RS OEMax

CSD5 Servo Drive

User Manual

Catalog Number(s): CSD5_xxBX1

RS Reliable & Smart Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. There are some important differences between solid state equipment and hard-wired electromechanical devices. 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 RS Automation Co., 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, RS Automation Co., Ltd. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by RS Automation Co., Ltd. with respect to use of information, circuits, equipment, or software described in this manual.

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

WARNING	Identifies information about practices or circumstances which may lead to serious personal injury or death, property damage, or economic loss.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.
CAUTION	Idnetifies information about proctives or circumstances that can lead to minor personal injury, properity damage, ecconomic loss, or product malfuntion. However, depending on the situraiton, failutre to follow the directions accompanying this symbol may also lead to serious consequences.

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	Jun 2011

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Preface

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

- Who Should Use This Manual
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Who Should Use This Manual

This manual is intended for engineers or technicians directly involved in the installation and wiring of the CSD5 servo drive, and programmers directly involved in the operation, field maintenance, and integration of the CSD5 servo drive with a Motion Card.

If you do not have a basic understanding of the CSD5 servo drive, contact your local RS Automation sales representative before using this product, for information on available training courses.

About This Publication

This manual provides detailed installation instructions for mounting, wiring, and troubleshooting your CSD5 servo drive, and system integration for your drive/motor combination with a Motion Card.

Additional Resources

The following documents contain additional information concerning related CSD5 servo drive products.You can view or download publications at www.rsautomation.biz

To order paper copies of technical documentation, contact your local RS Automation Korea distributor or sales representative.

For	Read This Document
Information on the installation of your CSD5 servo drive	CSD5 Servo Drive Installation Instructions
Information on the motors used together with CSD5 servo drive	Servo Motor User Manual

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

Table for Parameter Setting

This manual uses the following table for parameter description.

Example of Parameter Setting

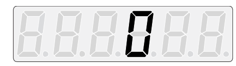
Parameter	 
Parameter Name	Motor Forward Direction
Description	You can choose the rotational direction of the motor
Setting Value	• 0: CW • 1: CCW
Initial Value	0
Applicable Mode	All
Others	Servo-OFF > Setting > End

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 value. 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 eh setting window.

Parameter Name: describes the value selectable by the user and the selected value.

Description: describes the function and usage of parameter.

Setting Value: describes the value selectable by the user and the selected value.

Initial Value: Initial Value displayed when the parameter is selected.

Applicable Mode: alphabetically displays the corresponding control mode in setting parameter, and displays (ALL) if all are included.

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

Combinational control mode indicates the alphabets of two modes, combined in a row.
ex) speed + position mode (SF), torque-speed mode (tS).

Others: normally, as described in an example of automobile, 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 > End	Set it in Serve-OFF status, and apply the power again

Terminology

The following describes terminologies used in this manual.

- **Servo Drive or Drive**: Refer to the CSD5 Servo Drive
- **Servo Motor or Motor**: Refer to the servo motor exclusively for the CSD5 drive.
- **Host Controller** : Refers to a controller or a device that gives command to the drive and controls it.
- **Initial Value**: Refer to the value set at the factory before the shipment.
- **Setting Value**: Refers to the initial value or the value changed and set by the users.
- **User’s Manual**: Simply indicated as ‘manual’.

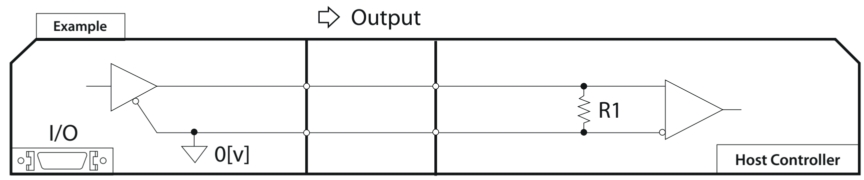
Notation Description

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

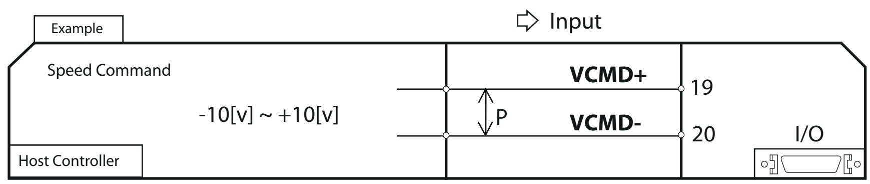
1. Use ‘/’ in front of Active Low signal.

$\overline{\text{SV-ON}}$ ➡ /SV-ON

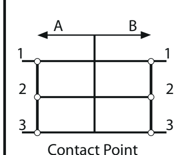
2. A figure box with both the top corners cut off diagonally represents a circuit diagram. If I/O for I/O signal or a connector attached to the servo driver is on the left, it is the output of I/O or servo drive.



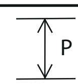
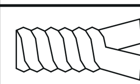
3. If I/O for I/O signal or a connector attached to servo driver is on the right, it is the input from the host controller to I/O or servo drive.



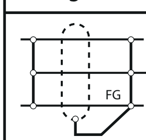
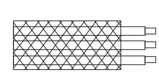
4. The following shows the symbols used on the circuit diagram.

Signal	Description
	▸ The figure represents the pin number of the connector, which can be marked with alphabets tather than the numbers. ▸ The contact is the connection between the side A and B with the connector.

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

Signal	Figure	Description
		▸ The 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.

Signal	Figure	Description
	 Shield	▸ 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.

1. Descripbes things to know before using the product.
2. Describes the outline of product and marking.
3. Describes precations upon product installation.
4. Describes wiring with the host controller and peripheral equipment.
5. Describes the operator for various settings.
6. Describes brief functions of the product.
7. Describes the basic settings that users should set.
8. Describes the fucntion of the product for each control modes.
9. Describes the tuning to implement optimum performance of load system.
10. Describes simple supplementary functions.
11. Describes the protective function, fault diagnosis and troubleshooting.
12. Describes items corresponding to various numerical data in the Appendix.

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.

Safety Precautions

This is CSD5 User 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.

Usage

CAUTION

... Do not touch the inside of servo drive.

... Make sure that the servo drive and the motor are fully grounded.

... Completely discharged before handling after power off.

... Do not put excessive stress on the motor power and encoder cable.

... Never touch the revolving part of the motor during operation .

WARNING

... Avoid using the product near wet places or corrosive and inflammable materials.

... Operate the system with no load during pilot operation.

... Never touch the heat sink directly.

Storage

WARNING

... Do not store the product near wet places, rain, toxic gas or fluid.

... Keep the product out of the direct rays of the sun and store it within the storage temperature and humidity ranges.

... Avoid overloading if the product is stored in a warehouse.

Transportation

WARNING

... Do not carry the product by holding the cable and the motor shaft.

Installation and Wiring

WARNING	... Install a cooling fan to prevent excessive temperature increase. (Refer to the Chapter 2) ... Be careful not to wiring cables around the heat sink.

