

	Description	Reference
Row Display 1	When using as a position mode, if the difference between load position and position command is smaller than [Pr-5.00] value, the servo drive can display (</P-COM> position completion detection) signal. It is on when </P-COM> signal is displayed.	5-23
	When using as a speed mode, if the difference between motor speed and speed command is smaller than [Pr-5.02] value, the servo drive can display (</V-COM> speed coincidence detection) signal. It is on when </V-COM> signal is displayed.	5-29
Row Display 2	When the rotation speed of the motor is higher than the setting value of rotation detection level [Pr-5.03], the servo drive can display (</TG-ON> rotation detection) signal. It is on when </TG-ON > signal is displayed.	5-35
Row Display 3	It is on when Z-pulse output of the encoder is detected.	

Overview of the Parameter Setting Mode

This section includes brief explanation of the parameters in parameter setting mode.

- The Parameter sets and saves various functions to make drive suitable for equipment.

- There is a parameter that can be always set regardless of the status of the drive, and those that must be in certain status of the drive when setting them. Be careful to set parameter in reference to the contents in the Chapter 4-2.
- The table below is to aid the understanding of parameter group.
- The contents related to parameter setting are described in details in Chapter 5, 6, 7, 8 and the Appendix along with the functional description of the servo drive.

From  To 

Parameter Group			Parameter Group Description
Group 0	0.00 to 0.14	15	User parameter related to basic setting and I/O signal
Group 1	1.00 to 1.15	16	User parameter related to gain and gain tuning
Group 2	2.00 to 2.13	14	User parameter related to speed control mode
Group 3	3.00 to 3.06	7	User parameter related to position control mode
Group 4	4.00 to 4.06	7	User parameter related to torque control mode
Group 5	5.00 to 5.14	15	User parameter related to supplementary function

Overview of the Monitor Mode

This section includes brief explanation of the parameters in monitor mode.

- Displays several numerical data generated as the motor is controlled by the drive.
- The contents of the monitor mode can be checked regardless of the status of the drive.
- Be fully aware of the numbers and units displayed in monitor mode shown in the table below and refer to it when using the servo drive.
- The table below shows the brief contents of each item in the monitor mode.

From  To 

Item	Monitor Contents (Unit)	Item	Monitor Contents (Unit)	Item	Monitor Contents (Unit)
00	Speed feedback [rpm]	07	Position command pulse frequency [kpps]	14	Torque command offset [mV]
01	Speed command [rpm]	08	Electrical angle [°]	15	I/O status

02	Speed error [rpm]	09	Mechanical angle [°]	16	Alarm history
03	Torque command [%]	10	Accumulated load rate of regenerative resistor [%]	17	Firmware version
04	Position feedback [pulse]	11	DC Link voltage [V]	18	Motor & Encoder Type
05	Position command [pulse]	12	The number of rotation data of absolute encoder	19	Analog speed command voltage [0.01V]
06	Position error [pulse]	13	Speed command offset [mA]	20	Analog torque command voltage [0.01V]
				21	Drive rated output
				22	Absolute encoder 1-time rotation data
				23	encoder feedback counter

NOTE

- The item of the monitor mode, whose value is more than 6 digits, is not displayed at once by the 6-digit 7-segment LED display.
- Refer to the Chapter 7-50 for details on how to check such items.

Overview of the Operation Mode

This section includes brief explanation of the parameters in operation mode.

- The motor can be run in operation mode.
- Each item provides a special function, which can be used.
- Just as in the parameter setting mode, there is a status where the operation is possible/impossible according to the status of the servo drive, during the use of the operation mode. Refer to the Chapter 7-35 for details of operation mode.
- The table below shows the brief functions of each item in the operation mode.

From  To 

Item	Operation	Item	Operation
00	Jog operation	07	Adjustment of Current feedback offset
01	Off-line auto tuning	08	Alarm reset
02	Homing	09	Alarm history clear
03	Auto adjustment of the Speed command offset	10	Absolute encoder reset

04	Auto adjustment of the torque command offset	11	2-group gain storing
05	Manual adjustment of the speed command offset	12	Parameter initialization
06	Manual adjustment of the torque command offset		

NOTE Refer to the Chapter 7-35 for details of operation mode and key button manipulation.

Basic Setting

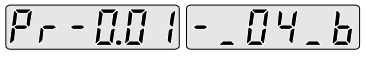
This section includes the introduction of the control mode and the basic setting.

Overview of the Basic Setting

Basic setting must be done before using the servo drive.

1. Other parameters can be set after the basic setting.
2. The basic setting is possible only after connecting the control power of the servo drive.
3. After all setting three types of basic setting, reapply the power.
4. The setting values of the basic setting are saved even if the power is cut off or parameter is initialized by [run-12] function of the operation mode.
5. To change basic setting value, change it directly from corresponding parameter and reapply the power.

As shown below, the basic setting uses three parameters to set 3 types.

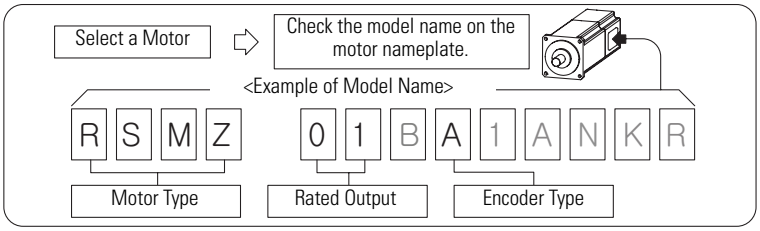
	Basic Setting Parameter	Setting
1		Control mode (optional) setting
2		Motor setting Motor type setting Motor capacity (rated output) setting Encoder type setting
3		Main power input (optional) setting

- The key button manipulation flow chart is provided in the description of the basic setting to aid the understanding of the key buttons. While performing the basic setting, get accustomed to key button manipulation. Key button manipulation flowchart is not described after Chapter 5.

The following figure is an example of the nameplate attached to the motor.

- Before performing basic setting, be sure to check the following three contents of the model name.

- Before mounting a motor to the equipment, check the model name of the motor in advance. Depending on the motor type, the motor may be mounted in such direction that the nameplate is not visible.



Control Mode Setting

Control Mode Type

As in the table below, there are 4 kinds of basic control modes and 6 kinds of associated control modes.

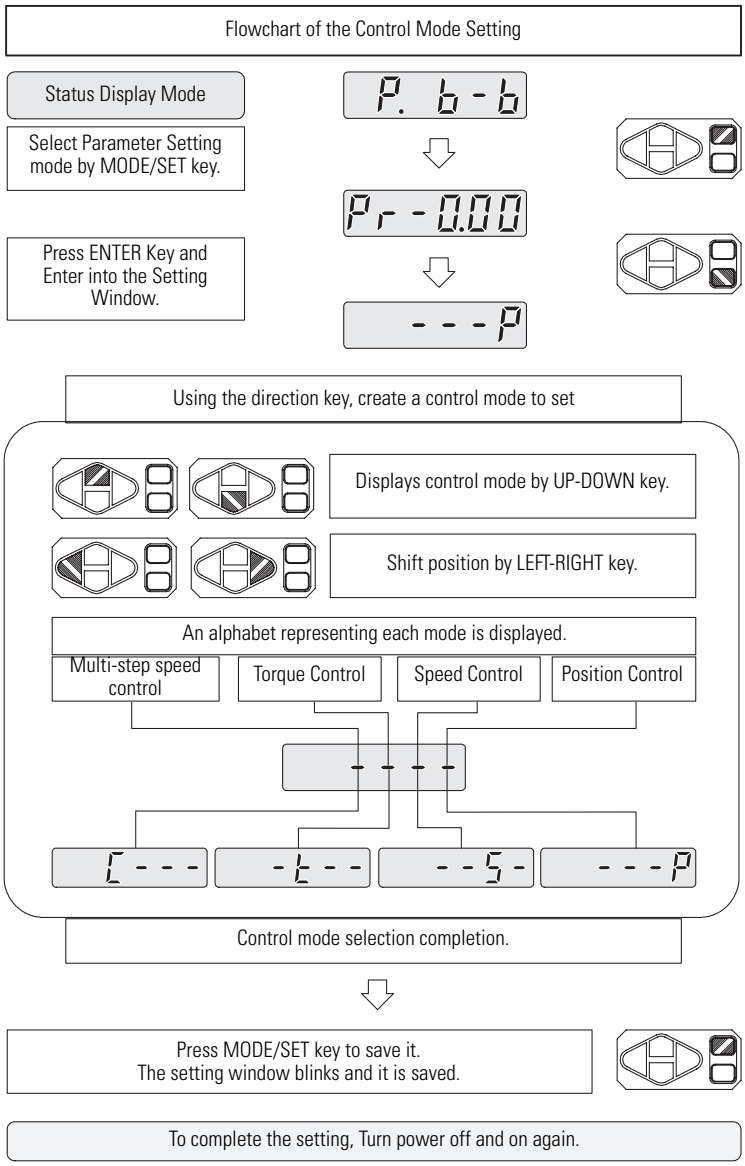
- The drive has another drive exclusively for the position control. For this drive, there is no need for a separate control mode selection. (Refer to the Chapter 1-7)
- Combinational control mode cannot be used by combining more than 3 types. Make sure to combine two types only.
- The table below shows the control mode types. Refer to the chapter 5 for function for each control mode.

Basic Control Mode		Associated Control Mode	
Display	**Description**	**Display**	**Description**
- - - P	Position mode	- - SP	Speed + position mode
- - S -	Speed mode	- t S -	Torque + speed mode
- t - -	Torque mode	- t - P	Torque+ position mode
C - - -	Multi-step mode	C - - P	Multi-step speed + position mode
		C - S -	Multi-step speed + speed mode
		C t - -	Multi-step speed + torque mode

Control Mode Setting Method

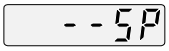
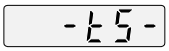
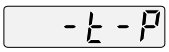
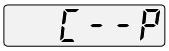
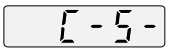
Describes control mode setting method focusing on the key button manipulation.

- Apply the power and set it as shown in the flowchart below.



Combinational Control Mode Setting

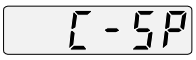
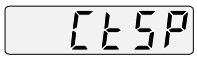
Combinational control mode should be set as below.

Associated Control Mode	Display	Setting Window Display
Speed + position control	(SP)	
Torque + speed control	(TS)	
Torque + position control	(TP)	
Multi-step speed + position control	(CP)	
Multi-step speed + speed control	(CS)	

Precautions

The following are the precautions in setting associated control mode.

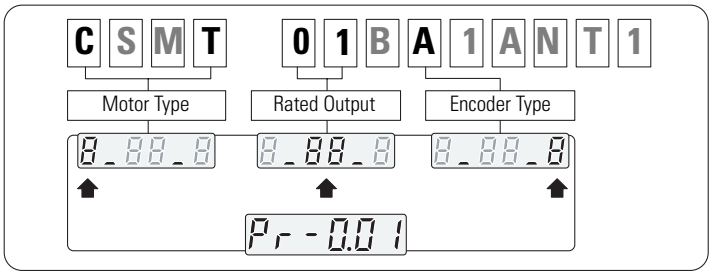
- Combinational control mode cannot be used by combining more than 3 types. Make sure to combine two types only.
- If the setting is correctly entered, the setting window blinks once when MODE/SET key is used to save the data. However, if wrong setting is entered, it does not blink nor is saved.

Wrong Input by entering more than 3 types	
	

Motor Setting

Select a motor to connect to the servo drive and set three items of the motor.

- If a motor to connect to the drive is selected, verify the nameplate on the motor. Motor setting is divided into three items as below.
- Motor setting should be done from the parameters [Pr-0.01]. As shown in the following figure, the setting window of [Pr-0.01] has a predefined place for each item, and the same alphabet as the ones on the model name of the motor. (Use both capital letters and lowercase letters)



Motor Type

Motor types of the servo motor are indicated in 4 digits, and the code starts with CSM for all motors. Thus, the first 3-digit, CSM, is omitted in the display of the motor.

Display	Model	Display	Model	Display	Model
-_00_0	CSM	d_00_0	CSMD	rF00_0	RSMF
t_00_0	CSMT	H_00_0	CSMH	rH00_0	RSMK
r_00_0	CSMR	K_00_0	CSMK	rL00_0	RSML
9_00_0	CSMQ	r500_0	RSMS	r900_0	RSMQ
2_00_0	CSMZ	rd00_0	RSMD	r200_0	RSMZ
5_00_0	CSMS	rH00_0	RSMH		

Rated output (capacity)

Rated output (capacity) and display of the motor are shown below.

Display	Capacity	Display	Capacity	Display	Capacity
0_A3_0	30 [W]	0_01_0	100 [W]	0_10_0	1 [kW]
0_A5_0	50 [W]	0_02_0	200 [W]	0_15_0	1.5 [kW]

Encoder Type

In encoder type setting, serial absolute encoder whose encoder type is Q and E type transmit encoder data to the drive and automatically performs setting as it is connected to the drive.

The encoder type display is shown below.

Motor Series : CSMT, CSMR, RSMS/D/H/F/K/L, RSMZ/Q

Display	Number of Pulse/ 1 Rotation	Encoder Type	Display	Number of Pulse/ 1 Rotation	Encoder Type
	131072	Serial Absolute		131072	Serial Inc.
Motor Series: CSM, CSMT, CSMR			Motor Series: RSMZ/Q		
Display	Number of Pulse/ 1 Rotation	Encoder Type	Display	Number of Pulse/ 1 Rotation	Encoder Type
	2048	15wire Inc.		2500	11wire Inc.
	2048	9wire Inc.		2048	Full Absolute
			Motor Series: RSMS/D/H/F/K/L		
	2048	Compact Absolute		10000	15wire Inc.
	2500	15wire Inc.		5000	15wire Inc.
	2000	15wire Inc.		6000	15wire Inc.

Precautions

Setting sequence is in order of motor model, rated output (capacity), and encoder type. The encoder type is classified into group 1 and group 2, according to motor model, and an encoder that corresponds to each motor type is displayed. In addition, only the rated output of the motor that corresponds to the type selected is displayed only.

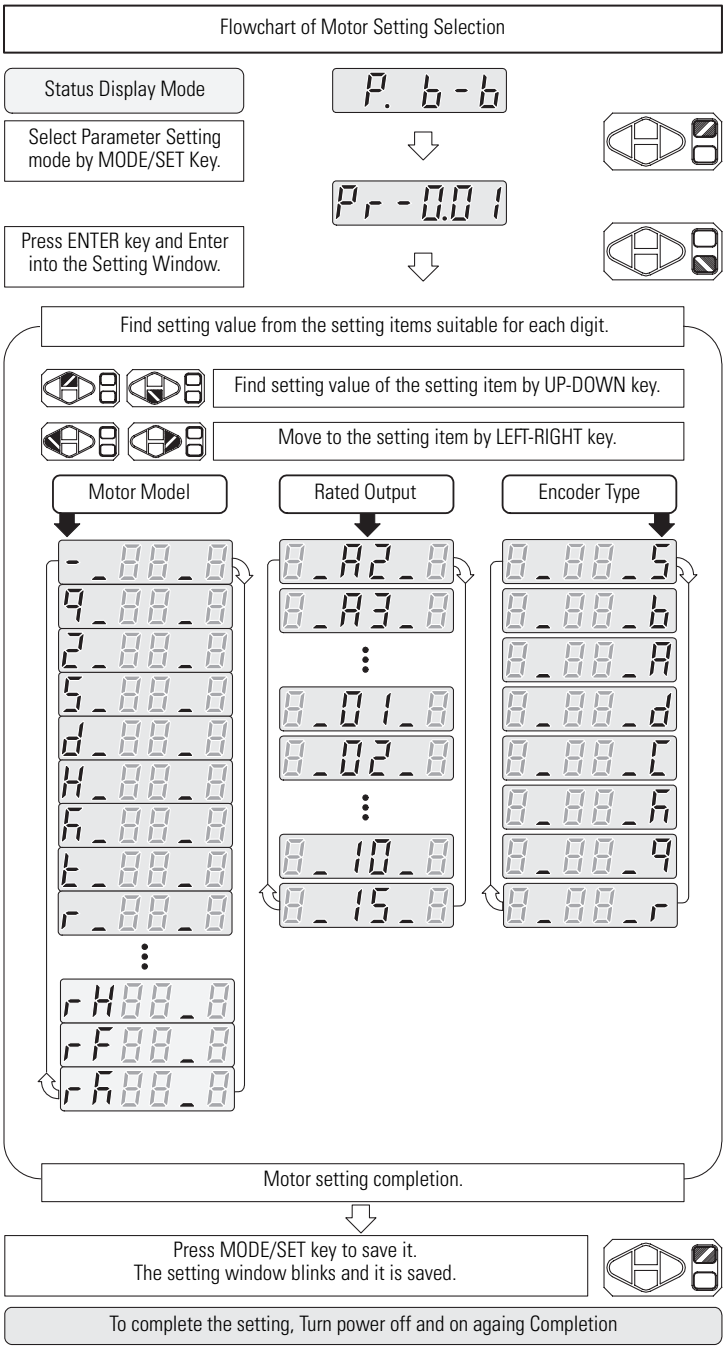
A setting example of an encoder in the encoder type 1 is shown in the following motor setting flowchart.

- In the following flowchart, the encoder type is in order of (S, B, A, D, C, K, Q).
- In case of using a model in encoder type 2, the encoder type is displayed in order of (A, B, D, H, J, M, E).

The table below is a setting example for each motor type.

CSM-A3BB2ANT3	CSMZ-02BH1ANM3	CSMT-04BQ1ANT3	RSMD-10BA1ASK3
			

Motor setting flowchart

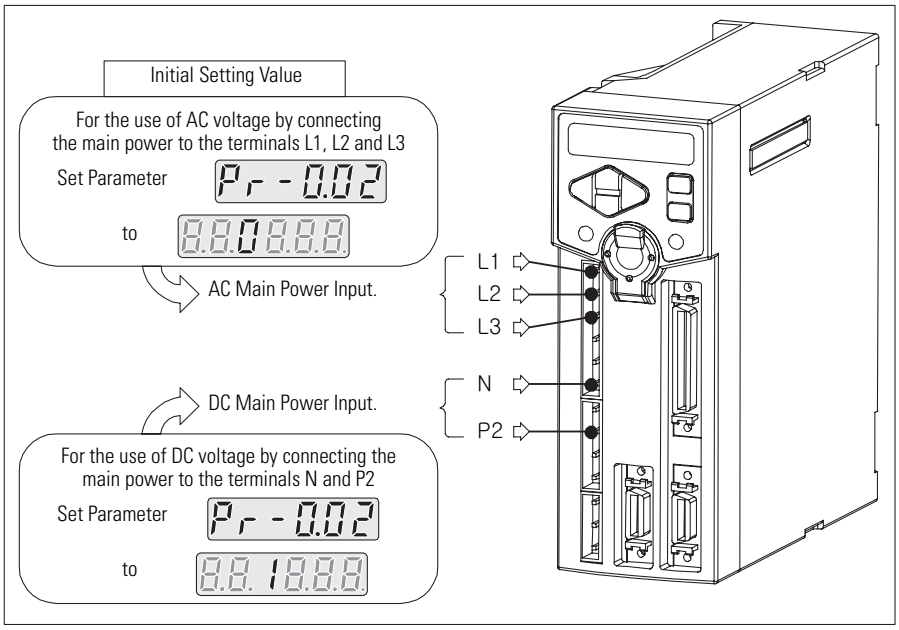


Main Power Selection

Main power input

The servo drive, as described in the Chapter 3-3, can accept two types of main power input (Refer to the Chapter 3-3 for details.).

- Initial value is set so as to use AC power through terminals L1, L2 and L3.
- Set this when DC voltage is used as the main power.
- The figure below is provided to help the understanding of the selection.



- The following describes the allowable momentary power down time setting according to the main power input selection.

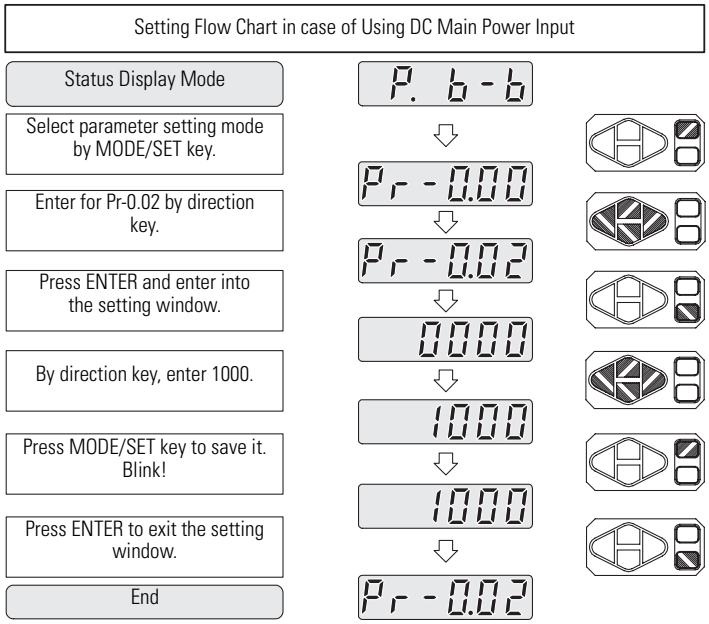
Pr - 5.10				Allowable Temporary Power Down Time
Setting Range	Initial value	Unit	Others	Servo OFF > setting > completion
20 to 1000	20	[msec]	Mode	ALL
Set the time to process the temporary power down by the servo alarm. If main power is not input within the set time, it generates temporary power down servo alarm (E.AcoFF). Refer to the chapter 8.2.2.				

NOTE The servo drive does not verify the status of temporary power down in case of using DC main power input terminal with input of main power from [Pr-0.02].

Flowchart of the main power input selection

Set it as shown in the following flowchart.

- Setting is on the fourth digit of the setting window. Make sure to use the correct digit.



WARNING

Main power can be input to either the input terminal of AC main power through terminals (L1, L2 and L3) or the input terminal of DC main power through terminals (N and P2). Be sure to connect it to only of them.

Basic setting is all finished for the use of the drive. Reapply the power.

- To connect other motor type after completing the basic setting of motor connected to the servo drive initially, or to change the parameter setting at the basic setting, be sure to enter into corresponding parameter and change it.

- Basic setting value is preserved even if the power is cut off or the parameter is initialized (Refer to the Chapter 7-48). (But, the main power input selection is initialized by the parameter initialization)

- A flowchart for the key button manipulation is included in the description of the basic setting of the servo drive to help the understanding of the key button manipulation. But, it is not provided in Chapter 6,7 and 8. Read the following section on startup, and get accustomed to the manipulation of the key buttons.

Startup

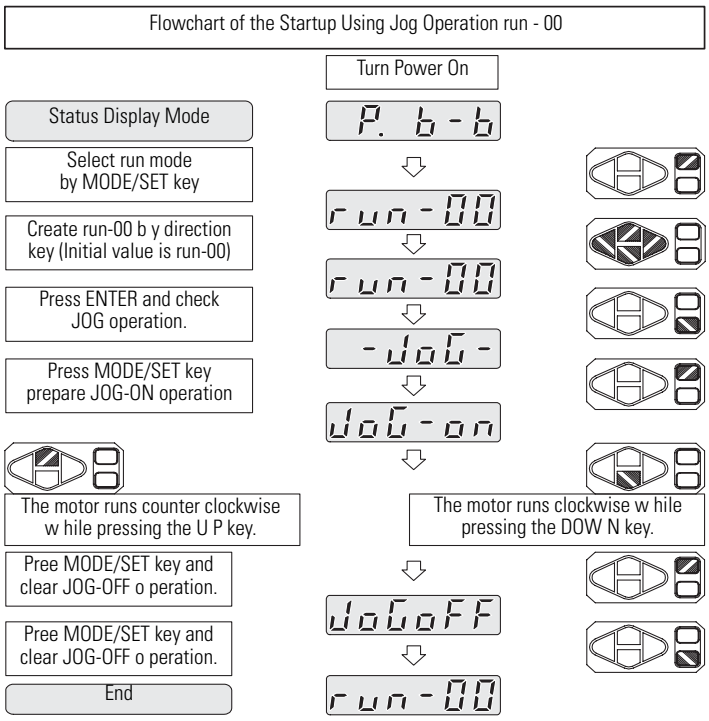
Before Startup

1. Be well aware of wiring in Chapter 3 and connect main power and control power normally. In addition, by configuring emergency stop input circuit, clear the emergency stop status.
2. Connect the motor and encoder properly.
3. Perform basic setting in reference to the Chapter 4-6
4. Do not connect the load to the motor for safety purposes. If the motor is mounted on the equipment, remove coupling of the motor shaft so that load may not move.

Startup

Start up the drive by using jog operation function. (Startup 1)

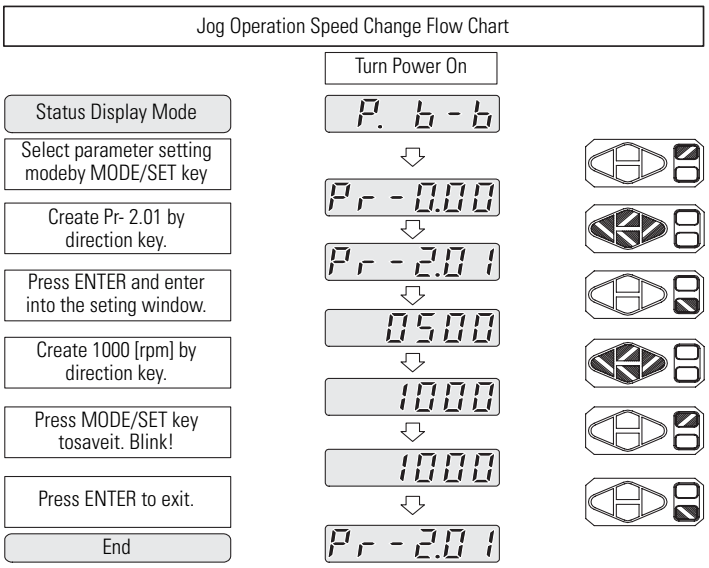
- The jog operation is possible in Servo-OFF status. Remove the wiring between the drive and the host controller, or apply Servo-OFF signal from the host controller.
- The speed of the motor can be set from the drive for the jog operation.
- The initial value of the jog operation speed is 500 [rpm].
- At startup 1, run the drive at the factory setting speed, 500 [rpm].
- Startup the drive according to the following flowchart.



Startup the drive by changing the speed. (startup 2)

- Start up the drive by changing the speed from the initial value, 500 [rpm] to 1000 [rpm].
- The change of Jog operation speed should be done at [Pr-2.01]. The speed set here is not related to other operation, and applied only upon the Jog operation.
- Setting range is 0 to 5000 [rpm]. Initial value is 500 [rpm].

- Change the Jog operation speed by according to the following flowchart.



- If setting is wrong, the setting window does not blink when saving it by pressing the MODE/SET key.
- If setting is completed normally, retry the Jog operation [run-00].
- You can see that the speed is changed from 500 [rpm] to 1000 [rpm].

NOTE

- At first, the drive is not tuned suitable for the load or motor.
- Upon startup, first perform off-line auto tuning described in the Chapter 7-36, then startup the drive to run the motor more smoothly in a stable condition.

WARNING

- To prevent the injury, check the operation range of the motor shaft or load upon operation, and keep it away from the drive.
- Run the drive after preparing the E-stop circuit. Then, you can cope quickly with an emergency situation.
- Refer to the Chapter 3-15 for E-stop information.

Check up Items during Startup

You can check the servo motor status and the motion of the system whether they occur noise or vibration or not during the jog operation.

NOTE If noise and vibration occur from the servo motor, perform off-line autotuning by referring to the Chapter 7-25. Then, you can run the motor more smoothly in a stable condition.

Function for Control Mode

Introduction

This chapter describes the sequence input/output function of I/O signal connector CNI and the function for each control mode.

Sequence I/O (Input/Output) Signal

What is Sequence I/O Signal?

To provide the optimum performance that is suitable for user's equipment, 50 pin connector of CN1 is used to allow the drive can input/output signals that has various functions.

- Input provides 16 functions and you can freely allocate input signal of each function with 7 pins from CN1 No. 3 to CN1 No. 9.
- Output provides 8 functions and you can freely allocate output signal of each function with three pairs of pins such as (41, 42), (43, 44) and (47, 48) of CN1.

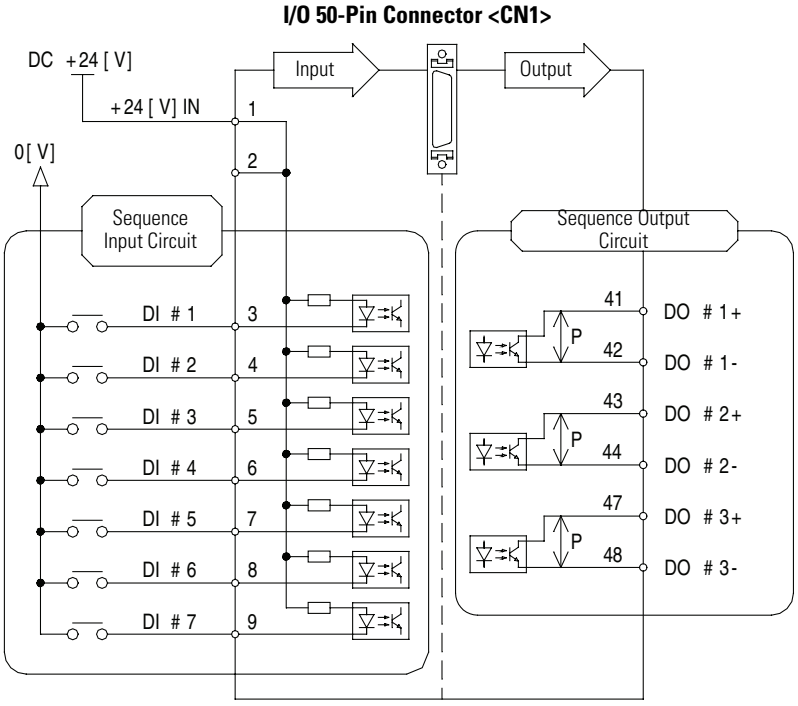
Sequence I/O signal means the I/O signal of various functions that are required for servo drive control by the host controller.

Sequence I/O signal is not to process input or output signal with the designated pin of CN1, but to select the function that the user requires in terms of circuit design of host controller and to directly allocate the selected functions to the designated pin.

Therefore, the host controller can do the sequential control that fits to the equipment to operate servo drive.

The following figure is sequence I/O part among 50 pins of CN1.

- Sequence Input is indicated as (DI#1) to (DI#7). (Digital Input Channel)
- Sequence Output is indicated as (DO#1) to (DO#3). (Digital Output Channel)



Function of Input Signal

The following is the brief explanation on 16 functions of sequence input signal. Details for each signal is explained in the reference pages listed on the right side of the table.

Type	Description	Mode	Reference
</SV-ON> Servo-ON	When input is ON, voltage is applied to the servo motor and when input is off, the voltage is cut off.	All	4-2
</A-RST> Alarm reset	It releases the servo alarm.	All	7-44
</G-SEL> Gain group conversion	Use 2 group gain for the section where input is on, and current gain for the section where input is OFF. It converts gain of 2 groups.	All	6-27
</P-TL> Limit forward torque	When a signal is on, it limits forward torque by the setting value [Pr-4.03].	All	5-41
</N-TL> Limit reverse torque	When a signal is on, it limits reverse torque by the setting value [Pr-4.04].	All	
<P-OT> Prohibit forward operation	It prohibits a motor from rotating forward when the load part reaches to the limit of available section.	All	7-2
<N-OT> Prohibit reverse operation	It prohibits a motor from rotating to the reverse direction when the load part reaches to the limit of available section.	All	
</P-CON> P/PI control conversion	It converts Speed controller from PI controller type to P controller type. It is used for faster response completion as restrain overshoot of transient state.	P S C	6-21
</C-SEL> Control mode conversion	It is used to convert the control mode when using Mixed control mode.	Combinational Control Mode Only Refer to 5.6	
</C-DIR> </C-SP1> </C-SP2> </C-SP3> </C-SP4> Terminal speed command	The rotation direction</C-DIR> and rotation speed </C-SP1 to /C-SP4> of the motor are determined by the above input in terminal speed control mode. Rotation speed of </C-SP1 to /C-SP3> is set in [Pr-2.05 to Pr-2.11]. Rotation speed of </C-SP4> is set by analog speed command voltage. </C-DIR> is used to change motor roatation direction in speed control mode.	C	5-45
</Z-CLP> Zero clamp	When analog command value in the speed control is lower than the setting value of speed zero clamp level [Pr-5.04], the input value is ignored.	S	5-31
</INHIB> Inhibit pulse command	It ignores position command pulse in the section where the signal is on.	P	5-21
</ABS-DT> Absolute Encoder Data Transmission	Transmits absolute encoder data to host controller through EA, EB when the signal is ON.	P	7-32

</PCLR>	Clear position command, position feedback, and position error.	P	5-21
/START	Control motor rotation start or stop by using terminal signal in speed or terminal speed control mode.	S, C	5-33
/GEAR	In position control mode, the 2nd electronic gear parameters [Pr-3.05] and [Pr-3.06] are used when input is ON. The basic electronic gear parameters [Pr-3.01] and [Pr-3.02] are used when input is OFF. Switch between two electronic gear ratios.	P	5-23

Function of Output Signal

The following is the brief explanation on 8 functions of sequence output signal. Details for each signal is explained in the pages listed on the right side of the table.

Type	Description	Mode	Details
/P-COM (+, -) (Positioning Completion detection)	It is on when the position error is within the output width of position completion signal [Pr-5.00].	P	5-23
/NEAR (+, -) (Position approach detection)	It is on when the position error is within the output width of position approach signal [Pr-5.01].	P	
/V-COM (+, -) (Speed coincidence detection)	It is on when the speed difference between command speed and the rotation speed are within the output width of speed coincidence signal [Pr-5.02].	P S C	5-29
/TG-ON (+, -) (Rotation detection)	It is on when the motor rotates with the speed more than the setting value of rotation detection level [Pr-5.03].	All	5-35
/T-LMT (+, -) (Torque limit detection)	It is on when motor torque is reached the setting value of torque limit.	All	5-41
/V-LMT (+, -) (Speed limit detection)	It is on when motor speed is reached the setting value of speed limit.	All	5-36
BK (+, -) (Breaker control)	It is the signal for control of the brake that is mounted inside and outside of the servo motor.	All	7-6
/WARN (+, -) (Warning detection)	It is on when the servo warning is detected.	All	8-4

NOTE

- The sequence I/O signal name is indicated by < > in this manual.
- ex) </SV-ON>, </P-COM>

Input Signal Allocation Method

Refer to the table below to allocate to CN1 pin by searching the function that is suitable for your condition.

Setting Value	8	7	6	5	4	3	2	1	0
Input Channel No.	Always valid	DI#7	DI#6	DI#5	DI#4	DI#3	DI#2	DI#1	Always invalid
CN1 Pin No.		9	8	7	6	5	4	3	

- As shown in the table below, the related function is already allocated to the sequence input parameter and its position in the setting window and it means that you use the related function as setting certain value among '1 to 8' except '0' to the setting position.

- For example, if you want to put certain function to CN1 No. 5 pin, you can find the related parameter of that signal and the position in the setting window according to the table below and enter '3' as the setting value.
- Set '0' when the function of input signal is not used.
- If you want to make input signal ON all the time regardless to the wiring, set '8'.

The following table is to arrange the parameter for each function and 7-segment number position in the setting window. Set so that the related parameter of each signal and the number position in the setting window is not in the wrong.

7-Segment	4th Position	3rd Position	2nd Position	1st Position
Setting window of each parameter	0	0	0	0
Pr-0.05	</P-CON> Initial value 4	<N-OT> Initial value 3	<P-OT> Initial value 2	</SV-ON> Initial value 1
Pr-0.06	</C-SEL>	</P-LT> Initial value 7	</N-TL> Initial value 6	</A-RST> Initial value 5
Pr-0.07	</C-SP3>	</C-SP2>	</C-SP1>	</C-DIR>
Pr-0.08	</PCLR>	</G-SEL>	</INHIB>	</Z-CLP>
Pr-0.09	</GEAR>	</C-SP4>	</START>	</ABS-DT>

The table below is the example to allocate sequence input signal.

Pr-0.05 0.0.7.0.0.0	Enter '7' in the 4th position in setting window of the parameter [Pr-0.05]. This is to use </P-CON> function and it means that the CN1 No. DI#7 pin is used as an input pin.
Pr-0.08 0.0.0.3.0.0	Enter '3' in the 3rd position in setting window of the parameter [Pr-0.08]. This is to use </G-SEL> function and it means that the CN1 No. DI#3 pin is used as an input pin.
Pr-5.09 0.0.0.0.0.8	Enter '8' in the 1st position in setting window of the parameter [Pr-5.09]. This is to use </SV-ON> function and since it is set as '8', it always remains as servo-ON status after the power is allowed regardless of wiring.

Output Signal Allocation Method

Refer to the table below to allocate to CN1 pin after searching the function that is suitable for your condition.

Setting Value	3	2	1	0
Output Channel No.	DO#3	DO#2	DO#1	Always Invalid
CN1 Pin No.	47, 48	43, 44	41, 42	

Set the setting value as '0' when the output of the related signal is not used.

The following table is to arrange the parameter for each function and 7-segment number position in the setting window. Set so that the related parameter of each signal and the number position in the setting window is not in the wrong.

7-Segment	4th Position	3rd Position	2nd Position	1st Position
Setting window of each parameter	0	0	0	0
Pr-0.09	</V-COM>	</BK> Initial value 3	</TG-ON> Initial value 2	</P-COM> Initial value 1
Pr-0.10	</WARN>	</NEAR>	</ V-LMT>	</T-LMT>

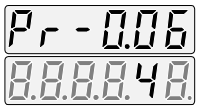
The table below is the example to allocate sequence output signal.

Pr-0.09 0.0.0.0.0.1	Set '1' in the 1st position in setting window of the parameter [Pr-0.09]. It is set to use </P-COM> function and it means that we will use CN1 No. DO#1 pin as output pin.
Pr-0.10 0.0.3.0.0.0	Set '3' in the 4th position in setting window of the parameter [Pr-0.10]. It is set to use </G-SEL> function and it means that we will use CN1 No. DO#3 pin as output pin.

NOTE Sequence output signal is outputted when the situation that fits to the condition of each output. Therefore, related to sequence output signal allocation, there is no setting value that is output always regardless of wiring such as setting value '8' for input signal.

Notice for Signal Allocation

When you allocate the different functions to the same pin of CN1 as shown below, the drive indicates servo warning in the status mode.

	Set '4' in the 2nd position in setting window of the parameter [Pr-0.06]. It is set to use </N-TL>function and it means that CN1 No. **DI#4** pin is used as an input pin.
	Set '4' in the 2nd position in setting window of the parameter [Pr-0.08]. It is set to use </INHIB> function and it means that CN1 No. **DI#4** pin is used as an input pin.
When you allocate more than two signals to the same pin as described above, the servo warning is indicated.	
Status Display Mode 	In this case, when you reapply the power after completing the input allocation, the status display mode indicates servo warning (Pin). Check if you allocate more than two signals to the same pin of CN1.

NOTE Through monitor mode in the 7-50, you can check if the sequence I/O signal is input.

NOTE E-STOP lamp (Emergency stop) uses the fixed input pin of CN1 contrary to sequence input according to the allocation.

SALM +,- lamp (Servo alarm) uses the fixed output pin of CN1 in contradiction to sequence output according to the allocation.

NOTE Reapply the power after allocating the sequence I/O signal.

NOTE Servo drive has self-diagnostic function.

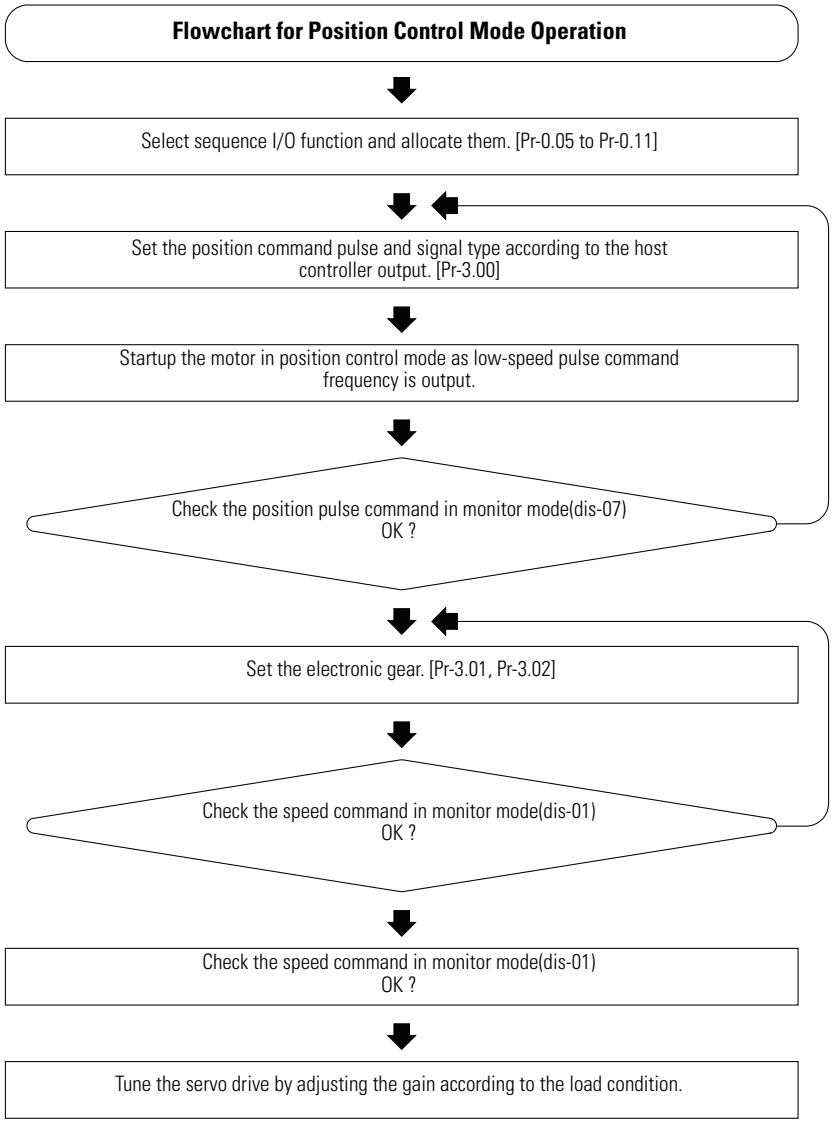
The (servo alarm) and (servo warning) is divided according to the importance of error diagnostic. For the details, see chapter 8.

Position Control Mode

Overview

The position control mode is used when the position command pulse is received from the host controller to move the load to a target position.

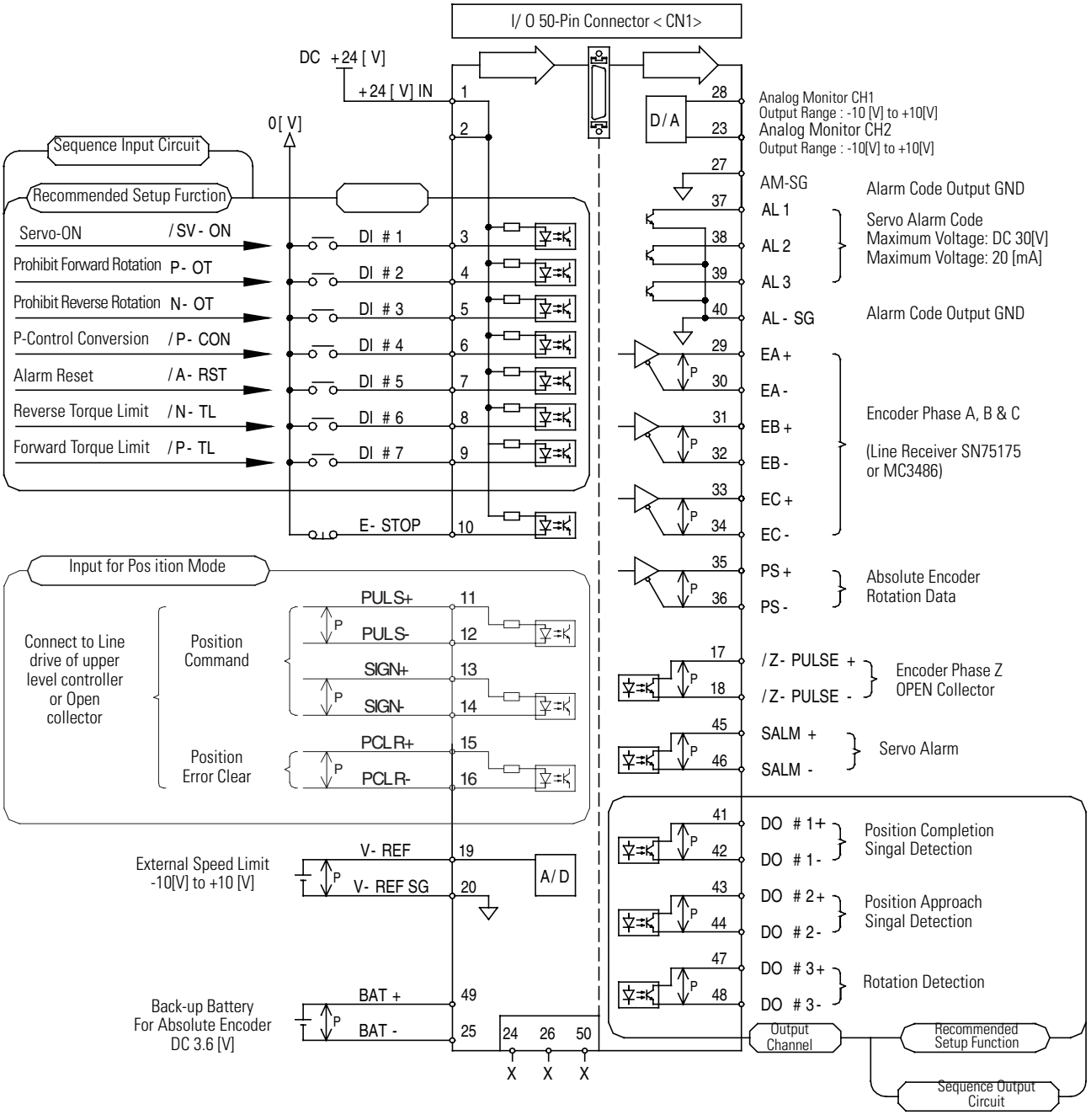
To operate the servo drive in position control mode, connect the position command pulse signal to PULS and SIGN input pins, connect other necessary input signals such as PCLR signal, and set as follows.