CAUTION	... Install drives with regular space (at least 10 mm) between them. ... Pay attention to the heat sink when wiring. (Refer to Chapter 2)

Maintenance and Repair

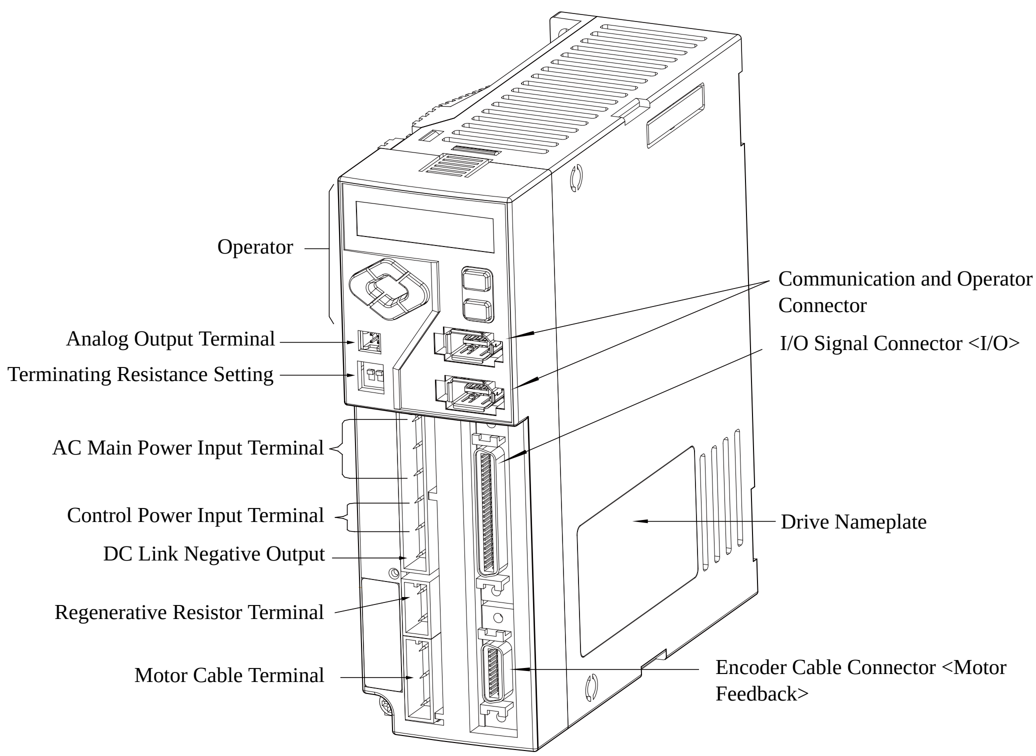
WARNING	... Do not disassemble or remodel the product. Any damage caused after the user disassembles or remodels the product will be excluded from the company's warranty. ... The company bears no responsibility for injuries or physical damage caused by remodeling of this product. ... Life-limited Parts by mechanical friction or heat requires regular . Refer to the Chapter 8. ... In case of a failure that cannot be dealt with, please contact the company’ s technical support team or after-sales service center.

Before Using the CSD5 Servo Drive

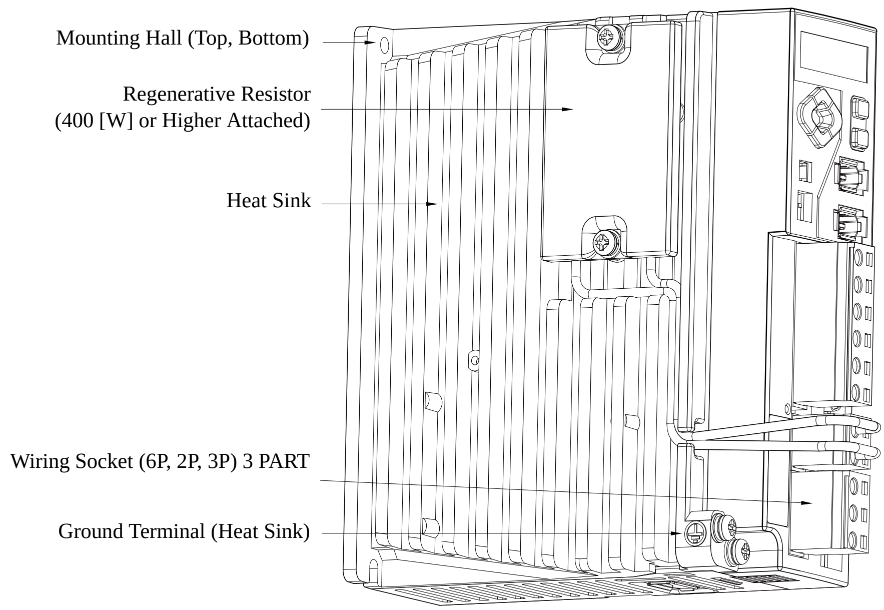
This chapter describes the general matters and optional specifications that you should know before using the CSD5 SERVO DRIVE.

Product Type and Each Part Name

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



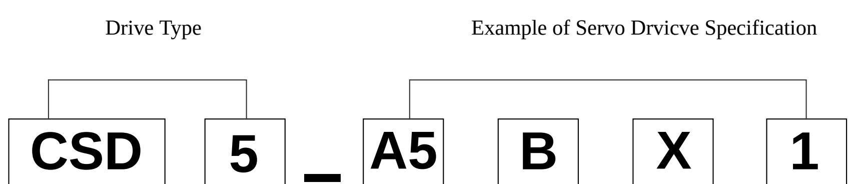
TIP For more detail information about Operator, please refer to " Chapter 4 Operator, Basic Setting and Startup".



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 RS Automation Servo Drive CSD5 Series.
- The serial number is included on the nameplate. Be careful not to erase the serial number during the use.



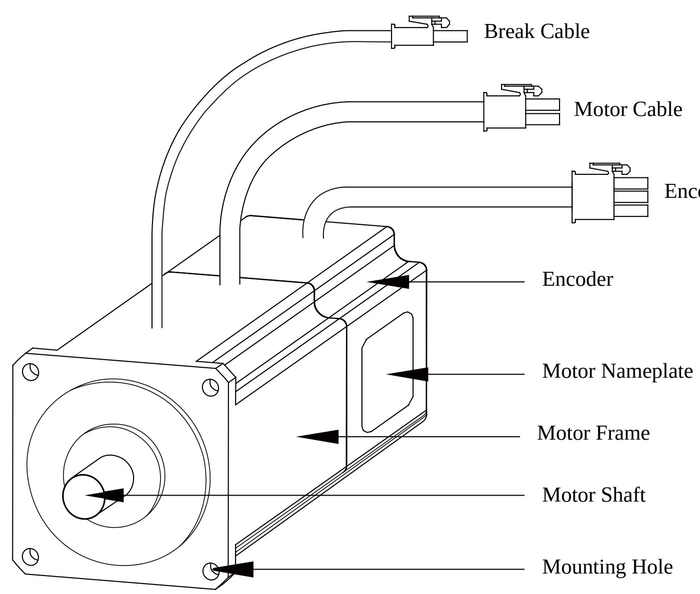
Mask	Rated
A5	50 [W]
01	100 [W]
02	200 [W]
04	400 [W]
08	800 [W]
10	1 [kW]
15	1.5 [kW]

Name of Each Motor Part

The following figure shows the name of each more 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.