NOTE Both All-In-One & Position-Control-Only model can support the position control mode.

Standard Wiring Example

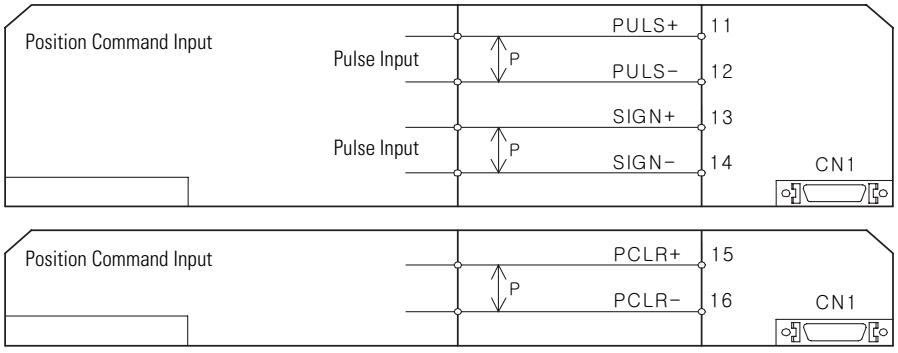
The following figure illustrates the standard wiring example of position control mode. You can set the sequence input/output signal, as you want if it is necessary for the system configuration.



Position Command Pulse

6 pins of CN1 receive 3 kinds of commands related to the position control mode.

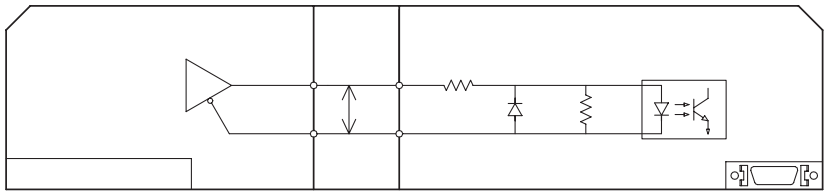
- Host controller sends the position command with the pulse input and sign input.
- To clear the position error to '0', send the PCLR command. Refer to the Chapter 5-21 for details on PCLR.



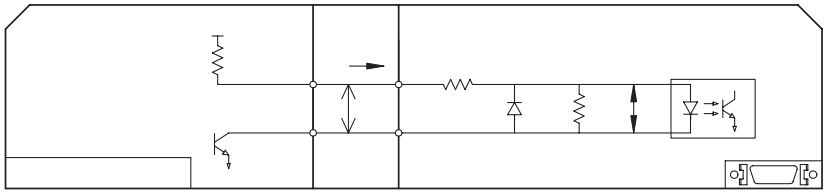
When the position control mode is used, there are line drive method and open collector method as the input types of the host controller. The servo drive supports two types of input.

The output of host controller

Connection ex.1: When it is line drive output (maximum allowable frequency 900 [kpps])



Connection ex.2: When it is open collector output (maximum allowable frequency 200 [kpps])



NOTE

Pay attention to the maximum allowable frequency.

For the line drive output: 900 [kpps]

For the open collector output: 200 [kpps]

Cautions

In the figure above, when it is open collector method and TR1 of host controller is ON, the servo drive identifies as low level input logic and if TR1 is OFF, the servo drive identifies as high level input logic.

In addition, set the Pull Up resistor R1 value to be within 7 [mA] to 15 [mA] by referring to the application example below.

Vcc of Host Controller	24 [V] ± 5 [%]	12 [V] ± 5 [%]	5 [V] ± 5 [%]
R1	2.2 [kW]	1 [kW]	180 [W]

NOTE

- When you use open collector method for the output of host controller, it is recommended to use 24 [V] for Vcc. In doing so, the operation is stable even in the environment with serious noise problem.
- When input voltage of 12, 14 and 16 of CN1 is not exactly low level (less than 0.6 [V]) or R1 value is higher than the suggested value, an error can occur. Therefore, use 24 [V] for Vcc of the host controller and 2.2 [K] for R1.

Set the position command pulse type for the host controller.

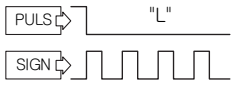
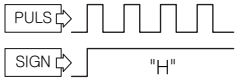
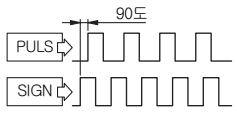
Pr-3.00	Position Command Pulse Input Selection		
Setting Value	0	Use the line drive output of the host controller.	
	1	Use the open collector output of the host controller.	
Applicable Mode	P	Others	Servo-OFF > Setting > End

NOTE

- Maximum allowable frequency of pulse command of host controller is,
  900 [kpps] for the line drive.
  200 [kpps] for the open collector.
- If it exceeds the maximum allowable frequency, excessive position command pulse "E.OvPUL" alarm occurs.
- Please be careful not to exceed the maximum allowable frequency.

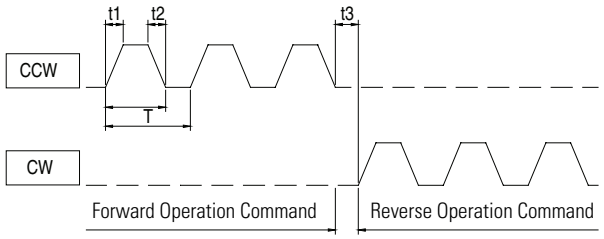
Position Command Pulse Setting

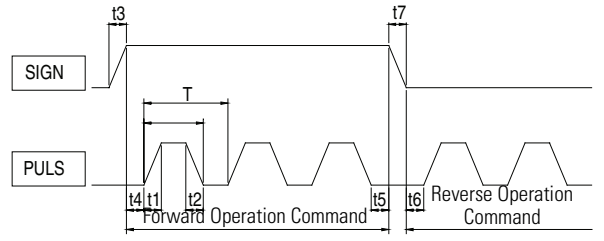
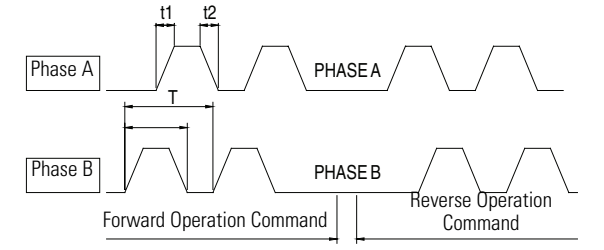
The position command supports 10 types as shown below. Check the applicable specification with reference to electric specification of the command pulse. If the electric specification such as timing is not appropriate, a position error can occur.

Pr-3.00 0.0.0.0.0.0			Position Command Pulse Form Selection	
Positive Logic				
Command Pulse Form	Forward Direction Operation	Reverse Direction Operation	Input Multiplication	Setting Value
CW + CCW			-	0
Pulse Train + Sign			-	2
Phase A + Phase B			-	4
			Duple	5
			Quadruple	6
Negative Logic				
CW + CCW			-	1
Pulse Train + Sign			-	3
Applicable Mode	P	Others	Servo-OFF > Setting > End	

NOTE You can verify the data related to the position through monitor mode in the Chapter 7-50.

Electrical Specifications of Position Command Pulse

<table>
<tr><th>Command Pulse Form</th><th colspan="3">Electrical Specification</th><th>Maximum Allowable Frequency</th></tr>
<tr><td rowspan="3">CW
+
CCW</td><td colspan="3"> 
</td><td rowspan="3">Line Drive:
900 [Kpps]

Open Collector:
200 [Kpps]</td></tr>
<tr><td>t1, t2 0.1 [us]</td><td colspan="2">τ 1.1 [us]</td></tr>
<tr><td>t3 > 3 [us]</td><td colspan="2">τ/T x100 50 [%]</td></tr>
<tr><td rowspan="2">Pulse Train
+ Sign</td><td colspan="3"> 
</td></tr>
<tr><td>t1, t2, t3, t7 0.1 [us]</td><td>t4, t5, t6 > 3 [us]</td><td>τ 1.1 [us]</td></tr>
<tr><td>2 Phase
Pulse Train
of 90
Difference
(A, B Phase)</td><td colspan="3"> 
</td></tr>
<tr><td>t1, t2 0.1 [us]</td><td>τ 1.1 [us]</td><td>τ/T x100 50 [%]</td></tr>
</table>

Electronic Gear

Electronic gear

The electronic gear is to set the amount of load movement per input command pulse.
The following is the example of Encoder that generates 2048 pulses per rotation.

- Encoder that the number of pulse is 2048, rotates once when the host controller transfers 2048 pulses to the drive. Then, is it possible to make a motor rotate once as transferring 1000 pulse (or other number of pulse)? (Yes, it can)
- Let's suppose that the ball screw load is operated by the pitch (Unit of load to be moved per rotation) with 15 [mm]. When the host controller transfers 2048 pulses, the load moves 15 [mm]. For easier calculation, is it possible to move one pitch (15 [mm]) with 1500 pulses? (Yes, it can)
- When you want to control the accurate angle using the servo drive, and if you control 360 degree with 2048 pulses, the number of pulse and the moving unit of the last mechanical part are different. So it is difficult to calculate.
- Therefore, the electronic gear is set for easier calculation of the input pulse of the host controller in respect to the distance or angle that is the moving unit of last mechanical part.
- When you use the electronic gear, the host controller can control without considering the number of pulse of the encoder or the reduction ratio of mechanical part.

Before setting the electronic gear

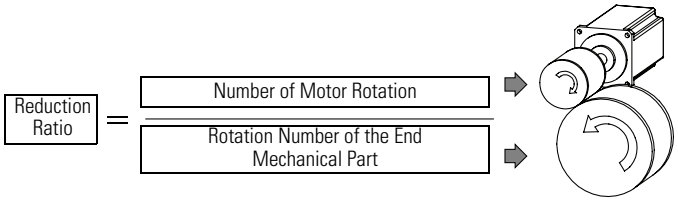
The following table explains the contents that you should know before setting the electronic gear.

	Description
Motor	Check the number of pulse of the encoder used. Refer to the Chapter 4-7.
Load	Check the reduction ratio applied from shaft to the mechanical part.

Reduction ratio

For the reduction ratio that is mentioned in electronic gear setting, refer to the explanation below.

The reduction ratio that is mentioned in electronic gear setting is the rotation ratio of motor and end mechanical part.

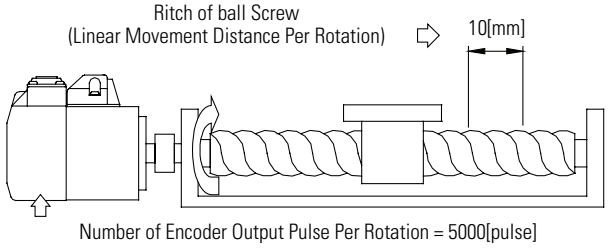


When the mechanical part rotates once while the motor rotates 5 times, then the reduction ratio is '5'. When the device part rotates 5 times while the motor rotates once, then the reduction ratio is '0.2'.

Example 1 of electronic gear setting

The following example on ball screw will help you to understand the electronic gear.

Example 1



- Ball screw is applied to the load above and the pitch is 10 [mm].
- When we suppose that the number of pulse of the encoder is 5000 [pulse], the reduction ratio is '1' because it is 1:1.

Electronic Gear Parameter	Setting
Electronic Gear Setting Numerator Pr-3.01	Electronic gear setting numerator parameter is as follows. Number of Encoder Pulse X Reduction Ratio
Therefore, it is 5000 [pulse] X 1 so that setting value is **5000**.	

Electronic Gear Setting Denominator Pr-3.02	Enter the number of pulse to make a motor rotate once. If you want to rotate a motor once by the host controller sending 1000 pulse to the servo drive, enter 1000 as a setting value. As a result, the ball screw rotates once with 1000 pulses, so the ball screw with the movement pitch of 10 [mm] moves 10 [um]. If you want to rotate a motor once by the host controller sending 10000 pulse to the servo drive, enter 10000 as a setting value. As a result, the ball screw rotates once with 10000 pulses, so the ball screw with the movement pitch of 10 [mm] moves 1 [um].

Precautions

When you set up the denominator as 10000, the ball screw moves 1 [um] per pulse of the host controller so that it shows better resolution than set with 1000.
If so, can you realize much better the resolution is if the denominator is set as 50000? No, you cannot. The resolution of the encoder that is selected is 5000. So the electronic gear has to satisfy the following formula because it is set according to the selected encoder.

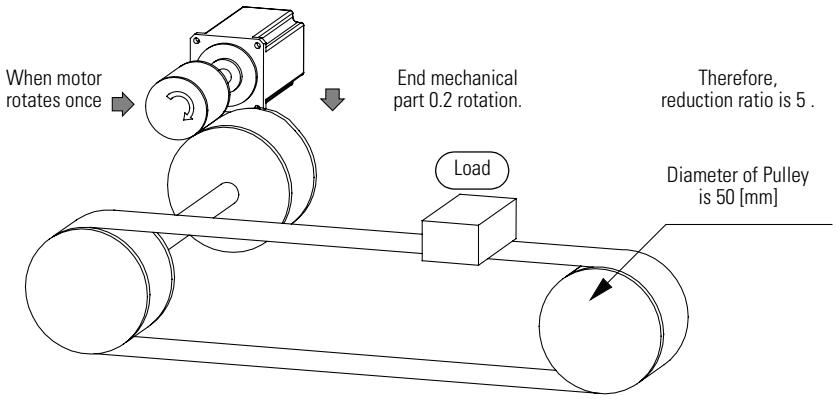
Number of Encoder Pulse X Reduction Ratio X 4 ≥ Setting Value of Pr-3.02

Therefore, the example 1 above can make a motor rotate with maximum of 20000 pulses from the host controller.

Example 2 of electronic gear setting

- This chapter explains the electronic gear setting for a belt load with the reduction ratio.

Example 2



- For the ball screw in the example 1, you can easily recognize the pitch through the ball screw specification, but you cannot find the load pitch that consists of belt and pulley. Therefore, let's suppose that the distance we want to move is 100 [um] per pulse from the host controller.

- Let's suppose that the number of pulse of the encoder is 2048 [pulse] and the reduction ratio is '5'.

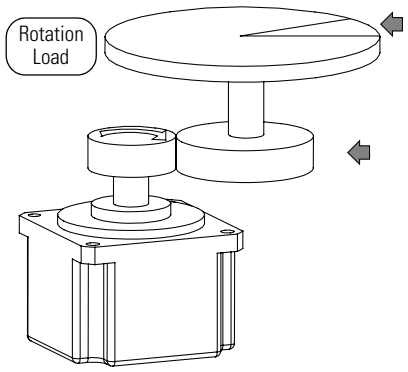
Electronic Gear Parameter	Setting
Electronic Gear Setting Numerator Pr-3.01	Electronic gear setting numerator parameter is as follows. Number of Encoder Pulse X Reduction Ratio
Therefore, 2048 [pulse] X 5, so the setting value is **10240**.	

Electronic Gear Setting Denominator Pr - 3.02	$\frac{\text{Load movement amount per 1 load shaft rotation}}{\text{Movement amount by 1 pulse from the host controller}} = \frac{3.14 \times 50[mm]}{100[um]} = 1570$
Rotate the pulley of the final mechanical part once with the 1570 pulses from the host controller. In this case, the linear moving distance of the final load per pulse from host controller is 100 [um].	
You can enter the numerator and denominator by reduction of fraction as the following.	
Pr - 3.01 Electronic Gear Numerator Pr - 3.02 Electronic Gear Denominat	$\frac{10240}{1570} = \frac{1024}{157}$

Example 3 of electronic gear setting

The following explains the electronic gear setting when it is a turn- table load with the reduction ratio.

Example 3



Desired rotation distance per one pulse from host controller = 0.1 [degree]

Load rotates once when motor rotates three times
Reduction Ratio = 3

- Let's suppose the distance we want to rotate per command pulse from the host controller is 0.1 [degree].
- Let's suppose that the number of pulse of the encoder 2048 [pulse] and the reduction ratio is '3'.

Electronic Gear Parameter	Setting
Electronic Gear Setting Numerator	Electronic gear setting numerator parameter is as follows.
Pr - 3.01	Number of Encoder Pulse X Reduction Ratio
Therefore, 2048 [pulse] X 3, so the setting value is **6144**.	

Electronic Gear Setting Denominator Pr - 3.02	$\frac{\text{Load movement amount per 1 load shaft rotation}}{\text{Movement angle by 1 pulse from the host controller}} = \frac{360[\text{Degree}]}{0.1[\text{Degree}]} = 3600$
Rotate the turntable load of the end mechanical part once with the 3600 pulses from the host controller. In this case, the rotation angle of the final load per pulse from host controller is 0.1 [degree].	
The electronic gear is applied only when the position control mode is used. You can easily adjust the distance or the angle of pulse command and load from the host controller by setting the electronic gear.	

NOTE

You should check two things below when setting the electronic gear.

- Check the number of pulse of encoder. Refer to the Chapter 4-7.
- Check the reduction ratio that is applied from shaft to the end mechanical part.

Electronic gear setting

Set the electronic gear to the parameter below.

Pr - 3.01			Electronic gear setting (Numerator)	
Setting Range	Initial value	Unit	Others	Servo-OFF > Setting > End
1 to 65535	Automatic	[pulse]	Applicable Mode	P
Number of Encoder Pulse × Reduction Ratio				

Pr - 3.02			Electronic gear setting (Denominator)	
Setting Range	Initial value	Unit	Others	Servo-OFF > Setting > End
1 to 65535	Automatic	[pulse]	Applicable Mode	P
The number of position command pulse of the host controller to rotate the load (Load shaft) once				

NOTE

- The Initial value of the electronic gear parameter is automatically set as the number of pulse of related encoder at the same time when the parameter is initialized (Run-12).

Precautions and other Specification

Setting value of the electronic gear should satisfy the following relationship.

- **[Number of pulse per rotation of motor] x [Reduction ratio] x 4 [Setting value of Pr-3.02]**
- If the relationship above is not formed, you can use it as pulse command but the resolution is not guaranteed.

Maximum resolution is

1 / [(Number of pulse per rotation of motor) X (Reduction ratio) X 4].

If the setting value of [Pr-3.02] does not satisfy the relationship above,
- Reduce the distance or angle needs to be moved with one command pulse. (=reduce the resolution)
- Use the high-resolution encoder, which outputs the number of pulse higher than the value set in [Pr-3.02] divided by 4, or increase the reduction ratio.

NOTE

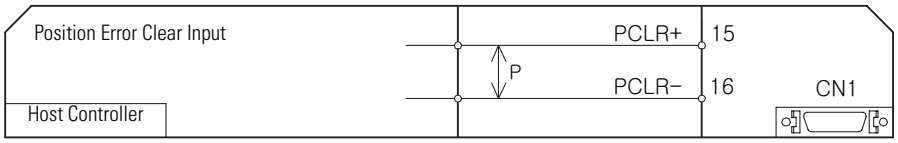
- Position control resolution of CSD3 Servo drive is 1 [pulse].
- In the example 1 on ball screw load, [Pr-3.01]=5000 and the maximum value for [Pr-3.02] is 5000 X 4=20000.
- Therefore, the minimum unit which moved by 1 command is 10 [mm] / 20000 = 0.5 [um].
- When actually applying, design with sufficient amount more than the minimum unit.

NOTE

- Servo drive can output the encoder by the host controller.
- Refer to the Chapter 7-6 (position feedback with the host controller) with the understanding of the electronic gear setting.

Position Error Clear (/PCLR)

If this signal is inputted, the position command, position error, and encoder feedback counter (dIS-23) are cleared to '0'. If the position command pulse is not inputted any more, the motor can be stopped from the current state. Input the Position Error Clear (PCLR) signal to (15,16) pin of CN1.



In the parameter below, set the parameter for the signal trigger condition to clear the error to '0' in position error clear input.

Select the trigger condition in the following parameter.

Pr-3.00		PCLR Input (Selection) Setting	
Setting Value	0	It clears in H level. Position error maintains '0' as long as the H level is maintained.	"H"
	1	It clears just once at a rising edge.	
	2	It clears in L level. Position error maintains '0' as long as L level is maintained.	"L"
	3	It clears just once at a falling edge.	
Applicable Mode	P	Others	Servo-OFF > Set > End

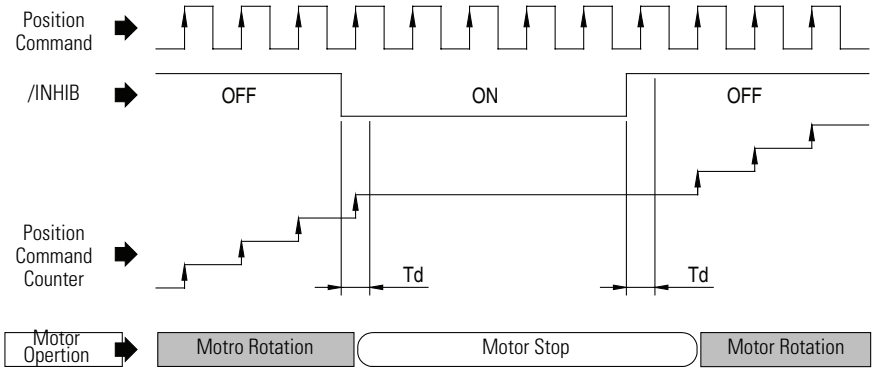
Pulse Command Inhibition</INHIB> Input

The position command counter can be stopped in the position control mode by setting the pulse command inhibition</INHIB> by the sequence input signal.

While </INHIB> input is ON, it is ignored even though the host controller sends the position command pulse to the servo drive.

Therefore, it locks the servo status in the current position. If </INHIB> signal is ON/OFF while the host controller continuously sends the position commands, the following operation occurs according to the </INHIB> signal status.

In the figure below, Td is about 10 [msec].



</INHIB> is a sequence input signal. To use the </INHIB> signal, allocate the </INHIB> signal with the reference to the sequence input/output signal in the Chapter 5-2.

NOTE

- If the setting value is '8' the setting signal is always valid regardless of the wiring, as shown in Input signal allocation method in the Chapter 5-5.
- Therefore, when setting the pulse command inhibition </INHIB> input as '8', the position command pulse is inhibited to lock the servo and the servo motor does not run.

Expansion of Electronic Gear Setting

When the electronic gear ratio needs to be changed in position control mode, the </GEAR> input can be used to switch from the first group of gear parameters to the second group of electronic gear parameters in Pr-3.05 and Pr-3.06. When the </GEAR> input is OFF, the first group of electronic gear parameters in Pr-3.01 and Pr-3.02 will be used. The Details of the newly added second group of electronic gear parameters are shown below.

Parameter	Pr-3.00
Parameter Name	change the setting method of eletronic gear parameters Pr-3.01 and Pr-3.02
Setting value	0 - Change eletronic gear parameters only when Servo-OFF 1 - Change eletronic gear parameters no matter what Servo-OFF or Servo-ON
Initial value	0
Mode	P
Misc.	Servo-OFF > Setting > Complete

The Second Group of Electronic Gear </GEAR> input

Parameter	
Parameter Name	Second electronic gear setting (numerator)
Description	The number of encoder pulses X deceleration ratio
Setting value	1~65535
Initial value	32768
Unit	Pulse
Mode	P
Misc.	Servo-OFF > Setting > Complete

Parameter	
Parameter Name	Second electronic gear setting (denominator)
Description	The number of position command pulses from a controller necessary to turn load axis one revolution
Setting value	1~65535
Initial value	32768
Unit	Pulse
Mode	P
Misc.	Servo-OFF > Setting > Complete

ATTENTION

If the gear ratio is changed frequently or if the change in gear ratio is large, severe machine vibration due to rapid acceleration/deceleration may occur in Servo ON state.

Position Completion Signal Detection </P-COM>, Approach Signal Detection </NEAR> Output

Position Completion Signal Detection </P-COM>

The position completion signal detection</P-COM> can be output with sequence output signal.

When you set the position command completion time to Servo drive that receives the position command from host controller, and the difference

between position feedback and position command is less than Setting value, the position completion signal detection </P-COM> can be output.

Setting the output width of position completion signal

Set the output width of position completion signal (Standard) to output the </P-COM> signal to the parameter below.

Pr - 5.00			Output Width of Position Completion Signal	
Setting Range	Initial value	Unit	Others	Setting > End
0 to 1000	10	[pulse]	Applicable Mode	P
When the number of position error pulse is within the value above, position completion signal detection </P-COM> signal is generated.				

Position approach signal detection </NEAR>

The position approach signal detection </NEAR> signal can be output with sequence output signal.

When setting the position command approach signal time to the servo drive that receives position command from the host controller, and the difference between the position feedback and position command is less than setting value, the position approach signal detection </P-COM> signal can be output.

Setting the output width of position approach signal

Set up output width of position approach signal (Standard) to generate </NEAR> signal to the parameter below.

Pr - 5.01			Output Width of Position Approach Signal	
Setting Range	Initial Value	Unit	Others	Setting > End
0 to 1000	20	[pulse]	Applicable Mode	P
When the number of position error pulse is within the value above, position Approach Signal detection </NEAR> signal is generated.				

Other explanation

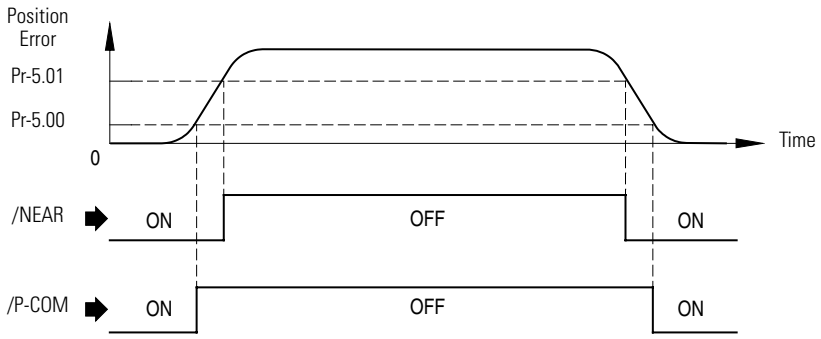
Position approach signal detection </NEAR> signal with position completion signal detection </P-COM> signal is useful to reduce the necessary operation at the position completion signal time. First, check the approach signal and preparing the next sequence before the host controller verifies the position completion signal detection signal. The setting of these parameters above do not influence on the accuracy of final position decision.

Therefore, you can adjust timing to output </P-COM> signal and </NEAR> signal by adjusting the number of position error pulse of [Pr-5.00] and [Pr-5.01].

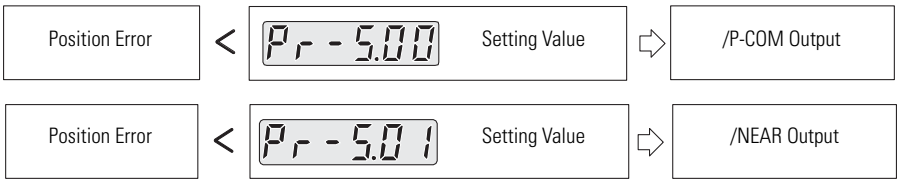
If the position completion signal detection </P-COM> signal is detected, the segment LED in line indication 1 of status indication mode is on. However, </NEAR> signal is not on.

Figure Explanation

Sequence output </P-COM> and </NEAR> signal output as shown below.



Thus, </P-COM> and </NEAR> output are ON when satisfying the following conditions.



WARNING

When [Pr-5.00] is set with high value during the low-speed operation, </P-COM> output signal remains ON.

NOTE

</P-COM> and </NEAR> are sequence output signal. To use </P-COM> and </NEAR> function, allocate </P-COM> and </NEAR> signal and refer to sequence input/output signal in the Chapter 5-2.

NOTE

</P-COM> and </NEAR> are sequence output signal. To use </P-COM> and </NEAR> function, allocate </P-COM> and </NEAR> signal and refer to sequence input/output signal in the Chapter 5-2.

NOTE

- When position completion signal detection </P-COM> signal is output, the servo drive turns line indication 1 on to allow verification of </P-COM> signal output.
- For status indication mode, refer to the Chapter 4-6.

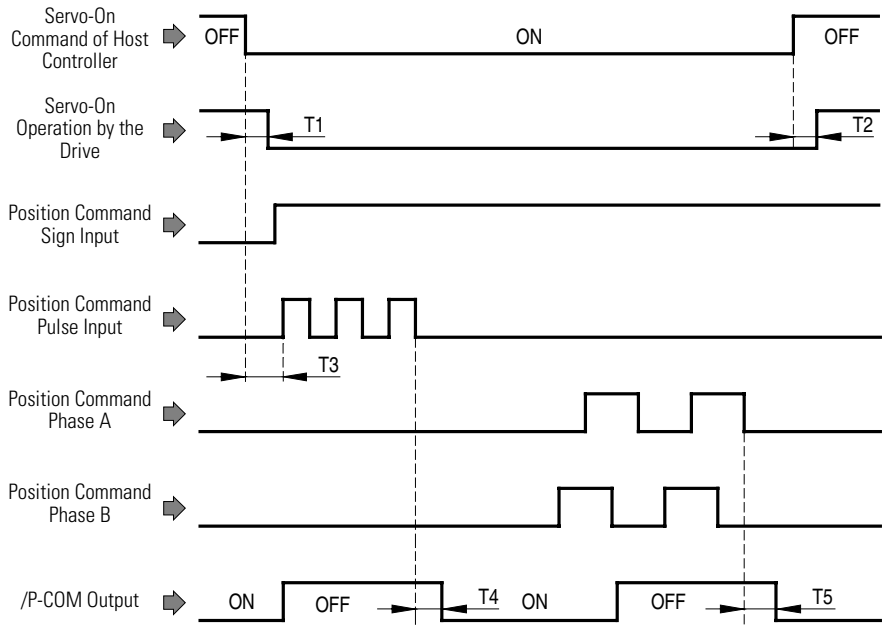
Output Width of Allowable Position Error

Set allowable position error limit.

Pr-5.09			Output Width of Allowable Position Error	
Setting Range	Initial Value	Unit	Others	Setting > End
0 to 65535	20480	[pulse]	Applicable Mode	P
If position error is bigger than setting value, the position error overflow servo alarm (E.PoSEr) occurs.				

Input/Output Signal Timing diagram

The figure below is a timing diagram of Input/Output signal in position control mode.



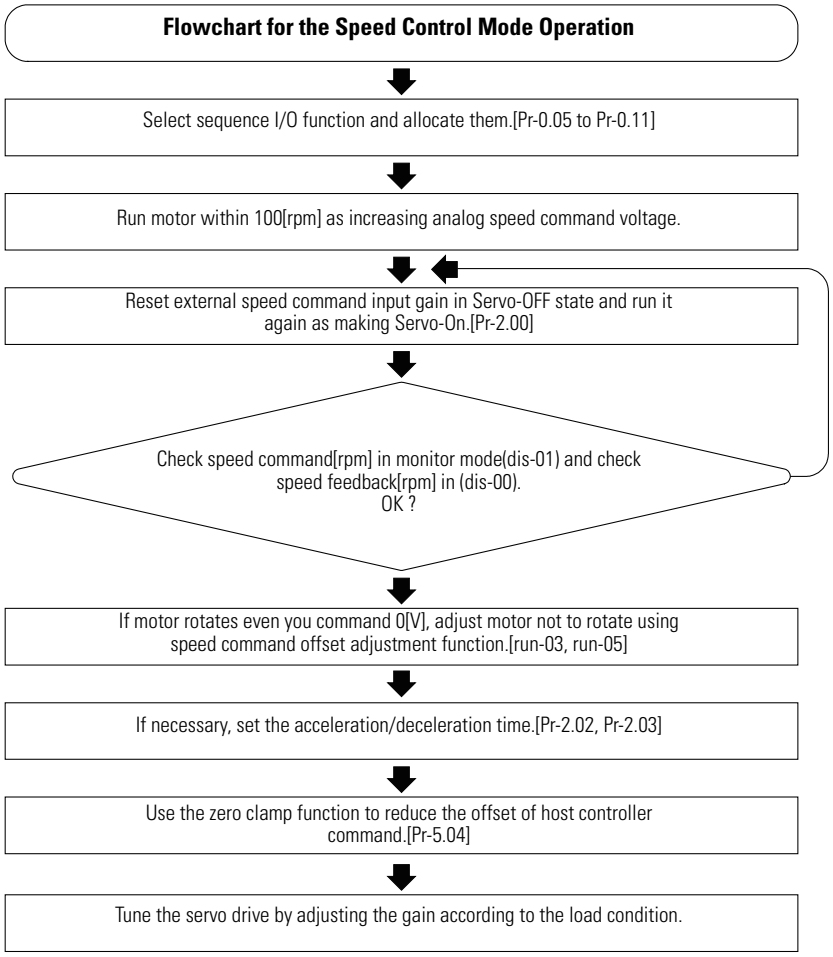
T1	T2	T3	T4	T5
Maximum 40 [ms]	Maximum 6 [ms]	Minimum 40 [ms]	Minimum 2 [ms]	

Speed Control Mode

Overview

The speed control mode is used to control the speed as inputting speed command of analogue voltage type that is generated by the host controller to servo drive even if the position control loop is formed in the host controller or not.

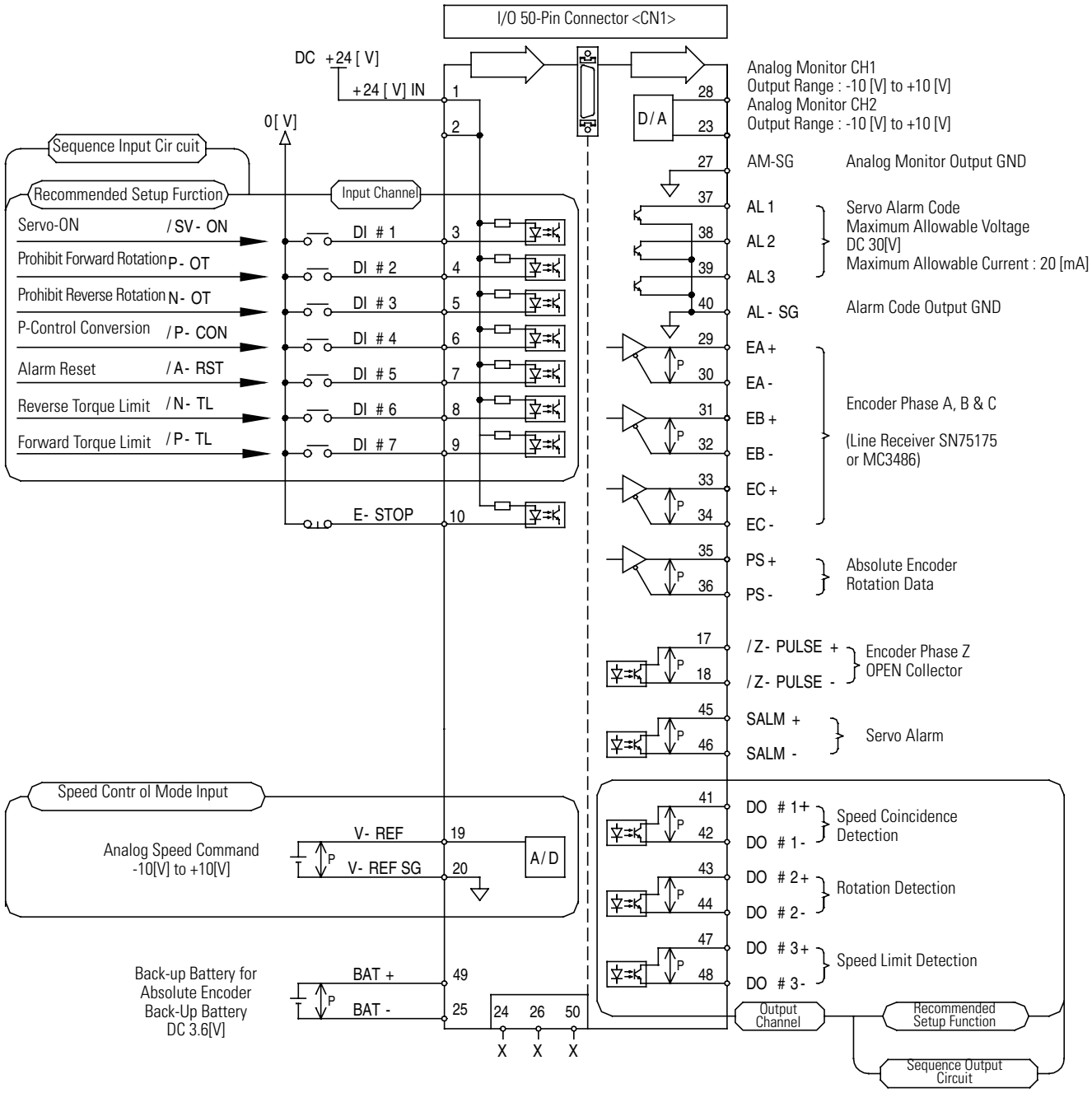
In order to operate servo drive in speed control mode, connect the analog speed command to the related input pin and set as the following.



NOTE For Position-Control-Only model, CSD3-xxBX1P, does not support the speed control mode.

Standard Wiring Example

The following figure illustrates the standard wiring example of the speed control mode. You can set sequence input/output signal, as you want if it is necessary for system configuration.

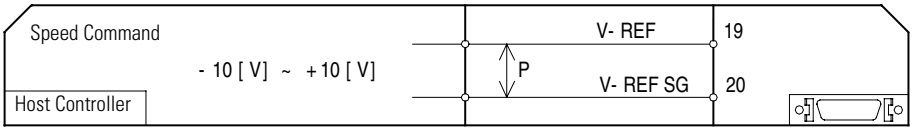


Speed Command Input

Speed Command

Two pins of CN1 receive one command related to the speed control mode.

Host controller sends the voltage command of analog type.



Speed Command Input Gain Setting

Set the relationship between the analog speed command voltage and the speed to the parameter below.

Pr-2.00			External Speed Command Gain & External Speed Limit	
Setting Range	Initial value	Unit	Others	Servo-off> Setting > End
10.0 to 2000.0	500.0	[RPM/V]	Applicable Mode	S
Set of speed command gain value [RPM] related to the analogue voltage 1 [V].				
This setting is used as external speed limit function if the servo drive is not used in speed control mode. For speed limit function, refer to the Chapter 7-18.				

Speed command is given according to the following relationship.

Speed Command [rpm] = Pr-2.00 Setting Value [rpm/V] X Input Voltage [V]

Therefore, If input voltage 6 [V] according to initial value, motor rotates 3000 [RPM] as the rated speed of motor, If input voltage 10 [V], motor rotates 5000 [RPM] as the maximum speed of motor. (Rated speed and maximum speed can be different according to motor type.)

NOTE

- Maximum allowable voltage of speed command input is DC -10 [V] to +10 [V].
- If analog speed command voltage is more than the maximum speed of set motor, over speed command servo warning ("OSC") occurs.

NOTE

- Motor can rotate even though the speed command is not output or the host controller inputs speed command as 0 [V]. It is because of the voltage offset between the host controller and the drive.
- The rotation of the motor can be prevented by offset using the automatic adjustment of speed command offset (Run-03) or manual adjustment (Run-05) function. Refer to the Chapter 7-35. for the automatic (manual) adjustment of the speed command offset,
- In addition, the rotation of motor can be prevented using the zero clamp function in the Chapter 5-31.

Zero Clamp </Z-CLP> Input

Even though the analog speed command of the host controller is 0 [V], some offset voltage can exist in servo drive input, resulting in slow rotation of the motor. In this case, prevent the subtle rotation of motor according to offset voltage using the zero clamp function.

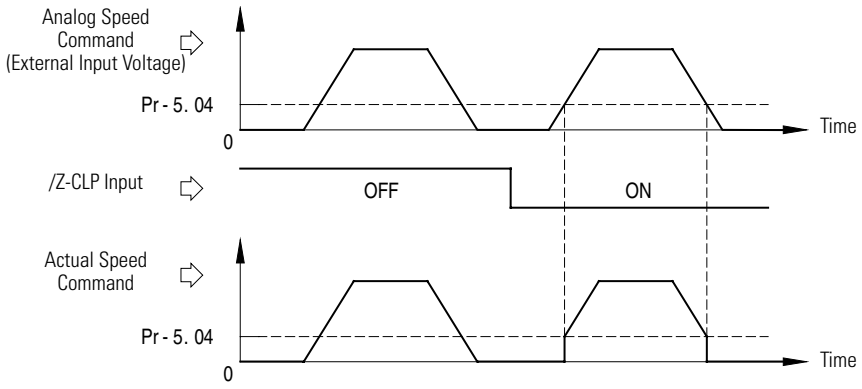
</Z-CLP> is a sequence input signal. To use </Z-CLP> function, allocate </Z-CLP> by referring to the sequence input/output signal in the chapter 5.1.

Set speed zero clamp level to the parameter below.

Pr-5.04			Speed Zero Clamp Level	
Setting Range	Initial value	Unit	Others	Setting > End
0 to 5000	0	[RPM]	Applicable Mode	S
Speed command that is below the value is ignored.				

If you turn the signal on or off to the pin of CN1 where the zero clamp function is allocated, the voltage command less than the zero clamp level [Pr-5.04] or lower is ignored. When the speed command value is higher than this level, the motor is accelerated to the command value.

In addition, if you set the sequence input as '8' with the reference of the input signal allocation method in the Chapter 5-7, the zero clamp function is always valid and if it is set as '0', the zero clamp function is not processed.

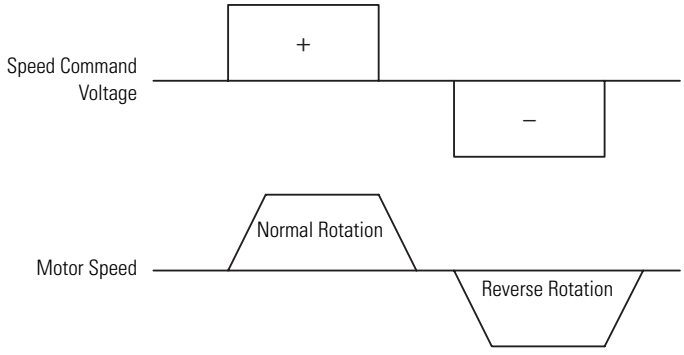


WARNING

- Do not use when you configure position control loop by host controller.
- Although /Z-CLP input is not allocated, The Drive automatically clamps the speed command as '0' in case any value is in Pr-5.04 except '0'
- The position loop may malfunction. In addition, set the acceleration time and deceleration time of (Pr-2.02) and (Pr-2.03) as '0' in this case.

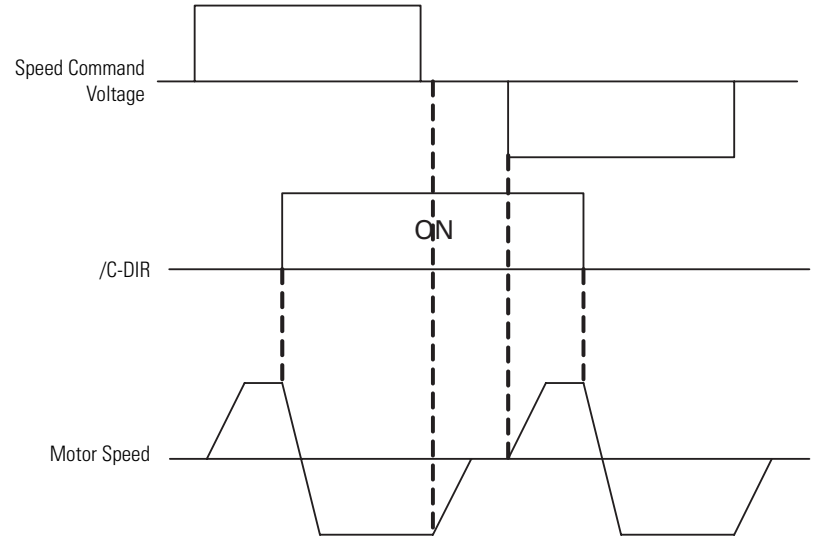
Rotation Direction Switch Input /C-DIR

Typically the direction of motor rotation in speed control mode is changed according to the analog voltage polarity as shown below.



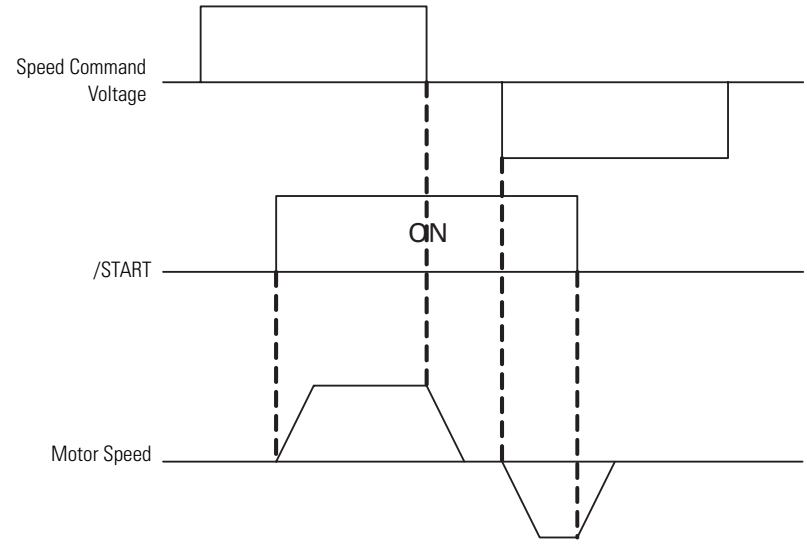
In some applications, the analog input used for speed command may not support negative voltages (e.g. PLC 0-10V analog output). In this situation, you can control the rotation direction using input </C-DIR>, which is also used in Multi-step Velocity Control Mode (Pr-0.00 = C). When input </C-DIR> is ON, the rotational direction of the motor will be inverted. For example if the analog input speed command polarity is positive and </C-DIR> is ON, then the analog input speed command will be interpreted as

negative. If the analog input speed command polarity is negative and </C-DIR> is ON, then the analog input speed command will be interpreted as positive.



Motor Rotation Start/Stop Input /START

With previous FW revisions, the motor begins to rotate when the speed command is entered after Servo-ON in the Velocity Control Mode (Pr-0.00 = S) or the Velocity Control Mode (Pr-0.00 = C). With the new FW, if the </START> input is assigned to an input pin, the </START> contact point input acts as an enable and can be used to control motor rotation start or stop.



(</START> is only configured to an input pin.)

Speed Coincidence Output Signal </V-COM>

The speed coincidence detection output is to indicate that the actual motor speed matches up to command speed within the allowable error. Like position completion output signal </P-COM> in position control mode, you can use it as an inter-lock signal in the host controller.

</V-COM> is a sequence output signal. To use </V-COM> function, allocate </V-COM> signal by referring to the sequence input/output signal described in the Chapter 5-2.

Set output width of speed coincidence signal to the parameter below.

Pr - 5.02			Output Width of Speed Coincidence Signal	
Setting Range	Initial Value	Unit	Others	Setting > End
1 to 1000	10	[RPM]	Applicable Mode	ALL
If speed error is within setting value, speed coincidence detection </V-COM> signal is generated.				

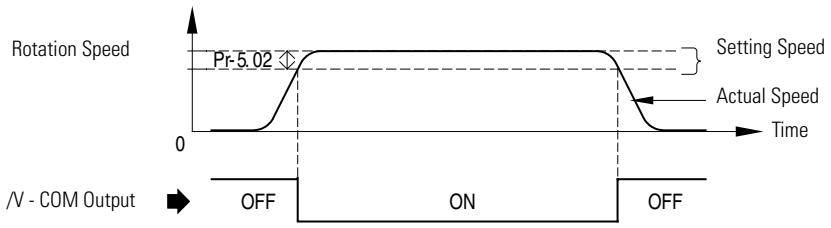
Speed coincidence detection </V-COM> output is ON when the following conditions are satisfied

Speed Error < Pr - 5.02 Setting Value ⇨ /V-COM Output

Therefore, you can adjust the timing to generate </V-COM> signal by adjusting the difference between the speed command and actual rotation speed to output width of speed coincidence signal [Pr-5.02].

Output width of speed coincidence signal [Pr-5.02] setting does not have influence on the final speed control.

Sequence output </V-COM> signal is generated as shown in the figure below.



NOTE </V-COM> is ON to the allocated sequence output channel when the output width of speed coincidence signal is Pr-5.02 = 100, the speed command is 2000 [rpm], and the actual rotation speed is in 1900 to 2100 [rpm],

NOTE

- When speed coincidence output signal </V-COM> is generated, the servo drive turns line indication 1 of status indication mode, on to allow verification of the output of the </V-COM> signal.
- For status indication mode, refer to the Chapter 4-2.

Rotation Detection </TG-ON> Output

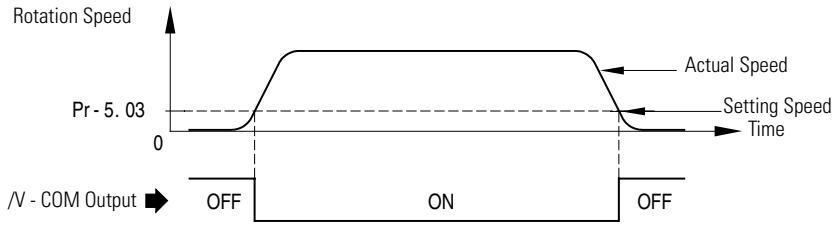
It indicates that the servo motor rotates at a speed higher than the set speed. It can be used as one condition to check the motor status when you change the control mode in mixed control mode, or before you change one sequence to other sequence among sequences.

</TG-ON> is a sequence output signal. To use </TG-ON> function, allocate </TG-ON> signal by referring to the sequence input/output signal in the Chapter 5-2.

Set rotation detection level in order to set the appropriate constant to satisfy the purpose such as control mode change or sequence conversion.

Pr - 5.03			Rotation Detection Level	
Setting Range	Initial Value	Unit	Others	Setting > End
1 to 5000	20	[RPM]	Applicable Mode	ALL
</TG-ON> signal is output if the motor rotates at a speed higher than the set value.				

Sequence output </TG-ON> signal is output as shown below.



NOTE

If you set rotation detection level Pr-5.03 too low, </TG-ON> signal can be output even with small vibration.

Speed Limit Function and Speed Limit Detection </V-LMT> Output

You can limit the speed of servo motor within a set speed in order to avoid the excessive operation of the load. Initial value is limited to 5000 [RPM] and you can change the speed limit according to the parameter setting below.

Set speed level that you want to limit to the parameter below.

Pr-2.12			Speed Limit	
Setting Range	Initial Value	Unit	Others	Setting > End
1 to 5000	5000	[RPM]	Applicable Mode	ALL
It limits the rotation speed of motor to keep below the speed of set value.				

Even though you set the speed limit [Pr-2.12] as 1000 [RPM] and send analog speed command related to 1500 [RPM] from the host controller, servo motor runs in 1000 [RPM].

On this occasion, if the speed of motor reaches to speed limit as allocating sequence output function speed limit detection </V-LMT>, you can generate </V-LMT> signal to the allocated output pin.

</V-LMT> is sequence output signal. To use </V-LMT> function, allocate </V-LMT> signal with reference to sequence input/output signal in the Chapter 5-2.

Speed limit detection </V-LMT> output is ON when the following conditions are satisfied.

NOTE Initial value of speed limit is automatically set as maximum speed of set motor at the same time when motor type is set in the basic setting in the Chapter 4-6.

NOTE Set speed limit [Pr-2.12] to maximum speed of motor if there is no excessive load. If the set value is too small, response performance is reduced.

NOTE

- Except the speed limit method by setting of speed limit [Pr-2.12], you can also limit the speed by the command from the host controller.
- Among two methods, you can select where to limit speed by speed limit selection [Pr-2.13].
- If you do not select the method by [Pr-2.12] in speed limit selection [Pr-2.13], setting value of speed limit [Pr-2.12] becomes invalid.
- For details on speed limit, refer to the Chapter 7-18.

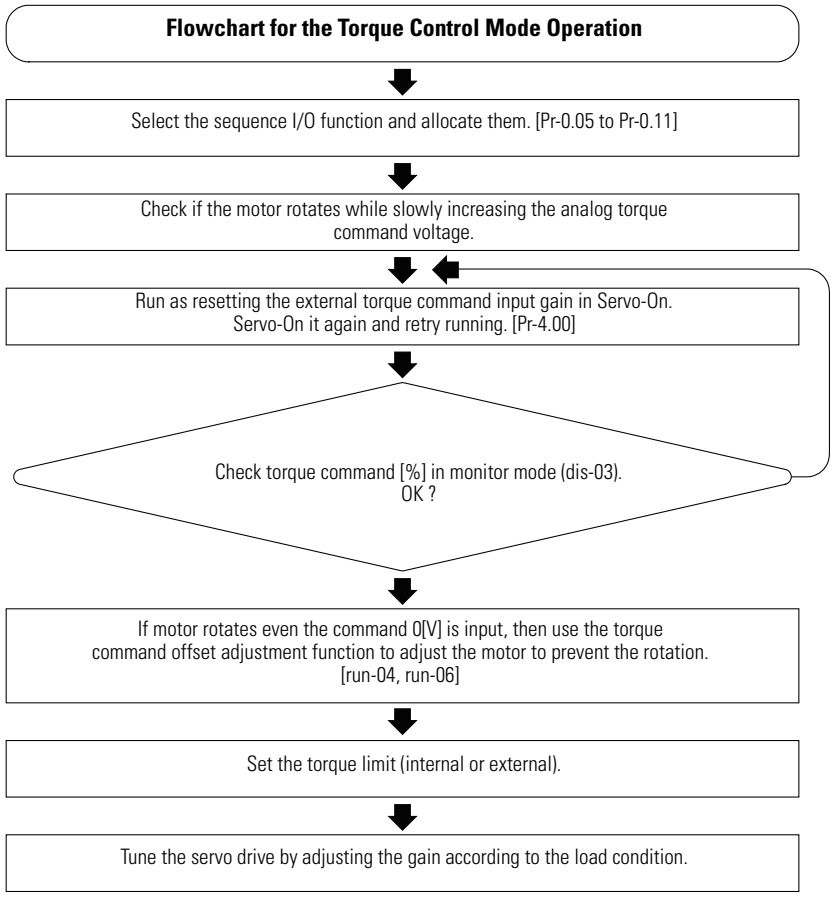
Torque Control Mode

Overview

The torque control mode is used to control the tension or the pressure of the mechanical part by using the servo drive.

Enter the voltage related to the desired torque from the host controller. Various setting values related to operation torque limit of motor are generally applied to the position or the speed control mode.

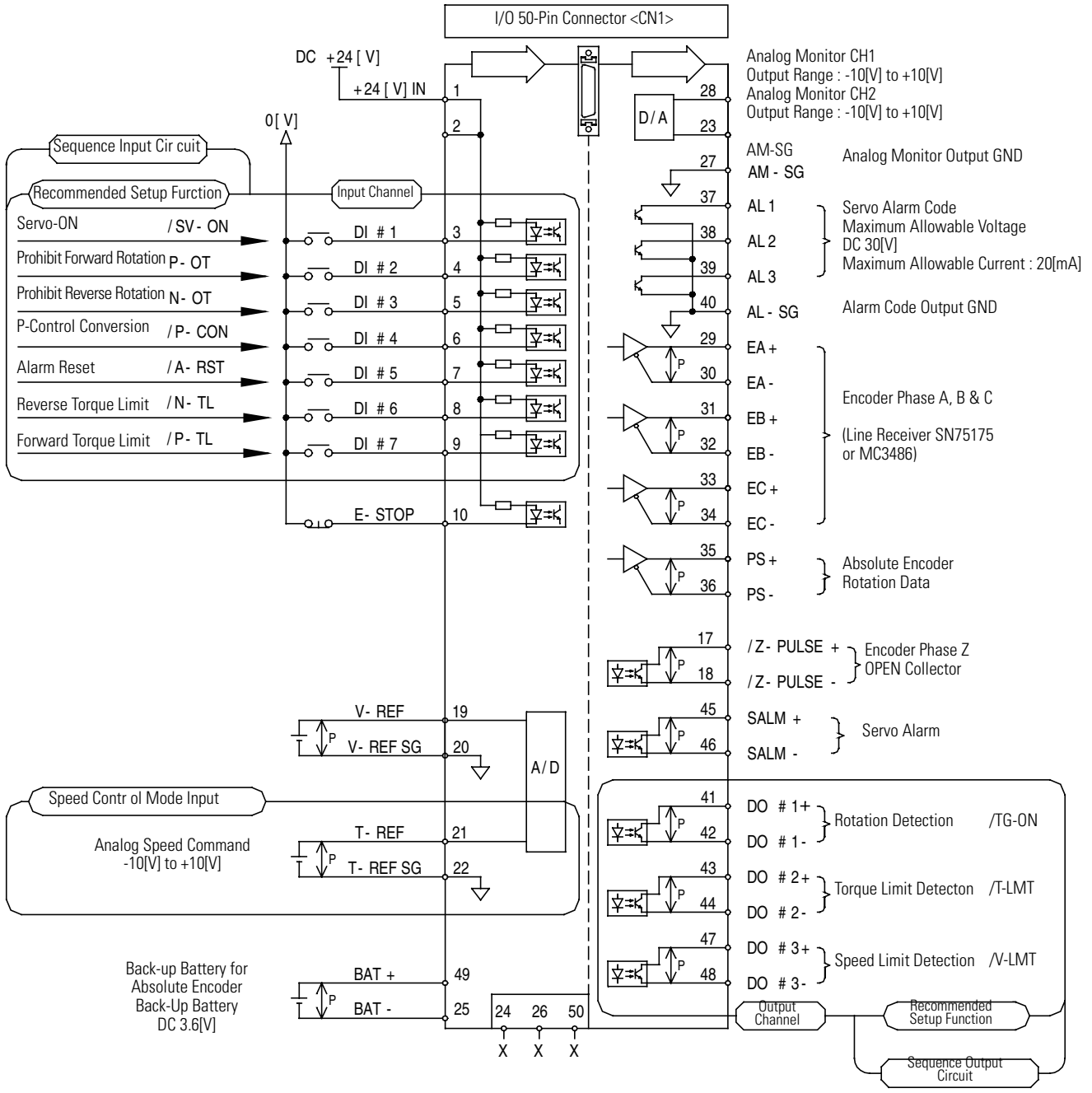
In order to operate the servo drive in a torque control mode, connect the analog torque command to the related input pin and set the required process as shown bellow.



NOTE If you set rotation detection level Pr-5.03 too low, </TG-ON> signal can be output even with small vibration.

Standard Wiring Example

The following figure illustrates the standard wiring example of the torque control mode. The sequence input/output signal can be set according to needs if it is necessary for the system configuration.

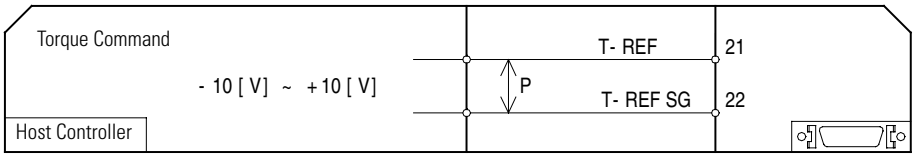


Torque Command Input

Torque Command

Two pins of CN1 receive one command related to torque control mode.

Host controller outputs the voltage command of the analog type.



External Torque Command Gain Setting

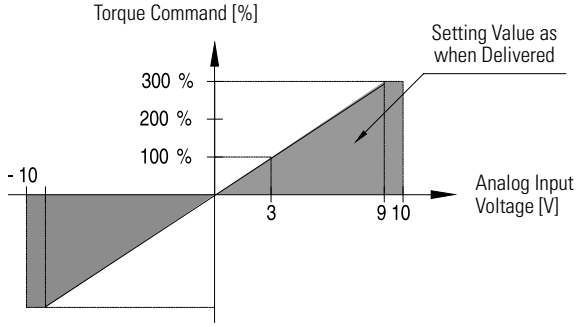
Set the relationship between the analog voltage value and torque command value to the parameter below.

Pr - 4.00			External Torque Command Input Gain	
Setting Range	Initial Value	Unit	Others	Servo-off> Setting > End
0.0 to 100.0	33.3	[%/V]	Applicable Mode	t
Set the gain of torque command value [%] related to analog voltage 1 [V].				

Speed command is given according to the following relationship.

$$\text{Torque Command [Nm]} = \frac{\text{Pr - 4.00 Setting Value} \times \text{Input Voltage [V]} \times \text{Rated Torque}}{100}$$

Therefore, according to the Initial value, when the input voltage is 3 [V], 100 [%] torque that is rated torque of motor occurs. In addition, when input voltage is 9 [V], 300 [%] torque that is maximum torque of motor occurs. (Rated torque and maximum torque can be different according to motor type.)



NOTE

- Maximum allowable torque command is DC -10 [V] to +10 [V].
- If the input reference voltage is changed, the torque command can be changed together. Therefore, use the accurate power supply.
- If you want a precise torque adjustment, it is recommended to use multi-turn variable resistor more than 10-turn (rotation).
- If analog torque command is over maximum torque of set motor, over (external) torque command warning, Servo warning ("OTC") occurs.

NOTE

- Motor can rotate even though torque command is not approved or the host controller outputs the torque command as 0 [V]. It is because of the voltage offset between the host controller and the drive.
- The rotation of motor due to offset can be prevented using automatic adjustment of torque command offset (Run-04) or manual adjustment (Run-06) function. For the automatic (manual) adjustment of the torque command offset, refer to the Chapter 7-35.

Torque Limit and Torque Limit Detection </T-LMT> Output

It can limit the torque of servo motor and can set separately in forward(reverse) direction.

Internal Limit

It means the drive limits itself according to the parameter setting regardless of the external signal.

External Limit

It receives the external sequence input signal. In addition, it sets up the limit value to the parameter that is different from internal limit, and torque is limited according to sequence input signal.

If the internal torque limit is set, the limit value is always valid. However, external torque limit setting is not always valid because it is controlled according to sequence input signal. It can be difference between internal torque limit and external torque limit.

Set the following two parameters for the internal torque limit.

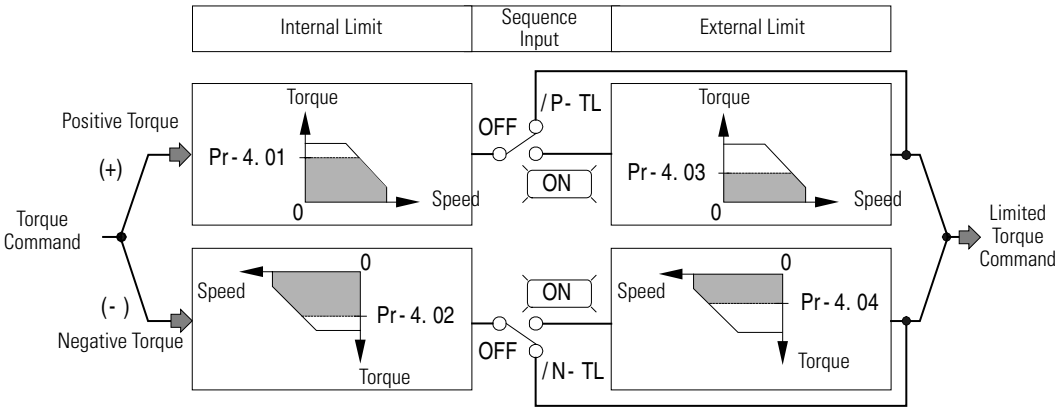
Pr-4.01			Forward Rotation Torque Limit (Internal Limit)	
Setting Range	Initial Value	Unit	Others	Setting > End
0 to 300	300	[%]	Applicable Mode	ALL
It limits positive torque in [%] unit related to rated torque.				

Pr-4.02			Reverse Rotation Torque Limit (Internal Limit)	
Setting Range	Initial Value	Unit	Others	Setting > End
0 to 300	300	[%]	Applicable Mode	ALL
It limits negative torque in [%] unit related to rated torque.				

Pr-4.03			External Forward Rotation Torque Limit </P-TL>	
Setting Range	Initial Value	Unit	Others	Setting > End
0 to 300	100	[%]	Applicable Mode	ALL
If </P-TL> is ON, it limits positive torque in [%] unit related to rated torque.				

Pr-4.04			External Torque Limit of Reverse Rotation </N-TL>	
Setting Range	Initial Value	Unit	Others	Setting > End
0 to 300	100	[%]	Applicable Mode	ALL
If </N-TL> is ON, it limits negative torque in [%] unit related to rated torque.				

Relationship between the internal and external torque limit



Cautions

</P-TL> and </N-TL> are sequence input signals. To use </P-TL> and </N-TL> functions, allocate </P-TL> and </N-TL> signals by referring to the sequence input/output signal in the chapter 5.1.

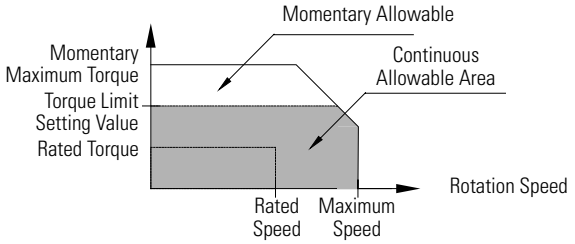
External limit of positive torque uses </P-TL> signal and that of negative torque uses </N-TL> signal.

Torque limit by internal limit [Pr-4.01] and [Pr-4.02] are prior to external torque limit </P-TL> and </N-TL> signal.

More explanation

Internal limit is used to limit maximum value of operation torque of motor(or output torque) within set range to protect the load system or the object on work.

Generally, the allowable torque limit of motor is as shown in the figure below. Therefore, torque limit in the speed over rated speed is achieved within the momentary operation range as shown in the figure. In high speed range, torque limit according to current motor speed is automatically processed inside Servo drive. If the values of [Pr-4.01] and [Pr-4.02] are set as shown in the following figure, torque of motor is limited as the lined area in the figure.



NOTE Depending on the motor type, there is a maximum instantaneous torque that is less than 300 [%]. If you set [Pr-4.01] and [Pr-4.02] to the value over maximum torque that motor allows, it is limited to maximum torque value as ignoring setting value.

Torque limit when over travel occurs

When over travel occurs except external and internal torque limits described above, you can limit torque as setting separate parameter.

For over travel, refer to the Chapter 7-2.

Set torque limit value when over travel occurs to the following parameter. Same setting value is applied both to positive and negative torque as being different from the internal and external torque limits.

Pr-4.05			Rotation Prohibition Torque Limit <P-OT>, <N-OT>	
Setting Range	Initial value	Unit	Others	Setting > End
0 to 300	300	[%]	Applicable Mode	ALL
Both forward and reverse rotation are limited by the same setting value.				

NOTE When setting value of rotation prohibition torque limit [Pr-4.05] is bigger than setting value of internal torque limit [Pr-4.01] and [Pr-4.02], the internal torque is prior to everything so that setting value of rotation prohibition torque is meaningless.

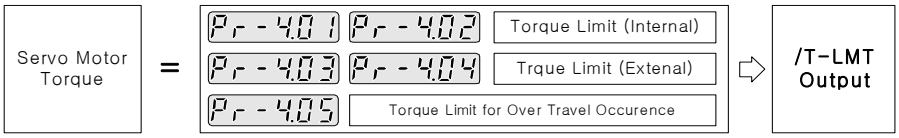
NOTE When setting value of rotation prohibition torque limit [Pr-4.05] is bigger than setting value of internal torque limit [Pr-4.01] and [Pr-4.02], the internal torque is prior to everything so that setting value of rotation prohibition torque is meaningless.

Torque Limit Detection </T-LMT> Output

As described before, torque that is added to motor can be limited by various setting. The state that torque is limited by setting value can be generated to host controller by sequence output. That output is torque limit detection </T-LMT> signal.

</T-LMT> is sequence output signal. To use </T-LMT> function, allocate </T-LMT> signal with reference to sequence input/output signal in the Chapter 5-2.

Torque limit detection </T-LMT> output is ON when satisfying the following conditions.



NOTE

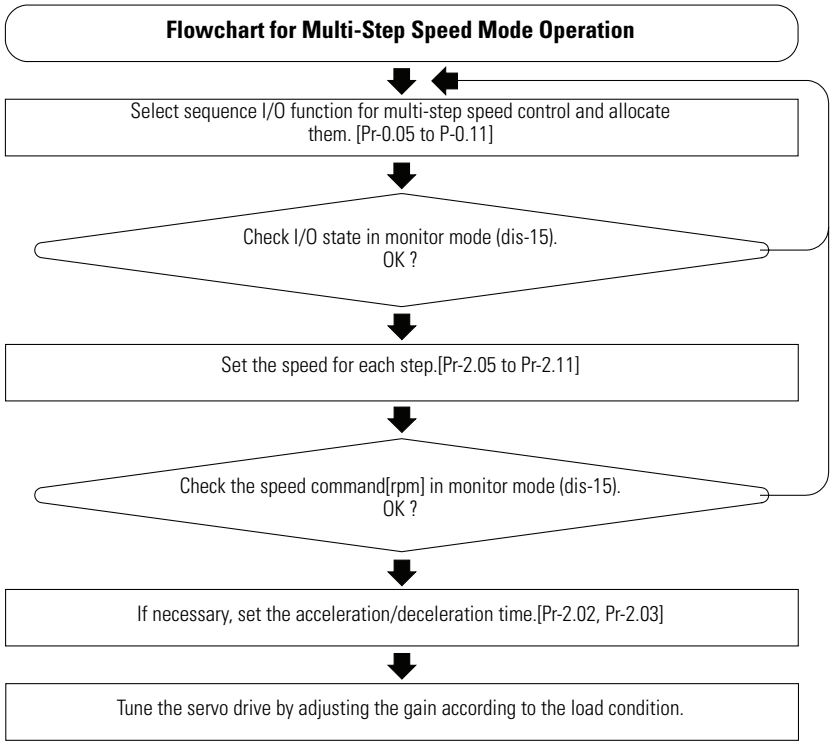
- Internal and external torque limits can be set separately when the rotation direction of the motor is forward and reverse.
- However, for torque limit by over travel </P-OT> and </N-OT> signal input, torque is limited by one setting value of rotation prohibition torque [Pr-4.05] regardless of rotation direction of motor.

Multi-Step Speed Mode

Overview

Multi-step speed mode is one of speed control method. It is to operate according to sequence input after setting operation speed in advance by parameter setting. It does not require separate speed command input or offset adjustment because it operates only with parameter and sequence input.

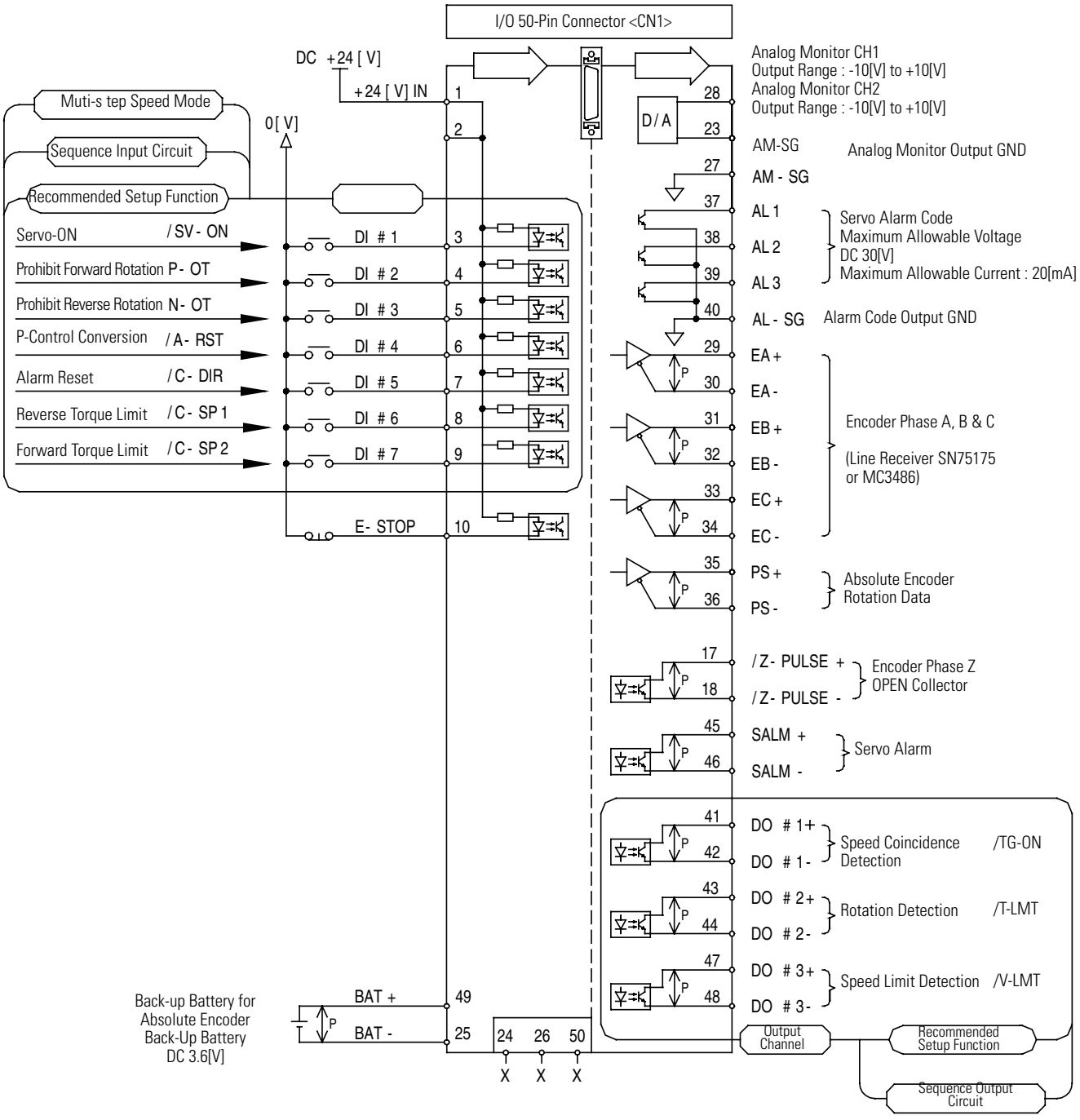
To operate servo drive as multi-step control mode, set the required process as follows.



NOTE For Position-Control-Only model, CSD3-xxBX1P, it does not support the multi-step speed control mode.

Standard Wiring Example

The following figure illustrates the standard wiring example of multi-step speed control mode. The sequence input/output signal can be set according to needs if it is necessary for the system configuration.



Multi-Step Speed Command Setting

Multi-step speed control mode does not have external signal input pin for each control mode unlike position, speed and torque control mode and can be operated only by sequence input. Therefore, sequence input signal has input signal that is exclusive for multi-step control mode and exclusive input signals are as follows.

/C-DIR	/C-SP1	/C-SP2	/C-SP3	/C-SP4

</C-DIR>

It is input signal to determine rotation direction of motor. If </C-DIR> signal is OFF, motor rotates forward, and if it is ON, motor rotates reverse.

	</C-DIR> Signal		**Motor Rotation Direction**
1	OFF	0	Forward Rotation
2	ON	1	Reverse Rotation

</C-SP1>, </C-SP2>, </C-SP3>

3 kinds of input signal can make 8 kinds of number and each number can set the rotation speed. In addition, parameter to set speed for each number is already designated. Refer to the following table.

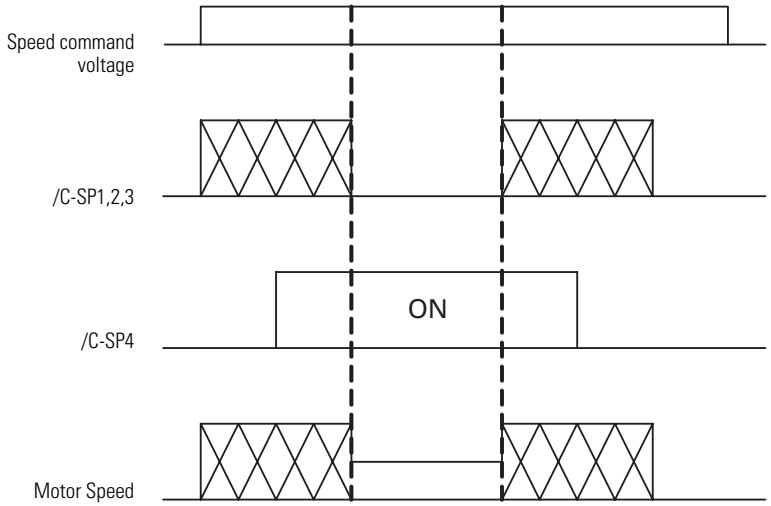
Multi-step speed	**Speed Setting Parameter**	**</C-SP3>**	**</C-SP2>**	**</C-SP1>**
Stop Command	0[RPM]	0	0	0
Speed Command 1		0	0	1
Speed Command 2		0	1	0
Speed Command 3		0	1	1
Speed Command 4		1	0	0
Speed Command 5		1	0	1
Speed Command 6		1	1	0
Speed Command 7		1	1	1
				

Setting Range	Initial Value	Unit	Mode in Use	Others
-5000 to 5000	100 to 700	[RPM]	C	Setting > End

You can control the rotation direction of motor differently to forward and reverse as approving </C-DIR> sequence input for each speed that is designated to each speed parameter.

</C-SP4>

In Multi-step Speed Mode (Pr-0.00 = C), </C-SP4> can be used to change the motor speed using analog speed input voltage without changing the control mode. When </C-SP4> is ON and <C-SP1>, <C-SP2>, and <C-SP3> are all OFF, the motor speed is controlled by analog speed input. The </Z-CLP> input and zero clamp function are all available. If the </C-SP4> input is ON and any one of <C-SP1>, <C-SP2>, and <C-SP3> inputs is ON at the same time, the motor speed is controlled by the corresponding contact inputs.



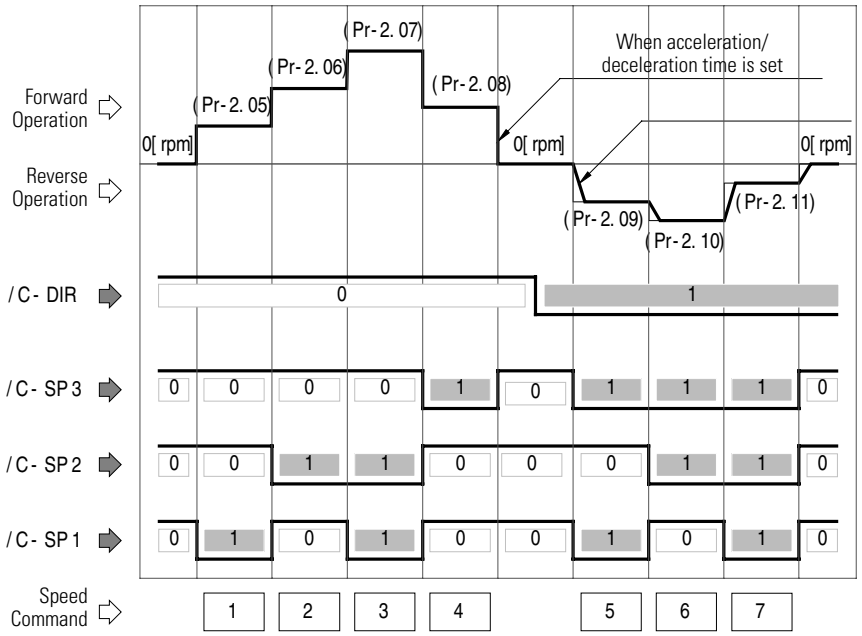
To use sequence input signal </C-DIR>, </C-SP1>, </C-SP2>, </C-SP3>, or </C-SP4> function, allocate signal with reference to sequence input/output signal in the Chapter 5-2.

NOTE

- If you do not change the rotation direction, you do not need to use </C-DIR> input.
- In addition, you do not need to use all </C-SP1>,</C-SP2> and </C-SP3>, and can adjust change level using only </C-SP1> or both </C-SP1> and </C-SP2> according to your needs.
- If you ser up '8' when you allocate sequence input signal as described in sequence input/output signal in the Chapter 5-2, you can always use valid input signal.
- </START> input can be used.

Multi-step speed mode

The following figure is to help you understand motor operation according to sequence input signal in multi-step control mode.



NOTE

- Set sufficient acceleration/deceleration time within the limit that does not disturb the response performance of the system in order to alleviate the impact when the speed is changed.
- For acceleration/deceleration time setting, refer to the Chapter 7-16.

Combinational Control Mode and </C-SEL> Function

Position control mode, speed control mode, torque control mode and multi-step speed control mode described are called the basic control modes. The servo drive provides combinational control mode function to combine basic control modes to meet the user's condition.

Combinational control mode uses two basic control modes.

Setting of Combinational Control Mode

Set combinational control mode to meet your condition with reference to the Chapter 4-7.

Convert two control modes by sequence input </C-SEL> signal.

</C-SEL> is sequence input signal. To use </C-SEL> function, allocate </C-SEL> signal with reference to sequence input/output signal in the Chapter 5-2.

If you set combinational control mode, you should use sequence input </C-SEL>. When you use combinational control mode, control mode is determined by </C-SEL> input signal. The following table is the relationship between </C-SEL> input signal and control mode conversion.

Mixed Control Mode Set in [Pr-0.00]		Control Mode & Display	
		</C-SEL> = OFF	</C-SEL> = ON
--SP	Speed-Position	--SP	--SP
-tS-	Torque-Speed	-tS-	-tS-
-t-P	Torque-Position	-t-P	-t-P
C--P	Multi-Step Speed +Position	C--P	C--P
C-S-	Multi-Step Speed +Speed	C-S-	C-S-
Ct--	Multi-Step Speed+ Torque	Ct--	Ct--

Each basic control mode is already described before. If Servo is ON, the current control mode is flashed and if the control mode is converted by </C-SEL> signal, the alphabet of the control mode is flashed.

Status Display Mode P.PIn	</C-SEL> is sequence input that is used only for combinational control mode. If you set combinational control mode in [Pr-0.00] and do not allocate </C-SEL> to sequence input, Servo drive indicate Servo warning "PIN" in state indication mode.

Current Control Mode	Condition for Control Mode Convention
Position Control Mode	1. </P-COM> Output = ON
Speed Control Mode	1. < /V-COM> Output = ON 2. </TG-ON> Output = OFF
Torque Control Mode	1. </TG-ON> Output = OFF
Multi-step Speed Mode	1. </C-SP1> to </C-SP3> Input = All OFF 2. </TG-ON> Output = OFF

As described before, mixed control mode uses two basic control mode. If you use two-control mode and one mode is working, other control mode input is ignored.

For example, when the speed control mode is used, position command pulse or analog torque command is ignored and only when the control mode is converted by </C-SEL> signal, the related input will be valid.

NOTE

- Some parameter functions are valid in special control mode.
- For example, acceleration/deceleration time setting [Pr-2.02] and [Pr-2.03], S-Curve Operation time setting [Pr-2.04] are valid in speed control mode but invalid in position or torque control mode.
- Therefore, be careful when converting the control mode.

Tuning by Gain Setting

Introduction

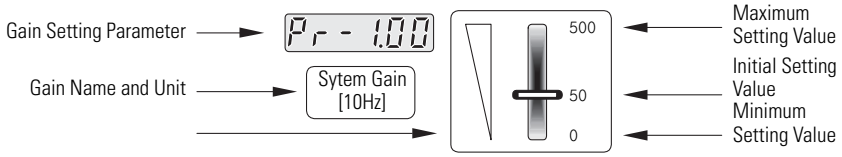
This chapter explains the servo drive setting that can achieve its optimum performance to satisfy different load system as controlling servomotor.

Before you Begin

Mark Explanation

The following icon is used for tuning.

Tunning Icon



Gain Introduction

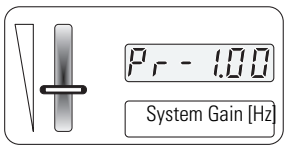
As the audio system has equalizer to adjust the audio quality, the drive also requires adjustment to achieve the optimum performance for each load. Equalizer adjustment is not essential for the audio system, but the adjustment is important fact that is directly connected to performance for servo drive.

You should adjust servo drive to satisfy load condition in order to achieve optimum performance for each control.

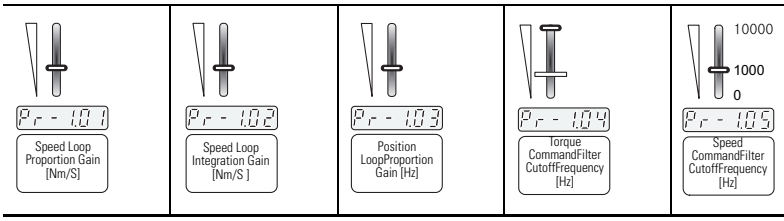
In addition, the adjustment made to the motor that is connected to drive, to achieve the optimum performance through gain setting, is called Tuning.

Servo drive gain

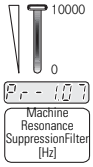
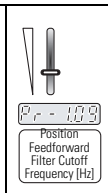
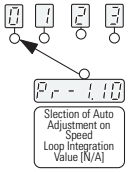
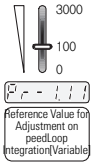
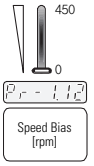
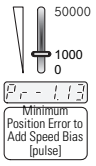
What kind of drive gains are there that acts like equalizers of audio system? Parameter group 1 has gain setting parameter for tuning and it is classified as follows.

<System Gain > Bandwidth of Speed Control Loop	
It can adjust five basic gains at the same time. It is the same as the **Bandwidth of overall speed control loop** of the servo drive.	

<Basic Gain> They are five fundamental gains for tuning.



IMPORTANT In case of BX2 Rev.B servo drive, the system gain is limited to 10Hz at its minimum to guarantee a proper level of motion characteristics when velocityresponse level [Pr-1.15] is set too low. For more information about velocity response level, refer to peterkang.

<Applicable Gain> They are four gains that with separate functions.				**<Others>** They are four parameters with supplementary function that is required for tuning.			
							

As mentioned above, gains in parameter group 1 and 13 parameters related to gain are explained and the details are explained hereinafter.

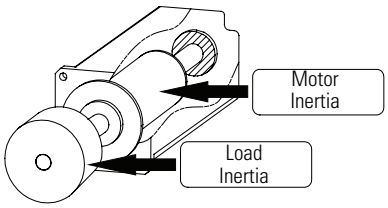
Parameter that is most important for tuning. (Inertia Ratio)

The parameter that is considered to make motor, that is connected to servo drive achieve the optimum performance in tuning, is the inertia ratio setting parameter. First of all, you should understand that inertia ratio and gain settings are interlocked, and refer to the explanation hereinafter.

Inertia Ratio

What is inertia ratio?

The following figure explains the Inertia Ratio.



- It shows the ratio of load inertia compared to the motor (rotor) inertia.
- If the motor (rotor) inertia is 3 [gfcms^2] and the load inertia is 30 [gfcms^2], the inertia ratio is 10 [times].
- For the motor inertia table, refer to the motor specification in the appendix.

Setting Unit

Setting value of Inertia Ratio uses the unit, [times]. For example, if the motor inertia is same as the load inertia, the Inertia Ratio is 1 [time] and the setting value is '1'.

The setting value of the Inertia Ratio is determined by the following formula.

$$\text{Inertia Ratio} = \frac{\text{Load Inertia}}{\text{Load Inertia}}$$

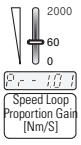
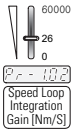
Setting Parameter

Set the Inertia Ratio to the following parameter.

Pr - 0.04			Inertia Ratio	
Setting Range	Initial Value	Unit	Others	Setting > End
0.00 to 60.00	1.00	[Times]	Applicable Mode	ALL
It can be automatically set by off-line auto tuning function in the Chapter 7-36.				

Inertia Ratio and Gain

If the Inertia Ratio is adjusted by certain reason, it automatically changes the following two basic gains at the same time with the adjustment. Therefore, the Inertia Ratio setting means gain setting, so that you should be careful when adjusting or setting the Inertia Ratio.

Two basic gains that are changed according to the adjustment of Inertia Ratio.	
	

Gain Setting Configuration

This chapter explains the overall configuration (Position, Speed, Torque) related to the gain setting.

The following diagram will help you understand the gain configuration related to position, speed and torque.