TIP For more detailed infroamtion about Servo Motor, please refer to “ Servo Motor Manual” .

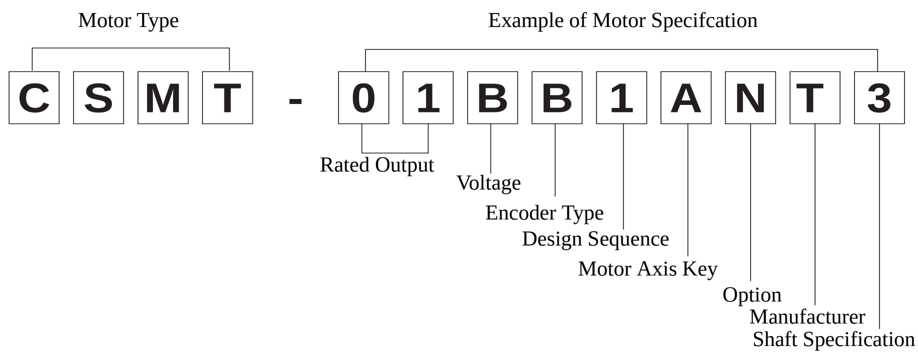


TIP RS Automation does not provide cables. For more information about specification and order code of cables below, refer to "Servo Motor Manual (Publication SMOTOR-UM002)".

- Motor 3 phase Power Cable
- Encoder Cable
- Motor Break Cable
- I/O Cable
- Communication Cable

Model Number of the Motor

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



TIP For more detailed information about each motor name plate items, refer to Servo Motor Manual.

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 equipments necessary for the installation.

Servo Drive Installation

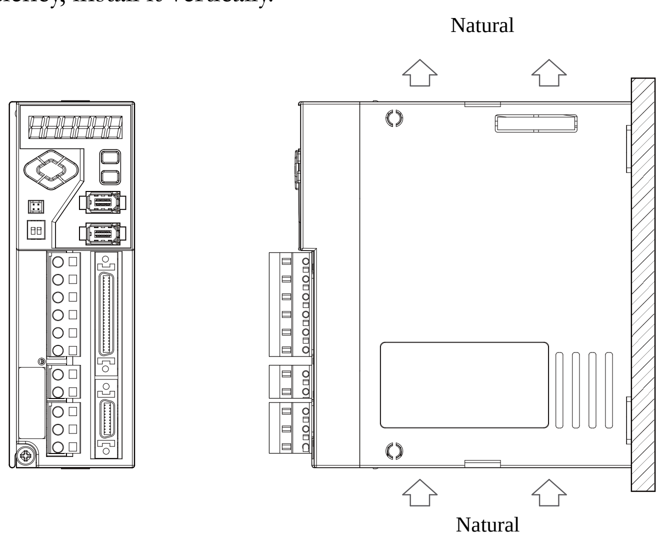
Precautions

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.

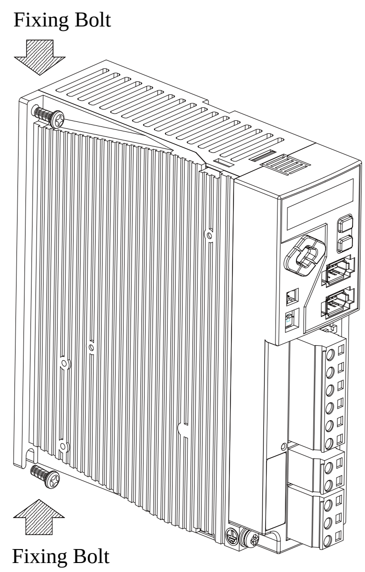
Install the Servo Drive Vertically

Servo drive less than 400 [W] applies the natural convective cooling, and the servo drive with more than 0.8 [kW] uses the cooling fan. To increase the cooling efficiency, install it vertically.



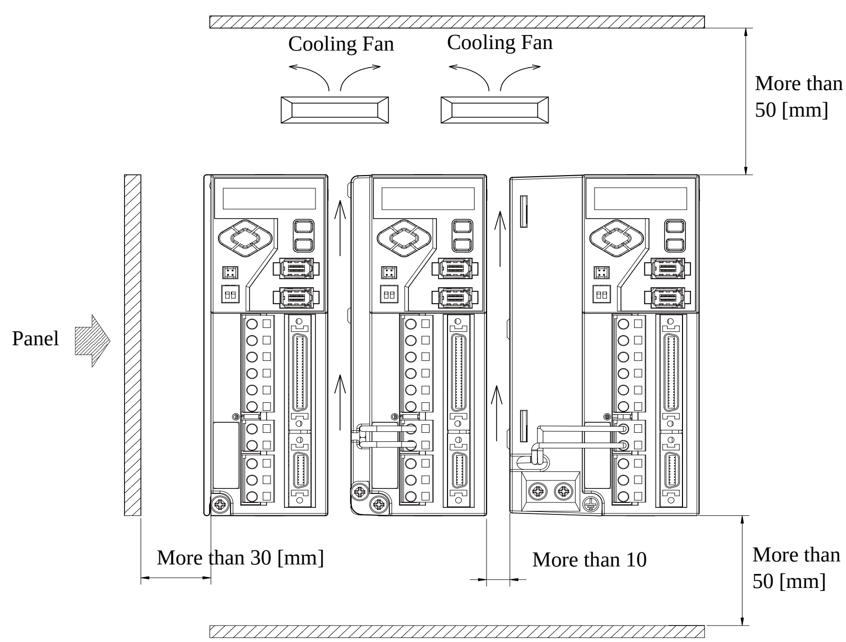
Fixing Bolt

... 400 [W] or less: M4xL1 0 mounting holes at the top & bottom
... 0.8 [kW] or more: M5xL10 mounting holes at the top & bottom



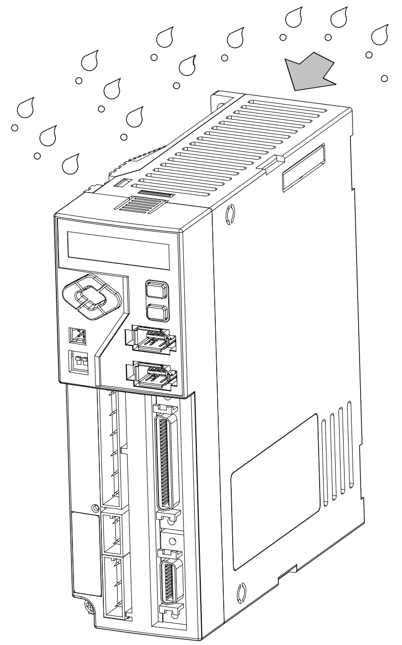
Use A Cooling Fan When Installing Several Drives.