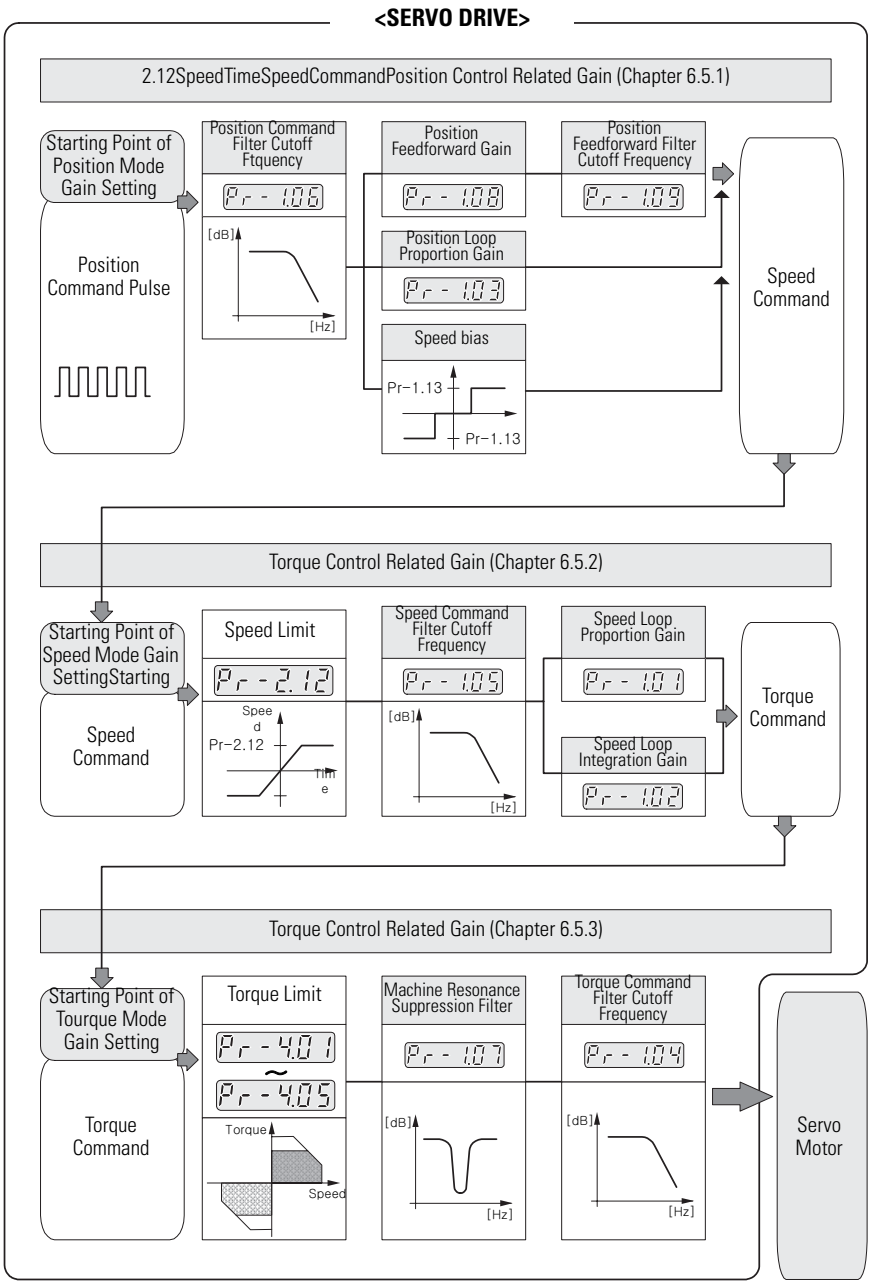
Starting point for position mode gain setting	
1	• Position mode using the position pulse command of host controller includes all gains related to speed and torque from starting point to the servo motor as shown in the figure below. • Servo drive first generates the speed command using the position command of the host controller, speed command generates the torque command and finally, it transfers the torque command to the servo motor. Therefore, when you use the position mode, the gain can be set properly. • If gain related to position control is set properly but the gain related to torque or speed is not set properly, the optimum tuning cannot be achieved.
Starting point for speed mode gain setting	
2	• Speed mode using speed command of the host controller includes all gains related to torque from starting point to the servo motor as shown in the figure below. • Servo drive first generates torque command using speed command of the host controller and finally, it transfers the torque command to the servo motor. Therefore, when you use the speed mode, the gains related to speed and torque can be set properly. • If gain related to speed control is set properly but gain related to torque is not set properly, the optimum tuning cannot be achieved.
Starting point for torque mode gain setting	
3	• Torque mode using torque command of host controller includes all gains related to torque from starting point to servo motor as shown in the figure below. • You can adjust gains related to torque in torque mode.

NOTE If gains related to position are set in the condition that response quality is not sufficiently guaranteed through gain settings related to speed control, system becomes unstable. Therefore, firstly you should sufficiently secure the response quality of speed control loop to make the response quality of whole position control system good.

NOTE

- For speed limit details, refer to the Chapter 7-18.
- For torque details, refer to the Chapter 5-38.

Gain diagram related to position, speed and torque



Automatic Gain Setting

Auto Tuning

There are two functions, which automatically detects the load status inside servo drive.

- Off-line-auto-tuning
- On-line-auto-tuning

Off-line Auto Tuning

Tuning function

IMPORTANT BX1 and BX2 servo drives automatically detect and set only load inertia ratio.

However, BX2 Rev.B servo drive automatically detects and sets load inertia ratio, friction coefficient, and resonant frequency.

Two basic gains are automatically set based on the detected data.

Tuning mode

There are two tuning modes.

- Inertia identification
- Inertia identification and resonance frequency

The tuning mode during Run-01 execution is set by autotuning mode setting [Pr-0.03.N0]. For more information, refer to PeterKang.

Operation (Tuning) method

- For Operation method for off-line auto tuning, Refer to *Off-line Auto Tuning Operation (run-01)* on page 7-36.

Velocity Response Level [Pr-1.15]

IMPORTANT This parameter is only applicable to BX2 Rev.B servo drive.

This is used to automatically set an initial system gain by determining available max. bandwidth based on the inertia ratio which is obtained from Run-01.

After autotuning, max. bandwidth is determined, and the system gain [Pr-1.00] is determined by [Pr-1.15].

Parameter	
Parameter Name	Velocity response level
Description	define max. system gain % recommended by a sysem based on inertia measured from autotuning
setting	0 ~ 150
default	50
Unit	%
Mode	All
Other	servo-OFF > setting > power off/on> end

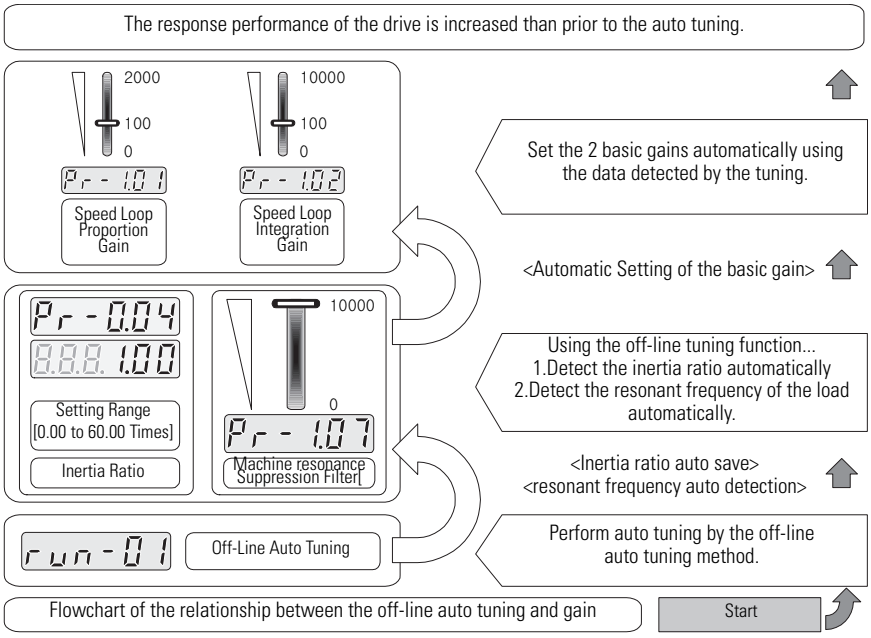
This parameter defines max. system gain % recommended by a system after execution of 'inertia identification' or 'inertia identification and resonance frequency' according to [Pr-0.03.N0] setting. For example, if 'max. available frequency' of a system is '100Hz' after autotuning, its system gain [Pr-1.00] is set to '50Hz' according to its default value.

'Max. available frequency' is determined based on estimated inertia and also system characteristics. Therefore, its default is set to '50%' and Pr-1.00~Pr-1.05 are automatically set to appropriate values when it is changed. However, system gain is limited to 10Hz at its minimum to guarantee a proper level of motion characteristics when velocity response level [Pr-1.15] is set too low.

Explanation of the relationship flow between off-line auto tuning and gain

- When you run off-line auto tuning, drive automatically Inertia Ratio [Pr-0.04] of load system and automatically set two basic gains as being suitable for Inertia Ratio. Therefore, it is recognized that the response quality of servomotor is improved at the same time.

- In addition, load system sometimes does resonant (vibration) in the specific frequency range because of vibration noise. For those situations, it intercepts vibration of load system using resonant frequency that is automatically detected by auto tuning. Resonant frequency of load system becomes the setting value for resonance suppression filter [Pr-1.07] and if you know the exact resonant frequency of the load, you can set it directly.



NOTE

- Only as operating off-line auto tuning, you can prevent resonant noise caused by resonant frequency of load system and three basic gains.
- Off-line auto tuning automatically sets Inertia Ratio [Pr-0.04] and resonant suppression filter [Pr-1.07], but when you know exactly each value, you can directly set.
- However, if the value set directly is not accurate, the response quality is degraded and becomes the reason of resonant noise. Therefore, be careful when setting it directly..

On-line Auto Tuning

Overview

On-line Auto Tuning is used when load is continuously changed during the operation. It continuously changes the gain value according to load state in order to maintain the regular response quality of system even though load state is changed.

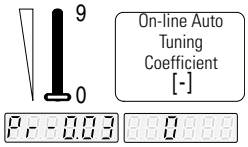
Precautions

Do not use On-line Auto Tuning for the cases below if possible, and we recommend using the Off-line Auto Tuning or manual gain setting.

- When fine or large change is made to the Inertia ratio during the load operation.
- If Inertia ratio is changed in two types during load operation, you do not need to change. In this case, refer to the Chapter 6-27.
- When big torque does not occur during load operation because acceleration/deceleration time is long or maximum rotation speed or torque limit is set low.

On-line auto tuning coefficient setting

Set the following parameter to use On-line Auto Tuning.

On-line Auto Tuning Coefficient		Function	
		If this value is not '0', use On-line Auto Tuning function. The higher you set the value, the more delicately it responses to load change and respond quickly.	
Applicable Mode	ALL	Others	Setting > End

If load is quickly changed, you need to set the On-line Auto Tuning coefficient high, but it can be momentarily unstable in the load environment that the vibration is large. So, pay extra caution.

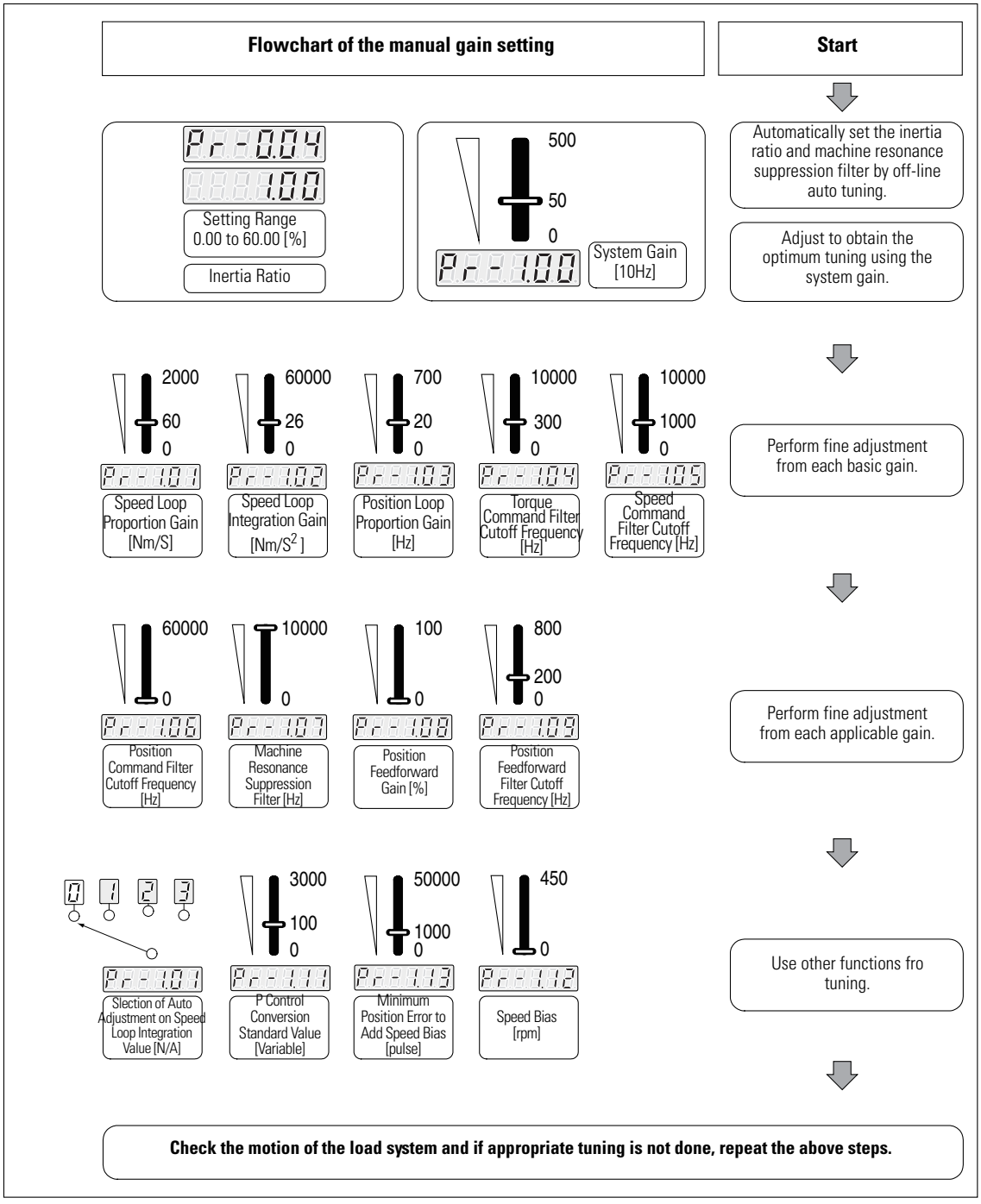
If the response quality of control loop is decreased during On-line Auto Tuning, increase the value of system gain [Pr-1.00] and if noise or vibration occurs, reduce that value.

For system gain [Pr-1.00], refer to the Chapter 6-12.

Manual Gain Setting

Gain Setting Flowchart

The following figure illustrates whole structure and procedure of Manual Gain Setting.

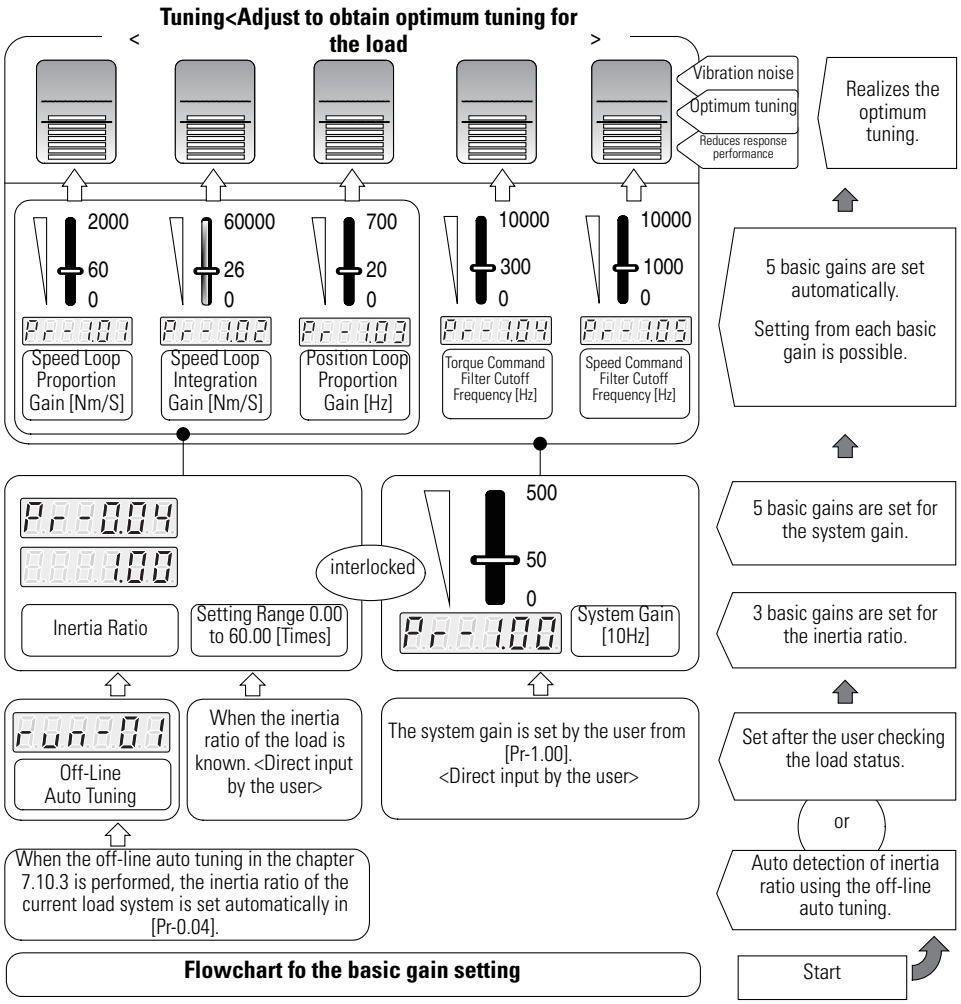


Basic Gain Setting

The following explains five Basic Gain Settings for Tuning.

Basic Gain Setting by System Gain and Inertia Ratio	
1	Firstly, execute the Off-line Auto Tuning for automatic setting of Inertia Ratio [Pr-0.04].
2	Set system gain to optimum Tuning level. If vibration noise occurs in load system, reduce tuning level to prevent vibration noise.
3	Adjust in each basic gain in detail.
If the tuning is not sufficient, set again from the Off-line Auto Tuning.	

The following figure illustrates the flowchart that Inertia Ratio and system gain set basic gain as being interlocked. Adjust to make the optimum tuning as making Inertia Ratio and system gain refer to each other whenever Inertia Ratio is changed or the system gain is adjusted.



If response performance is decreased after Off-line Auto Tuning, increase the value of system gain [Pr-1.00], and do Off-line Auto Tuning again. We recommend securing the maximum response quality as increasing the value of system gain [Pr-1.00] until noise or vibration occurs.

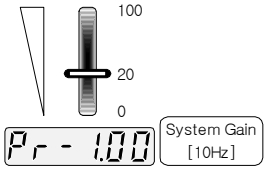
When maximum response quality is guaranteed in the condition that the value of Inertia Ratio [Pr-0.04] is accurately set and there is no vibration noise in load system, (When you set the value of system gain [Pr-1.00] as high as you can), it becomes bandwidth of whole speed control loop.

As described above, as exactly set Inertia Ratio [Pr-0.04] and set basic gains using system gain [Pr-1.00], you can get response quality.

The following table is for Inertia Ratio and system gain Setting.

Pr - 0.04			Inertia Ratio	
Setting Range	Initial Value	Unit	Others	Setting > End
0.00 to 60.00	1.00	[Times]	Applicable Mode	ALL

- This is the parameter to set load inertia ratio to motor inertia.
- When you change this value above, two basic gains [Pr-1.01, Pr-1.02] are changed by referring to the value [Pr-1.00].

System Gain		Function	
		• It is bandwidth of whole speed control loop. If you increase this value, gain value increases in general and response quality is improved. • When you change this value above, basic five gains [Pr-1.01, Pr-1.02, Pr-1.03, Pr-1.04, Pr-1.05] are changed by referring to the Inertia Ratio [Pr-0.04]. • If you set the value too high compared to load condition, vibration noise may occur.	
Applicable Mode	ALL	Others	Setting > End	

To over response characteristics, we will explain gain setting related to torque, speed and position in the Chapter 6-14.

In addition, the Chapter 6-20 will give you the detailed explanation on various functions to acquire fast response quality in gain setting.

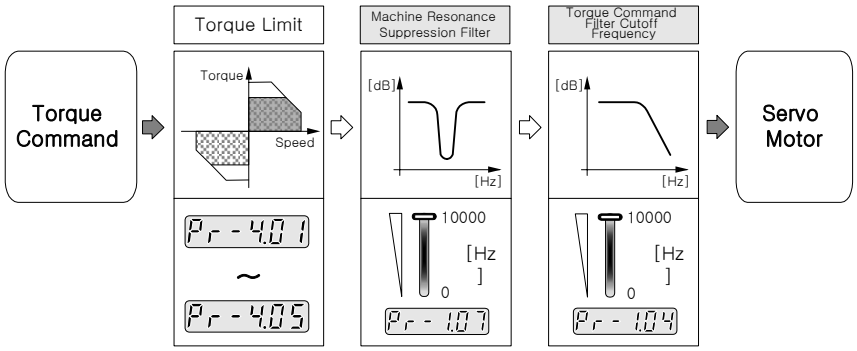
Position, Speed, Torque Related Gain Setting

Torque Control Related Gain

There are resonance suppression filter and torque command filter gains related to torque related gain.

The following figure is related to torque in Gain Setting Diagram.

Torque Control Related Gain



Resonance suppression filter

It suppresses resonance of load system.

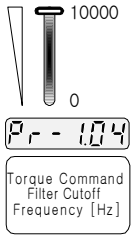
Machine Resonance Suppression Filter		Function	
10000 0 Pr - 1.07 Machine Resonance Suppression Filter [Hz]		When load system is resonant in the specific frequency range, it suppressed vibration by load resonance. If it is appropriately set, you can increase other gain more. So you can considerably improve the stability and response quality of the whole system. If it is not properly set, vibration or noise can occur.	
Applicable Mode	ALL	Others	Setting > End

NOTE

- Resonance frequency of load = it is setting value of resonance suppression filter [Pr-1.07].
- Resonance Suppression Filter [Pr-1.07] automatically find out resonance frequency and set the value by itself when you execute Off-line Auto Tuning.
- For Off-line Auto Tuning, refer to the Chapter 7-36.
- If you know exactly mechanical resonance frequency range of load, you can directly enter the value.

Torque command filter cutoff frequency

It suppresses high frequency factor that is included in torque command.

Torque Command Filter Cutoff Frequency		Function	
		• It suppresses high frequency factor that is included in torque command. It makes torque command itself smooth as suppressing high frequency over set frequency, so it can reduce vibration or noise. • The more the value is, the better the response quality is, but if you set too high, vibration can occur. If you reduce this value in the condition that the load rigidity is high, you can suppress oscillation. • Do not set too small more than necessary because it is a delay factor. The load system can be unstable.	
Applicable Mode	ALL	Others	Servo-OFF > Setting > End

If load system uses belt or chain, rigidity is low so that you cannot expect the fast response. In addition, if you excessively increase speed control or position control related gains, it can be oscillated. For those loads, it is difficult to set the value of torque command filter [Pr-1.04] within about 100 [Hz].

NOTE

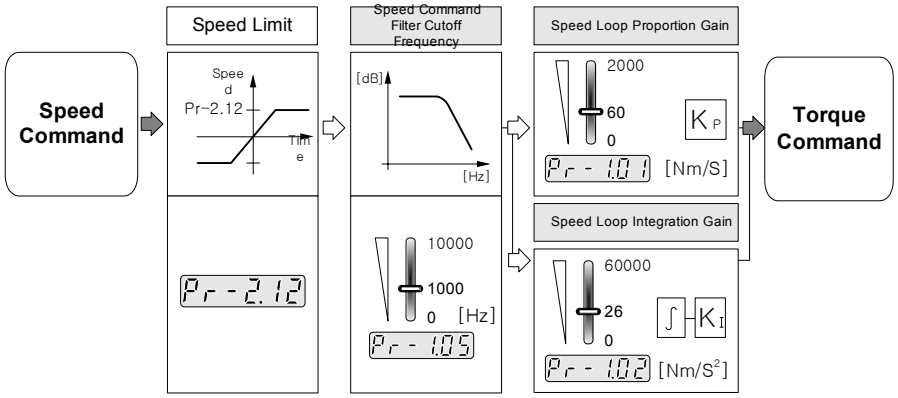
- For torque mode that host controller directly approves torque command through CN1 of servo drive, you can indirectly adjust gain of whole control loop as adjusting external torque command input gain [Pr-4.00]. That is to say, if you increase [Pr-4.00], it has the same effect as increasing gain. And if you reduce [Pr-4.00], it has the same effect as reducing gain.
- For external torque command input gain [Pr-4.00], refer to the Chapter 5-40.
- For torque limit, refer to the Chapter 5-38

Speed Control Related Gain

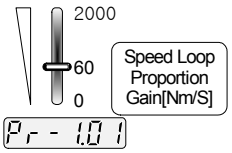
Speed related gain includes speed command filter, speed loop proportional gain and speed loop integration gain.

The following figure is related to speed in Gain Setting Diagram.

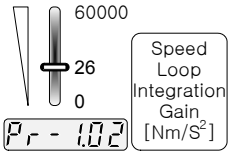
Speed Control Related Gain



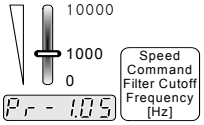
Speed loop proportion gain

Speed Loop Proportion Gain		Function	
		• The higher the value is set, the better response of speed control loop is. • Set as high as you can within the limit that vibration does not occur.	
Applicable Mode	ALL	Others	Setting > End

Speed loop integration gain

Speed Loop Integration Gain		Function	
		• It is to remove error in normal state as responding to very small input. • The higher the value is set, the better response is and completion time is reduced. • Set this value to low level in the environment that load inertia is big or vibration can easily occur.	
Applicable Mode	ALL	Others	Setting > End

Speed command filter cutoff frequency

Speed Command Filter Cutoff Frequency		Function	
		It makes speed command itself smooth as suppressing high frequency that is included in speed command. If this value is'0', speed command filter is not used.	
Applicable Mode	ALL	Others	Setting > End

Speed control related gain setting procedure

- Increase speed loop proportional gain [Pr-1.01] to the limit that vibration noise does not occur.
- Confirm [Pr-1.01] as the value of 80 to 90 [%] of maximum setting value.
- Increase speed loop proportional gain [Pr-1.02] as checking over response (overshoot, completion time, whether vibration or noise occurs). If you set it too low, response quality is degraded and if you set too high, vibration or noise can occur. Maximum setting value of [Pr-1.02] is as the following formula.
  [Pr-1.02] 300 X [Pr-1.01]2 X Inertia of applied motor (Appendix)
- If position control related gain of host controller is set high more than necessary or in the environment where the noise is too big, reduce the value of speed command filter [Pr-1.05].
- It is better to set the value of torque command filter [Pr-1.04] as long as there is no vibration in load side.
- As repeating over response state, adjust gain in detail.

NOTE

- Value of [Pr-1.01] and [Pr-1.02] is scaled based on inertia value of motor.
- Therefore, if Inertia Ratio [Pr-0.04] for 100 [W] motor or 1 [kW] motor is same as 10 [times], the appropriate gain of [Pr-1.01] and [Pr-1.02] becomes the same.

NOTE

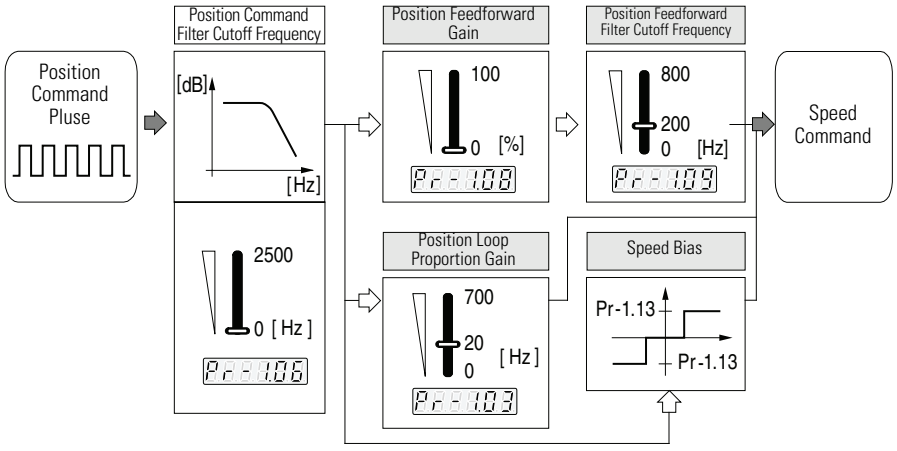
- For speed mode that host controller directly approves speed command through CN1 of servo drive, you can indirectly adjust gain of whole control loop as adjusting external speed command input gain [Pr-2.00]. That is to say, if you increase [Pr-2.00], it has the same effect as increasing gain. And if you reduce [Pr-2.00], it has the same effect as reducing gain.
- For external speed command input gain [Pr-2.00], refer to the Chapter 5-30.

Position Control Related Gain

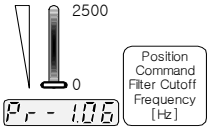
Position related gain includes position FF gain, position FF filter and position loop proportional gain.

The following figure is related to position in Gain Setting Diagram.

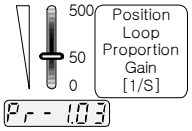
Position Control Related Gain



Position command filter cutoff frequency

Position Command Filter Cutoff Frequency		Function	
		It makes position command itself smooth as suppressing high frequency that is included in position command. If this value is'0', position command filter is not used.	
Applicable Mode	ALL	Others	Setting > End

Position loop proportion gain

Position Loop Proportion Gain		Function	
		The higher the value is set, the better position control response is.	
Applicable Mode	ALL	Others	Setting > End

Position control related gain setting procedure

- Increase the value of speed loop proportional gain [Pr-1.01] in the condition while the initial value of position loop proportional gain [Pr-1.03] is set.
- If there is vibration noise in load, reduce the value of [Pr-1.01] as 80 to 90[%] of that moment.
- Increase the value of [Pr-1.03] again up to the level that vibration noise does not occur in over response.
- Increase speed loop integration gain [Pr-1.02] as checking over response (overshoot, completion time, whether vibration or noise occurs). If you set too low, response quality is degraded and if you set too high, vibration or noise can occur. Maximum setting value of [Pr-1.02] is as the following formula.
  [Pr-1.02] 300 X [Pr-1.01]2 X Inertia of applied motor (Appendix)
- If necessary, you can suppress the excessive change of position command as reducing the value of position command filter [Pr-1.06].
- It is better to set torque command filter [Pr-1.08] as high as possible until vibration does not occur in load side.
- As repeating over response state, adjust gain in detail.

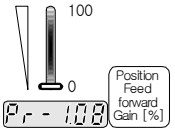
NOTE Position FF gain, position FF filter and speed bias function are explained in the Chapter 6-20.

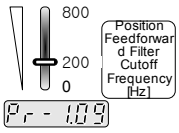
Tip to get fast response

Feed forward function

For position feed forward (FF) diagram, refer to the Chapter 6-18. Position FF makes differentiation factor on position command in position control mode approved in speed command through feed forward method. Therefore, over response characteristics is improved so that you can reduce position output time.

The related parameter to set is as follows.

Position Feed forward Gain		Function	
		The higher the value is set, the better position control response performance.	
Applicable Mode	Position	Others	Setting > End

Position Feed forward Filter Cutoff Frequency		Function	
		• It makes position command itself smooth as suppressing high frequency that is included in position command. • If torque command filter [Pr-1.04] is not '0', it is valid. • If this value is '0', position FF filter is not used. • When you set big value for torque command filter [Pr-1.04] and overshoot or vibration occurs, reduce this value.	
Applicable Mode	Position	Others	Setting > End

If you use position FF function, speed command increases or reduces much as responding to increase or reduction of position command. Therefore, if position command is entered as the type to be significantly changed (that is to say, in case of high acceleration or high deceleration), position FF has overshoot.

At this moment, if you want to reduce position output time, find out appropriate value as slowly increasing the value of [Pr-1.04] as checking over response.

In addition, it is good method to suppress high frequency factor of position FF using speed command filter [Pr-1.05] or making position command itself smooth using position command filter [Pr-1.06].

WARNING

If you use it with On-line Auto Tuning, the system can be unstable.

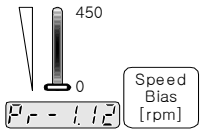
Speed Bias Function

It provides to add bias to speed command according to position error as another method to reduce position completion time in position mode.

You can quickly reduce position error if you use this function because the part where position error is big gives much bigger speed command to reduce the error.

It has the same effect as applying relatively high position proportional gain in the part where position error is big. So you can reduce position completion time around maximum level.

The related parameter to set is as follows.

Speed Bias		Function	
		If position error is more than setting value of bias standard width [Pr-1.13], much bigger speed command that adds the setting value is sent. It is valid only when the value of [Pr-1.13] is not '0'.	
Applicable Mode	Position	Others	Setting > End

For speed bias function, refer to the Chapter 6-18.

If absolute value of position error is more than the setting value of speed bias standard width [Pr-1.13], speed command as much as setting value of speed bias amount [Pr-3.05] is added to or reduced from the position control output.

Adjust [Pr-1.12] and [Pr-1.13] in turn while checking the over response.

NOTE As reference, if you set the value of [Pr-1.12] too high or the value of [Pr-1.13] too low, vibration can occur.

P/PI Mode Setting Function

When you control speed or position, if you set speed loop integration gain [Pr-1.02], it responds to the delicate command so that you can accurately control and make the error in the normal state '0'.

However, if you increase speed loop integration [Pr-1.02] to increase response quality, overshoot occurs in speed response as over response and as a result, position completion time can be increased. Therefore, you can reduce position completion time as setting instantly integration gain as '0' and suppressing overshoot if necessary. In that case, speed control loop is changed from 'PI controller' type to 'P controller' type.

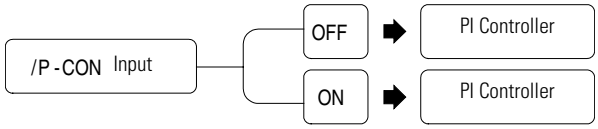
There are two methods to change speed control loop from 'PI controller' type to 'P controller' type.

1	Control by sequence input P control conversion </P-CON> signal.
2	Method to use P/PI mode switching function by parameter setting.

Control by sequence input P control conversion </P-CON> signal.

</ P-CON> is sequence input signal. To use </ P-CON>, allocate </ P-CON>with reference to sequence input/output signal in the Chapter 5-2.

</ P-CON> signal is allocated and speed controller is determined as following type according to allocated input channel signal.

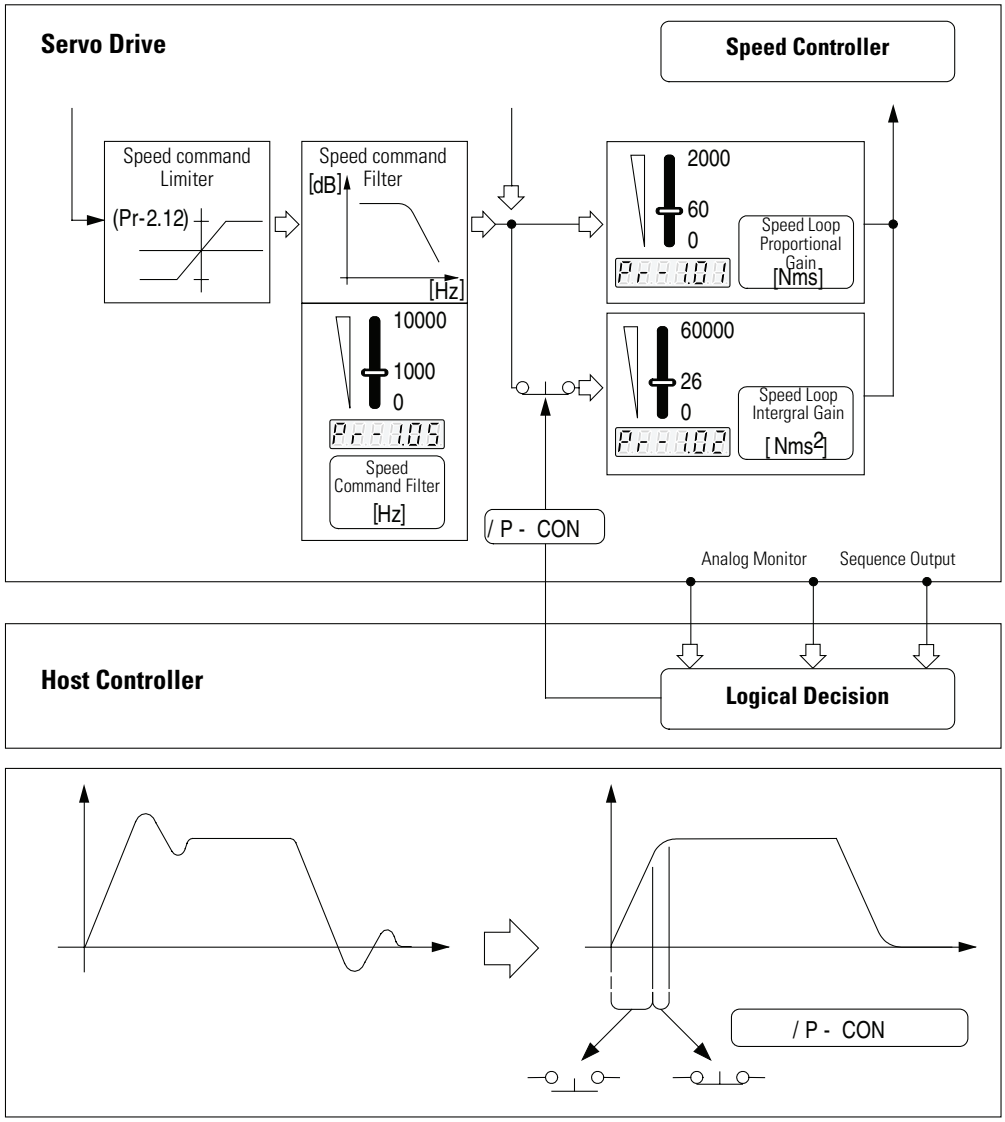


Therefore, host controller checks analog output such as speed or torque of servo drive and sequence output such as </P-COM>, < /V-COM>, </ TG-ON> and programs logics to convert controller from 'PI controller' type to 'P controller' type.

WARNING

- Do not use this function when overshoot occurs.
- If some offset is included in speed command when you use speed mode, if you use 'P controller' type, motor does not respond to the offset related to '0' speed command and remains without moving.

The following figure illustrates the conversion of 'PI controller' and 'P controller' using</P-CON> input in speed control loop (speed controller).



Method to use P/PI mode switching function by parameter setting.

Meanwhile, yon can operate speed controller as 'P controller' type by parameter setting without allocation external sequence input. According to parameter setting, you can change speed controller to 'P controller' type.

- When internal torque command is bigger than certain value [%].
- When speed command exceeds certain value [rpm].
- When position error is bigger than certain value [pulse].

For setting related to cases above, use the following parameter.

Pr - 1.10				Selection of Auto Adjustment on Speed Loop Integration Value
Setting Value	0	P/PI mode conversion is not used.		
	1	If torque command is more than setting value of [Pr-1.11] (PI control P control)		
	2	If speed command is more than setting value of [Pr-1.11] (PI control P control)		
	3	If position error is more than setting value of [Pr-1.11] (PI control P control)		
Applicable Mode		P, S, C	Others	Servo-OFF > Setting > End

Pr - 1.11				Reference Value for Adjustment on Speed Loop Integration Value
Setting Limit	Initial value	Unit	Others	Setting > End
0 to 3,000	100	Variable	Applicable Mode	P, S, C
Initial Setting value is operates as 'P controller' type when torque command exceeds 100 [%].				

NOTE Unit of P control conversion standard value [Pr-1.11] follows the unit of command that is selected in selected parameter of P control conversion switch [Pr-1.11].

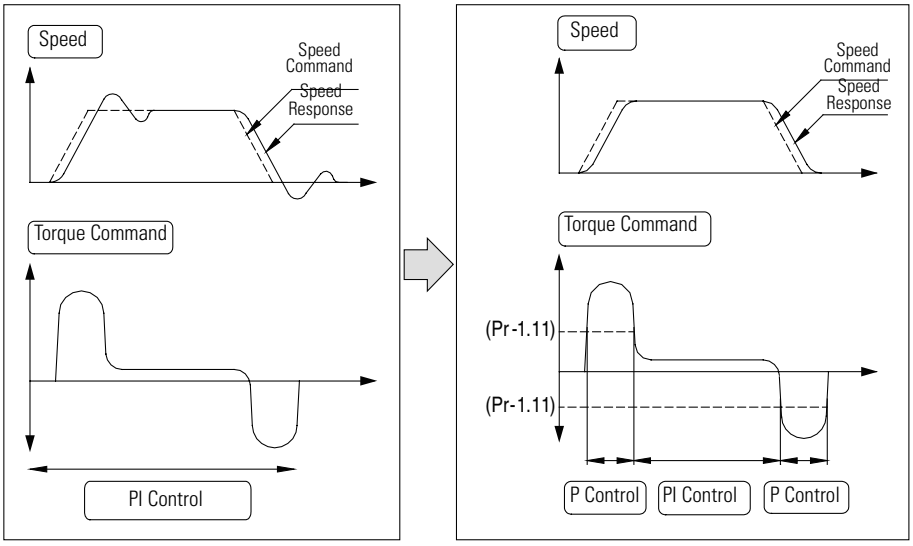
Position error	[Pulse]	Speed command	[rpm]	Torque command	[%]

WARNING

- Sequence input </P-CON> signal is converted prior to setting of [Pr-1.10] and [Pr-1.11]. That is to say, if </P-CON> is ON regardless of current motor condition or setting of motor value, speed controller is converted to 'P controller'.
- To reduce overshoot of speed response or position completion time using this function, you should set appropriate value to [Pr-1.10] and [Pr-1.11]. For optimum setting, check carefully speed, torque, and position and be careful for setting.

The following figure is example of speed response when speed controller is converted from 'P1 controller' type to 'P controller' type in the over response condition.

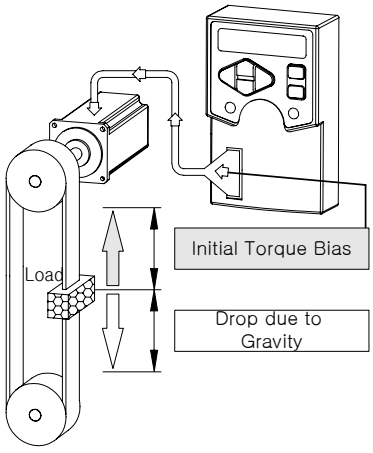
In the over response condition in acceleration-deceleration section, if torque command is higher than setting value of P/PI mode conversion standard value [Pr-1.11], it becomes 'P controller' type and the other section becomes 'PI controller' type.



Initial Torque Bias

It provides downturn by gravity of vertical shaft load during initial operation.

Initial Torque Bias

Downturn of Load by gravity and initial torque bias	
	• If you approve Servo-ON signal to operate motor in the condition that load is vertical as shown in the figure, downturn of load by gravity can occur. • In addition, when you change from Servo-On to Servo-OFF, you need to hold or release motor brake. If you do not appropriately adjust the timing, instantly load drops and vibration occurs in the device. • As characteristics of those vertical shaft load, speed overshoot occurs in motor control and position output time is delayed. In addition, if you try to operate motor as holding the brake, it can be the reason of Servo alarm.
• Initial torque bias approves motor toward the direction against initial torque that relates to downturn when approving initial Servo-ON signal in order to prevent downturn by gravity when controlling vertical shaft load. • If you set initial torque bias appropriately against the strength that load drops, you can prevent the downturn of vertical load during initial operation.	
• If you control the vertical shaft load, use the motor that has built-in brake or install brake.	

Initial Torque Bias Setting Procedure

Set the appropriate value following the procedure below.

Step	Remark
Step 1	Check motor rotation direction (forward/reverse) and load direction (up/down).
Step 2	Stop load in the special position using '0' speed control or fixed location control.
Step 3	If it remains without moving, check torque command value in (dis-03) of the Chapter 7-50, and set that value to [Pr-4.06] below. Set positive value if the direction that load goes up is forward direction of motor, and negative value if the direction that load goes up is reverse direction of motor. For definition on forward and reverse rotation, refer to the Chapter 6-7.
Step 4	Do detailed adjustment on the basis of current setting value as checking torque, speed, position response of motor.

Initial Torque Bias Setting

Set initial torque bias to the following parameter.

Pr-4.06			Initial Torque Bias	
Setting Limit	Initial value	Unit	Others	Setting > End
-100 to 100	0	[%]	Related Mode	ALL

- If you set this value as the value not '0', as soon as you do Servo-ON, control is started and the value of torque command is started from Setting value of parameter.
- Since torque to maintain the current state occurs from the beginning, you can prevent the phenomenon that load drops.
- Therefore, you can suppress overshoot of speed response so that you can reduce position completion time.

NOTE

- For other method to control brake, refer to motor brake control in the Chapter 7-6.
- You can suppress the instant drop of the load only as setting brake control timing in the Chapter 7-6.

WARNING

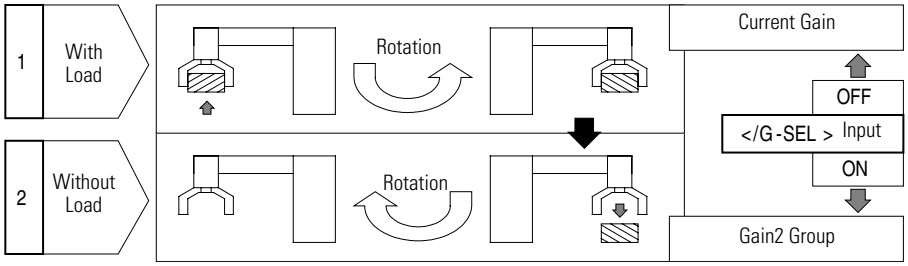
- If you set value of initial torque bias [Pr-4.06] too high, load can temporarily goes up.
- Be careful to make appropriate setting.

</G-SEL> Function

As shown in the figure below, two different conditions of load can be repeated. For example, robot moves a object to other position and return to the original position without any load after laying a object down.

If those movements are repeated too fast, On-line Auto Tuning is not smoothly performed. In addition, if you operate different load condition with the same gain, the response quality in one side is degraded.

In this case, you can effectively use sequence input </G-SEL> function.



The following details per step is to use </G-SEL> function.

Step	Remark
Step 1	Set the optimum gain to fit for No. 2 condition in the figure above.
Step 2	Save gain in No. 2 condition using gain storage function (run-11). At this moment, saved gains is 2nd group gain. (For run-11 function, refer to the Chapter 7-35.)
Step 3	Set the optimum gain to fit for No. 1 condition in the figure above (current gain)
Step 4	Allocate the input pin for sequence input </G-SEL> with reference to the Chapter 5-2.
Step 5	Use as matching </G-SEL> signal with the repeated movement No. 1 and No. 2.

Therefore, if you use as dividing different loads into current gain and 2nd group gain, you can satisfy the response quality of both different load conditions.

</G-SEL> is sequence input signal. To use </G-SEL> function, allocate </G-SEL> signal with reference to sequence I/O signal in the Chapter 5-2.

WARNING

When you use </G-SEL> function, you cannot use On-line Auto Tuning.

Applications

Introduction

This chapter describes the contents that the users should know in terms of fragmentary application function, operation mode and monitor mode when using the servo drive.

Motor Suspension

It describes the suspension of the motor except the stopping by normal operation.

Overview

The general overview on the each situation when the motor is stopped is explained.

With the exception of motor suspended by the normal operation, the servo drive suspend its operation when the below situation occurs and result in suspension of the motor.

Servo Alarm Occurrence	Over Travel Occurrence

The motor can be stopped by 2 above factors in normal operation of the drive, and the method of stopping the motor for each suspension factors may be set in several forms.

- The method to suspend the motors by the servo drive is classified as below.

Suspended by Using Dynamic Brake Function
Suspended by Torque Control Consistent with Normal Operation

Servo Alarm (Refer to Chapter 8-6)

The content on servo alarm is described in detail in the Chapter 8-6.

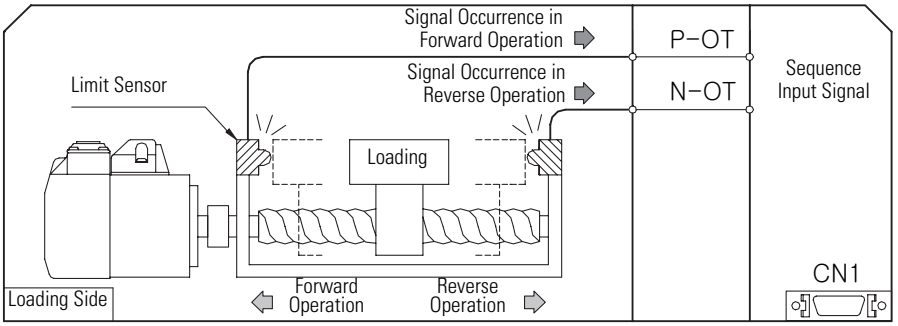
Over Travel <P-OT>, <N-OT>

Over Travel (OT)

When the load exceeds the operation range while running, the load system may be damaged. To respond to this situation, the sensor is installed at the edge of the operation range as shown in the figure below to prevent the damages to the load system.

- Allow the operation within the range so that the loading does not reach the sensor during the operation.
- The servo drive stops the motor to protect the load system when the signal from the sensor occurs due to the loading exceeding the operation range by a certain error.

- At this time, the signal occurring in forward rotation of the motor is called <P-OT> signal and the signal occurring in reverse rotation is called <N-OT> signal.



Rotation prohibition signal in over travel occurrence

The rotation prohibition signal in over travel occurrence is the sequence input signal and is classified as below.

Display	Signal Name	Description
<P-OT>	Prohibit forward operation	Signal occurs during forward operation.
<N-OT>	Prohibit reverse operation	Signal occurs during reverse operation.

Over travel signal input

- <P-OT> and <N-OT> are the sequence input signals. In order to use the <P-OT> and <N-OT> functions, refer to the sequence input & output signal in Chapter 5-2 and allocate the <P-OT> and <N-OT> signals.
- The No. 4 pin of CN1 has the <P-OT> signal, and the No. 5 pin of CN1 has the <N-OT> signal allocation as a factory setting.

NOTE The over travel signal is not the servo alarm signal but it is a signal for the protection of the load system. When the over travel signal is inputted, the drive status display mode shows the characters that the signal is inputted.

Refer to the content of status display mode in the Chapter 4-2.

NOTE The sensor signal to cope with over travel may be used in performing the zero return function described in the Chapter 7-38.

Refer to the Chapter 7-38.

Selection of stop method in over travel occurrence

Select the over travel stop method from the below parameter.

- The information on dynamic brake is described in the following section.

Dynamic Brake

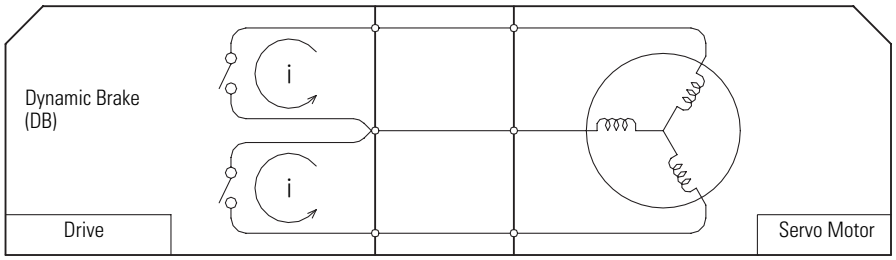
The CSD3 servo drive has the dynamic brake circuit.

Dynamic Brake (DB)

When the motor cable (U, V, W) of the servo motor is all short circuited and the motor shaft is rotated with hands, it is easy to find out that there is much more loading in the rotation than when not short circuited. The drive uses such characteristic of the motor when stopping the motor. This is referred to as a dynamic brake (DB).

The following figure shows the internal DB circuit of the servo drive.

- If the motor cable is connected to the servo drive and if the power is not supplied to the servo drive, the switch in the below figure is short-circuited. This indicates that the DB is in operation.
- Also, the servo drive controls the DB switch according to the parameter setting for the DB operation.
- The DB cannot be used while stopping the motor with normal torque control. The normal torque control is done in servo-ON, but the DB is only operated in servo-OFF.



DB stop

DB Stop is operating the DB to stop the motor during the run.

Free run stop

Free Run Stop is stopping the motor during the run by the friction of the load only.

DB Stop Method Setting

Set the DB stop method on the below parameter.

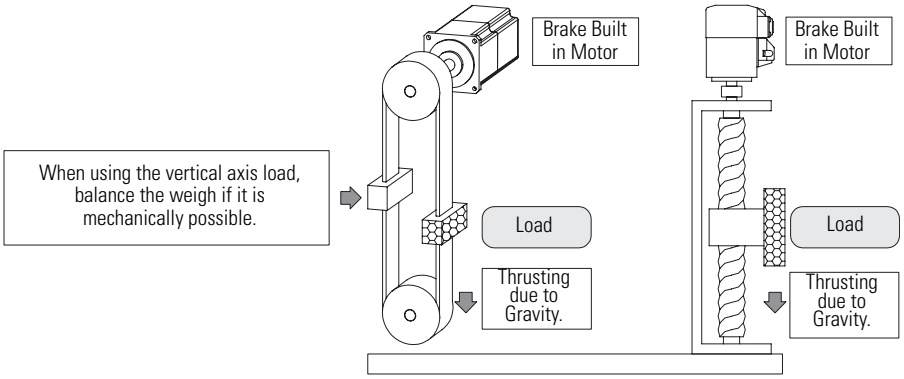
				Selection of DB Stop Method
Setting Value	0	DB stop. DB stop is maintained even after the complete stop.		
	1	DB stop. DB operation is released after the complete stop.		
	2	The DB is not used, but free run stop.		
Applicable Mode		ALL	Other	Servo-OFF > Setting > End

Motor Brake Control

Motor Brake

This function is used when the motor is equipped with the mechanical brake.

- If the load is movable by the gravity (e.g.: When applied in the vertical axis control)
- The fall can be prevented when the power is off or the drive servo is off.



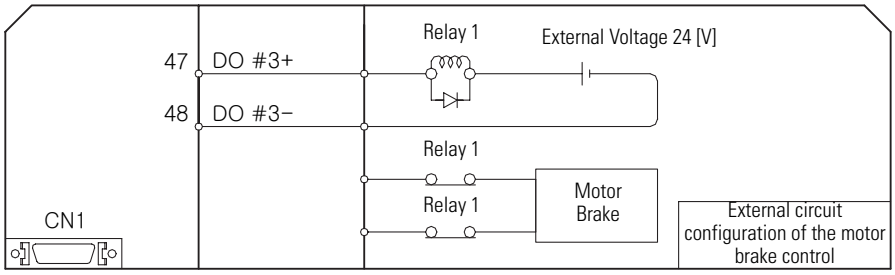
Sequence signal allocation

- In order to use the motor brake, refer to the sequence input & output signal in the Chapter 5-2 first and allocate the <BK> sequence output signal.
- The signal for brake control is outputted with the allotted pin.
- The factory setting is DO#3 (No. 47 and No. 48 pins of CN1).

Circuit configuration

- The drive cannot use the high voltage and current that can directly control the motor brake. Therefore, the motor brake cannot be connected directly to the drive and used. And it is possible to control the brake indirectly by configuring the external relay circuit.
- Refer to the indirect control circuit through the relay shown below.

- The output channel of CN1 can be adjusted by the user according to the condition since the sequence output signal is used. The example below is based on a factory setting.



Motor brake control setting

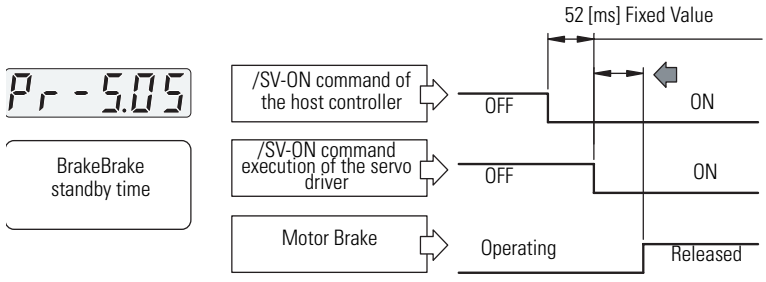
- After the allocation of the brake output signal, the detailed setting on the brake control can be made in the below parameter.

- Set appropriately by observing the motion of the load.

Pr - 5.05			Delay Time of Brake Output Signal after Servo ON	
Setting Range	Initial Value	Unit	Other	Servo - Off > Setting > End
0 to 1000	0	10 [ms]	Applicable Mode	ALL

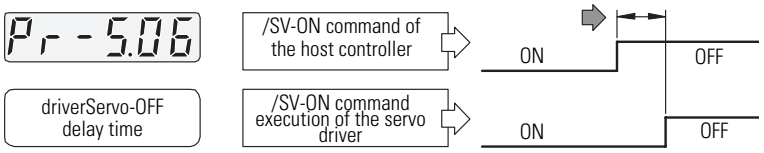
The motor brake has to be released first if the motor brake is in operation when the drive is about to start the motor. At this time, if the brake is released before servo-ON (or simultaneously), the vertical load will immediately fall. The drive has to be servo-on first and to prevent the fall of the vertical load, then release the brake.

This setting is used to secure the time from the servo drive becomes servo-ON to the release of the motor brake.



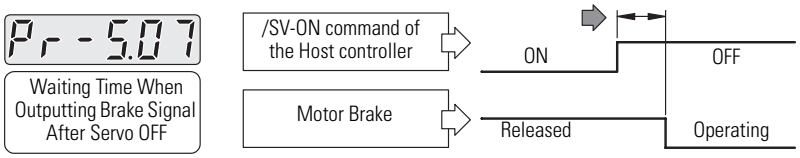
Pr - 5.06			Servo-OFF Delay Time	
Setting Range	Initial Value	Unit	Other	Servo - Off > Setting > End
0 to 1000	0	10 [ms]	Applicable Mode	ALL

The time between the receiving the servo-off command from the host controller to the actual servo-off by the drive can be set.
This setting is used in securing the time for operating the motor brake while the host controller commanded the servo-off.



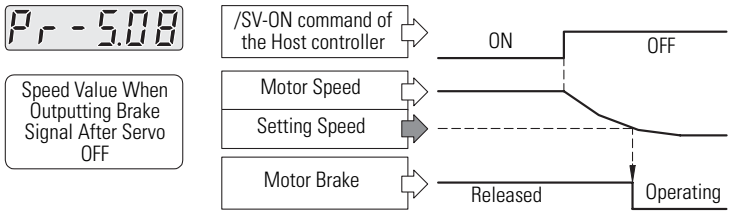
Pr-5.07			Waiting Time When Outputting Brake Signal after Servo OFF	
Setting Range	Initial Value	Unit	Other	Servo - Off > Setting > End
0 to 1000	50	10 [ms]	Applicable Mode	ALL

In order to stop the motor from the host controller, the servo-off command is outputted from the drive.
At this time, the actual time when the motor brake is operated, can be set.



Pr-5.08			Speed Value When Outputting Brake Signal after Servo OFF	
Setting Range	Initial Value	Unit	Other	Servo - Off > Setting > End
0 to 1000	100	[rpm]	Applicable Mode	ALL

The motor speed when the motor brake is operated, can be set.

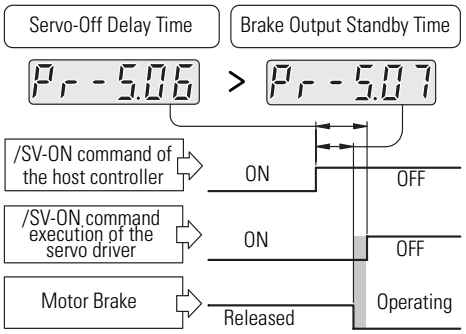
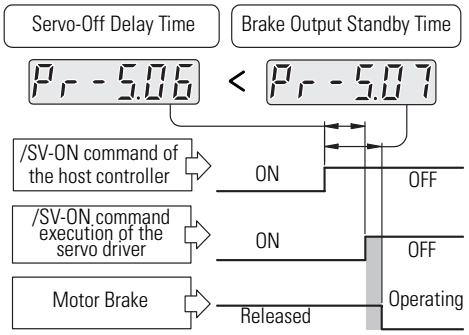


NOTE The brake attached to the motor should not be used to stop the running motor. Use it to maintain the stop status of the motor immediately before or after the stop.

Precautions when Setting

The below are the precautions when setting the time in Servo-ON and Servo-OFF.

- As shown on the right column, if the brake operates after the actual servo-off is completed, it will temporarily be descended by the gravity in case of vertical load.
- As shown on the left column, lowering of the load is prevented by operating the motor brake early, before the actual Servo-OFF.
- In order to prevent the fall by the gravity, set the time properly.

O	X
	

Brake signal is outputted according to the priority among [Pr-5.07] and [Pr-5.08].

Waiting Time When Outputting Brake Signal After Servo OFF Pr - 5.07	Speed Time When Outputting Brake Signal After Servo OFF Pr - 5.08

Other

- Even when the brake attached to the motor is not used, a separate brake may be manufactured and installed by the user.
- When controlling the extra manufactured brake, it can be controller by the signal from the servo drive.

NOTE

- Sequence output signal <BK> that is to control the motor brake is allocated at the time of the shipment.
- When not using the motor brake, allocate and use other output signal needed.
- The detailed contents on the sequence input and output is described in the Chapter 5-2.

Change of Motor Rotation Direction

Overview

The rotation direction of the motor is easily convertible.

- When the rotation direction of the motor is wired differently than the intent of user by the pulse input, the rotation direction of the motor can be reversed by the below parameter setting without the separate wiring.
- When the movement direction of the final mechanical part on loading side is operated to the opposite direction of the setting, the motor rotation direction can be easily converted.

Definition of Forward Rotation - CW (Clockwise)

If the motor shaft rotates in clockwise when the load is viewed from the motor, it is rotating in forward direction.

Definition of Reverse Rotation - CCW (Counterclockwise)

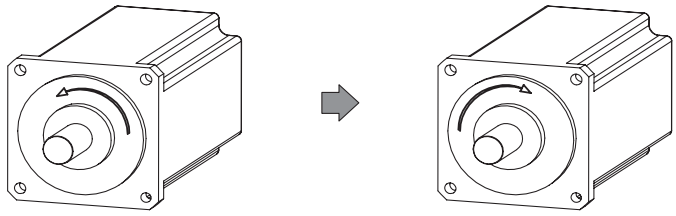
If the motor shaft rotates in counterclockwise when the load is viewed from the motor, then it is rotating in reverse direction.

Rotation direction setting

Set the direction of the rotation in the below parameter.

Pr-002			Selection of Rotation Direction
Setting Value	0	Forward rotation is set as the CCW direction.	
	1	Forward rotation is set as the CW direction.	
Applicable Mode	ALL	Other	Servo – Off > Setting > End

Forward Rotation	Reverse Rotation



NOTE

- This function is not applicable in the jog operation using (run-01).
- In the jog operation, the rotation direction of the motor and key button switch is mutually affixed.
- Refer to the Chapter 7-35 for the detailed description on the jog operation.

Regeneration Resistor

Regeneration Resistor

Regeneration Energy

- When stopping the running motor, the motor operates like a generator and the resulting energy is called the regeneration energy.

Regeneration Resistor

- The regeneration energy occurring when the motor is stopped is absorbed by the servo drive in some degree, but if the energy exceeds the capacity, a separate device is needed to consume the regeneration energy. The regenerative resistor is mounted on the exterior of servo drive in order to consume the regeneration energy.

- If there is excessive regeneration energy that causes the damage to the Servo Drive, but the Servo Drive is equipped with the protective circuit to shield off such phenomenon.

Regeneration Energy Generating Condition

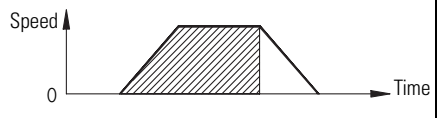
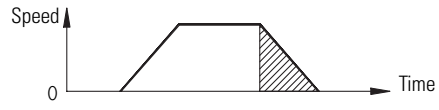
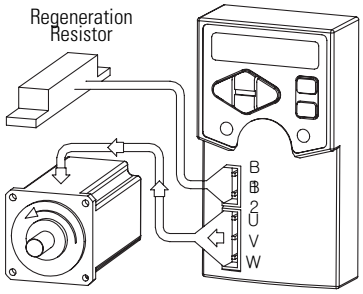
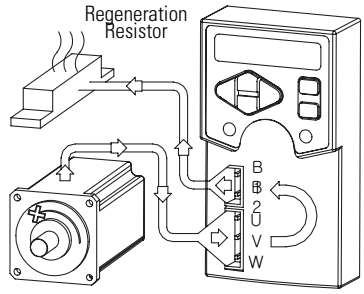
- When the speed is decelerating

- When the motor is continuously rotated by the strength of the load - for example (- loading condition) or (when of operating the vertical axis loading)

Precaution

- Regenerative resistor equipped on the servo drive is designed to consume the regeneration energy in relatively short period of time such as in between the stops.

- It is not appropriate to the case when the regeneration energy is generated too much, like the cases of minus loading condition and vertical load that rotates the servo motor with the gravity. However, when the rated power of regenerative resistor that is calculated by referring to the Chapter 7-13 is smaller than the regenerative resistor attached at the time of shipment, the internal regenerative resistor can be used as is without any special actions.

Acceleration and Constant Speed	Deceleration
	
	

Specification of regenerative resistor mounted on the drive

The allowable power is 20 [%] of the rated power of the regenerative resistor mounted on the drive.

Servo Drive	Mounted Regenerative Resistor Specification		
	Resistance [W]	Rated Power [W]	Allowable Power [W]
200 [W] or Less	-	-	-
400 [W]	50	30	6
1 [kW]	50	70	14
1.5 [kW]	30	70	14

External Regenerative Resistor

The regenerative resistor that the user connects to the outside for load is called external regenerative resistor. The following is the description when using the external regenerative resistor.

General Specifications

The user may consume the regeneration energy generated in the load system by increasing the rated power of regenerative resistor and installing the external regenerative resistor if the rated power of mounted regenerative resistor consumes small regeneration energy.

- In order to increase the allowable power of regenerative resistor, the mounted regenerative resistor and external regenerative resistor are connected in parallel. Another way is to remove the internal regenerative resistor and install the separate external regenerative resistor.

Precautions

- When the rated power is increased for regenerative resistor on the above two methods, the following conditions have to be satisfied.

Total regenerative resistor of rated power shall be 70[W] or less.
The resistance of the total regenerative resistor has to be 30 to 50 [W].

NOTE

- The resistance for regenerative resistor can be ascended to 200 degree or higher of the temperature on the rated loading condition
- When the separate cooling fan is not used, the temperature of the regenerative resistor may increase excessively. Therefore, user should lower it to 20 [%] of the rated power.

NOTE

- The contents relating to the regenerative resistor is important. When the rated power of regenerative resistor is increased, make sure to keep the above two contents.
- When the wrong regenerative resistor is selected, it may cause the product damage and may reduce the performance.

Regenerative Resistor Selection Standard

Regenerative resistor selection standard through the allowable number of repetition

The regenerative resistor has to be selected with the specification that meets the load system of the user. One of the selection standards may be the selection of optimal regenerative resistor that satisfies the load system by calculating the frequency of repeated motion of the motor.

- The repeated frequency means the frequency of operation that the motor rotates and stops regardless of the rotation direction of the motor. The permitted repetition frequency means the maximum repetition frequency per minute.

- The motor regenerative resistor selection by the repetitive frequency is limited to the loading operated in the horizontal direction.

Refer to the below formula to calculate the maximum allowable repetition frequency of the load system.

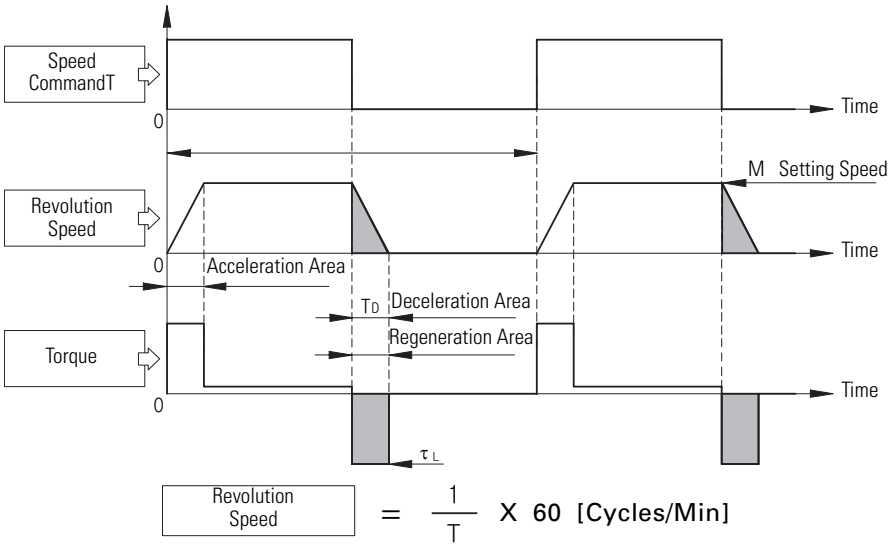
$$\text{Allowable repetition frequency} = \frac{\text{Allowable repetition frequency in without load}}{1+n} \times \left(\frac{\text{Maximum speed}}{\text{Setting speed}}\right)^2 \text{[Cycles/Min]}$$

- Contents necessary in calculation shall be referred to the below [Reference Figure 1] and [Reference Chart 1].
- (n) is the inertia ratio.
- The maximum speed shall be referred to the motor specifications of the appendix.

WARNING

Make sure to use the actual repetition frequency of the motor smaller than the permitted repetition frequency calculated on the above formula.

[Reference Figure 1] It shows the acceleration and deceleration of the motor in certain operation cycle in horizontal axis.



$$\text{Revolution Speed} = \frac{1}{T} \times 60 \text{ [Cycles/Min]}$$

[Reference Chart 1] It shows the allowable repetition frequency per minute when operated without the load.

- It is left as blank if there is no applicable capacity of the motor type.

Allowable Repetition Frequency for no Load [Cycles/Min]										
Motor Capacity [W]	300	400	500	600	750	800	900	1000	1200	1500
CSM/CSMT		320		70		53		90		
CSMP/CSMR		40								
CSMD/RSMD					69			31		17
CSMF/RSMF		35			19					9

CSMH/RSMH			14					7		4
CSMK/RSMK	54			76			40		14	
CSMQ/RSMQ		46			61					30
CSMS/RSMS								43		27
CSMZ/RSMD		88			63					

NOTE

When the repetition frequency of actual motor is larger than the allowable repetition frequency, perform as the following.

- Lower the possible setting speed.
- Refer to The Chapter 7-16 to set the possible deceleration time in long period of time.
- Refer to The Chapter 5-41 and limit the possible torque.
- Make the inertia of load system small.

Setting for Smooth Operation

Overview

By setting the acceleration/deceleration time and S-curve operation time on the servo drive, the impact that may occur in acceleration or deceleration can be reduced to result in smoother operation.

Definition of Acceleration Time

Time it takes to accelerate from stop status to motor's rated speed.

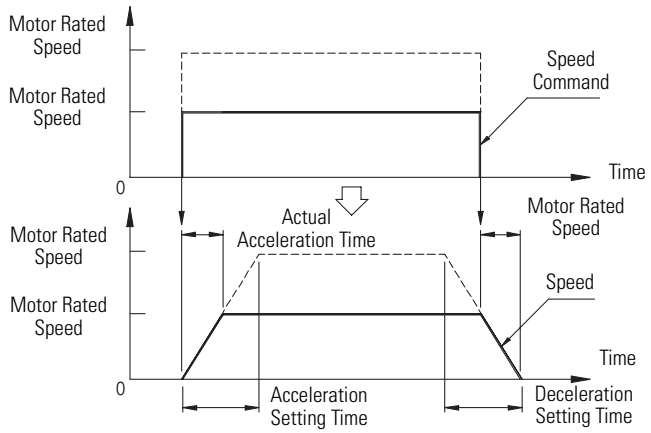
Definition of Deceleration Time

Time it takes to decelerate from motor's rated speed to a stop status.

Speed Command and Acceleration/Deceleration Time

The below figure shows the command implementation of servo drive on the speed command after setting the acceleration/deceleration time.

It shows the longer time of performance in command as much as the deceleration time.



Acceleration/Deceleration Time Setting

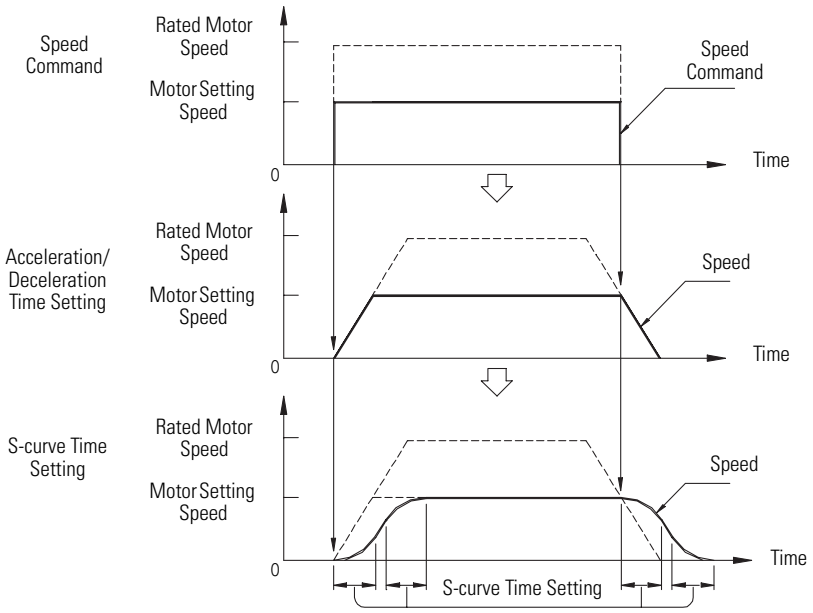
Set the acceleration/deceleration time on the below parameter.

Pr-202			Acceleration Time	
Setting Range	Initial Value	Unit	Other	Setting > End
0 to 60000	0	[ms]	Applicable Mode	ALL

Pr-203			Deceleration Time	
Setting Range	Initial Value	Unit	Other	Setting > End
0 to 60000	0	[ms]	Applicable Mode	ALL

Definition of S-curve operation

As shown in the below figure, by performing the S-curve command at the conversion point of acceleration/deceleration, more smooth operation can be had.



S-Curve operation time setting

Set the S-curve operation time on the below parameter.

Pr-2.04			S-Curve Operation Time	
Setting Range	Initial Value	Unit	Other	Setting > End
0 to 5000	0	[ms]	Applicable Mode	ALL

Caution

The total command performance time differs by the acceleration-deceleration and S-curve operation time.

If the total consumed time for initial speed command is 10 seconds, the total time of speed command time after the acceleration-deceleration time setting is (10 seconds + Pr-2.03). Also, the total time (10 seconds + Pr-2.03 + Pr-2.04) of speed command performance after the S-curve time setting.

NOTE

- If the S-curve setting value is set as '0', the S-curve operation is not used.
- Also, without the setting of acceleration/deceleration time, the S-operation alone shall not be used. For the use of S-curve operation, first set the acceleration/deceleration time that is appropriate to the user's situation.

Speed Limiting Function

It describes the function to limit the rotation speed of the motor.

Ways to Limit the Speed

- Limit the speed through the independent setting of the servo drive (Internal speed limit)
- Limit the speed through the command from the host controller (External speed limit)

Internal Speed Limit

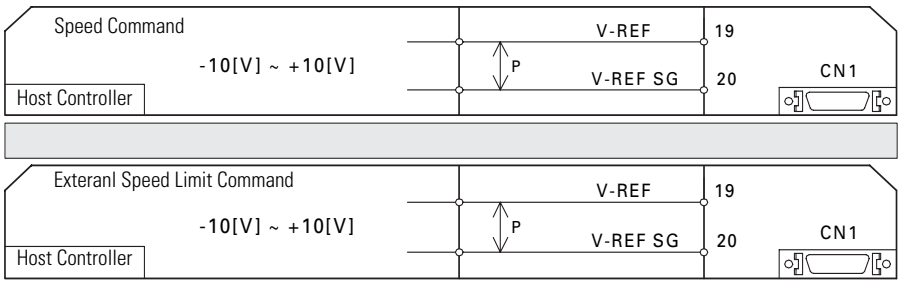
- Internal speed limit is operated by the value set by the user on the below parameter. Therefore, when the faster speed command than the setting value of below from the host controller, the servo drive is limited to the setting value and operated.

			Speed Limit	
Setting Range	Initial Value	Unit	Other	Servo-OFF > Setting > End
1 to 5000	Automatic	[rpm]	Applicable Mode	ALL
It limits the rotation speed of the motor to operate under the setting value.				
Initial value is automatically set with the maximum speed of the motor applicable together with the setting the motor model at the basis setting of the chapter 4.2.				

External Speed Limit

- The below figure is the input of function to allow the servo drive to make the speed control by permitting the analog speed command at the host controller when the servo drive is used as the speed mode. Refer to the speed mode in the chapter 5.3.
- If, the user does not use the speed mode and operate with other control mode (position, torque, multi-step speed), the below input can be used as the function limiting the speed. The speed limit utilizing the speed command input pin is referred to as external speed limit.
- When it is used as speed mode, the external speed limit function may not be used and the speed may be limited by the internal speed limit.
- The speed may be limited to a speed equivalent to the analog voltage command inputted from the host controller.

When operated in speed mode, the analog speed command of host controller is executed



External Speed Limit Value

The parameter below is the parameter setting the relationship between the analog speed command voltage and the speed when operating with speed mode. When it is not used as the speed mode, the speed is limited to the applicable speed at the below parameter setting.

- Select the analog command voltage and speed to be limited, and set the external speed limit value of the below parameter.

Pr-2.00			External Speed Command Gain and External Speed Limit Value	
Setting Range	Initial Value	Unit	Other	Servo-OFF > Setting > End
10.0 to 2000.0	500.0	[rpm/V]	Applicable Mode	S
Set the speed command value [rpm] on analog voltage 1 [V], and limit it with the set speed.				

External speed limit value is given by the following relationship.

External speed limit [rpm] = Pr-2.00 Setting Value [rpm/v] X Input Voltage [V]

Accordingly, when the input voltage is 6 [V] following the initial value, it is limited to the rated speed of motor, 3000 [rpm], and limited to 5000 [rpm], the maximum speed of motor when the input voltage is 10 [V].

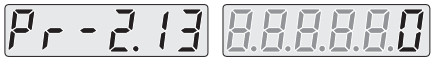
The Voltage Command of Host Controller and External Speed Limit

When the speed mode is used with V-REF (No. 19 pin of CN1) and V-REF SG (No. 20 pin of CN1) of servo drive, the motor is rotated to the forward direction in the + voltage. And the motor is rotated to the reverse direction in the - voltage when permitting the analog speed command of -10 [V] to +10 [V] range. However, when of using it as external speed limit function, the classification of + and- voltage is not made.

For example, when +1 [V] is permitted at the host controller and set with 500 for [Pr-2.00], the external speed limit value becomes 500 [rpm], and it is limited in all forward and reverse directions. Also, if -1 [V] is permitted, both forward and reverse directions are limited to 500 [rpm].

Speed Limit Selection

Select how to make the speed limit at the below parameter.

				Speed Limit Selection
Setting Value	0	The speed limit function is not used.		
	1	It is limited by the internal speed limit [Pr-2.12].		
	2	It is limited by the external speed limit.		
	3	Compare the internal speed limit [Pr-2.12] and external speed limit to limit in small value.		
Applicable Mode		ALL	Other	Servo-OFF > Setting > End

Position Feedback to the Host Controller

Overview

Servo drive controls the servo motor by using several information received from the encoder. Also, the servo drive has the function to output the encoder information to host controller. In this the chapter, it describes the output function of encoder information.

Types of Output Sent to Host Controller

The total of 5 below encoder signals is outputted to the host controller.

Mark	Output	Type
EA	Output on Encoder A (/A)	Line drive
/EA		
EB	Output on Encoder B (/B)	
/EB		
EC	Output on Encoder C (/C)	
/EC		
PS	Absolute Encoder Position Data Output	
/PS		
/Z-PULSE+	Open Collector Output of Encoder Z (+/-)	Open collector
/Z-PULSE-		

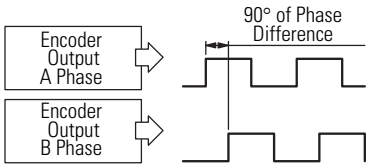
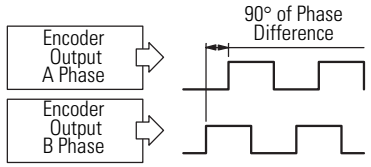
Example of Wiring with Host Controller

Refer to the chapter 3.8 for the example of wiring of the host controller and servo drive.

Direction Change of Output Pulse

- The direction of encoder pulse outputted to the host controller is converted.

- Set the below parameter to convert the direction of output pulse.

Pr-3.00			Encoder Output Pulse Direction
Setting Value	0	In forward rotation, the encoder output A phase have a lead of 90 ° over B phase.	
	1	In forward rotation, the encoder output B phase have a lead of 90 ° over A phase.	
Applicable Mode	ALL	Other	Servo-OFF > Setting > End

Pulse Dividing Circuit

Overview

Servo drive may adjust the number of pulse of encoder through the dividing circuit function before outputting to the host controller through the input received from the encoder.

Adjustment calculation formula for pulse number

The number of output pulse is adjusted by the formula below.

$$\frac{\text{Numerator (Pr-3.03)}}{\text{Denominator (Pr-3.04)}} \times \text{Number of Encoder Pulse} = \text{Output to Host Controller}$$

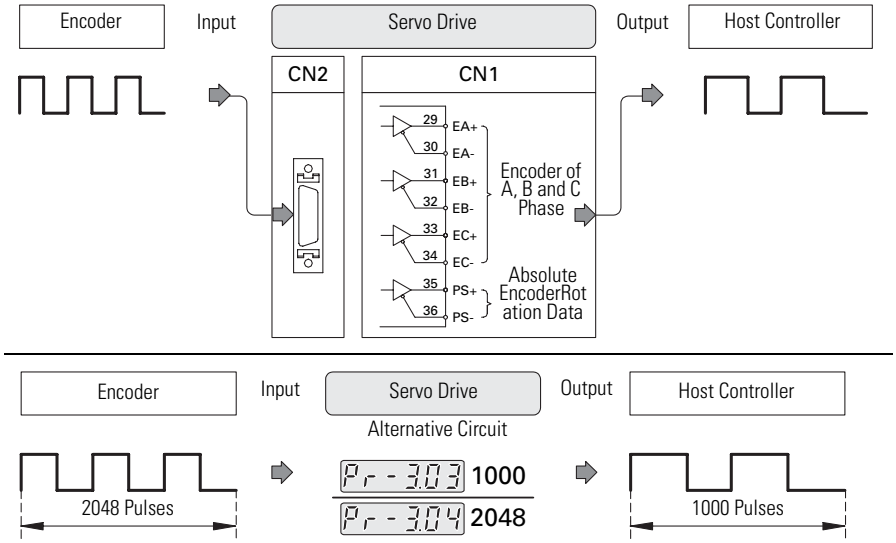
This is a simple example to help understanding.

When the type of encoder connected to the drive is outputted 2048 pulses per 1 revolution, and output 1000 pulses per 1 revolution with the host controller.

$$\frac{\text{Pr-3.03 } 1000}{\text{Pr-3.04 } 2048} \times 2048 = \text{Pulse Output}$$

Servo drive receives 2048 pulse per 1 revolution from the encoder, but outputs 1000 pulse to the host controller.

Input of encoder signal and output to the host controller.



Setting

Set the pulse dividing circuit numerator and denominator from the below parameter.

Pr - 3.03			Number of Encoder Pulse per 1 Rotation (Numerator)	
Setting Range	Initial Value	Unit	Other	Servo-OFF > Setting > End
1 to 32768	Automatic	[Pulse]	Applicable Mode	ALL

Pr - 3.04			Number of Encoder Pulse per 1 Rotation (Denominator)	
Setting Range	Initial Value	Unit	Other	Servo-OFF > Setting > End
1 to 32768	Automatic	[Pulse]	Applicable Mode	ALL

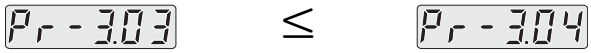
NOTE The initial value of dividing circuit is automatically set the number of encoder pulse applicable to the encoder type at the basic setting of The Chapter 4-6 at the same time.

NOTE Even when the motor rotates at a fixed speed, the encoder output pulse may have jittering of 33 [usec] depending on the rotation speed.

Precaution

Servo drive may not output to the host controller for the number of pulse that is more than the input pulse number. Accordingly, the below condition has to be complied.

NOTE Make sure to comply with the following condition in the setting of alternative circuit.

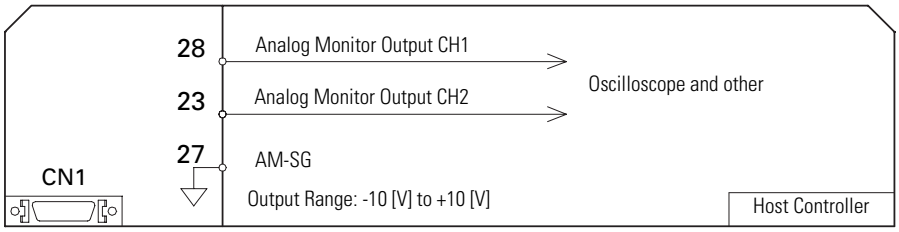


Analog Monitor Output

Overview

Servo drive outputs the signal for analog monitor which allows the user to confirm the actual controlling situation by using the oscilloscope and others.

- The monitoring is possible from all control mode and has two channels.

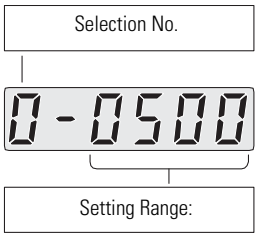


Setting

Set the output type and range that the users want to confirm from the below parameter.

Pr-5.13 3-0500			Analog Monitor Output CH2 Selection and Scaling	
Setting Range	Initial Value	Unit	Other	Setting > End
0-0001 to 6-2500	3-0500	Below Chart	Applicable Mode	ALL

The types of output and unit chart showing the setting window.



Setting Example	Selection No.	Type	Setting Range	Unit
	0	Speed Command	1 to 500	[rpm]
	1	Torque Command	1 to 30	[%]
	2	Position Command	1 to 5000	[pulse]
	3	Speed Feedback	1 to 500	[rpm]
	4	Torque Feedback	1 to 30	[%]
	5	Position Feedback	1 to 5000	[pulse]
	6	Position error	1 to 2500	[pulse]

Monitoring Sample

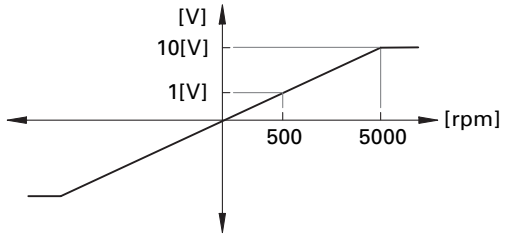
- The below figure is the monitoring sample.
- Set the monitoring type and input the setting value applicable to 1 [V] output.

- The output range is –10 [V] to +10 [V].

Monitoring Sample 1	Pr-5.12 0-0500

Confirm the speed command of host controller through the analog monitor output CH1.

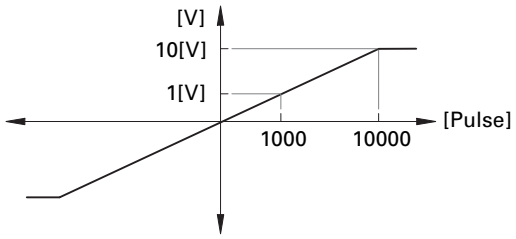
- The speed command confirmation of host controller applicable to monitor output 1 [V] is 500 [rpm].
- By outputting of maximum of 10 [V], the confirmation can be made up to 5000 [rpm].
- Accordingly, the confirmation range of entire speed command is -5000 [rpm] to 5000 [rpm].



Monitoring Sample 2	Pr-5.13 2-1000

Confirm the position command of host controller through the analog monitor output CH2.

- The position command confirmation of the host controller applicable to the monitor output 1 [V] is 1000 [pulse].
- By outputting of maximum of 10 [V], the confirmation can be made up to 10000 [pulse].
- Accordingly, the confirmation range of entire position command is -10000 [pulse] to 10000 [pulse].

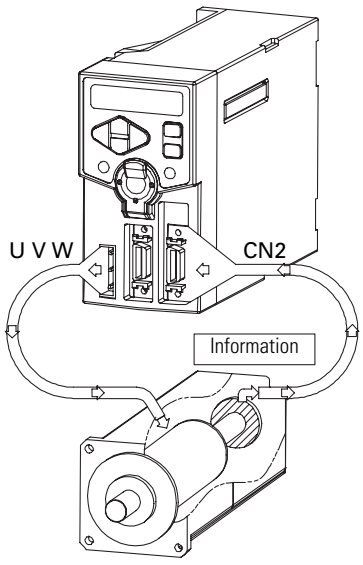
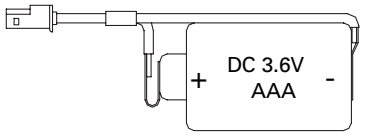


Use of Absolute Encoder

It describes on the matters related to the absolute encoder, battery and other absolute encoder.

What is an Absolute Encoder?

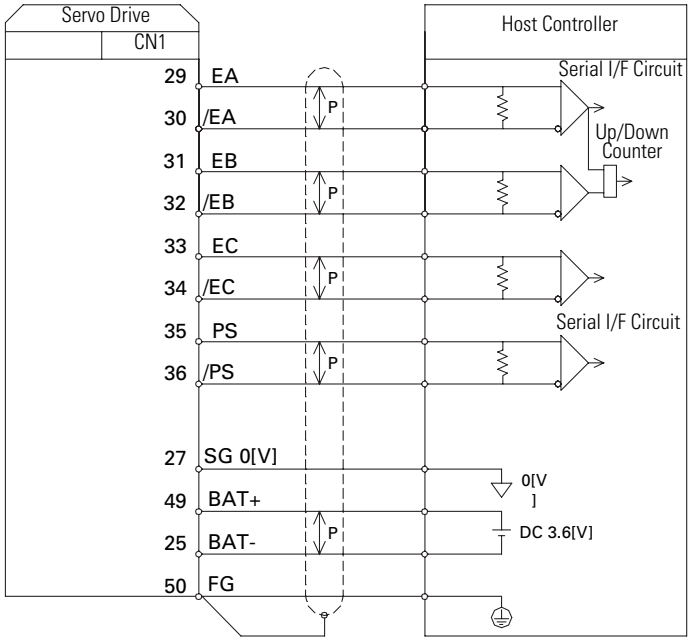
- Absolute encoder is an encoder that can detect the absolute position of input.
- Absolute encoder can store and memorize the absolute position information of the load system by using the battery power if the power of servo drive is cut off.
- Absolute encoder does not accumulate the error by the noise during the signal transmission.
- Also, if the power is cut off as in the incremental encoder, there is no need to adjust again for initial load position, and the operation of equipment can immediately be executed by using the saved information.
- When the host controller needs the absolute position of load system in the power cut off, the motor that is equipped with the absolute encoder has to be used.

Drive Output and Encoder Information Flow	Types of Absolute Encoder
	H, J Type Absolute Encoder Q, E Type Absolute Encoder Absolute Encoder has to be Connected with the Battery. 