When installing several drives, you must the following criteria. Install a cooling fan to prevent excessive temperature increase.If the surrounding temperature is higher than the operational temperature, it may reduce the performance.



Use the Drive in a Clean Environment

Use the drive in a clean environment where there is no dust or humidity.

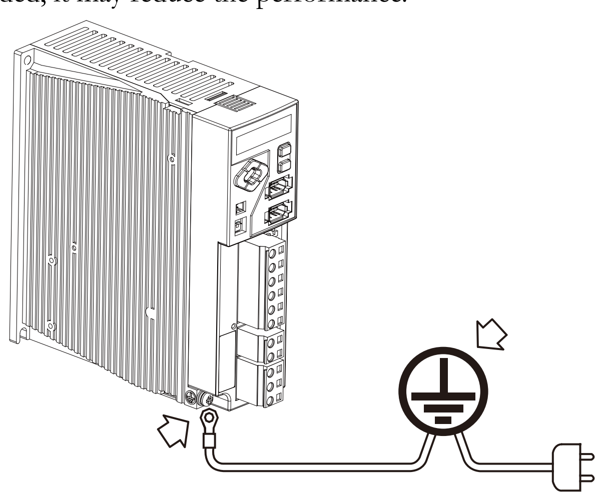


Ground

There is a grounding terminal at the bottom of the heat sink.

- 200 [W] or less: 1 mounting hole for M4 BOLT
- 400 [W] or above: 2 mounting holes for M4 BOLT

If not grounded, it may reduce the performance.



Installation Environment

CSD5 Servo Drive installation environment is like below.

Table 2.1 CSD5 Servo Drive Installation Environment

Item	Installation Environment
Storing Temperature	Store it within -25 ~ 85 [℃]
Operational Temperature	Use it within 0 ~ 50 [℃]
Operational Humidity	Use it below 5 ~ 95 [%] RH at a place without condensations
Vibration	5-55Hz @ 0.35mm(0.014") double amplitude, continuous displacement, 55-500Hz @ 2g peak constant acceleration
Operational Location	Installation environment must meet the follwoing conditions: • Indoors • Well ventilation • Easy checkup • Without explosive gas

IMPORTANT

... To maintain reliability for a long time, use it within to 0~35 [℃].

... Install a separate cooling device at a place with high ambient temperature and use it within the operational temperature.

Servo Motor Installation

TIP For numerical data related to the installation of the servo motor, please refer to Servo Motor User Manual.

Chapter 3

Wiring

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.

CAUTION

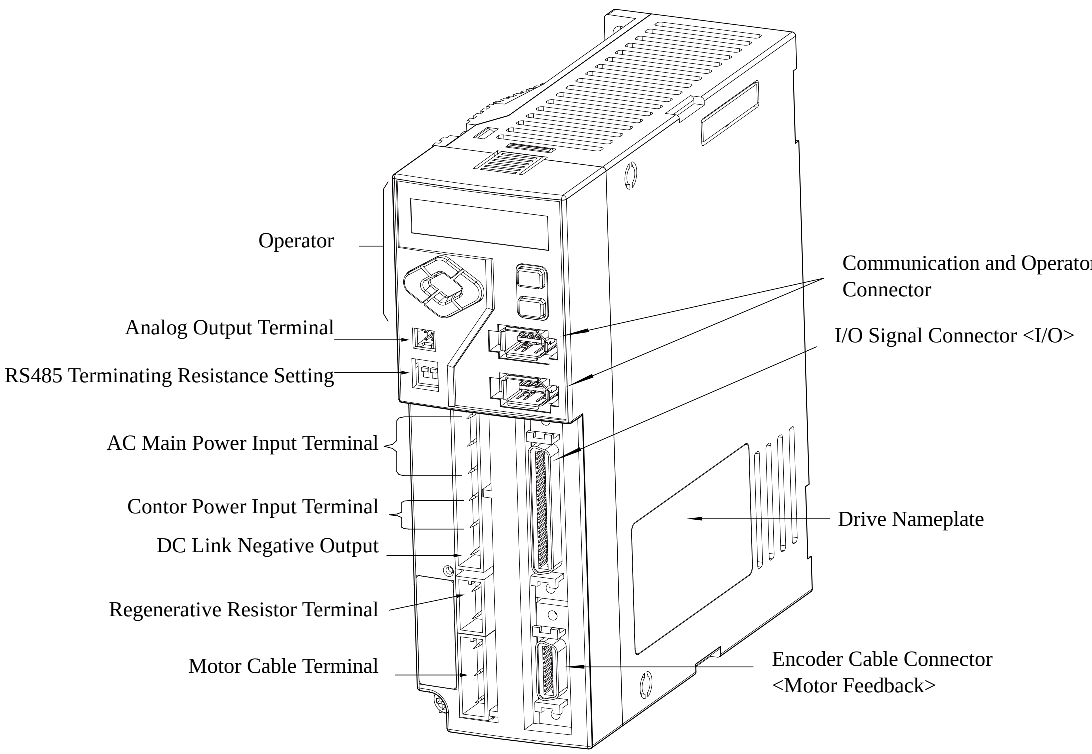
... Wiring should be done only by the qualified personal.

... High voltage remains in the drive even through the power is off. Therefore, do not inspect components unless inside Charge lamp is off.

... Pay attention to the polarity when wiring.

... 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.



The I/O signal connector I/O and encoder cable connector Motor Feedback are included only in the description of the signal circuit. The description of other connectors and 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.

Table 3.1 Electric Circuit

Terminal	Terminal Symbol	Purpose	
AC Power Terminal	L1, L2, L3	400 [W] or lower	Single phase 200 ~ 240 [V] (50/60 [Hz]) (L3 port must not be used)
		800 [W] or higher	3 phase 200 ~ 240 [V] (50/60 [Hz]) (800 [W] can be used as Single phase)
Control Power Terminal	L1C, L2C	No output division	Single phase 200 ~ 240 [V] (50/60 [Hz])
Motor Cable Terminal	U, V, W	Connect the motor cable.	
Grounding Terminal (Heat Sink)	⏚	Connect the power and motor cable to the grounding terminal.	
Regenerative Register Connection Port	B1, B2	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.

AC Power Terminal (L1, L2, L3) and Control Power Terminal (L1C, L2C)

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 3-5 page "Electric Circuit Diagram"for the Electric Circuit Diagram of the power separation.

Motor Cable Connectors (U, V, W)

WARNING

The motor cable connectors (U, V, W) are output terminals. Do not connect the input power. It may cause of the drive damage.