Contact with the Host Controller

When the motor equipped with the absolute encoder is used, the standard connection with the drive and host controller is as below figure.

- For memorizing and maintaining the absolute position information, the absolute encoder shall be connected to a battery.
- The battery may be connected to CN5 of servo drive, and can be connected with No. 49 and No. 25 pins of CN1 connected from the host controller. Make sure to connect one of the two places.



Battery

Battery

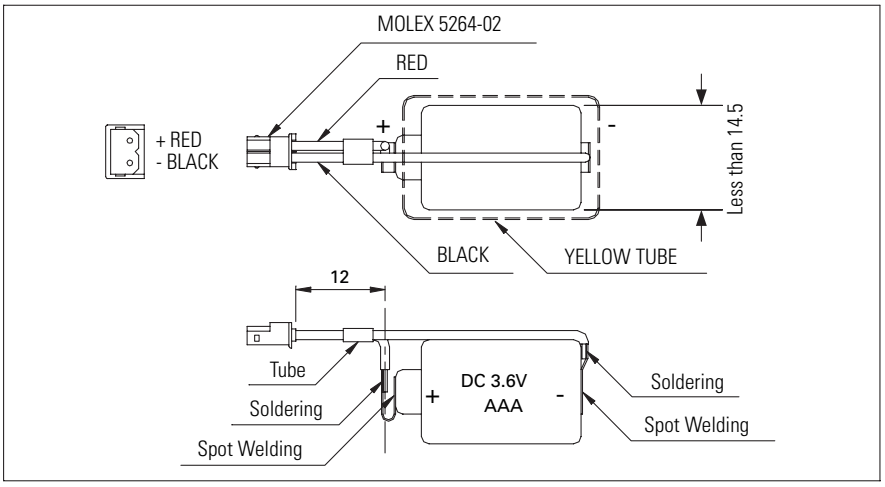
It describes the battery for absolute encoder information preservation.

- When the power of servo drive is cut off, the battery memorizes the absolute position of the load system and helps maintain it.
- If the power of servo drive is cut off and discharged the battery power to lower than the standard, the saved information in absolute encoder may be damaged.
- Battery specification connected to CN5: Lithium battery 3.6 [V], 1/2 AA (AAA) size.

- The voltage of battery is not directly monitored from the drive but the error is checked indirectly through the encoder. Prepare the low voltage detection circuit as needed basis.

Battery Specification

The below figure is the specification of battery connected to CN5 of servo drive.



Battery Voltage Diagnosis

The voltage monitored with encoder is displayed for servo warning and alarm depending on the following situation.

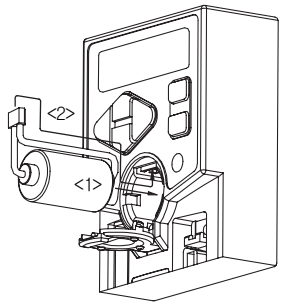
Servo Warning	Servo Alarm
When the voltage of battery for absolute encoder is 3.2 [V] or less, 'absolute encoder battery low voltage warning' occurs. At this time, the below warning characters are displayed in the status display mode. Replace the battery before having 'low voltage alarm for inside absolute encoder' occurs with the low battery voltage in having the warning.	When the capacitor voltage of encoder inside is about 2.7 [V] or less, the 'low voltage alarm for inside of absolute encoder' occurs. At this time, the servo drive stops the operation. When 'low voltage alarm for inside of absolute encoder' occurs, the saved information on encoder may be damaged.
A.P.-bAt	E.AbSbE

NOTE

- When 'absolute encoder battery low voltage warning' occurs, the H, A type of absolute encoder automatically clears the warning if the battery voltage is in normal operation range, but the Q Type encoder is reset for warning by performing the alarm reset (run-08). At this time, multi-step rotation data is not reset.
- A or H type absolute encoder has a super condenser in it, so its voltage is maintained for 30 min. even when its battery is disconnected. When a battery is re-connected, 'internal low voltage alarm' occurs. Then, reset the alarm.
- The super condenser of RSMx motor Q type encoder can maintain its voltage for min. 3.5 hours even after power is disconnected if it is charged for 3 hours or more before the disconnection.

Connecting Battery to CN5

The below figure is how to connect the battery to CN 5 of servo drive.



Connection Sequence

1. Prepare the proper battery for specification.
2. Open the battery cover.
3. Push it all the way in to the No. <1> direction.
4. Contact the connector to the No. <2> direction.
5. Close the battery cover.
6. The polarity is consistent if the battery specification is complied.

Reset of Absolute Encoder

Implement the absolute encoder reset (run-10) in the following cases.

- For initial trial operation.
- When separate the drive and encoder cable after cutting off the power and connected again.
- When wanting to reset the number of rotation data.

Caution has to be taken on the following

- The reset operation of absolute encoder is possible only in servo-OFF status.

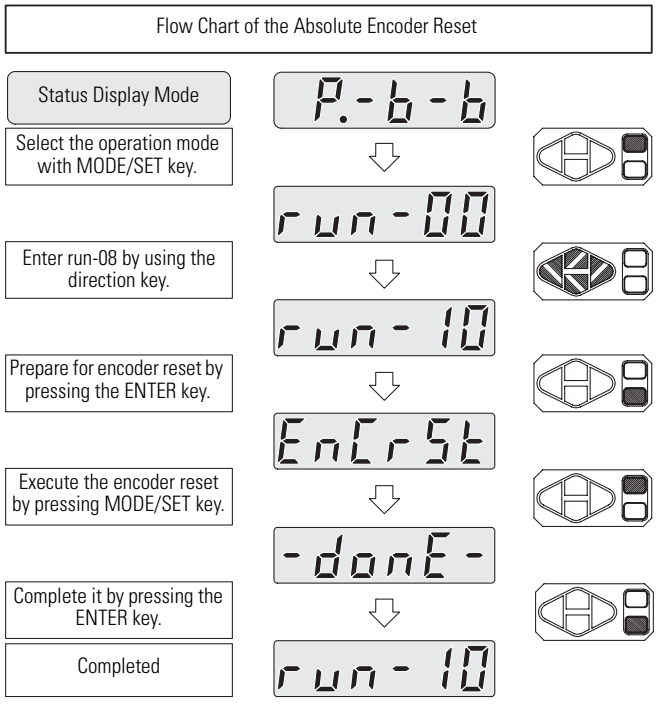
- When of A, H, J Type encoder, resetting the encoder takes about 5 seconds. Keep sufficient time on this.
- Depending on the encoder type, the performance content is different in times of absolute encoder reset and alarm reset. Refer the below chart and use it after a full understanding.

	A, H, J Type Encoder	Q Type Encoder
Alarm Reset (run-08)	Encoder related alarm and warning reset. The number of rotation data reset.	Encoder related alarm and warning reset.
Absolute Encoder Reset (run-10)	Encoder related alarm and warning reset. The number of rotation data reset.	The number of rotation data reset. Encoder related alarm and warning reset.

NOTE

- A, H, J Type encoder performs the same functions of absolute encoder reset and alarm reset. Both two cases have the number of rotation data resetting.
- When of using the encoder of Q Type, make sure to perform the absolute encoder reset for resetting the number of rotation data.

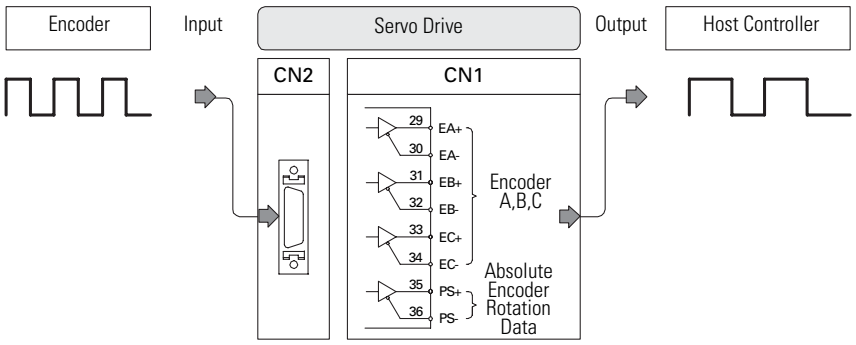
Refer to the below flow chart to make absolute encoder reset.



Data Transmission of Absolute Encoder

This Chapter describes the sequence of drive receiving the data of absolute encoder and sending it to the host controller. After sufficiently understand it, and then design the host controller.

- As shown in the figure below, the drive is outputted for absolute information through the PS (+,-), EA (+,-), EB (+,-) terminals.



PS (+, -) serial data frame structure

- Through the PS output, the structure of transmission frame of data sending to host controller is as follows.
- Data is structured with "multiple rotation data & 1 rotation data, and alarm".

The transmission size of data varies depending on the data.

Absolute Encoder	The number of rotation Data	1 Rotation Data	Transmission Cycle
A, H, J Type Absolute Encoder	13 bits	11 bits	About 50 [ms]
Q Type Absolute Encoder	16 bits	17 bits	About 50 [ms]

Structure of transmission frame (A, H type absolute encoder)

STX	Absolute Data (Variable digit)			&	Date (3bit) (Alarm content)	BCC	ETX
	The number of rotation data (0 to 8191)	&	1 Rotation Data (1 to 2047)				

Structure of transmission frame (Q type absolute encoder)

STX	Absolute Data (Variable digit)			&	Date (3bit) (Alarm content)	BCC	ETX
	The number of rotation data (0 to 65535)	&	1 Rotation Data (1 to 131071)				

Data Transmission Format

Data Transmission Method	Asynchronous
Baud Rate	9600 [bps]
Start Bit	1 bit
Stop Bit	1 bit
Parity	None
Character Code	ASC Code
Data Format	10 to 19 Characters

NOTE

- Through the monitor mode (dis-12) of The Chapter 7-50, the multi-step rotation data of absolute encoder can be confirmed.
- Division ratio is applied to 1 rotation data sent to PS output (Not applied to A, H type encoder).

Caution

- STX indicates the beginning of transmission packet, and is applicable to ASCII code 02H.
- ETX indicated the end of transmission packet, and is applicable to ASCII code 03H.
- Multi-step rotation data has the range of –32768 to +32767 (-4096 to +4095). (The parenthesis is applicable to A, H Type encoder. +/- indicates rotation direction.)

Serial Data Transmission for EA (+, -) and EB (+, -)

- For the host controller not receiving the serial data output using the PS (+, -), the data of absolute encoder is sent to the host controller in the form of incremental pulse form through the output of EA and EB, the incremental encoder output signal. From the absolute data, send the 1 rotation data first, then send the multi-rotation data. The host controller multiplexes the received pulses by 4 times.

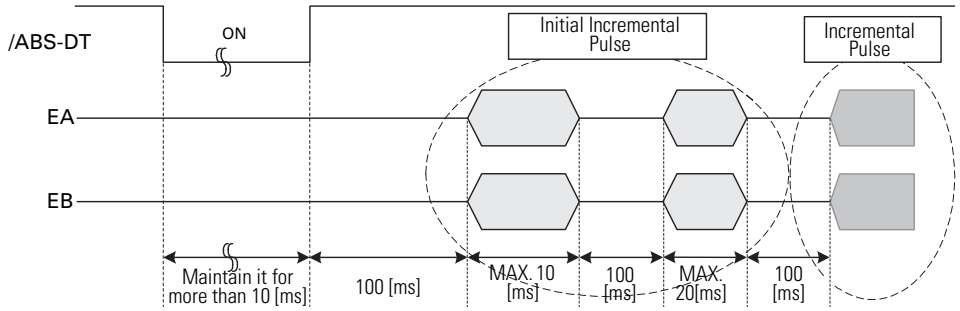
Sequence of receiving the absolute serial data through EA and EB

1. Clear the Up/Down counter for incremental pulse counter to 0 and make it in the absolute encoder data receiving standby status.
2. The /ABS-DT signal inputted to drive is maintained in low level for 10 [ms] or more.
3. After 100 [ms] since /ABS-DT is off, receive the 1 rotation data transmitted from the drive.

4. Receive the number of rotation data, and then receive 1 rotation data transmitted after 100 [ms].

5. EA and EB of drive are operated in normal incremental encoder output signal after the lapse of about 50 [ms] after transmitting the 1 rotation data to which division ratio is applied.

PAO Serial data reception sequence



Content of each signal

Signal Name	Status	Signal Content
EA (+,-)	When initialize it by turning on the power	Initial incremental pulse
	In normal operation after the initialization	Incremental pulse
EB (+,-)	When initializing it by turning on the power	Initial incremental pulse
	In normal operation after the initialization	Incremental pulse
EC (+,-)	Always	Original pulse
PS (+,-)	Always	Serial data of absolute encoder

Operation Mode Function

Things to Know First

First understand the below content before reading the description of the operation mode.

1. From the flow chart content, the content of display of status display mode may be different from the actual condition.
2. The content displayed in the flow chart and the key operation sequence is the same with the actual condition.
3. The black part of key button mark on the right means to press.
4. The upper left side with servo-ON, servo-OFF means the status of servo drives status in setting.
5. It describes to the order from (run-00) to (run-12).
6. Before using the functions of operation mode, the content of each functions and flow chart shall sufficiently understand and operate it.

Adjust or operate in the black display status.

When the status of drive is not maintained, the following content is displayed during the performance or storage of each operation mode.


Jog Operation (run-00)

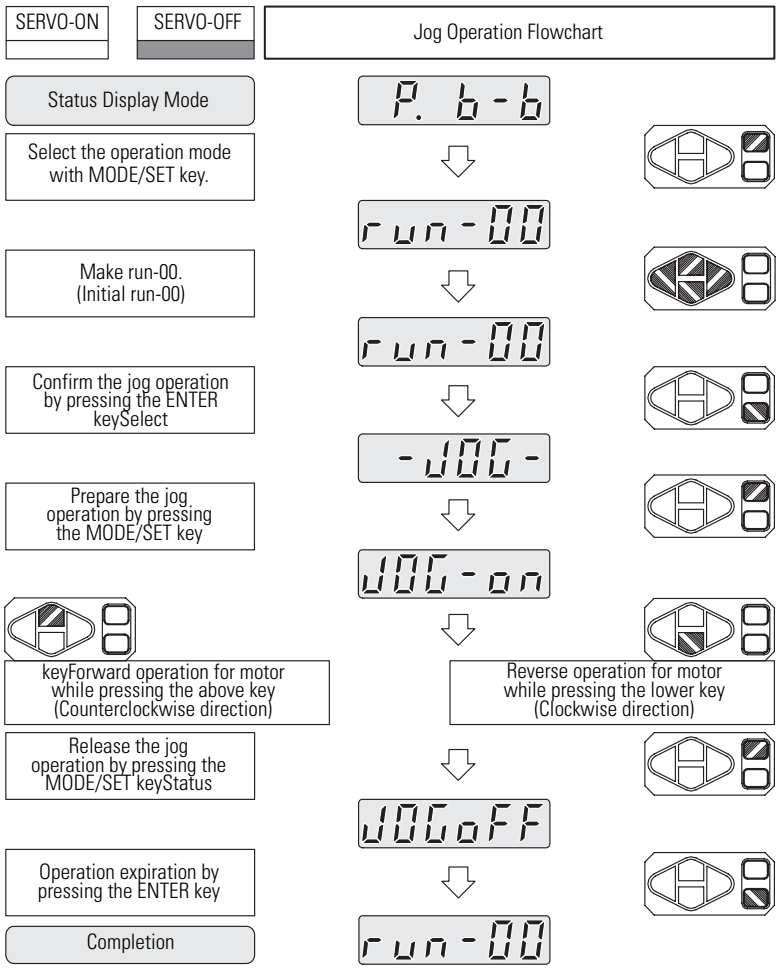
Function Description

By using the direction key of the operator, the motor can be made for forward rotation or reverse rotation.

- It is an appropriate function when the trial operation of equipment or simple operation is required.
- The speed of the motor is determined with the setting value of [Pr-2.01]. Confirm the setting value of [Pr-2.01] in advance before operation and adjust it for situation.
- The operation can be possible in the range of 0 to 5000 [rpm] and the initial setting speed is 500 [rpm].

How to Operate

Refer the flow chart of the below and operate.



Off-line Auto Tuning Operation (run-01)

Function Description

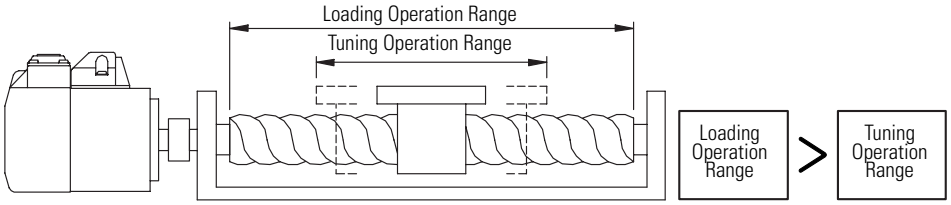
Refer the Chapter 6-7 for detailed description on off-line auto tuning.

Caution

The following shall be carefully reviewed before operation.

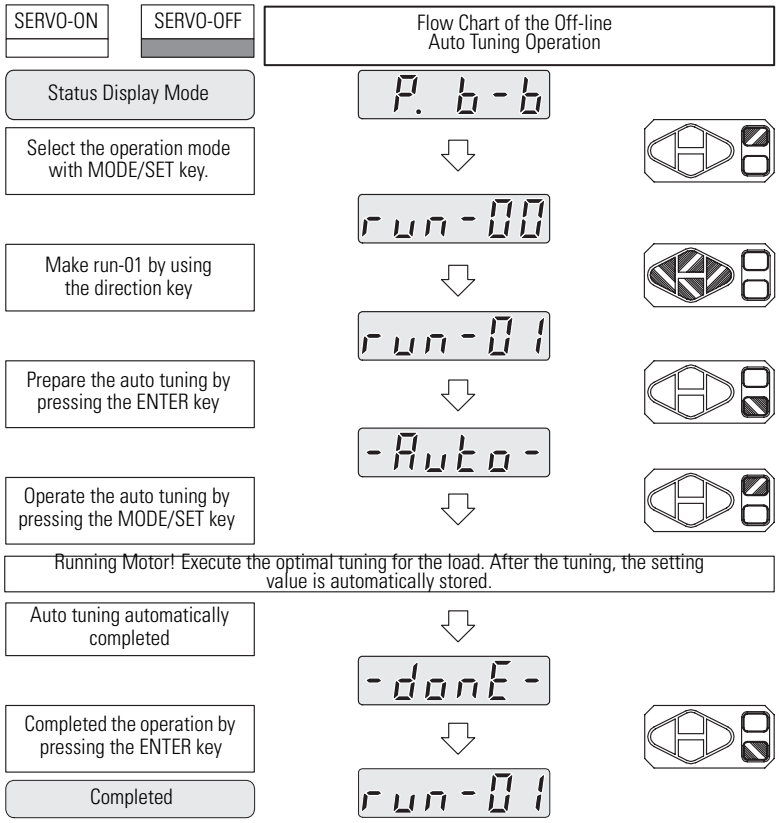
NOTE

- With the jog operation of the Chapter 7-35, the loading is positioned in the middle of operation area.
- The motor rotates 3 times in 360° forward and reverse direction.
- Confirm the loading not to exceed the operation range during tuning.



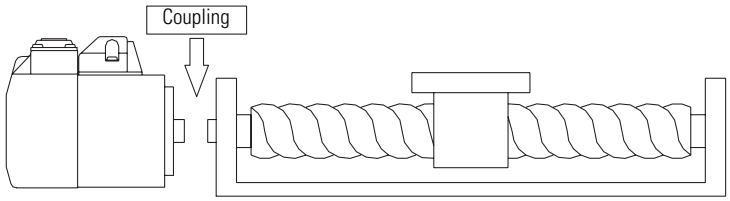
How to Operate

Refer to the below flow chart to operate.



Searching an Origin Pulse(run-02)

The function is to search a origin (Z-Pulse). When needing to align the location of motor shaft and machine shaft, run this function. Do not couple motor and machine shaft



- The run-02 operation must be done in Servo-On status.
- The searching speed is fixed as 10 [rpm]

Auto Adjustment of Speed Command Offset (run-03)

When of operating the speed mode by the host controller or combination control mode related to the speed, it is a function to automatically adjust with the offset voltage of the speed command.

Function Description

- When the analog speed voltage command is made to 0 [V], the motor has to stop. But there is such a case that the motor slowly rotates.
- This is because of the phenomenon that the small amount of voltage offset by the host controller or external circuit. This function automatically adjusts such an offset voltage.

Operation Sequence

- Connect the host controller to the CN1 and the speed voltage command is made to 0 [V].
- At this time, if the motor is not rotating, it can be said that there is no offset voltage. However, if the motor is slowly rotating, there is an offset voltage occurring.
- Make automatic offset adjustment. The drive reads the voltage of adjustment as 0 [V] and stops the motor.

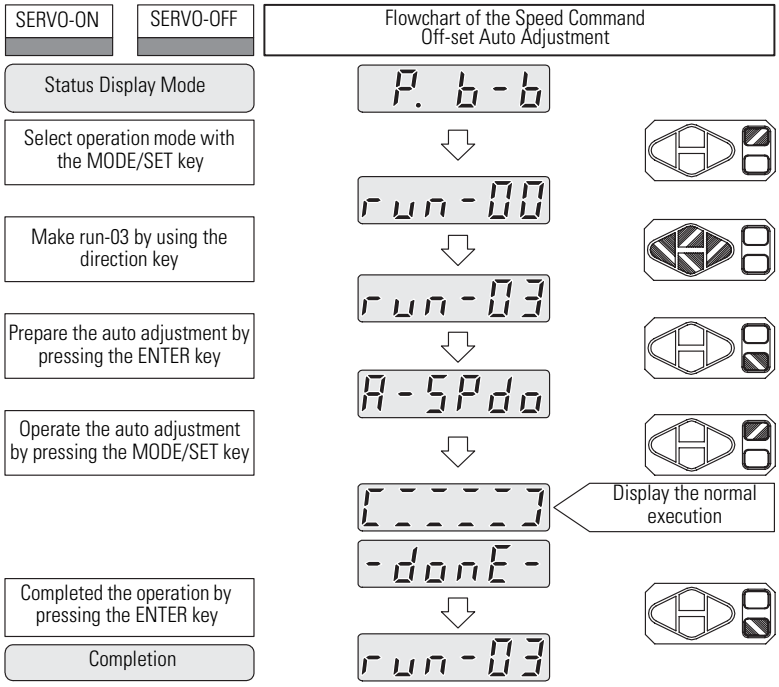
Other

- The voltage range that is possible for offset adjustment is –1 [V] to +1 [V]. The voltage exceeding the range cannot be adjusted, and there is no showing in the display during the normal operation in the below figure.

- The size of actually offset voltage can be confirmed in (dis-13) of The Chapter 7-50.
- Understand the speed zero-clamp function of speed mode of the Chapter 5-31 together.

How to Operate

Refer the below flow chart and operate.



Auto Adjustment of Torque Command Offset (run-04)

When the operation is made with torque control mode from the host controller or combination control mode related to torque, it is a function to automatically adjust with the offset voltage of the torque command.

Function Description

- When the analog torque voltage command is made to 0 [V], the motor has to stop. But there is such a case that the motor slowly rotates.
- This is because of the phenomenon that the small amount of voltage offset by the host controller or external circuit. This function automatically adjusts such an offset voltage.

Operation Sequence

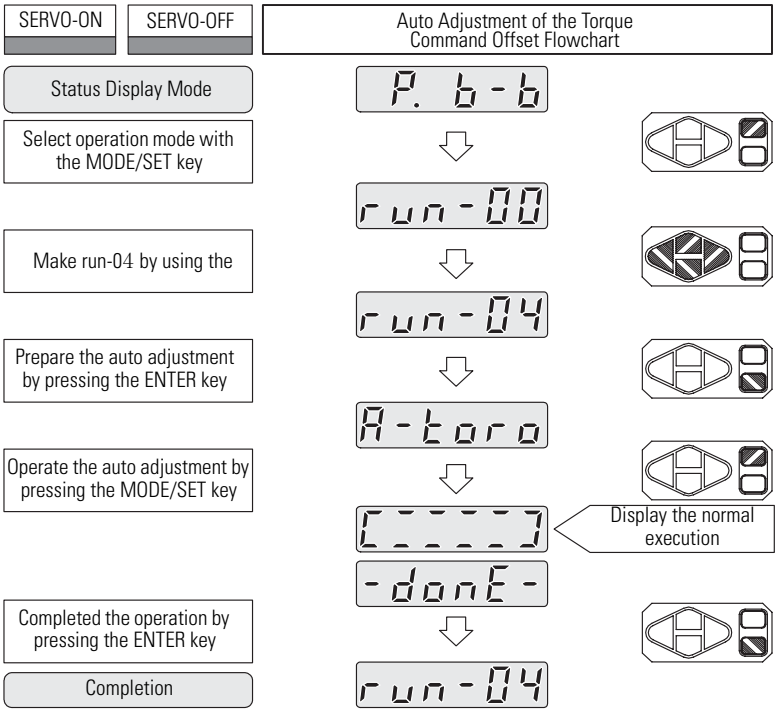
- Connect the host controller to the CN1 and the torque voltage command is made to 0 [V].
- At this time, if the motor is not rotating, it can be said that there is no offset voltage. However, if the motor is slowly rotating, there is an offset voltage occurring.
- Make offset automatic adjustment. The drive reads the voltage of adjustment as 0 [V] and stops the motor.

Other

- The voltage range that is possible for offset adjustment is –1 [V] to +1 [V]. The voltage exceeding the range cannot be adjusted, and there is no showing in the display during the normal operation in the below figure.
- The size of actually offset voltage can be confirmed in (dis-14) of the Chapter 7-50.

How to Operate

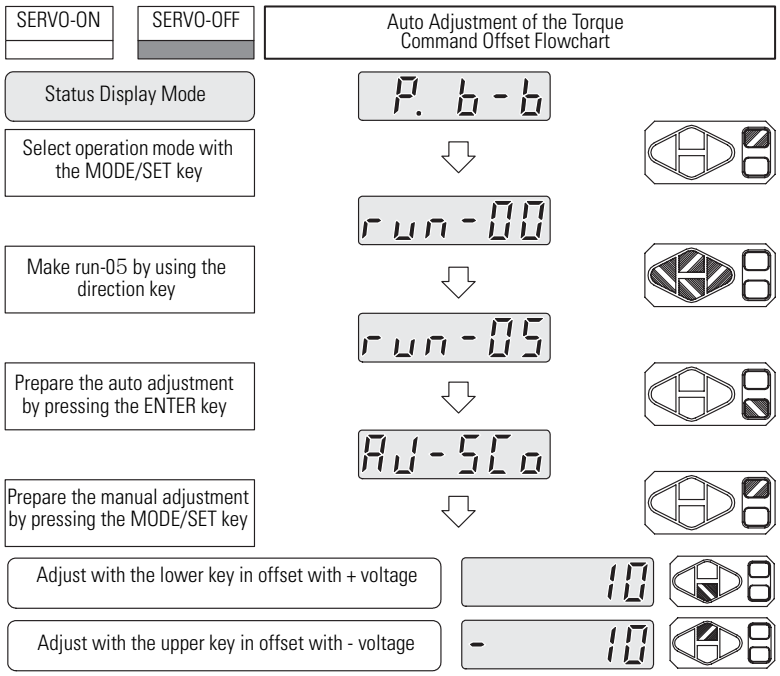
- Refer the below flow chart and operate.



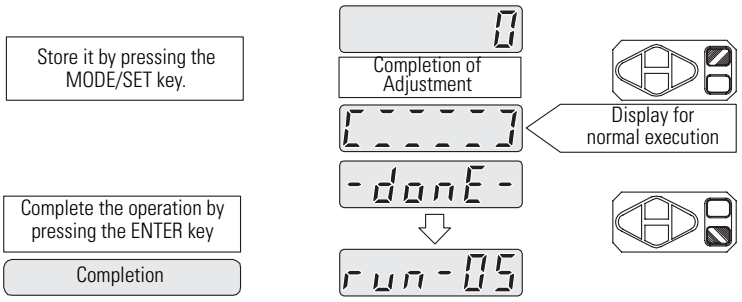
Manual Adjustment of Speed Command Offset (run-05)

First understand the content of Auto Adjustment of Speed Command Offset in the Chapter 7-38.

- It is same function with the automatic adjustment and can make more precise adjustment than the automatic adjustment of speed command offset.
- The below flowchart describes under the premises of voltage applicable to the speed of –10 [rpm] or +10 [rpm] is offset.



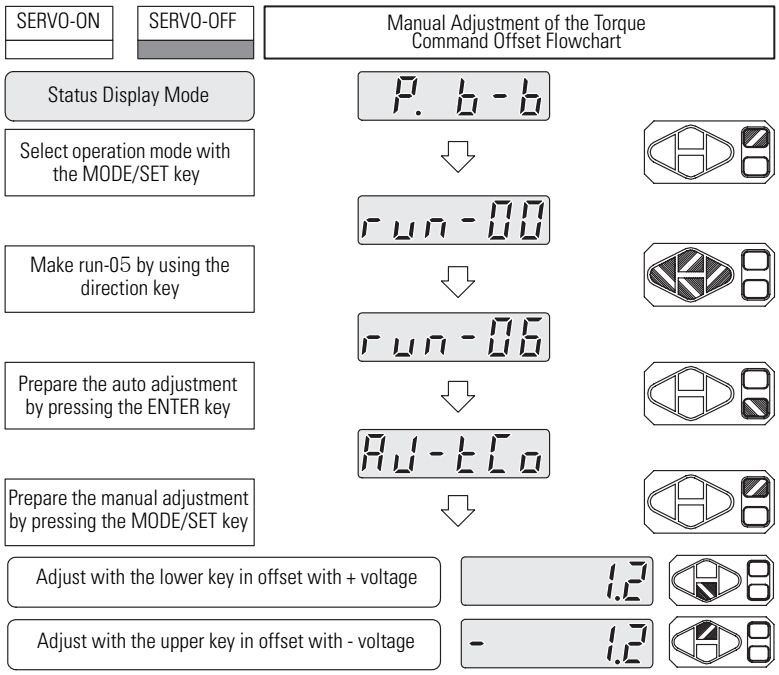
- If offset is being made, it shows the speed [rpm] applicable to offset voltage.
- Continue to press the direction key to slowly stop the motor with the speed nearing to 0 [rpm]. Once 0 [rpm] is reached, release the direction key to confirm that the motor has stopped.
- If the motor is still rotated slowly, confirm the motor completely stop by pressing the direction key one in a while. It is not to adjust one operation of direction key per 1 [rpm]. When the motor is completely stopped, it is progressed as below.



Manual Adjustment of Torque Command Offset (run-06)

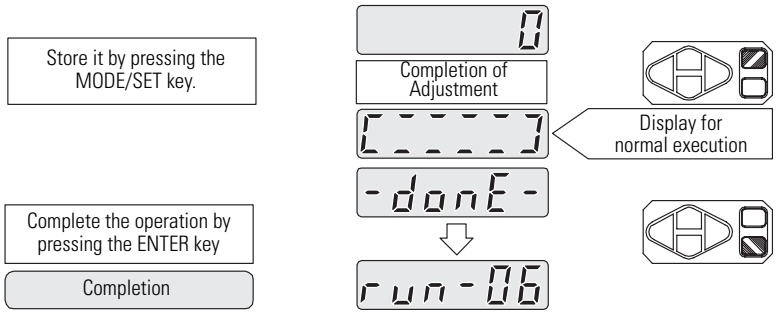
First, understand the content Auto Adjustment of Torque Command Offset in the Chapter 7-39.

- It is the same function with the automatic adjustment and can make more precise adjustment than the automatic adjustment of torque command offset.
- The below flowchart describes under the premises of offset voltage applicable to the torque of –1.2 [%] or +1.2 [%].



- If offset is being made, it shows the torque [%] applicable to offset voltage.
- Continue to press the direction key to slowly stop the motor with the torque nearing to 0 [%]. Once 0 [%] is reached, release the direction key to confirm that the motor has stopped.

- If the motor is still rotated slowly, confirm the motor completely stop by pressing the direction key one in a while. It is not to adjust one operation of direction key per 0.1 [%]. When the motor is completely stopped, it is progressed as below.



Adjustment of Current Feedback Offset (run-07)

The offset current that may occur when sensing the current flow on the motor is automatically adjusted.

Function Description

- Servo drive sense and control the current flowing on the motor. If the actual current flowing on the motor is not accurately sensed, the control may become difficult.
- Servo drive may automatically adjust the offset current that may occur in sensing the current flowing on the motor.

Precaution

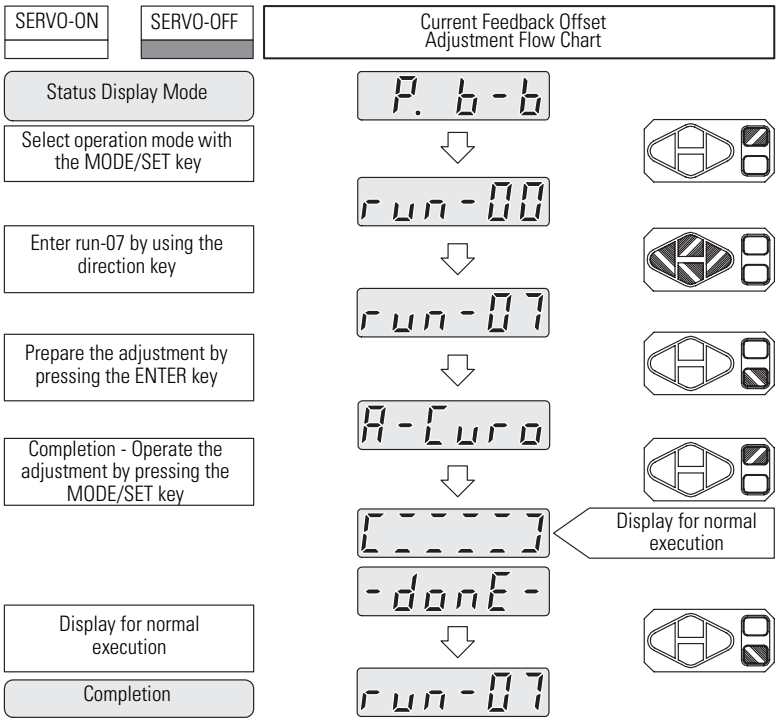
- Make sure to adjust it in servo-OFF status.
- Adjust only when it is determined to have a particularly significant occurrence of offset current than other drives.
- When the adjustment is not made correctly, perform the (run-12) of The Chapter 7-48. In this case, it is initialized with other parameters.

WARNING

- Motor Current Feedback Offset is already adjusted in shipment.
- It is possible to make small torque ripple and the improvement of control characteristics by the current offset adjustment, but the characteristics may be lowered if it is adjusted carelessly.
- Adjust only when there is particularly large current offset.
- Do not adjust if it is in vertical loading.

How to Operate

Refer to the below flow chart and operate.



Alarm Reset (run-08)

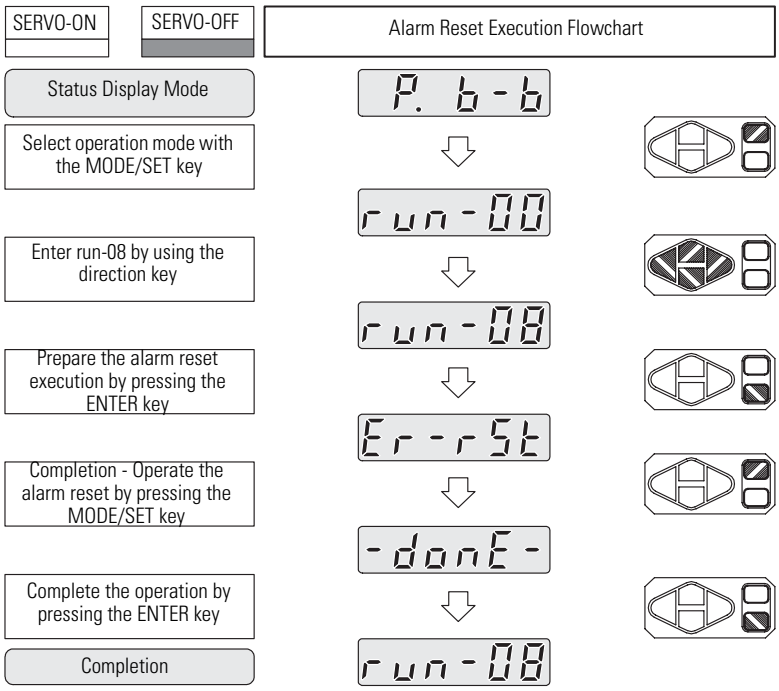
Servo drive may reset the servo alarm detected by the independent error diagnostic function.

Function Description

- The drive monitor the system with the independent error diagnosis function from the moment the power is connected. At this time, if there is an error in the servo drive, it displays the servo alarm.
- User has to understand the content of alarm and resolve the causes of alarm for a normal use of the drive.
- If an alarm occurs, find out the content of alarm and resolve it. After that, reset it through the alarm-reset operation. When the content of alarm is resolved with no further problems, the occurred alarm is no longer displayed.
- Even if the reset is made, if the action taken is not sufficient or other error occurs, the drive continuously displays the alarm content.

How to operate

Refer to the flow chart below and operate.



Alarm Reset by Sequence Input </A-RST> Signal

There is another way to reset the alarm by using the sequence input signal </A-RST>. Refer to The Chapter 5-2.

NOTE

- Chapter 8 describes the detailed content relating to servo alarm.
- Also, the history of alarm occurred from the beginning to this point can be inquired through the monitor mode. (Refer to The Chapter 7-50.)

Alarm History Clear (run-09)

Alarm History

Servo drive may store the servo alarm that is detected by the independent error diagnosis function.

- When servo alarm occurs, the monitor mode (dis-16) is automatically stored in the order of occurrence, and the user may confirm the alarm in the order of the alarm occurred from (dis-16).

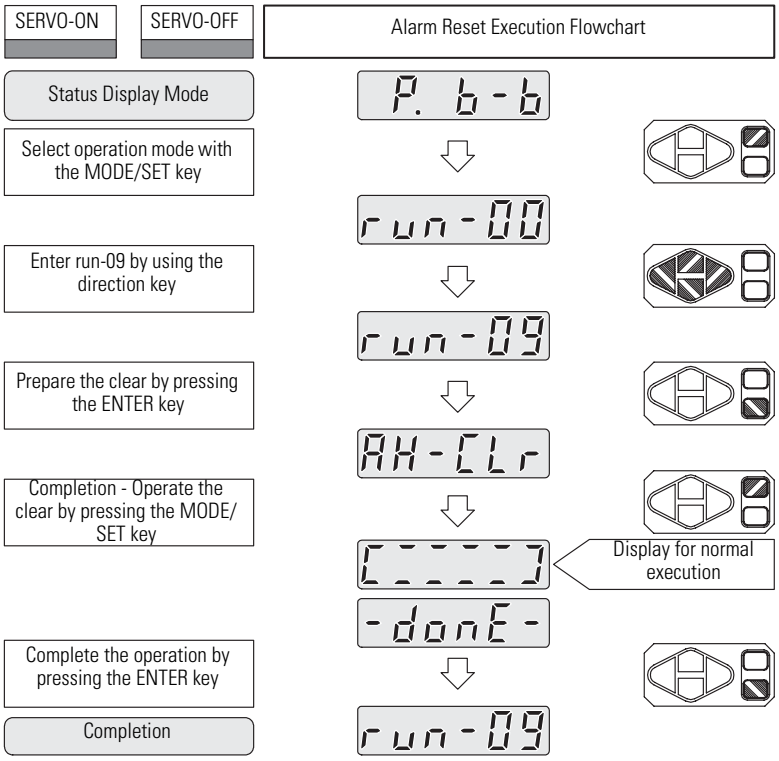
- Servo alarm can be stored up to 8, and the alarm occurring thereafter is stored by deleting the earliest occurring alarm from the 8 already stored alarm.

Alarm History Clear

All alarm stored on monitor mode (dis-16) is deleted.

How to Operate

Refer to the flow chart below and operate.



Absolute Encoder Reset (run-10)

- The reset of absolute encoder refers to the Chapter 7-27.

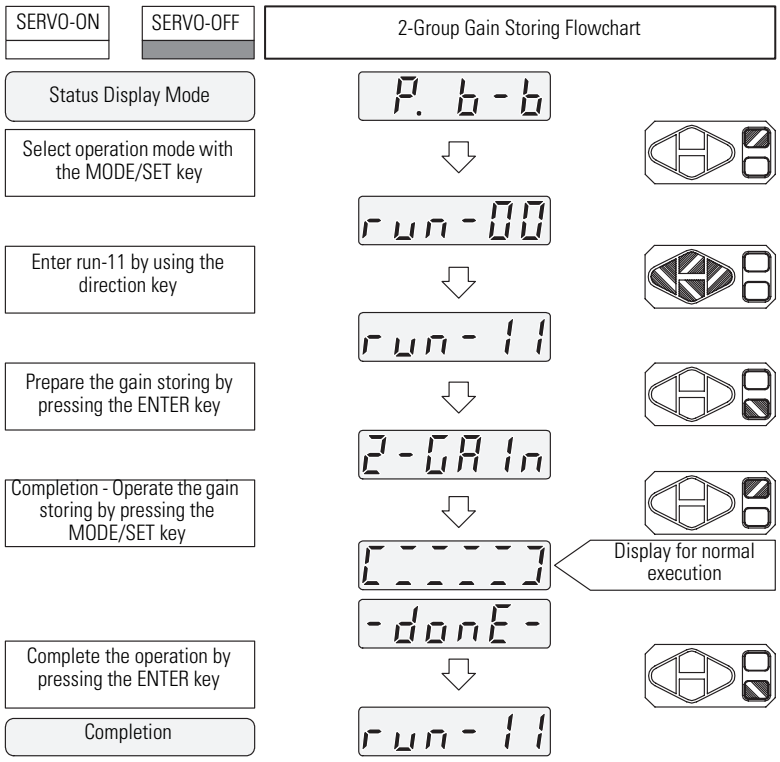
2-Group Gain Storing (run-11)

Function Description

- Understand the content of the Chapter 6-27 first.
- When the optimal tuning that is appropriate to the load system is made, it is stored.

How to Operate

- Refer to the flow chart below and operate.



NOTE

- When the </G-SEL> function of the Chapter 6-27 is not used, the main storage function is meaningless.
- Understand the content of the Chapter 6-27 before using it.

Parameter Initialization (run-12)

This function is to initialize the user parameter to the same status as the factory setting values.

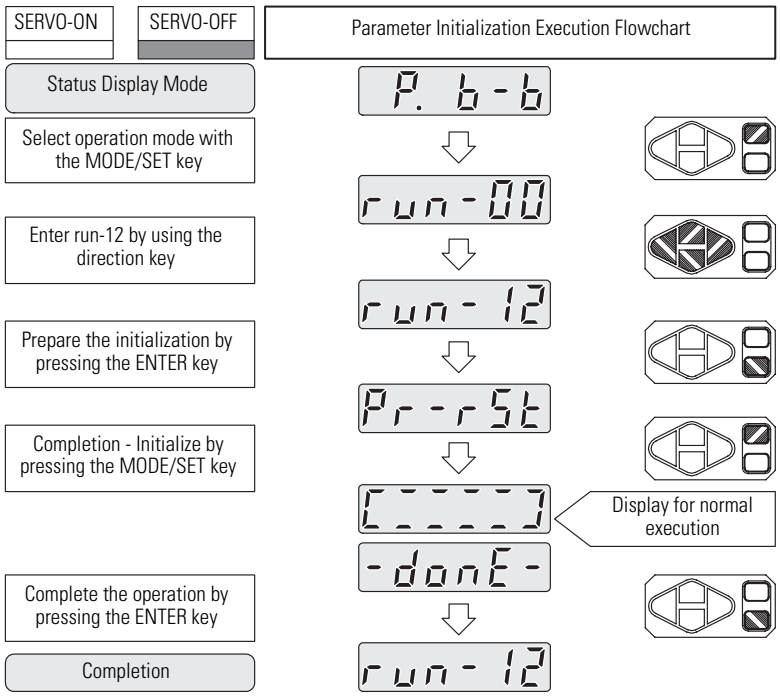
General Matter

- The initialization of parameter is operated carefully. After initializing parameter, the parameter has to be reset in meeting the load.
- The below parameter is still maintained after initializing parameter.

For changing the below parameter, directly change from the parameter.			
Pr-0.00	Control mode setting (optional)	Pr-0.05 to Pr-0.11	Sequence input & output signal
Pr-0.01	Motor setting	Pr-3.01 to Pr-3.04	Electronic gear and Pulse dividing circuit
Pr-0.04	Inertia ratio	Pr-4.01, Pr-4.02	Internal torque limit
		Pr-4.05	Rotation prohibition torque limit

How to Operate

Refer to the flow chart below and operate.



NOTE

- The portable operator that is provided for selective specification may store and keep all value set on the parameter of the current servo drive.
- In addition, it can be downloaded to other servo drive and use it quickly and conveniently.

Monitor Mode Function

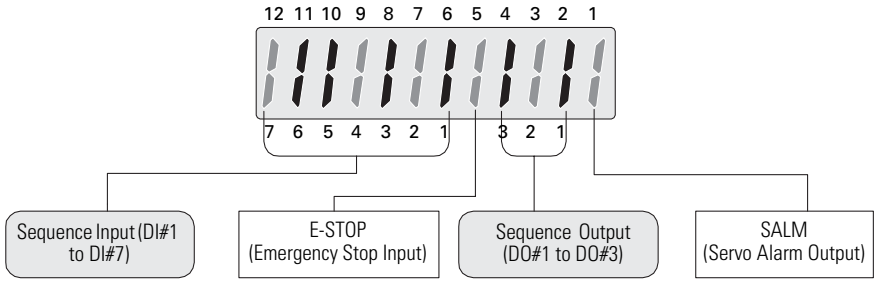
Introduction of Monitor Function

The below chart describes the function expressed in each monitor.