Regenerative Register Connection Port

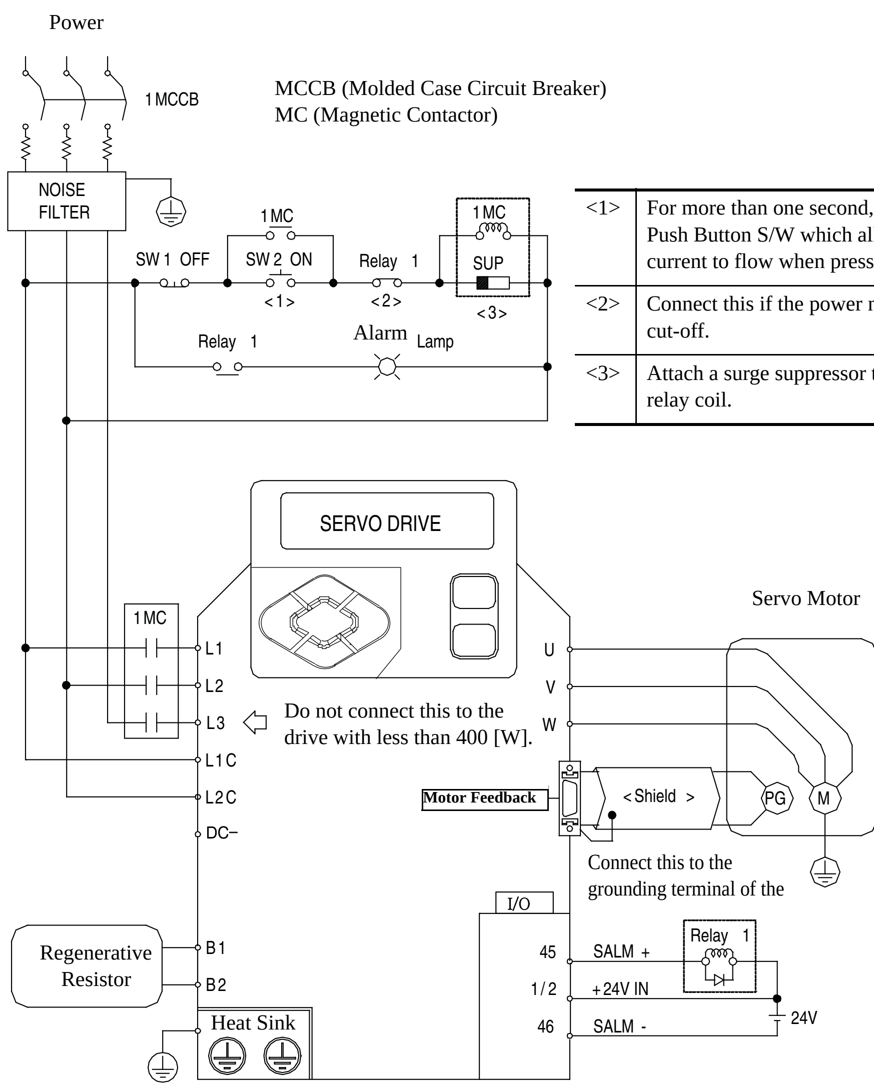
Refer to the 7-12 page "Reneration Resister" for more information the Regeneration Resistor.

CAUTION

... When wiring the wiring socket, be careful not to expose the core wire. It may cause an electric shock.

... Completely discharged before handling after power off.

Electric Circuit Diagram



<1>	For more than one second, press the Push Button S/W which allows the current to flow when pressed.
<2>	Connect this if the power needs to be cut-off.
<3>	Attach a surge suppressor to the MC relay coil.

CAUTION

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.

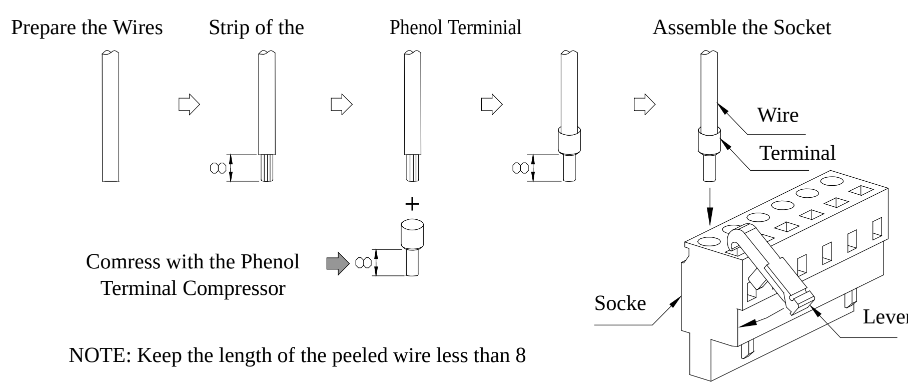
- Connect only one wire at wire inlet of the socket.
- If the wire is pulled accidentally with an excessive force, rewire it properly.
- The peeled wire can be used. (Keep the length of the peeled core wire less than 8 [mm].)
- The use of phenol terminal is recommended for the reliability of wiring.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

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

1. As shown in the figure, insert lever in the socket and press it.

2. Insert wire into socket and release the lever.

3. Pull it slightly to check if the connection between the socket and wire is normal.

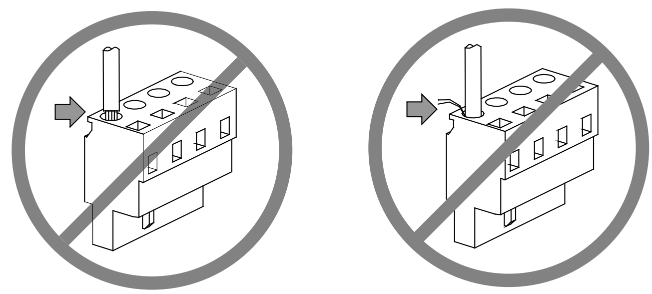


The thickness of wire allowed by the socket is shown below.

	Thickness of Wire
Twist	AWG20 ~ AWG14

CAUTION

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



NOTE

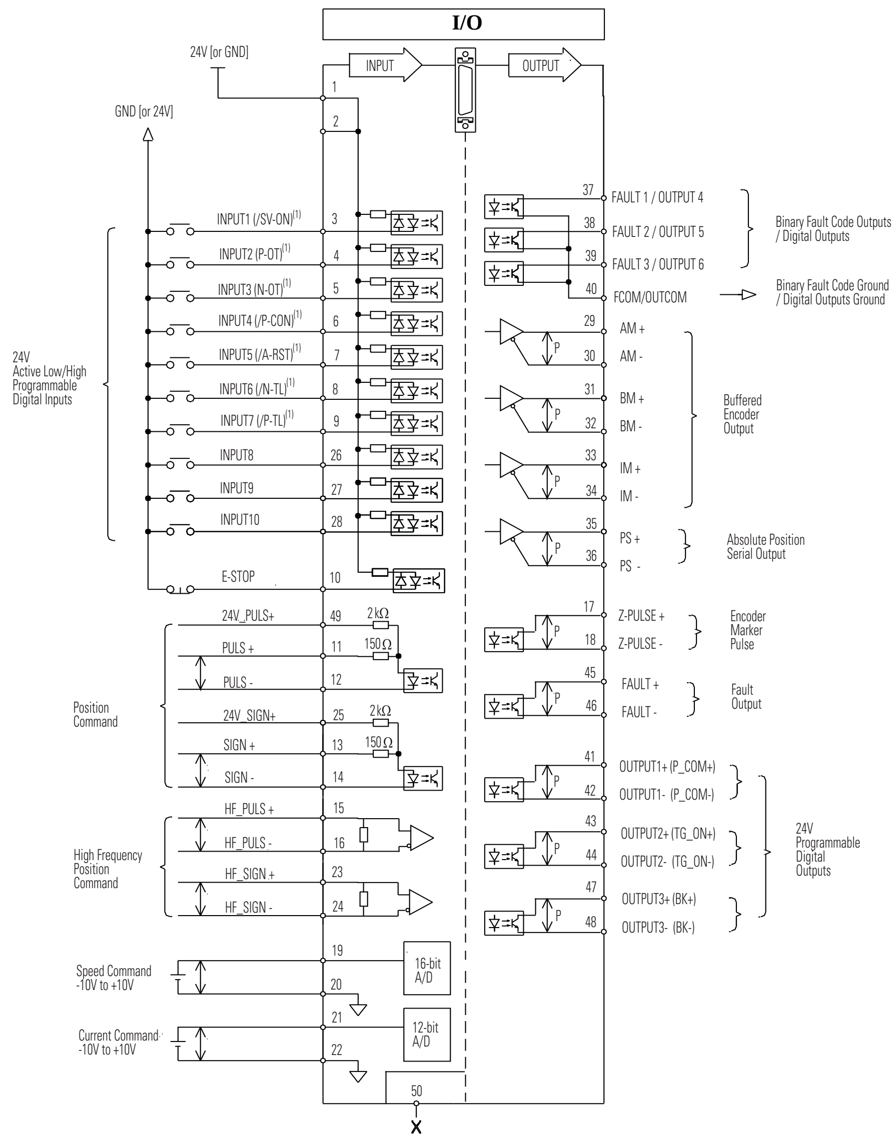
The lever is a small tool, used when wiring. Keep it for other wiring jobs.

I/O Signal (I/O)

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 does not have the separate terminal. It must be connected to motor encoder cable.



(1) Factory Default Value

Table 3.2 (I/O) Pin Arrangement for host controller connections

Pin	Symbol	Description	Pin	Symbol	Description
1	+24V IN	External 24 [V] input for contact point input	26	INPUT8	Digital input 8
2	+24V IN	External 24 [V] input for contact point input	27	INPUT9	Digital input 9
3	INPUT1	Digital input 1(/SV-ON)(1)	28	INPUT10	Digital input 10
4	INPUT2	Digital input 2(P-OT)(1)	29	AM+	Encoder signal output A+
5	INPUT3	Digital input 3(N-OT)(1)	30	AM-	Encoder signal output A-
6	INPUT4	Digital input 4(/P-CON)(1)	31	BM+	Encoder signal output B+
7	INPUT5	Digital input 5(/A-RST)(1)	32	BM-	Encoder signal output B-
8	INPUT6	Digital input 6(/N-TL)(1)	33	IM+	Encoder signal output Z+
9	INPUT7	Digital input 7(/P-TL)(1)	34	IM-	Encoder signal output Z-
10	ESTOP	ESTOP(Default:Disable)	35	PS+	Absolute Encoder Position data output+
11	PULS+	Position command pulse input+	36	PS-	Absolute Encoder Position data output-
12	PULS-	Position command pulse input-	37	FAULT1/ OUTPUT4	Alarm code output 1/Digital output 4
13	SIGN+	Position command sign input+	38	FAULT2/ OUTPUT5	Alarm code output 2/Digital output 5
14	SIGN-	Position command sign input-	39	FAULT3/ OUTPUT6	Alarm code output 3/Digital output 6
15	HF_PULS+	High frequency position command pulse input+	40	FCOM/ OUTCOM	Alarm code/ Output ground
16	HF_PULS-	High frequency position command pulse input-	41	OUTPUT1+	Digital output 1 +(P_COM+)(1)
17	Z-PULSE+	Encoder Z-pulse output (Open collector)	42	OUTPUT1-	Digital output 1 -(P_COM-)(1)
18	Z-PULSE-	Encoder Z-pulse output (Open collector)	43	OUTPUT2+	Digital output 2 +(TG_ON+)(1)
19	VCMD+	Speed command input+	44	OUTPUT2-	Digital output 2 -(TG_ON-)(1)
20	VCMD-	Speed command input-	45	FAULT+	Alarm generation signal output+
21	ICMD+	Current command input+	46	FAULT-	Alarm generation signal output-
22	ICMD-	Current command input-	47	OUTPUT3+	Digital output 3 +(BK+)(1)
23	HF_SIGN+	High speed position command sign input+	48	OUTPUT3-	Digital output 3 -(BK-)(1)
24	HF_SIGN-	High speed position command sign input-	49	24V_PULS+	Open collector pulse input + for 24 [V] level
25	24V_SIGN+	Open collector sign input + for 24 [V] level	50	NC	Not Available

(1) Factory default values

(I/O) Input Signal

Sequence Input Signal (Allocation)

Refer to the 5-1 page "Sequence I/O (Input/Output) Signal" for details of sequence input signal.