Monitor Mode Item	Name	Unit
	Speed feedback	[rpm]
	Speed command	[rpm]
	Speed error	[rpm]
	Torque command	[%]
	Position feedback	[pulse]
	Position command	[pulse]
The dis-04 and dis-05 are displayed each upper and lower digits (each 5 digits, total 10 digits) separately by left and right key in case of overflowing count data		
	Position error	[pulse]
	Position pulse command frequency	[kpps]
	Electrical angle	[û]
	Mechanical angle	[û]
	Regeneration accumulation loading rate	[%]
	DC Link Voltage	[V]
	Multi-rotation data of absolute encoder	-

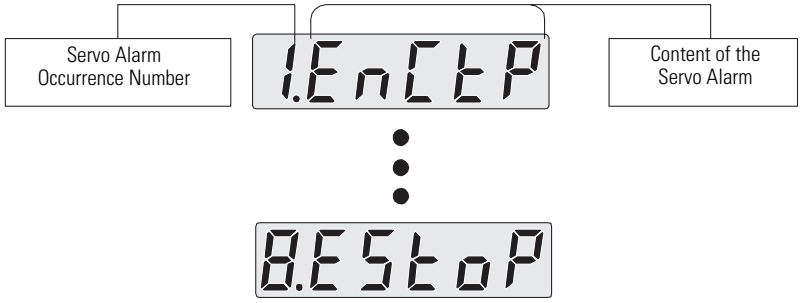
d15-13	Speed Command Offset	[mA]
d15-14	Torque Command Offset	[mV]
d15-15	Input & Output Signal Confirmation	

When the sequence input & output, emergency stop and servo alarm signal are on, the applicable displays of each position are lit.



d15-16	Up to 8 servo alarm is stored.

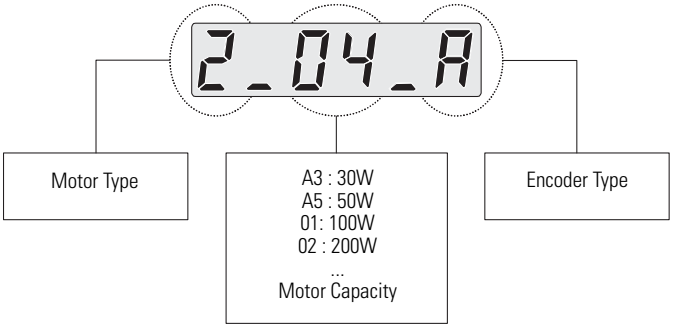
The alarm that occurs most recently is the number 1 servo alarm occurrence.
If all 8 alarms are stored, the alarm occurring thereafter is stored as number 1 with the earliest alarm (No. 8 alarm) is deleted.
Refer the Chapter 8-4 for the content of servo alarm.



d15-17	It displays the software version of servo drive.

Example of Version Display → UEr2.42

d15-18	Motor and Encoder Type



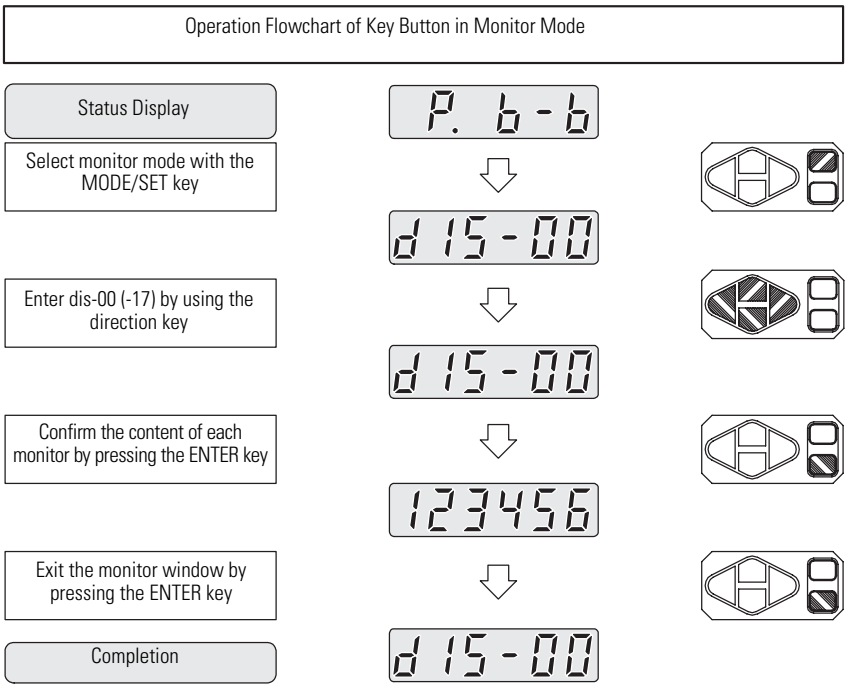
d15-19	Analog speed command voltage	V
d15-20	Analog torque command voltage	V
d15-21	Drive rated output	-
d15-22	Absolute encoder 1 rotation data	-
d15-23	Encoder Feedback Counter	pulse

When the number of digits increase, you can use left or right key to display the upper significant bits and low significant bits (5 digits each, total 10 digits)

Key Button Operation

It describes the key button operation of monitor mode.

- The content of monitor mode can be confirmed regardless of servo drive status.
- Refer to the below flow chart to confirm the content of each monitor item.
- Use the upper and lower direction key to confirm the alarm history (dis-16)


Operation Flowchart of Key Button in Monitor Mode
Status Display
P. b-b
Select monitor mode with the MODE/SET key
d15-00
Enter dis-00 (-17) by using the direction key
d15-00
Confirm the content of each monitor by pressing the ENTER key
123456
Exit the monitor window by pressing the ENTER key
d15-00
Completion

Inspection and Protection Functions

Introduction

In this chapter, the inspection and the protective function of servo drive are described.

Inspection

It describes the basic inspection, abnormality diagnosis and how to take action of servo motor and drive. Also, it describes the protection function of drive and action to take in times of alarm occurs as well as any action to take in times of breakdown following the alarm code.

Inspection of Motor

Motor does not have a brush that causes mechanically abrasive part. A simple inspection is sufficient as follow. By considering the use environment, determine the appropriate inspection time.

Item	Period	Inspection and Repair	Action
Vibration and Noise	Daily Check	Determine with Sense and Hearing	It shall not be larger than normal times
Presence of Eternal Foreign Substance	In Occurrence	Cleaning with Vacuum Cleaner	
Insulation Resistance	1 year	Measure with Insulation resistance meter 500 [V] 10 [MW]	Inquiry to the company if the measuring value is 10 [MΩ] or less
OIL SEAL	5000 hours	Oil Seal Replacement	Only for motor that has oil seal
Overall Inspection	20000 hours (5 years)	Inquiry to the Company	Disassembly and worn-out part replacement
In the event of disassemble the servo motor for repair or inspection, a care shall be taken for A/S not available.			

Inspection of Drive

Servo drive is equipped with electronic circuit. The dust and foreign substance may cause the breakdown or malfunction that the dust shall be cleaned and tighten the nuts on a regular basis (1-year).

Item	Inspection Period	Inspection and Repair	Action
Cleaning of Main Body and Board	Once or more per year	Do not have dust or oil	Clean with compressed air or fabric
Socket, Connector, Nut	Once or more per year	Do not allow loosening of socket, connector, nut and others	Do not allow loosening
Abnormal Part on Main Body and Board	Once or more per year	There is no discoloration by heat, damage or open circuit	Inquiry to the company
In the event of disassemble for repair and inspection the servo drive, be careful that the A/S is not available.			

Part Inspection

The part below may have mechanical abrasion or material degradation. A regular inspection is needed for prevention and preservation.

Part	Use Period	Use Requirement
Capacitor	3-year	Ambient temperature: Annual average of 30 degree Load rate: less than 80 [%] Operation rate: less than 20 hours /day
Cable	3-year (based on flexible cable)	
Power Device	3-year	
Regeneration Resistor	2-year	
DB Resistor	2-year	
FAN	2-year	
Cooling Fan	4 to 5 year	
Fuse	10-year	

Battery Inspection for absolute Encoder (7.9.3)

Refer to Chpater 7-28 for absolute encoder battery.

Protection Function

It describes the equipped protection function and actions taken in times of abnormal operation in order to protect the servo drive and load system. The protection function is classified into two types depending on the importance.

1. Servo warning: It displays a minimal abnormality that does not require the suspension of operation when occurred.
2. Servo alarm: It displays the very serious abnormality that requires the suspension of operation when occurred.

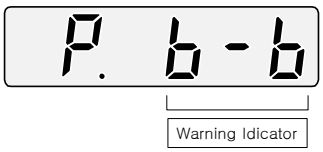
   - It is classified depending on the importance, but when an abnormality occurs, remove the cause immediately and use the servo drive in normal condition.

Servo Warning

There is a servo warning that displays a minimal abnormality as the protection function by the self-diagnosis.

1. Servo warning indication

   - It displays the mark that is applicable to a warning through the Status Display Mode.

Status Display Mode	Description
	The warning is displayed on the 3 digit of 7-segment as shown on the left. The character displayed the normal operation status does not flicker, but once the abnormality applicable for servo warning is sensed, the applicable character is displayed and flickers.

2. Servo warning types

   - Servo drive displays the warning characters for the following 6 situations.

Indicator		External Battery Low Voltage of Absolute Encoder
Cause	It occurs when the voltage of external battery of absolute encoder is 3.2 [V] or less.	
Action	Understand the content of Chpater 7-27 and replace the battery.	

Indicator		Absolute Encoder Counter Overflow
Cause	In the event the Q, E Type Absolute Encoder is rotated forward or reverse over 32768 (H, J Type Absolute Encoder is for 4096) revolution, it is displayed.	
Action	Refer to Chpater 7-27 and reset the Absolute Encoder.	

Indicator		Abnormal Initial Status of Absolute Encoder
Cause	There may be a time of motor rotating for over 100[RPM] when main power is ON.	
Action	It only occurs in the event of Absolute Encoder serial of Q, E Type. And when the resolution of 1 rotation data is 17bit, it automatically disassembled.	

Indicator		Over (external) Torque Command
Cause	When the external torque command is inputted with 300 [%] or more of the rated value, it is displayed.	
Action	When the torque command is inputted for 300 [%] or more of the rated value, the drive is automatically limited at 300 [%]. Also, when lowering the external torque command to 300 [%] or less of the rated value, it automatically disassembled.	

Display		Over (external) Speed Command
Cause	When the external speed command is inputted with the maximum speed or more of the motor, it is displayed.	
Action	When the speed command is inputted with the maximum speed or more of the motor, the drive is automatically limited at the maximum speed of motor. Also, when the external speed command is lowered for less than the maximum speed or less of the motor, it automatically disassembled.	

Indicator		Allocation Error of Sequence Input and Output
Cause	When sequence input & output signal is duplicated and allotted to the same input and output channel. In mixed control mode, when the control mode conversion </C-SEL> sequence input signal is not allotted. In multi-step control mode, when speed command </C-DIR>,</C-SP1>, </C-SP2>, </C-SP3> sequence input signal is not allotted, it is displayed.	
Action	Resetting it by referring Clause 5.1 of sequence input & output signal. After resetting, it is effective only when the power is re-allowed.	

Indicator		Over Motor Capacity
Cause	It occurs when motor power is set higher than the drive rated output.	
Action	Use a motor suitable to the drive or set the torque limit below the drive capacity.	

In times of servo warning, sequence output signal. </WARN>

- When the servo warning occurs, the servo drive may display that the servo warning occurs by the host controller through the sequence output signal </WARN> function.
- Warning detection </WARN> is sequence output signal. For </WARN> signal is to be outputted, first refer to the sequence input & output signal of Chpater 5-2 and allot the signal.

- Warning detection </WARN> is outputted by the output signal allotment and when the presence of servo warning from the host controller is not wanted, it does not allotted.

NOTE Servo warning can be conveyed to the host controller for the presence of servo warning through the sequence output channel.

Servo Alarm

For protection function by the self-diagnosis, there is the servo alarm that displays the important errors.

Servo alarm Indicator

- When servo alarm occurs, the 7-segment indicator displays the character applicable to the servo alarm and stops the operation regardless of current indication condition.
- Even when servo alarm occurs during the user setting and operating the key button by the user, the drive displays the content of alarm immediately.
- The alarm indicator character is flickering like the Servo warning.

Servo alarm storing and confirmation

- Servo drive may store the maximum of 8 alarm contents in the order of occurrence of servo alarm. Also, the stored alarm can be confirmed through the monitor mode (dis-16) of Chpater 7-50 and clear the stored alarm by using the operation mode (run-09) of Clause Chpater 7-45.

Servo alarm types

- Servo drive displays the alarm in the 34 situations below.

Indicator		Defective Internal Circuit of Servo Drive
Cause	When having a defect in a internal part of servo drive or circuit, it is displayed.	
Action	Replaced the product and inquire to the company.	

Indicator		Defective Power Circuit
Cause1	When it occurs at the time of inputting power, there is an error in control and main power circuit.	
Action1	Confirm the presence of wiring and power and inquire to the company if normal.	
Cause2	If it occurs during the operation, it is displayed if the over current occurs in the motor or the internal temperature of device for motor drive is increased for over the permitted temperature.	
Action2	Confirm the presence of error in the power and adjust the acceleration or deceleration time.	

Indicator		Over Current
Cause1	If it occurs when the power is ON, there is an error in the control and main power circuit.	
Action1	Confirm the presence of error in wiring and power, and inquire to the company if normal.	
Cause2	If it occurs during the operation, it is made when the rapid over current was flown on the motor. (when the current of 300[%] or more of rated current is flown to the motor for 2[ms] or more)	
Action2	Confirm the presence of error in the power, and adjust the acceleration or deceleration time.	

Indicator		Regenerative Over Current
Cause	It occurs when the over current is flown to the regeneration resistor due to the error in regenerative transistor and regeneration resistor.	
Action	Replace the servo drive or regeneration resistor.	

Indicator		Current Feedback Offset Error
Cause	In the event that current feedback offset adjustment (run-07) is made, it occurs when the offset current is ±5 [%] or more of rated current.	
Action	Confirm the motor condition and inquire to the company if it continues to occur.	

NOTE

- Current feedback offset adjustment is already made at the company in time of delivery.
- Adjust it only when the current offset is particularly large. Particularly, in the case of vertical load, do not adjust.

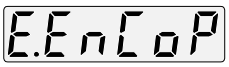
Indicator	E.CAbLE	Motor Power Cable Short (U, V, W)
Cause	It occurs when the motor cable is short-circuited.	
Action	Confirm the motor cable wiring.	

Indicator	E.InSoL	Torque Feedback Instantaneous Overload
Cause	It occurs when the torque feedback is operated at the maximum torque of 0.5 [sec] or more. (Wiring error), (excessive inertia of load), (error in setting rated output of motor)	
Action	Confirm the wiring of motor cable. Confirm the load condition and adjust the acceleration and deceleration time. Confirm motor setting value by referring Chpater 4-6.	

Indicator	E.ConoL	Torque Feedback Continuous Overload
Cause	It occurs when the torque feedback is continuously operated for rated torque several to several tens [sec] or more at the rated torque or more.	
Action	Confirm the motor cable wiring. Confirm the loading condition and adjust the acceleration and deceleration time. Confirm motor setting value by referring Chpater 4-6.	

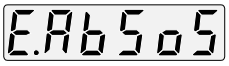
Indicator	E.rEGoL	Regenerative Overload
Cause	It occurs when the regenerative power of regeneration resistor is exceeded the permitted value.	
Action	Replace the regeneration resistor that is appropriate with the capacity of regenerative power. Adjust it to fit with regeneration resistor capacity setting parameter [Pr-5.11].	
Indicator	E.oHEAt	Heat Sink Overheat
Cause	It occurs when the heat sink temperature of servo drive exceeds approximately 95 ±10[°C] at 55[°C] or higher ambient temperature. It occurs when the cooling fan is not operated.	
Action	Ambient temperature of servo drive less than 55[°C] or lower. Refer to the installation of Chapter 2 to comply with the user environment.	

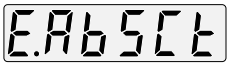
Indicator	E.EnCtP	Encoder Type Mismatching
Cause	It occurs when the encoder setting of motor setting [Pr-0.01] is wrong.	
Action	Reset the encoder by confirming the model name of the motor nameplate.	

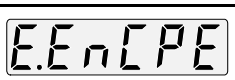
Indicator		Encoder Cable Open
Cause	It occurs when the encoder cable is short-circuited or the power is not supplied to the encoder.	
Action	Confirm the wiring of encoder.	

Indicator		Absolute Encoder Communication Error
Cause	It occurs when there is a communication error in the servo drive and absolute encoder.	
Action	Replace the motor when the wiring of encoder is confirmed and found no error.	

Indicator		Absolute Encoder Low Voltage Error
Cause	It occurs when the internal recharging capacitor voltage of absolute encoder is 2.7 [V] or less. It occurs when the battery for absolute encoder has defective connection or not connected.	
Action	Confirm the connection of battery. Replace the battery and refer to the Chpater 7-44 to reset the alarm.	

Indicator		Over Speed During Blackout of Absolute Encoder
Cause	It may occur with the motor rotates in high speed when the main power of servo drive is disconnected while normally operating and the encoder is operated with external battery.	
Action	Turn off/on power or reset the alarm.	

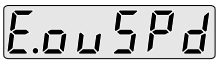
Indicator		Multiple Rotation Data Error of Absolute Encoder
Cause	It occurs if the number of rotation data is changed when main power of the servo drive is ON.	
Action	Turn off/on power or reset the alarm.	
Indicator		1-time Rotation Data Error of Absolute Encoder
Cause	It occurs if 1-time rotation data is changed when main power of the servo drive is ON.	
Action	Turn off/on power or reset the alarm.	

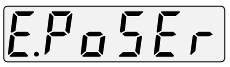
Indicator		Serial Absolute Encoder Parameter Error
Cause	EEPROM data error of absolute encoder.	
Action	Inquiry to the company.	

Indicator		Over Voltage
Cause	When the input voltage exceeds the rated voltage scope, when the regeneration resistor is short-circuited When the transistor for regeneration is in error, when operation is made for over the regenerative capacity	
Action	Use rated voltage, replacing the regeneration resistor, replacing the servo drive Confirm whether the inertia of load is excessive.	

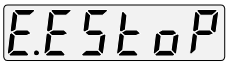
Indicator		Under Voltage
Cause	It occurs when the main input voltage is not within the scope of rated value.	
Action	Confirm the input voltage.	

Indicator		Instantaneous Blackout Error
Cause	It occurs when the main power is disconnected or lowered due to the instantaneous power failure.	
Action	Confirm the power or main circuit wiring (noise filter, magnetic contactor). Adjust the instantaneous power failure maintenance time set [Pr-5.10].	

Indicator		Over Speed
Cause	It occurs when the motor is rotated with a speed exceeding the maximum speed.	
Action	Confirm the wiring condition of encoder motor cable. Confirm whether there is any problem in tuning. Confirm whether there is any problem in external speed (torque) command input gain [Pr-2.00], [Pr-4.00].	

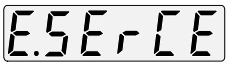
Indicator		Position Error Overflow
Cause	It occurs when the position error is exceeding the permitted error for position when controlling the position [Pr-5.09].	
Action	Confirm the pulse input wiring of host controller. Confirm whether the pulse input frequency is excessive or not. Reset the gain by referring Chapter 6. Confirm whether the inertia of load is excessive.	

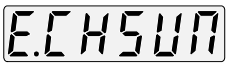
Indicator		Over Position Pulse Command
Cause	It occurs when the input pulse command frequency of host controller is high.	
Action	Confirm the types and frequency of input pulse. Line drive: 900[kpps] or less. Open collector: 200[kpps] or less	

Indicator		Emergency-Stop
Cause	It occurs when the emergency-stop signal is inputted from the external.	
Action	Resolve the emergency stop situation and release the emergency-stop input.	

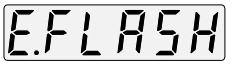
Indicator		CPU Fault Error
Cause	CPU error	
Action	Replace the servo drive in frequency occurrence and inquiry to the company.	

Indicator		Motor Out of Control Status
Cause	It occurs when the motor is impossible to control or the operation of encoder is defective.	
Action	Confirm the wiring of motor and encoder and replace the motor.	

Indicator		Serial Communication Error
Cause	It occurs when there is an error in between the portable operator and servo drive that is caused by the noise or connection cable error.	
Action	Connection without the noise environment and condition of connection cable.	

Indicator		Parameter Checksum Error
Cause	It occurs when there is an error in the memory that stores the user parameter.	
Action	Confirm and reset the recently set parameter and the rest shall be backed up. If frequently occurring, refer the Chpater 7-48 to return to the initial value for parameter.	

Indicator		Data Setting Range Error
Cause	It occurs when the setting value that exceeds the setting scope of parameter is inputted.	
Action	Set the parameter within the value of setting scope. Refer to Chpater 7-48 and return to the initial value of the parameter.	

Indicator		Flash Rom Error
Cause	It occurs when there is an error in the memory that stores the parameter.	
Action	Initialize the parameter by referring to Chpater 7-48. Replace the servo drive in the event of frequent occurrence.	

Indicator	E.UndEF	Servo Drive Capacity Undefined
Cause	It occurs when the rated output volume (capacity) of servo drive is wrongly set.	
Action	Inquiry to the company.	

Indicator	E.SEtuP	Setting error of motor encoder
Cause	It occurs when a wrong motor is connected to the servo drive.	
Action	Check motor.	

Signal Output in Servo Alarm

Once the servo alarm occurs, the presence of alarm occurrence and types of alarm can be outputted through the output pin of CN1. The presence of alarm occurrence is outputted with host controller through the No. 45 and No. 46 pins (SALM +/-) of CN1. Also, through the No. 37 to 39 (AL1 to AL3) pins, each of the alarm occurrence types can be outputted with host controller.

CN1 Output	Description
SALM +/-	Output is made when the alarm occurs regardless of the types of alarm.
AL1~AL3	Make the numbers of 7 types with the 3 output pins and it is classified to output by collecting the similar types of alarm in each of the cases.
The presence of servo alarm occurrence can be confirmed through the monitor mode (dis-15) of Chpater 7-50.	

The following chart shows the output of alarm group.

Alarm Group	Indicator	Alarm Name	SLAM Output	Alarm Code Output		
				AL1	AL2	AL3
1	E.Short	Defective Internal Circuit of Servo Drive	0	1	0	0
	E.IPMFt	Defective Power Circuit	0			
	E.OvCUr	Over Current	0			
	E.rEGOC	Regenerative Over Current	0			
	E.oFSEt	Current Feedback Offset Error	0			
2	E.CabLE	Motor Power Cable Open (U, V, W)	0	0	1	0
	E.InsOL	Torque Feedback Instantaneous Overload	0			
	E.ConOL	Torque Feedback Continuous Overload	0			
	E.rEGOL	Regeneration Overload	0			
	E.OHEAt	Heat Sink Overheat	0			

3	E.EnCtP	Encoder Type Mismatching	0	1	1	0
	E.EnCoP	Encoder Cable Open	0			
	E.AbSCE	Absolute Encoder Communication Error	0			
	E.AbSbE	Absolute Encoder Low Voltage Error	0			
	E.AbSOS	Over Speed During Blackout of Absolute Encoder	0			
	E.AbSMT	Multiple Rotation Data Error of ABS. Encoder	0			
	E.EnCPE	Serial Absolute Encoder Parameter Error	0			

4	E.OvvtG	Over Voltage	0	0	0	1
	E.UdvtG	Under Voltage	0			
	E.AcoFF	Instantaneous Blackout Error	0			

5	E.OvSPd	Over Speed	0	1	0	1
	E.PoSEr	Position Error Over Flow	0			
	E.OvPUL	Over Position Pulse Command	0			
	E.EstoP	Emergency-Stop	0			
	E.CPUFt	CPU Fault Error	0			
	E.SPDER	Over Speed Error	0			

6	E.SERCE	Serial Communication Error	0	0	1	1
	E.CHSUM	Parameter Checksum Error	0			
	E.RANGE	Data Setting Range Error	0			
	E.FLASH	Flash ROM Error	0			

7	E.UndEF	Servo Drive Capacity Undefined	0	1	1	1
	E.SetUP	Setup Error (of Mismatching Encoders with Motors)	0			

Confirmation before Requesting for A/S

In the event an error occurs in servo alarm that is not displayed, it describes the cause and action.

- If the main circuit power is allowed in a cause investigation, it is dangerous. After the power shall be disconnected to completely turn out the discharge-confirming lamp, take action on it. In the event the error is not resolved after taking an action, promptly request for A/S to the company.

- The chart below shows the diagnosis on errors when the alarm does not occur.

Errors	Cause	Inspection and Action
The motor does not run.	The power is not inputted.	Make correction after confirming the power wiring.
	Motor and encoder wiring is erroneously made.	Make corrections after confirming the wiring
	External command and position command is not inputted.	Confirm the wiring of input terminal and input it correctly.
	Servo-ON is not made.	The allotted parameter of sequence input signal (Pr-5.11) shall be confirmed for setting
	The selection of command pulse is wrong	Refer to Chapter 3.5 'Position Control' and correctly set it.
	Over trouble input is turned off.	P-OT, N-OT input signal is made to ON.
	It is in overload condition.	Release the overload condition and operate it.
	Servo alarm occurs.	Remove the cause for alarm and implement the alarm reset then re-start it.
Motor vibrates or has large overshoot in accelerating or decelerating.	The speed loop integration gain of servo is too high.	Lower the system gain [Pr-1.00]. Heighten the speed loop integration gain [Pr-1.02].
The motor rotates at the speed command '0'.	The speed command offset adjustment is erroneously made.	In put '0' to the speed command and redo the offset adjustment.
The encoder type setting error or encoder circuit alarm occurs.	The setting of motor and encoder is erroneous.	Confirm the motor setting parameter [Pr-0.01], then set it correctly.
	Motor and encoder wiring is erroneous.	Refer to the wiring in Chapter 3 and make a correction.
Strange noise is made.	Mechanical installation condition is bad.	Confirm the installation condition (coupling, nut tightening) and adjust.
Motor or drive is overheated.	The ambient temperature is high.	Lower the ambient temperature. (under 50°C)
	It is in overloaded condition.	Release the overload condition and operate it.

Parameter List

Introduction

In this chapter, the inspection and the protective function of servo drive are described.

Parameter List

Summary of Parameters

Parameter Group 0				
Parameter type	**Name**	**LED No.**	**Set range**	**Initial value**
Pr-0.00	Configure control mode	-	C,t,S,P	---P
Pr-0.01	Configure motor	-	-	-
Pr-0.02	Select method of DB halt	1	0~3	0
	Select method of over travel halt	2	0,1	0
	Select direction of rotation	3	0,1	0
	Select main power input	4	0,1	0
Pr-0.03	Autotuning mode	1	0.1	0
	Offline tuning speed	3	2~9	7
	Online tuning coefficient	4	0~9	0
Pr-0.04	Inertia ratio		0.00~60.00	1.00
Pr-0.05 Assign sequence input signals	/SV-ON	1	0~8	1
	P-OT	2	0~8	8
	N-OT	3	0~8	8
	/P-CON	4	0~8	4
Pr-0.06 Assign sequence input signals	/A-RST	1	0~8	5
	/N-TL	2	0~8	6
	/P-TL	3	0~8	7
	/C-SEL	4	0~8	0
Pr-0.07 Assign sequence input signals	/C-DIR	1	0~8	0
	/C-SP1	2	0~8	0
	/C-SP2	3	0~8	0
	/C-SP3	4	0~8	0

Parameter Group 0				
Parameter type	**Name**	**LED No.**	**Set range**	**Initial value**
Pr-0.08 Assign sequence input signal	/Z-CLP	1	0~8	0
	/INHIB	2	0~8	0
	/G-SEL	3	0~8	0
	Reserved	4	0~8	0

Pr-0.09 Assign sequence input signal	/ABS-DT	1	0~8	0
	/START	2	0~8	0
	/C-SP4	3	0~8	0
	/GEAR	4	0~8	0
Pr-0.10 Assign sequence output signal	/P-COM	1	0~3	1
	/TG-ON	2	0~3	2
	/BK	3	0~3	3
	/V-COM	4	0~3	0
Pr-0.11 Assign sequence output signal	/T-LMT	1	0~3	0
	/V-LMT	2	0~3	0
	/NEAR	3	0~3	0
	/WARN	4	0~3	0
Pr-0.12	Servo ID	-	1~255	1
Pr-0.13	Password	-	-	-
Pr-0.14	RS-232C communication speed	1	1~6	6
	RS-485 communication speed	2	1~6	2
	Data format	3	1~6	1
	Protocol	4	0,1	0

Parameter Group 1

Parameter type	Name	LED No.	Set range	Initial value
Pr-1.00	System gain	-	0~500	50
Pr-1.01	Speed loop proportional gain	-	0~10000	100
Pr-1.02	Speed loop integral gain	-	0~60000	100
Pr-1.03	Position loop proportional gain	-	0~700	20
Pr-1.04	Torque command filter	-	0~10000	1000
Pr-1.05	Speed command filter	-	0~10000	1000
Pr-1.06	Position command filter	-	0~60000	0
Pr-1.07	Vibration blocking filter	-	0~10000	10000
Pr-1.08	Position FF gain	-	0~100	0
Pr-1.09	Position FF filter	-	0~2500	200

Pr - 1.10	P control transition sqitch	-	0~3	1
Pr - 1.11	P control transition reference value	-	0~3000	100
Pr - 1.12	Speed bias amount	-	0~450	0
Pr - 1.13	Speed bias reference width	-	0~250	10
Pr - 1.14	Current Controller Bandwidth	-	0~2	1
Pr - 1.15	Velocity Response Level	-	0~150	50

Parameter Group 2

Parameter type	Name	LED No.	Set range	Initial value
Pr - 2.00	External speed command input gain	-	10.0~2000.0	500.0
Pr - 2.01	Jog operation speed	-	0~5000	500
Pr - 2.02	Acceleration time	-	0~60000	0
Pr - 2.03	Deceleration time	-	0~60000	0
Pr - 2.04	S-operation time	-	0~5000	0
Pr - 2.05	Contact speed command 1	-	-5000~5000	100
Pr - 2.06	Contact speed command 2	-	-5000~5000	200
Pr - 2.07	Contact speed command 3	-	-5000~5000	300
Pr - 2.08	Contact speed command 4	-	-5000~5000	400
Pr - 2.09	Contact speed command 5	-	-5000~5000	500
Pr - 2.10	Contact speed command 6	-	-5000~5000	600
Pr - 2.11	Contact speed command 7	-	-5000~5000	700
Pr - 2.12	Limit speed	-	1~5000	5000
Pr - 2.13	Select limit speed	-	0~3	0

Parameter Group 3

Parameter type	Name	LED No.	Set range	Initial value
Pr - 3.00	Position command pulse type	1	0~6	0
	Position command pulse type	2	0,1	0
	Encoder output pulse direction	3	0,1	0
	PCLR input selection	4	0~3	1
Pr - 3.01	Electronic gear (numerator)	-	1~65535	encoder pulse numbers
Pr - 3.02	Electronic gear (denominator)	-	1~65535	encoder pulse numbers
Pr - 3.03	Position output pulse adjustment (numerator)	-	1~65535	2048
Pr - 3.04	Position output pulse adjustment (denominator)	-	1~65535	2048
Pr - 3.05	2nd Electronic gear (numerator)	-	1~65535	32768
Pr - 3.06	2nd Electronic gear (denominator)	-	1~65535	32768

Parameter Group 4

Parameter type	Name	LED No.	Set range	Initial value
Pr - 4.00	External torque command input gain	-	0.0~100.0	33.3
Pr - 4.01	Forward torque limit	-	0~300	300
Pr - 4.02	Reverse torque limit	-	0~300	300
Pr - 4.03	Forward torque external limit	-	0~300	100
Pr - 4.04	Reverse torque external limit	-	0~300	100
Pr - 4.05	Rotation inhibit torque limit	-	0~3000	300
Pr - 4.06	Initial torque bias	-	-100~100	0

Parameter Group 5

Parameter type	Name	LED No.	Set range	Initial value
Pr - 5.00	Position completion determinaion width	-	0~250	10

Pr-5.01	Position approximation determination width	-	0~250	20
Pr-5.02	Speed match determination width	-	0~1000	10
Pr-5.03	Rotation detection level	-	1~5000	20
Pr-5.04	Speed zero clamp level	-	0~5000	0
Pr-5.05	Break release wait time	-	0~1000	0
Pr-5.06	Servo OFF delay time	-	0~1000	0
Pr-5.07	Break operation wait time	-	0~1000	50
Pr-5.08	Break operation start speed	-	0~1000	100
Pr-5.09	Allowed margin of position error	-	0~65535	20480
Pr-5.10	Instantaneous power failure allow time	-	20~1000	20
Pr-5.11	Recovery resistor capacity	-	0~1500	-
Pr-5.12	DA monitor output CH1 configuration	-	-	0-0500
Pr-5.13	DA monitor output CH2 configuration	-	-	3-0500
Pr-5.14	Select use of battery when using serial absolute value type encoder	1	0,1	0
	Select use of speed monitor	2	0,1	0
	Select use of excessive speed error detection function	3	0,1	0

Parameter Group 0

Parameter Group 0	System related parameters [Pr-0.00] to [Pr-0.13]
Pr-0.00	Configure control mode

- Configure by selecting the control mode to be used.
- Use the up/down/left/right arrow keys,to set up the control mode according to the table below.
- Under group control mode, the sequence input signal </C-SEL> is assigned and the </C-SEL>signal is applied through the assigned input channel. The control mode is changed upon ON/OFF of signal.

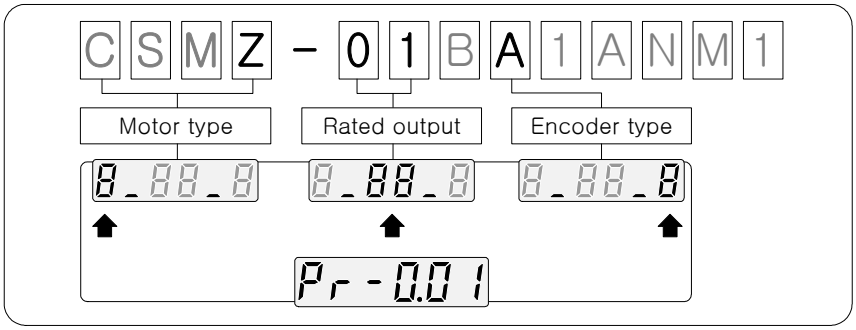
Basic control mode			
Configuration/display message	Control mode	Description	
---P	Position control mode	Executes position command according to pulse input	
--S-	Speed control mode	Executes speed command according to analog voltage command	
-t--	Torque control mode	Executes torque command according to analog voltage command	
C---	Contact speed control mode	Executes speed command according to sequence input signal	
Group control mode		Uses sequence input </C-SEL>	
		</C-SEL> = OFF	</C-SEL> = ON
--SP	Speed -position control mode	-SP	--SP
-tS-	Torque- speed control mode	tS-	-tS-
-t-P	Torque -position control mode	t-P	-t-P
C--P	Contact speed-position control mode	C--P	C--P
C-S-	Contact speed-speed control mode	C-S-	C-S-
Ct--	Contact speed-torque control mode	Ct--	Ct--

Applicable modes	ALL	Other details	Servo-OFF > Configuration > Reapply power>Completed
Detailed description	Refer to Chapter 4-13		

Pr-0.01	Motor configuration

- Configure the motor to be connected to the servo drive
- There are 3 configuration items: motor type,motor's rated output and encoder type.
- Check the model name which is printed on the motor's nameplate
- Push the up/down arrow keys to display alphanumerics for each configuration item.

- The figure below is an example of model name description on a motor's nameplate.
- By referring to the figure below, set the confirmed detailes to the suitable fields.



Example of motor configuration

CSM-A3BB2ANT3	CSMZ-02BH1ANM3	CSMT-04BQ1ANT3	CSMR-10BR1ANM3
-_A3_b	2_02_H	t_04_9	r_10_r
Applicable modes	ALL	Other details	Servo-OFF>Configure>Reapply power>Completed
Detailed description	Refer to Chapter 4-13		

Pr-0.02 8.8.0000	Selection of 4 basic functions

1	8.8.0000	Selection of dynamic brake(DB) halting method

- Description for the DB(dynamic brake) control.
- Set the halt method of servo drive for situations other than halt after normal operation, such as servo alarm or servo OFF.

Set value	Details
0	DB operation continued after DB halt
1	DB released after DB halt

2	Free run halt without using DB halt		
Applicable modes	ALL	Other details	Servo-OFF>Setting>End
Detailed description	Refer to Chapter 7-4		

2		Select method of overtravel halt

Select halt method to be applied when overtravel occurs

Set value	Details		
0	Halts while performing normal torque control in case overtravel occurs. Here, torque limit can be imposed by setting rotation inhibit torque limit [Pr-4.05]		
1	Halts according to the method set al the DB halt method selection set at [Pr-0.02] in case overtravel occurs.		
Applicable modes	ALL	Other details	Servo-OFF>Setting>End
Detailed description	Refer to Chapter 7-2		

3		Selection of rotation direction

Select the motor's rotation direction

Set value	Details		
0	Sets forward direction to CW		
1	Sets forward direction to CCW		
Applicable modes	ALL	Other details	Servo OFF > Setting > End
Detailed description	Refer to Chapter 7-10		

4		Selection of instantaneous outage detection

Select instantaneous outage detection option

Set value	Details		
0	Use the option		
1	Not use the option		
Default	0		
Applicable modes	ALL	Other details	Servo OFF > Setting > End

Pr-0.03 0700	Selection of Auto Tuning Function

1	0	Selection of Auto Tuning Mode

Select auto tuning mode

Set value	Details		
0	Inertia identification		
1	Inertia identification and resonance frequency identification		
Default	0		
Applicable modes	ALL	Other details	Servo OFF > Setting > End

2	0700	Offline tuning speed

Adjust the rotation speed for off-line auto tuning.

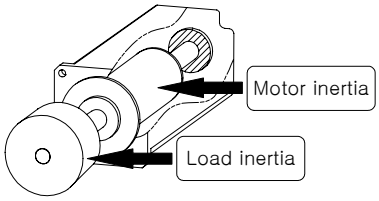
Set value	Details		
2 ~ 9	The larger the value, the higher the speed (set value*100[rpm]). Select an appropriate speed according to load condition.		
Applicable modes	ALL	Other details	Servo-OFF > Configuration > Complete
Detailed description	Refer to Chapter 6-7		

3	0000	On-line tuning coefficient

Selects whether on-line auto tuning to be used and its sensitivity.

Set value	Details		
0~9	If this value is not '0', on-line auto tuning is used. The higher this value is set, the faster is the response to load variation so that the motor responds to load change more quickly..		
Applicable modes	ALL	Other details	Servo-OFF > Configuration > Complete
Detailed description	Refer to Chapter 6-10		

Pr-0.04	Inertia ratio



- This ratio refers to the relative amount of load's inertia to that of the rotor.
- If the rotor's inertia is 3[gf.cm.s ·] and the load's intertia is 30[gf.cm.s ·], the inertia ratio is 10[times].
- As for the rotor's inertia table, please refer to the motor specifications on the appendix.

Set range	Initial value	Units	Other details	Setting > End
0.00 to 60.00	1.00	[times]	Applicable modes	ALL

- When setting the inertia ratio, 2 basic gain parameters ([Pr-1.01], [Pr-1.02]) are set automatically by referring to system gain [Pr-1.00].
- When off-line auto tuning [run-01] function is selected, the servo drive automatically senses the inertia ratio and sets the inertia ratio [Pr-0.04] accordingly.

Detailed description	Refer to Chapter 6-3

Pr-0.05 ~ Pr-0.09	Assignment of sequence input signals

Set values	8	7	6	5	4	3	2	1	0
Input channel number	Always valid	DI#7	DI#6	DI#5	DI#4	DI#3	DI#2	DI#1	Always invalid
CN1 pin number		9	8	7	6	5	4	3	

- As shown on the table below, relevant functions are already assigned to sequence input parameters and the number of digits of the related configuration window; the user enters relevant function by selecting a value in the range of '1-8' , excluding value '0'.
- For example, if a certain function is to be applied to Pin 5 of CN1, the parameter pertaining to that signal should be looked up from the table below and the set value entered as '3'.
- If the input signal function is not to be used,enter '0'.
- If the input signal should be always ON regardless of wiring, enter '8'.

The table below is a summary of parameters for each function and the 7-segment digits displayed on the configuration window. Be sure that the digits on the configuration window match the parameters relevant to each signal.

	7-segment	4th digit	3rd digit	2nd digit	1st digit
	Configuration window of each parameter	0	0	0	0
1	Pr-0.05	</P-CON> Initial value: 4	<N-OT> Initial value:8	<P-OT> Initial value:8	</SV-ON> Initial value: 1

2	Pr-0.06	</C-SEL>	</P-TL> Initial value:7	</N-TL> Initial value: 6	</A-RST> Initial value: 5
3	Pr-0.07	</C-SP3>	</C-SP2>	</C-SP1>	</C-DIR>
4	Pr-0.08	</PCLR>	</G-SEL>	</INHIB>	</Z-CLP>
5	Pr-0.09	</GEAR>	</C-SP4>	</START>	</ABS-DT>

Configuration example

Value '7' is set at the 4th digit of the configuration window for parameter[Pr-0.05].
This value has been set to use the </P-CON> function; it means that the pin DI#7 of CN1 is to be used as input pin.

Applicable modes	ALL	Other details	Servo-OFF>Configure>Reapply power>Completed
Detailed description	Refer to Chapter 5-2		

Pr-0.10 ~ Pr-0.11	Sequence output signal assignment

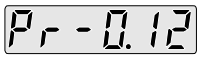
Set value	3	2	1	0
Output channel number	DO#3	DO#2	DO#1	Always invalid
CN1 pin number	47, 48	43, 44	41, 42	

If the relevant signal is not output, the value is set to '0'.

The table below is a summary of each parameter per function and 7-segment values. Be sure to set correct values for each signal's relevant parameter and each digit in the configuration window.

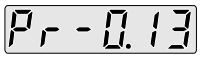
	7-segment	4th digit	3rd digit	2nd digit	1st digit
	Configuration window of each parameter	0	0	0	0
1	Pr-0.10	</V-COM>	</BK> Initial value 3	</TG-ON> Initial value: 2	</P-COM> Initial.value: 1
2	Pr-0.11	</WARN>	</NEAR>	</ V-LMT>	</T-LMT>

Configuration example			
	Value '3' has been set as the 4th digit on the configuration window of parameter [Pr-0.11]. This value is set to output the </NEAR> signal; it means that pin 47 and 48 of CN1 are to be used as output pins.		
Applicable modes	ALL	Other details	Servo-OFF > Configuration>Reapply power > Completed
Detailed description	Refer to Chapter 5-2		

	Servo ID

Set range	Initial value	Unit	Other details	Setting>End
1~255	1	-	Applicable modes	ALL

- Parameter for setting servo ID
- Fix this value to 1 if RS-232 is used.

	Password
Password parameter for A/S usage. Unrelated to user; do NOT use this parameter.	

	Protocol, Data Format, and BAUD Rate

Parameter		
Parameter Name	RS-232C communication speed	
Description	Set RS-232C communication speed.	
Set values	1 – 9600bps 2 – 14400bps 3 – 19200bps 4 – 38400bps 5 – 56000bps 6 – 57600bps	
Default	6	
Applicable modes	All	
Other	Set§>End	

Parameter	Pr-0.14	2
Parameter Name	RS-485 communication	
Description	Set RS-485 communication speed.	
Set values	1 – 9600bps 2 – 14400bps 3 – 19200bps 4 – 38400bps 5 – 56000bps 6 – 57600bps	
Default	2	
Applicable modes	All	
Other	Set§>End	

Parameter	Pr-0.14	1
Parameter Name	Data Format	
Description	Set data format.	
Set values		
Default	1	
Applicable modes	All	
Other	Set>End	

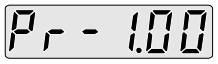
Set value	Data Bit	Parity Bit	Stop Bit
1	8	N	1
2	8	E	1
3	8	O	1
4	8	N	2
5	8	E	2
6	8	O	2

Parameter	Pr-0.14	0
Parameter Name	Communication Protocol	
Description	Set Communication Protocol.	

Set values	0 - RAK_ASCII 1 - Modbus_RTU
Default	0
Applicable modes	All
Other	Set>End

Parameter Group 1

Parameter Group 1	Parameters related to control gain [Pr-1.00] ~ [Pr-1.13]

	System gain

Set range	Initial value	Unit	Other details	Setting > End
0~500	50	[Hz]	Related modes	ALL

- A higher value results in higher position/speed/torque related gain values and higher responsiveness. (However, excessive values can result in noise and vibrations)
- Conversely, lower values result in smaller gain and lower responsiveness; however, the whole system's stability is increased.
- Refers to the bandwidth of the entire speed control loop.
- When this value is changed, the gain values [Pr-1.01], [Pr-1.02], [Pr-1.03], [Pr-1.04], [Pr-1.05] are set automatically according to the control mode while referring to the inertia ratio parameter [Pr-0.04].
- The lower limit is 10Hz.