Table 3.3 I/O Sequence Input Signal

Type	Description	Mode	Reference
</SV-ON> Servo-ON	When the servo is set to ON, voltage is applied to the servo motor; when it is set to OFF, voltage is cut off.	All	4-1 page
</A-RST> Alarm Reset	It disables the Servo's Alarm.	All	7-49 page
</G-SEL> Gain Group Conversion	Use 2-group gain where it is set to ON and use current gain where it is set to OFF. It converts gain of 2 groups.	All	6-36 page
</P-CL> Forward Torque Limit	When it is set to ON, limit the forward torque by the set value [Ft-4.03].	All	5-46 page
</N-CL> Reverse Torque Limit	When it is set to ON, limit the reverse torque by the set value [Ft-4.04].	All	5-46 page
<P-OT> Prohibit Forward Rotation	It prohibits the motor from rotating forward when the load device reaches the limit of the available section.	All	7-2 page
<N-OT> Prohibit Reverse Rotation	It prohibits the motor from rotating reversely when the load device reaches the limit of the available section.	All	7-2 page
</P-CON> P Control Conversion	It converts the Seed Controller from PI type controller to P type controller. It is used to suppress the overshoot of the excessive response and complete a faster response.	F, S, P, I	6-30 page
</C-SEL> Control Mode Conversion	It is used to convert Control Mode when using it as Combination Control Mode.	Combinational Control Mode Only	5-57 page
</C-DIR> </C-SP1> </C-SP2> </C-SP3> </C-SP4> Contact Speed Command	At the Contact Speed Control Mode, these input combinations decide the rotation direction of the motor </C-DIR> and the rotation speed </C-SP1 ~ /C-SP4>. The rotation speed for </C-SP1~/C-SP3> input is set in [Ft-2.05~Ft-2.11]. The analogue speed command voltage decides the rotation speed for </C-SP4>. </C-DIR> is used to change the motor rotation direction in Speed Control Mode.	P	5-51 page
</Z-CLP> Zero Clamp	Ignores the input value in the Speed Control when the command value is lower than the value set in the Speed Zero Clamp Level [Ft-5.05].	S	5-35 page
</INHIB> Inhibit Pulse Command	Inhibits the position command pulse where it is ON.	F	5-25 page
</ABS-DT> Absolute Encoder Data Transmission	When it is set to ON, transmits the absolute encoder data to a higher level through AM, BM signals.	F, I	7-50 page
</PCLR>Position Error Clear	Clears position command, position feedback, and position error.	F, I	5-25 page
</START>Start	Set to start or stop the motor rotation by using the contact signal in Speed/Contact Speed Control Mode.	S, P	5-37 page
</GEAR>Electronic Gear Rate Shift	In the Position Control Mode, use the 2nd electronic gear parameter [<:fc 2>Ft<:/fc>-3.05]and [Ft-3.06] where it is ON, use the basic electronic gear parameter [Ft-3.01]and [Ft-3.02] where it is OFF. It shifts between two electronic gear ratios.	F	5-27 page
</R-ABS>Absolute Encoder Multi-rotation Data Reset	Reset the multi-rotation data of the absolute motor.	All	7-34 page

Table 3.3 I/O Sequence Input Signal

Type	Description	Mode	Reference
</BANK_SEL>Gain Bank Select	Uses the 3rd and the 4th Gain Bank when it is set to ON.	All	6-38 page
</A-CL>Analog Torque Limit	Current Limit Function is activated by the analogue torque command input values when it is set to ON.	S, P	
</H_SENS>Home Sensor	When activated, the sensor indicates the Return to Home sequence that is detected.	I	
</SHOME>Start Homing	When activated, the system starts returning to home.	I	.
</PAUSE>Index Pause	When activated, it decelerates until stop and pause the index sequence. It decides whether to stop or to continue the motion by constantly monitoring the input status.	I	.
</STOP>Index Stop	When activated, index movement ends.	I	.
</I-SEL0> Index Selection 0 Input </I-SEL1> Index Selection 1 Input </I-SEL2> Index Selection 2 Input </I-SEL3> Index Selection 3 Input </I-SEL4> Index Selection 4 Input </I-SEL5> Index Selection 5 Input	Used for the combinations to allocate indexes.	I	.
</H_STOP>Homing Stop	Stops Homing operation when it is set to ON.	I	
</START_I>Start Indexing	Starts Indexing when it is set to ON.	I	
</ABS-MD> Absolute Position Data Transfer Mode	Absolute Data transfered to host contoller by photo coupler output which output Fault Code when it is set to ON.	F	

General Input Signal (Fixed)

Power

Table 3.4 Power Input Signal

Signal Name	Symbol	Function	Mode	Reference
External power input	+24V IN	As control power input for contact point signal, +24 [V] power should be prepared by users. Power Specifications: 21.6 ~ 26.4V, 210mA	All	

Emergency Stop

Table 3.5 Emergency Stop Input Signal

Signal Name	**Symbol**	**Function**	**Mode**	**Reference**
Emergency Stop	E-STOP	Connect and use an extra emergency stop switch to quickly act upon emergency situation, users can select whether to use in [Ft-0.05] constant.	All	3-18 page

Position Command

Table 3.6 Position command input signal

Signal Name	**Symbol**	**Function**	**Mode**	**Reference**
Pulse Command	PULS+	Receives position command by pulse input. Can respond to line drive or 12 [V] & 5 [V] open collector output of the host controller.	F	5-10 page
	PULS-			
	SIGN+			
	SIGN-			
High Frequency Pulse Command	HF_PULSE+	Connect the high frequency pulse input to this terminal. (Line Drive less than 3 [Mpps])	F	
	HF_PULSE-			
	HF_SIGN+			
	HF_SIGN-			
Open Collector(24 [V]) Pulse Command	24V_PULSE+	For Open Collector 24 [V] pulse input, connect to this terminal without a pull-up resistance.	F	
	PULS-			
	24V_SIGN+			
	SIGN-			
Speed Command Input	VCMD+	Receives analog speed command. (-10 [V] ~ +10 [V])	S	5-32 page
	VCMD-			
Torque Command Input	ICMD+	Receives analog torque command. (-10 [V] ~ +10 [V])	C	5-43 page
	ICMD-			

(I/O) Output Signal

Sequence Output Signal (Allocation)

Refer to the 5-1 page "Sequence I/O (Input/Output) Signal" for details of sequence output signal.

Table 3.7 I/O Sequence Output Signal

Signal Name	Description	Mode	Reference
</S_ALM> Alarm	Outputs when Servo Alarm sets off.	All	8-5 page
</P-COM (+, -)> Position Completion Detection	Turns to ON, when the position error is within the set value of the position completion range [Ft-5.00].	F, I	5-28 page
</NEAR (+, -)> Position Proximity Detection	Turns to ON, when the position error is within the set value of the position completion range [Ft-5.02].	F, I	5-28 page
</V-COM (+, -)> Speed Match Detection	Turns to ON when the deviation between the speed command and the motor rotation speed is within the set value of the speed match decision range [Ft-5.03].	F, S, P, I	5-38 page
</TG-ON (+, -)> Rotation Detection	Turns to ON when the motor is rotating above the set value of the rotation detection level [Ft-5.04].	All	5-39 page
</T-LMT (+, -)> Torque Limit Detection	Turns to ON when torque reaches the set value of the torque limit.	All	5-46 page
</V-LMT (+, -)> Speed Limit Detection	Turns to ON when speed reaches the set value of the speed limit.	All	5-41 page
<BK (+, -)> Brake Control	It is the signal for the brake control installed inside or outside of the servo motor.	All	7-6 page
</A-VLD> Absolute Position Valid	Turns to ON when the absolute position data is valid while using the absolute motor.	All	
</RDY> Drive Ready	Means getting the operation ready while in the Servo-OFF status.	All	
</WARN (+, -)> Warning	Turns to ON when a Servo warning is detected.	All	8-3 page
</HOMC (+,-)> Axis Homing	When activated, it shows the completion of the Homing operation.	I	.
</IMO (+,-)> In Motion	Turns to ON when in motion.	I	.
</I-DW> In Dwell	When activated, it indicates that the motor is on the hold position in the index movement and on stand-by for the dwell time assigned.	I	.
</O_ISEL0> Index Selection 0 Input </O_ISEL1> Index Selection 1 Input </O_ISEL2> Index Selection 2 Input </O_ISEL3> Index Selection 3 Input </O_ISEL4> Index Selection 4 Input </O_ISEL5> Index Selection 5 Input	Used to output the index number in use in the selected indexing operation.	I	.
</E_SEQU> Sequence Operation Completion	Turns to ON when the index movement is complete.	I	

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

Table 3.8 Alarm Code Output Signal

Signal Name	Symbol	Function	Mode	Reference
Alarm code	FAULT1/OUTPUT4 (Alarm 1/Digital output 4)	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	8-3 page

NOTE If one or more of Alarm code (FAULT1, 2, and 3) set to Digital output, Alarm code does not output.