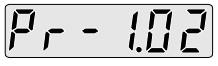
Detailed description	Refer to Chapter 6

	Speed loop proportional gain

Set range	Initial value	Unit	Other details	Setting > End
0~10000	60	[Nms]	Applicable modes	PSC

- Parameter which determines the responsiveness of speed control.
- Value changed simultaneously with change of inertia ratio[Pr-0.04] or system gain[Pr-1.00]

Detailed description	Refer to Chapter 6

	Speed loop integral gain

Set range	Initial value	Unit	Other details	Setting > End
0~60000	100	[Nms^2]	Applicable modes	PSC

- Removes steady state speed tolerance.
- Overshoot in speed response can occur if set value is too large.
- Value changed by change in inertia ratio[Pr-004] or system gain[Pr-1.00].

Detailed description	Refer to Chapter 6

Pr - 1.03	Position loop proportional gain

Set range	Initial value	Unit	Other details	Setting > End
0~700	20	[Hz]	Applicable modes	P

- Parameter which determines the responsiveness of position control
- Change set value according to rigidity of load
- Value changed according to system gain[Pr-1.00]

Detailed description	Refer to Chapter 6

Pr - 1.04	Torque command filter

Set range	Initial value	Unit	Other details	Setting > End
0~10000	1000	[Hz]	Applicable modes	ALL

- Suppresses hih frequency components of torque command
- Value changed according to system gain[Pr-1.00].

Detailed description	Refer to Chapter 6

Pr - 1.05	Speed command filter

Set range	Initial value	Unit	Other details	Setting > End
0~10000	1000	[Hz]	Applicable modes	ALL

- Sets low pass cutoff frequency of speed command to suppress high frequency components
- Value changed according to system gain[Pr-1.00]

Detailed description	Refer to Chapter 6

Pr - 1.06	Position command filter

Set range	Initial value	Unit	Other details	Setting > End

0~60000	0	[Hz]	Applicable modes	ALL
Sets low pass cutoff frequency of position command to suppress high frequency components				
Detailed description	Refer to Chapter 6			

Pr - 1.07	Vibration blocking filter

Set range	Initial value	Unit	Other details	Servo OFF > Setting > End
0~10000	10000	[Hz]	Applicable modes	ALL

- Torque commands around the set frequency are blocked to suppress vibrations at a specific frequency band.
- If set to '0', the vibration blocking filter function is not used.
- System gain can be increased further if the resonant frequency according to load is used appropriately
- If value is not set according to load's resonant frequency, vibration or noise will occur.
- This parameter is automatically set after auto tuning.

Detailed description	Refer to Chapter 6

Pr - 1.08	Position FF gain

Set range	Initial value	Unit	Other details	Setting>End
0~800	200	[%]	Applicable modes	ALL

- Larger values result in faster position completion and smaller position tolerances at transient response condition.
- Value can differ according to load's type or rigidity; too large values result in vibration.

Detailed description	Refer to Chapter 6

Pr - 1.09	Position FF filter

Set range	Initial value	Unit	Other details	Setting>End

0~2500	200	[Hz]	Applicable modes	ALL

- Valid if position FF gain[Pr-1.08] is not '0'.
- If a value other than '0' set for [Pr-1.08] results in overshoot or vibration, set this value to '0'.

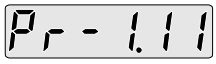
Detailed description	Refer to Chapter 6

	P control transition switch

Changes the speed controller from proportional integral(PI) to proportional(P) automatically during transient response to suppress overshoot of speed response. Therefore, the position completion time gets shorter in case of position control.

Set value	Details
0	P/PI mode transition not used
1	If torque command exceeds torque value[%] set at [Pr-1.11], speed controller changes from PI to P.
2	If torque command exceeds torque value[rpm] set at [Pr-1.11], speed controller changes from PI to P.
3	If the position tolerance exceeds the position tolerance value[pulse] set at [Pr-1.11], the speed controller changes from PI to P.
Default	3

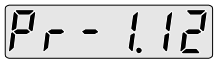
Applicable modes	ALL	Other details	Servo-OFF > Setting > End
Detailed description	Refer to Chapter 6-21		

	P control transition reference value

Set range	Initial value	Unit	Other details	Setting>End
0~3000	100	[Variable]	Applicable modes	ALL

- The unit is determined according to the value set at [Pr-1.10]
- Torque[%],speed[rpm],position[pulse]
- If the speed torque command or the position tolerance exceeds the value set in this parameter, the speed controller changes from PI type to P type,

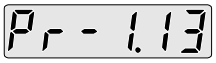
Detailed description	Refer to Chapter 6-21

	Speed bias amount

Set range	Initial value	Unit	Other details	Setting>End
0 to 450	0	[rpm]	Applicable modes	ALL

- In order to shorten the position decision time, if the position tolerance is larger than the value of [Pr-1.13], a speed bias equal to the value set here is applied.

Detailed description	Refer to Chapter 6-21

	Speed bias reference width

Set range	Initial value	Unit	Other details	Setting>End
0 to 250	10	[pulse]	Applicable modes	ALL

- Set to shorten position decision time; determines at above how many pulses of position tolerance the bias should be applied.

Detailed description	Refer to Chapter 6-21

Pr-1.14: Current Controller BW

Parameter	
Parameter Name	Current Controller BW
Description	Set Current Controller BW.
Set values	0 ~ 2
Default	1
Unit	N/A
Applicable modes	All
Other	Servo-OFF > Setting> Power On> End
Details	0: High bandwidth (10KHz) 1: Middle bandwidth (66.67% of High bandwidth) 2: Low bandwidth (33.34% of High bandwidth)

Pr-1.15: Velocity Response Level

Parameter	
Parameter Name	Velocity Response Level
Description	Set max. system gain % recommended by the drive based on the inertia ratio determined by auto tuning.
Set values	0 ~ 150
Default	50
Unit	%
Applicable modes	All
Other	Servo-OFF >Setting >Power On > End
Details	

Parameter Group 2

Parameter group 2	Speed related parameters [Pr-2.00] to [Pr-2.13]

	External speed command input gain

Set range	Initial value	Unit	Other details	Servo-OFF > Setting > End
10.0~2000.0	500.0	[rpm/V]	Applicable modes	S

- Sets the speed command value[rpm] for the analog speed command input pin(Pin 19,20 of CN1)
- Speed command[rpm] = (Pr-2.00) [rpm/V] x Input voltage[V]

Detailed description	Refer to Sec. 5.3, Sec.7.6

	Jog operation speed

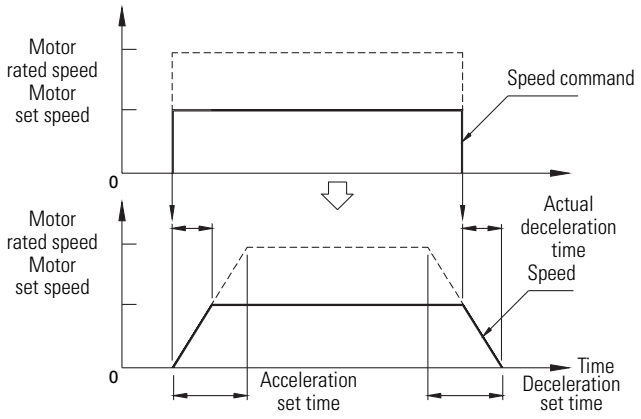
Set range	Initial value	Unit	Other details	Setting > End

0~5000	500	[rpm]	Applicable modes	ALL
Sets speed for jog operation using (run-00) This set value is applied on approach speed for homing(run-02).				
Detailed description	Refer to Chapter 4-22, Chapter 7-35			

Pr-2.02	Acceleration time
Pr-2.03	Deceleration time

Set range	Initial value	Unit	Other details	Setting>End
0 to 60000	0	[msec]	Applicable modes	ALL

- Acceleration/deceleration time and S-operation time are set for smooth operation.
- Acceleration time is the time needed for acceleration from '0' speed to motor's rated speed.
- Deceleration time is the time needed for deceleration from rated speed to '0' speed.



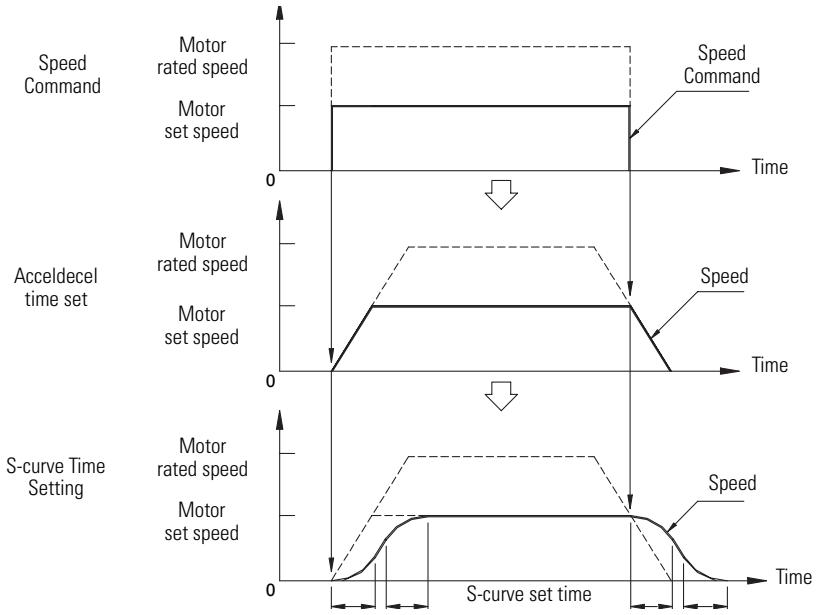
Detailed description	Refer to Chapter 7-16

Pr-2.04	S-operation time

Pr-2.05 ~ Pr-2.11	Contact speed command

Set range	Initial value	Unit	Other details	Setting > End
0 to 5000	0	[msec]	Applicable modes	ALL

- S-operation time set for smooth operation
- Applied only when acceleration/deceleration time have been set. If value is set to '0',S-operation is not performed; if a value other than '0' is set, S-operation is performed on acceleration/deceleration.



Detailed description	Refer to Chapter 7-27

Pr-2.05 ~ Pr-2.11	Contact speed command

Set range	Initial value	Unit	Other details	Setting > End
-5000 to 5000	100 to 700	[rpm]	Applicable modes	C

- Sets each contact speed commands for contact speed control mode
- The operation speed should be entered in advance into the relevant parameters as below.
- According to combination of the sequence input signals </C-SP1>, </C-SP2>, </C-SP3>, operation at preset speed is possible.
- In addition, sequence input signal </C-DIR> is used to change the rotation direction of each speed command.
- To reduce impact of speed change, set the acceleration/deceleration time to a sufficient value which should not interfere with system responsiveness

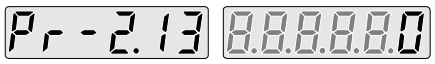
Contact speed	Speed set parameter	</C-SP3>	</C-SP2>	</C-SP1>
Halt command	0 [rpm]	0	0	0
Speed command 1	Pr-2.05 0.0.0100	0	0	1
Speed command 2	Pr-2.06 0.0.0200	0	1	0
Speed command 3	Pr-2.07 0.0.0300	0	1	1
Speed command 4	Pr-2.08 0.0.0400	1	0	0
Speed command 5	Pr-2.09 0.0.0500	1	0	1
Speed command 6	Pr-2.10 0.0.0600	1	1	0
Speed command 7	Pr-2.11 0.0.0700 Parameter / Initial value[rpm]	1	1	1
Detailed description	Refer to Chapter 5-45			

Pr-2.12	Limit speed

Set range	Initial value	Unit	Other details	Servo-OFF>Setting>End
1~5000	5000	[rpm]	Applicable modes	ALL

- Limits the operation speed to below this set value in all control modes. .
- There are two methods of speed limitation: limitation thorough this value and limitation through speed command of upper level controller. Configure by referring to speed limit method selection of [Pr-2.13].
- In addition, in torque control mode,the mode is changed automatically to speed control mode if motor speed exceeds this value; speed control is performed using limit speed command.
- If the analog speed command exceeds motor's maximum speed, the excessive speed command warning "OSC: is issued.
- If excessive speed command warning is issued, the speed command is automatically reduced to the motor's maximum speed.

Detailed description	Refer to Chapter 7-18

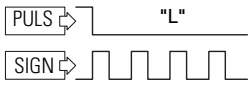
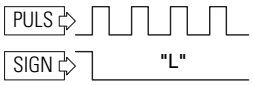
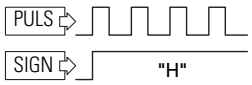
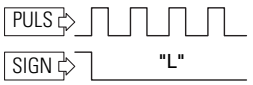
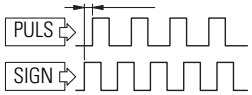
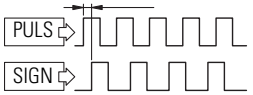
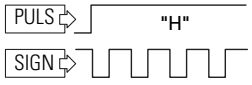
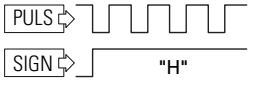
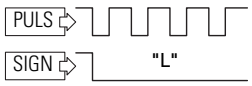
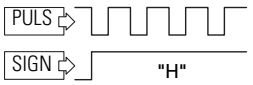
	Speed limit selection

Select the method of speed limitation			
Set value	Details		
0	Speed limit function not used.		
1	Limited by [Pr-2.12]		
2	Speed limited by analog speed command(in modes other than speed control mode)		
3	Speed limited to [Pr-2.12] or analog speed command, whichever is the smaller		
Applicable modes	ALL	Other details	Servo-OFF>Setting>End
Detailed description	Refer to Chapter 7-18		

Parameter Group 3

Parameter Group 3	Position related parameters [Pr-3.00] to [Pr-3.04]

	Position command pulse type

Select the pulse type of the higher level controller's position command pulse.				
Positive logic				
Pulse type	Forward rotation	Reverse rotation	Input multiplier	Set value
CW + CCW			-	0
Pulse train+Sign			-	2
A phase+ B phase			X1 times	4
			X2 times	5
			X4 times	6
Negative logic				
CW + CCW			-	1
Pulse train+Sign			-	3
Applicable modes	P	Other details	Servo OFF>Setting>End	
Detailed description	Refer to Chapter 5-9			

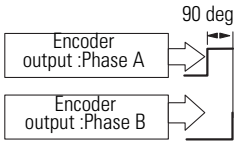
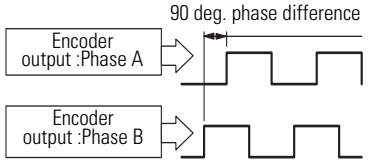
	Position command pulse type

- Sets the position command pulse type of higher level controller.
- For line drive output, the maximum allowed input frequency is 900 [kpps].
- For open collector output, the maximum allowed input frequency is 300 [kpps].
- If pulse input frequency exceeds the maximu allowed input frequency, an excessive command pulse servo alarm (E.ovPUL) is issued.

Set value	Details		
0	Uses the line drive output of higher level controller		
1	Uses open collector output of hiher level controller		
Applicable modes	P	Other details	Servo-OFF>Setting>End
Detailed description	Refer to Chapter 5-9		

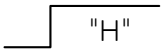
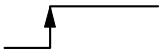
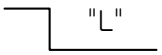
Pr-3.00 0.0.0.0.0.0.	Encoder pulse output direction

Sets the encoder's pulse direction when the servo drive outputs encoder pulse to higher level controller.

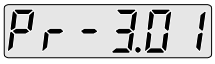
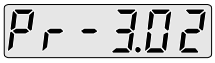
Set value	Details	
0	Phase A of encoder output leads 90 ° at forward rotation	
1	Phase B of encoder output leads 90 ° at forward rotation	
Applicable modes	ALL	Other details: Servo-OFF>Setting>End
Detailed description	Refer to Chapter 7-21	

Pr-3.00 0.0.1.0.0.0.	PCLR input selection

When this signal is input, the position error is cleared to '0' so that, if no more position command pulses are input, the moor can be halted at current condition. The position error clear(PCLR) input signal is input at pins (15,16) of CN1.
Sets the signal's trigger condition at position error clear input to clear the error to '0'.

Set value	Details	
0	Cleared at H level. As long as H level is maintained, the error stays at (0).	
1	Cleared only once at rising edge.	
2	Cleared at L level. As long as L level is maintained, the error stays at (0).	
3	Cleared only once at falling edge.	

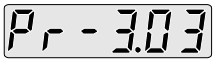
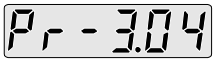
Applicable modes	P	Other details	Servo-OFF>Setting>End
Detailed description	Refer to Chapter 5-9		

	Electronic gear (Numerator)
	Electronic gear (Denominator)

Set range	Initial value	Unit	Other details	Servo-OFF>Setting>End
1~65535	2048	[pulse]	Applicable modes	P

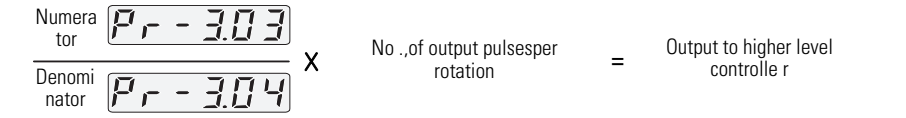
- By using the electronic gear function, the amount of motor rotation pr input command pulse can be set arbitrarily.
- The following relationship has to be satisfied: No.,of pulses per 1 motor rotation x Reduction ratio x 4 (Pr-3.02)
- Maximum resolution=1/ ([No.of pulses per 1 motor rotation] x [Reduction ratio] x 4)

Detailed description	Refer to Chapter 5-9

	Position output pulse adjustment (Numerator)
	Position output pulse adjustment (Denominator)

Set range	Initial value	Unit	Other details	Servo-OFF > Setting > End
1 to 65535	2048	[pulse]	Applicable modes	ALL

- Sets the number of pulses to be output through the servo drive's encoder signal output (EA+, EA-, EB+, EB-) for one motor rotation/
- At [Pr-3.03] , the numerator of the encoder's output divider ratio is entered. Generally, the number of pulses to be output at 1 motor rotation is entered.
- At [Pr-3.04], the denominator of the encoder's output divider ratio is entered. Generally, the number of pulses output from the encoder connected to the motor for 1 rotation is entered.
- For the encoder output division ratio, the relationship [Pr-3.03] £ [Pr-3.04] has to be satisfied.



Detailed description	Refer to Chapter 7-21

Pr-3.05	2nd Electronic gear (Numerator)(1)
Pr-3.06	2nd Electronic gear (Denominator)

(1) The same function as Pr-3.01 or Pr-3.02. These are effective only when /GEAR input is ON.

Set range	Initial value	Unit	Other details	Servo-OFF>Setting>End
1~65535	32768	[pulse]	Applicable modes	P

- By using the electronic gear function, the amount of motor rotation per input command pulse can be set arbitrarily.
- The following relationship has to be satisfied: No.,of pulses per 1 motor rotation x Reduction ratio x 4 (Pr-3.02)
- Maximum resolution=1/ ([No.of pulses per 1 motor rotation] x [Reduction ratio] x 4)

Detailed description	Refer to Chapter 5-9

Parameter Group 4

Parameter Group 4	Torque related parameters [Pr-4.00] to [Pr-4.06]

Pr-4.00	External torque command input gain

Set range	Initial value	Unit	Other details	Servo OFF>Setting>End
0.0~100.0	33.3	[%/V]	Applicable modes	ALL

- Set the speed command value[%] for 1[V] on the analog torque command input pin(pin 21,22 of CN1)
- Torque command[%] = [Pr-4.00] [%/V] x input voltage[V]

Detailed description	Refer to Chapter 5-38

Pr-4.01	Forward torque limit
Pr-4.02	Reverse torque limit

Set range	Initial value	Unit	Other details	Setting > End
0~300	300	[%]	Applicable modes	ALL

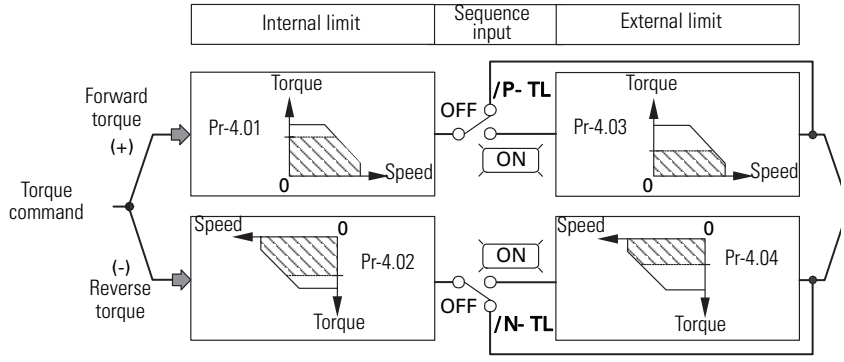
Limits forward and reverse direction torque on motor separately. (internally limited)

Detailed description	Refer to Chapter 5-38

Pr-4.03	Forward torque external limit
Pr-4.04	Reverse torque external limit

Set range	Initial value	Unit	Other details	Setting>End
0~300	100	[%]	Applicable modes	ALL

- The torque imposed on the motor is internally limited automaticaly by the values set on [Pr-4.01], [Pr-4.02]. Additionally, it is also limited by the values set on [Pr-4.03], [Pr-4.04] when external </P-TL>,</N-TL> signals are input through sequence input.
- The torque limit according to internal limit [Pr-4.01] and [Pr-4.02] takes precedence to external torque limit </P-TL> and </N-TL> signals.



Detailed description	Refer to Chapter 5-38

Pr-4.05	Rotation inhibit torque limit

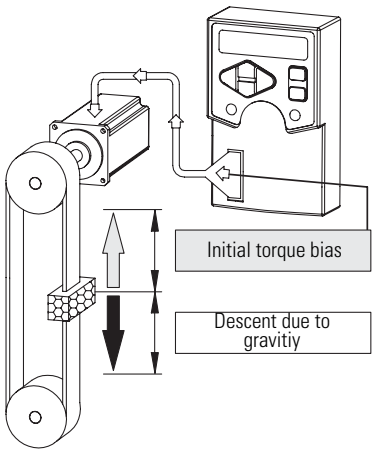
Set range	Initial value	Unit	Other details	Setting>End
0~300	300	[%]	Applicable modes	ALL

- Limits the torque imposed on the motor if the motor is halted by overtravel(<P-OT>,<N-OT>) input signal during rotation.
- Unlike external and internal torque limit, the torque limit value for overtravel input is same for forward and reverse direction.

Detailed description	Refer to Chapter 5-38

Pr-4.06	Initial torque bias

Set range	Initial value	Unit	Other details	Setting > End
-100~100	0	[%]	Applicable modes	ALL



- If, as in the figure, the servo IN signal is applied to drive the motor while the load is along the vertical axis, descent of load due to gravity can take place.
- In addition, the motor brake has to be engaged or released on servo-ON and servo-OFF; if the timing is not adjusted properly, the load descends momentarily thereby causing vibration on equipment.
- This property of vertical axis load results in speed overshoot on motor control which in turn increases the position decision time. In addition, if an attempt to drive the motor is made while the brake is engaged, a servo alarm may be issued.

- Initial torque bias is a function to apply an initial torque equal to the load's descent which occurs when the servo-ON signal is applied in a direction opposite to the iitial torque descent direction in order to prevent descent due to gravity when trying to control such vertical axis load.
- If the initial torque bias has been set properly according to the load's descending power, the descent of vertical load at initial stage of operation can be prevented.

If vertical load is controlled, use a motor with built-in brake or install a brake system.

Detailed description	Refer to Chapter 6-20

Parameter Group 5

Parameter Group 5	Parameters related to auxillary functions [Pr-5.00] ~ [Pr-5.13]

Pr-5.00	Position completion decision width

Set range	Initial value	Unit	Other details	Setting > End
0~250	10	[pulse]	Applicable modes	P

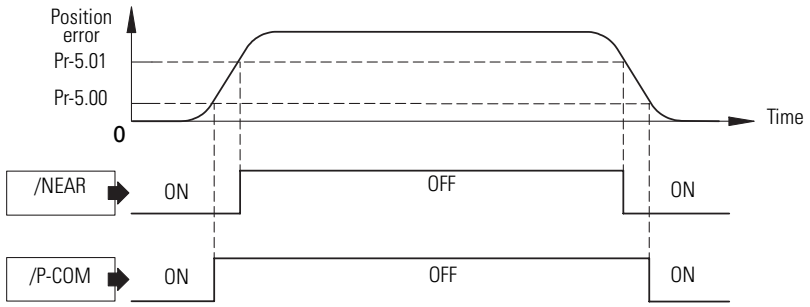
- Set to output the position completion indication singal</P-COM>, a sequence output signal.
- Sets the position(pulse) error range to output the position completion indication signal when the servo drive performs position(pulse) command according to the higher level controller's position(pulse) command
- When the position error comes within set range and the position pulse command frequency is entered below 100[pps] the position completion detection signal(/P-COM> is output at the assigned output pin.

Detailed description	Refer to Chapter 5-38

Pr-5.01	Position approximation decision width

Set range	Initial value	Unit	Other details	Setting > End
0 to 250	20	[pulse]	Related modes	P

- Set to output the position approximation detection signal </NEAR> .which is a sequence output signal.
- Sets the position(pulse) error's range to output the position approximation detection signal when the servo drive performs position(pulse) command according to position(pulse) command of higher level controller.
- If position error is within set range and the input position pulse command's frequency is below 100[pps] , the position completion detection signal</NEAR> is output to the assigned output pin.

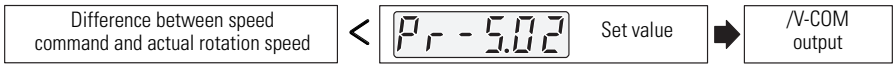


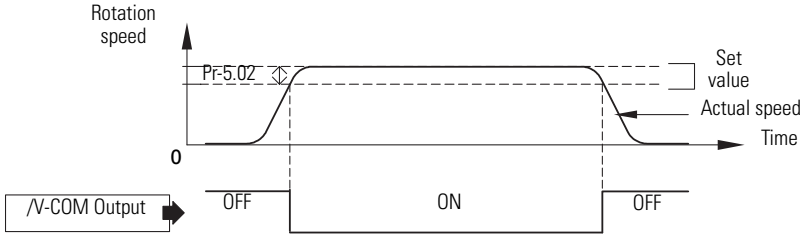
Detailed description	Refer to Chapter 5-38

Pr-5.02	Speed match decision width

Set range	Initial value	Unit	Other details	Setting > End
0 to 1000	10	[rpm]	Applicable modes	S

- Set to output speed match detection signal</V-COM> which is a sequence output signal.
- Sets the speed error range for output of speed match signal when the servo drive performs speed command according to speed command of higher level controller.
- When the speed error is within set range and </V-COM> output is assigned to sequence output signal, the speed match detection signal</V-COM> is output to assigned output pin.



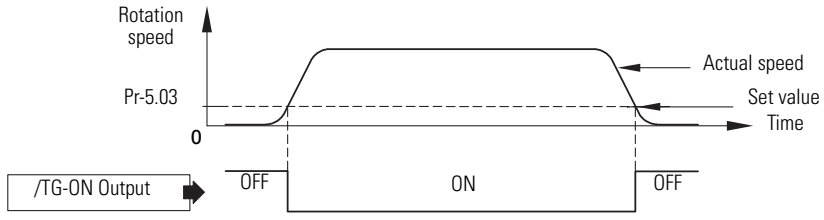


Detailed description	Refer to Chapter 5-28

Pr - 5.03	Rotation detection level

Set range	Initial value	Unit	Other details	Configure>Complete
1 to 5000	20	[rpm]	Applicable modes	ALL

- Set to output rotation detection signal</TG-ON> which is a sequence output signal.
- </TG-ON>signal is output if the servo motor's rotation speed exceeds set value.
- If value is set too small, rotation detection signal can be output even due to small vibrations.

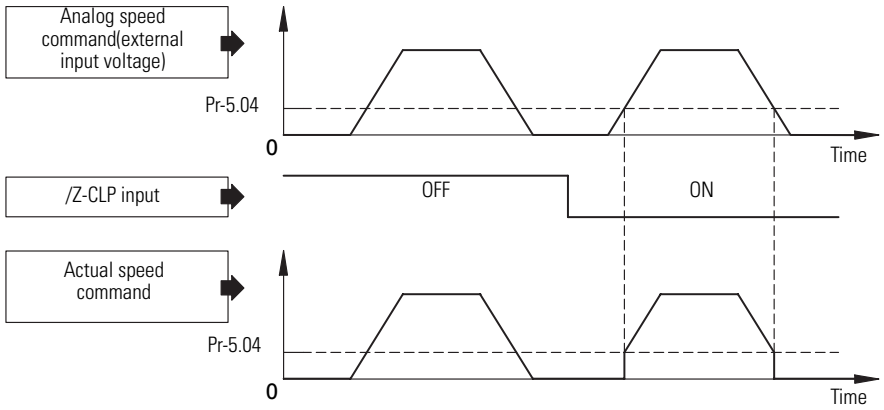


Detailed description	Refer to Chapter 5-28

Pr - 5.04	Speed zero clamp level

Set range	Initial value	Unit	Other details	Configure>Complete
0~5000	0	[rpm]	Applicable modes	S

- Used if the motor shows slight operation even when setting analog speed command to '0' at speed control mode. The zero-clamp function ignores small speed commands to keep motor at halted state.
- Small speed commands below set value are ignored; if speed command exceeds set value, motor is accelerated to set speed.
- Zero clamp function is activated when sequence input signal </Z-CLP> is assigned and signal is input into assigned input pin.
- If a value other than '0' is set at Pr-5.04, automatical speed clamp is performed regardless of </Z-CLP> input even if </Z-CLP> input is not assigned.

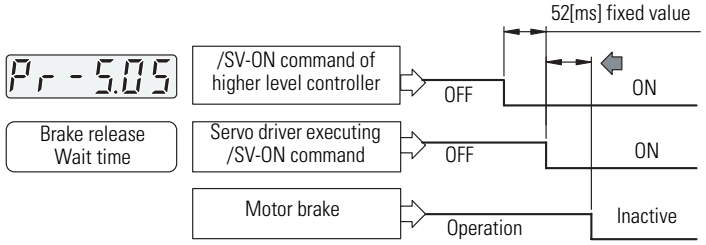


Detailed description	Refer to Chapter 5-28

Pr-5.05	Brake release wait time

Set range	Initial value	Unit	Other details	Servo-OFF>Setting>End
0~1000	0	10[ms]	Applicable modes	ALL

- Parameter set to control brake installed on motor.
- If motor brake is in engaged state when the drive is about to drive the motor, the brake has to be released first.
- Here, if the brake is released before servo is set ON(or at the same time), the vertical load will descend temporarily. Therefore, the drive should first set servo ON to prevent descent of vertical load then release the brake.
- This parameter is set to reserve time from servo drive setting servo –ON to release of motor brake.

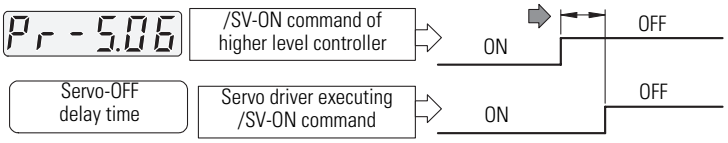


Detailed description	Refer to Chapter 7-6

Pr-5.06	Servo-OFF delay time

Set range	Initial value	Unit	Other details	Servo-OFF>Configure>Complete
0~1000	0	10[ms]	Applicable modes	ALL

- The time from the drive's receiving servo-OFF command from higher level controller to the drive's actually setting servo-OFF can be set.
- This parameter is used to set the delay time from the higher level controller's command to set servo-OFF to the drive's activating the motor drive.

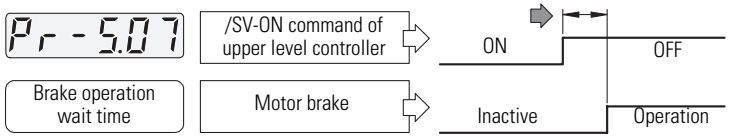


Detailed description	Refer to Chapter 7-6

Pr-5.07	Brake operation wait time

Set range	Initial value	Unit	Other details	Servo OFF>Configure>Complete
0~1000	50	10[ms]	Applicable modes	ALL

- Higher level controller issues Servo-OFF command to drive in order to halt motor.
- The time delay from this point to the motor brake's actual operation can be set.

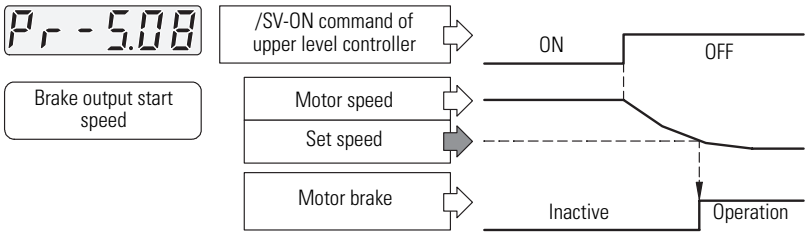


Detailed description	Refer to Chapter 7-6

Pr-5.08	Brake operation start speed

Set range	Initial value	Unit	Other details	Servo-OFF > Configure > Complete
0~1000	100	[rpm]	Applicable modes	ALL

The motor speed at the point the motor brake is activated can be set.



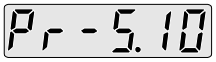
Detailed description	Refer to Chapter 7-6

Pr-5.09	Position error range

Set range	Initial value	Unit	Other details	Configure>Complete
0~65535	20480	[pulse]	Applicable modes	P

- If the difference between position command and actual position exceeds th set value, a position error overflow servo alarm(E.PoSEr) is issued.

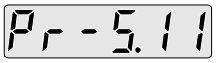
Detailed description	Refer to Chapter 5-9

	Temporary power failure allow time

Set range	Initial value	Unit	Other details	Servo-OFF>Configure>Complete
20~1000	20	[ms]	Applicable modes	ALL

- Sets the duration of temporary power failure above which a servo alarm should be issued.
- If the main circuit power supply sustains a failure for a time longer than the set value, the temporary power failure servo alarm(E.AcoFF) is issued.
- Not valid if the main power input is set to DC input terminal at [Pr-0.02].

Detailed description	Refer to Chapter 4-13

	Reserved

	Analog monitor output CH1 selection and scaling

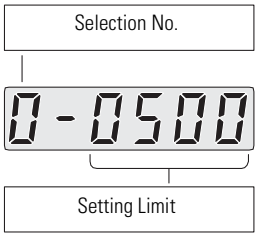
Set range	Initial value	Unit	Other details	Configure > Complete
0-0001 ~ 6-2500	0-0500	Refer to table below	Applicable modes	ALL

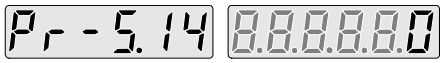
- The servo drive outputs analog monitoring signals which can be input into an oscilloscope so that the user can monitor the control operation.

Detailed description	Refer to Chapter 7-25

	Analog Monitor Output CH2 Selection and Scaling

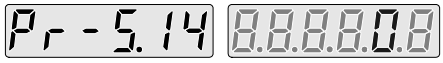
Setting Limit	Initial Value	Unit	Others	Setting > End
0-0001 ~ 6-2500	3-0500	Table below	Applicable Mode	ALL

Setting Example	Selection No.	Type	Setting Limit	Unit
	0	Speed command	1~500	[rpm]
	1	Torque command	1~30	[%]
	2	Position command	1~5000	[pulse]
	3	Speed Feedback	1~500	[rpm]
	4	Torque Feedback	1~30	[%]
	5	Position Feedback	1~5000	[pulse]
	6	Position Error	1~2500	[pulse]
Details	Chapter 7-25			

	Selection of battery when using serial absolute value encoder

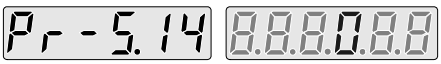
Sets whether battery should be used when using serial absolute value encoder.
This parameter is not valid when using ordinary absolute value encoders.
If value is set to 1, the serial absolute value encoder is recognized as a serial incremental encoder; therefore, in this case, the multirotation data from the absolute value encoder is not valid.

Set value	Details		
0	Battery used		
1	Battery not used		
Applicable modes	ALL	Other details	Servo-OFF > Configure > Reapply power > Completed

	Selection of speed monitor use

When high resolution encoder is used by activating speed monitor, the speed ripple occurring at low speed operation can be reduced.

Initial value	0		
Set value	Details		
0	Speed monitor is not used		
1	Speed monitor is used		
Applicable modes	P,S,C	Other details	Servo-OFF > Configure > Reapply power > Completed

	Selection of excessive speed error detection

When excessive speed error detection function is used, E.SPDER error shows up when the speed error is out of tolerable speed error range.

Set value	Details		
0	Excessive speed error detection function is not used		
1	Excessive speed error detection function is used		
Applicable modes	S, P	Other details	Servo-OFF > Configure > Reapply power > Completed

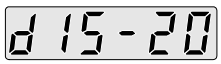
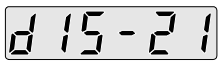
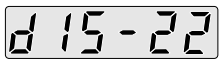
Operation Mode Function List

	Jog Operation
	Off-Line Auto Tuning
	Homing
	Auto Adjustment of Speed Command Offset
	Auto Adjustment of Torque Command Offset
	Manual Adjustment of Speed Command Offset
	Manual Adjustment of Torque Command Offset
	Adjustment of Current Feedback Offset
	Alarm Reset
	Alarm History Clear

	Absolute Encoder Reset
	2-Group Gain Storing
	Parameter Initialiaztion

Monitor Mode Function List

Monitor Mode	Name	Unit
d15-00	Speed Feedback	[rpm]
d15-01	Speed Command	[rpm]
d15-02	Speed Error	[rpm]
d15-03	Torque Command	[%]
d15-04	Position Feedback	[pulse]
d15-05	Position Command	[pulse]
d15-06	Position Error	[pulse]
d15-07	Position Command Pulse Frequency	[kpps]
d15-08	Electrical Angle	[û]
d15-09	Mechanical Angle	[û]
d15-10	Regeneration Accumulation Loading Rate	[%]
d15-11	DC Link Voltage	[V]
d15-12	The Number of rotation data of Absolute Encoder	-
d15-13	Speed Command Offset	[mV]
d15-14	Torque Command Offset	[mV]
d15-15	Input & Output Signal Status	Refer to 7.11
d15-16	Alarm History	Refer to 7.11
d15-17	Firmware Version	[rpm]

	Motor & Encoder Type	Refer to 7.11
	Analog speed command voltage	[0.01V]
	Analog torque command voltage	[0.01V]
	Drive rated output	-
	1-time rotation data of absolute encoder	-
	Encoder Feedback Counter	Pulse

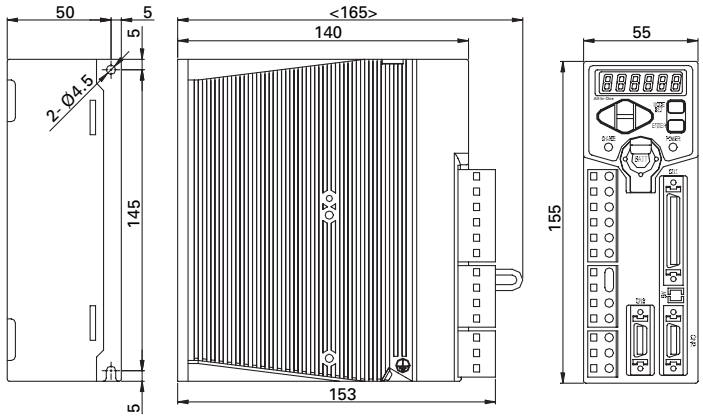
Servo Drive Specification

Introduction

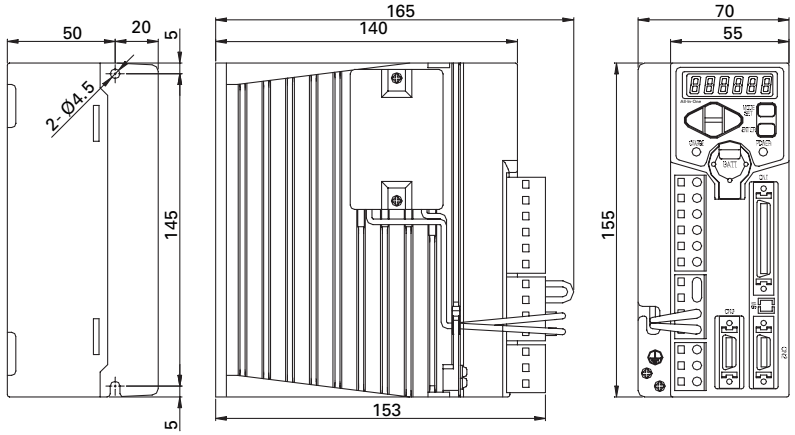
Servo Drive Specification

Outline Drawing

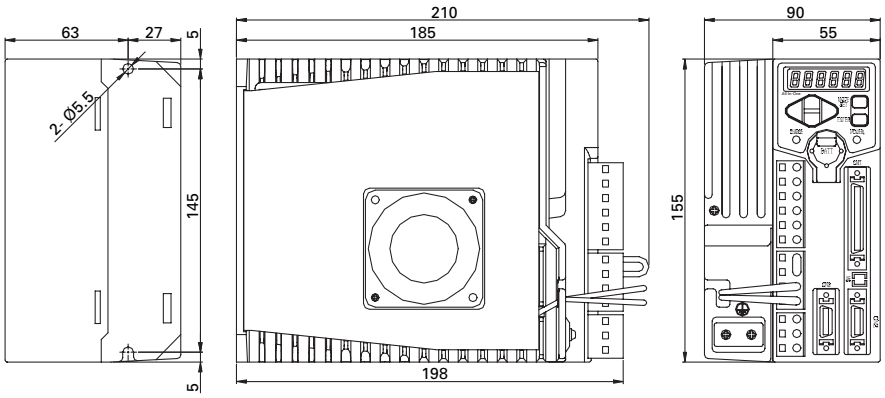
Model	Rated Output	Input Power	Weight
CSD3-A5BX2	50[W]	1 Phase 200-230[V], 50/60[Hz]	0.9[kg]
CSD3-01BX2	100[W]		
CSD3-02BX2	200[W]		



Model	Rated Output	Input Power	Weight
CSD3-04BX1(P)	400[W]	1 Phase 200-230[V] 50/60[Hz]	1.2[kg]



Model	Rated Output	Input Power	Weight
CSD3-10BX1(P)	1[kW]	3 Phase 200-230[V], 50/60[Hz]	2.1[kg]
CSD3-15BX1(P)	1.5[kW]		



Specification

Basic Specification	**Control Method**			**PWM control using ASIPM**
	Feedback Method			2048/2500/5000/10000 P/R (Incremental/Absolute Type) 131072 P/R (17bit Serial Incremental/Absolute Type)
	Operation Temp./Humidity			0 to 50/90% RH or less
	Storing Temp./Humidity			-25 to 80/90% or less
	Mounting Method			Base Mounting Type
Performance	SpeedTorque Control	Speed Control Range		1:5000
		Speed Variation	Load Variation	±0.01% or less (at rate speed or in load rate 0 to 100%)
			Voltage Variation	0% (at rate speed or in supply voltage 170 to 253VAC)
			Temp. Variation	±0.1% or less (at rated speed or in ambient temperature 25±25)
		Frequency Bandwidth		550Hz
		Torque Control Precision		±2%
		Acceleration /Decelertion Time		0 to 60sec
	Position Control	Feedforward Compensation		0 to 100%
		Positioning Completion width		0 to 250[pulse]
Command Signal	Position Control	Command Pulse Type		CW+CCW, Pulse + Sign A phase + B phase (90°phase difference)
		Command Pulse Input Type		Line Drive : Differential Signal Level 2.8 to 3.7V Open Collector : External 24V DC, 12V DC, 5V DC
		Frequency		Line Drive : Max 900[kpps] Open Collector : Max 200[kpps]
		Control Signal		Postion Error Clear Signal
	Speed Control	Command Voltage		±10V DC (16Bit A/D conversion)
		Input Impedance		About 8.3 MΩ
		Circuit Time Constant		1μs
	Multi-Step Speed	Rotation Direction Selection		Used by sequence Input setting.
		Speed Selection		

I/O Signal	Position Feedback	Output Type	Line Drive Output : A, B, Z pulse, Absolute Encoder Data Open Collector Output : Z pulse
		Dividing Ratio	User Defined
	Sequence Input		Servo-On, Alarm Reset, Gain Group Change Forward/Reverse Torque Limit, Homing Forward/Reverse Rotation Limit P/PI or control mode change Multi-Step Speed Command Zero-Clamp, Position Command Override Absolute Encoder Data Transmission
	Seauence Output		Positioning Completion, Position Nearing Speed Coincidence, Rotation Detection Torque Limit Detection, Speed Limit Detection Brake Control Signal, Warning
Emergency Stop			H/W Emergency Stop Input
Dynamic Brake			Operate in case of main power-off or alarm
Regenarative Resistor			Built in 400W or more
Protection			Overcurrent, Overvoltage, Overload, Overspeed Overregenertion, Overheat Temporary Power Down, Low Voltage, CPU Fault Communication Fault
Monitoring			2CH D/A outputs for measuring commands or feedback, error
Communication			RS-232C

CSD3 Plus Servo Drive User Manual (CSD3-xxBX2 Rev.B)

OEMAX Controls

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