Encoder Signal

Table 3.9 Encoder Signal

Signal Name	Symbol	Function	Mode	Reference
Encoder Signal Output	AM+	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	7-24 page
	AM-			
	BM+			
	BM-			
	IM+			
	IM-			
Absolute Encoder Position S pulse	PS+	Outputs the number of rotation by serial data when the absolute encoder is used.	All	7-24 page
	PS-			

Servo Alarm

Table 3.10 Servo Alarm Output Signal

Signal Name	Symbol	Function	Mode	Reference
Servo alarm Monitor Output	FAULT+	It is displayed if the servo alarm is generated.	All	7-28 page
	FAULT-			

Encoder Z-pulse Display

Table 3.11 Encoder Z-pulse Output Signal

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 -			

(I/O) Input Circuit and Interface

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

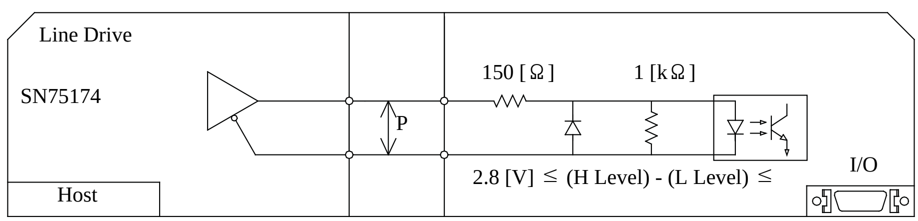
Pulse Command Input Circuit

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. Refer to the 5-10 page "Position Control Mode" for the servo drive setting according to the selection.

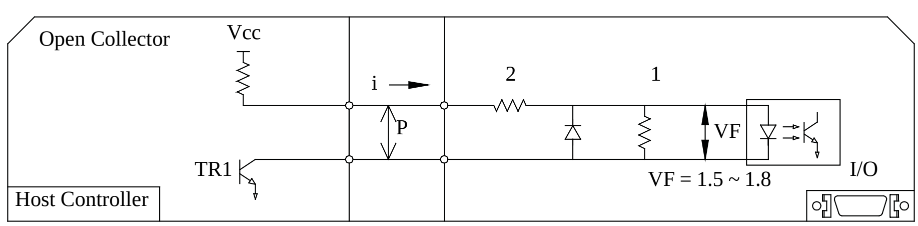
Line drive - Maximum allowable frequency 900 [kpps](Duty ratio: 50:50)

- Input pin number
  ... PULS+ (11), PULS- (12)
  ... SIGN+ (13), SIGN- (14)



Open Collector (24 [V])- Maximum Allowable Frequency 250 [kpps]

- Input pin number
  ... 24V : PULS+ (49) , PULS- (12)
  ... 24V : SIGN+ (25), SIGN- (14)

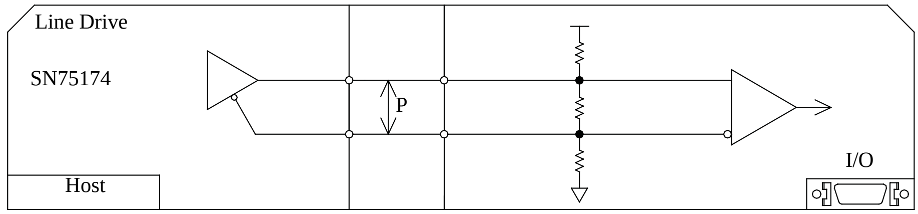


NOTE For Open Collector 24 [V] input, it does not need the external resistance.

High Frequency Line Drive - Maximum Allowable Frequency 3 [Mpps]

- Input pin number

... PULS+ (15), PULS- (16)
... SIGN+ (23), SIGN- (24)



NOTE Maximum allowable frequency of host controller's pulse command is

... 900 [kpps] for the line drive
... 3 [Mpps] for high speed line drive
... 250 [kpps] for the open collector

If the maximum allowable frequency is exceeded, [E.PoSEr] 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

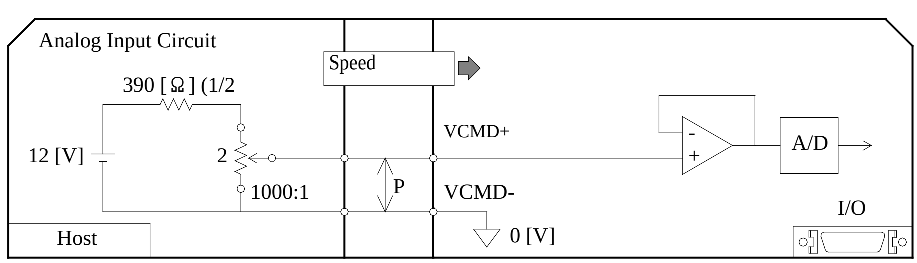
The drive receives analog voltage output of the host controller with speed, speed of torque control mode and torque command.

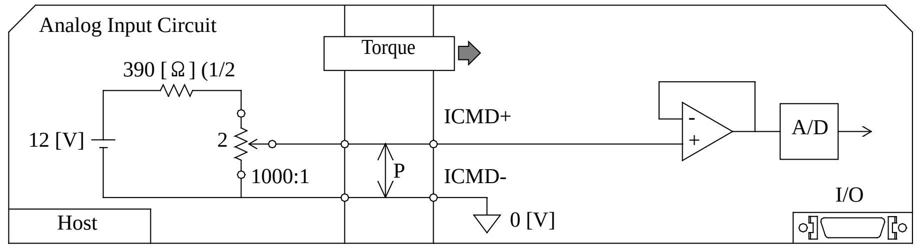
Input impedance of speed and torque commands is about 10 [kΩ].

Maximum allowable voltage range of input signal is -10 [V] to +10 [V].

Input pin of I/O that uses analog voltage output of the host controller:

... Speed Command: VCMD+ (19), VCMD- (20)
... Torque Command: ICMD+ (21), ICMD- (22)

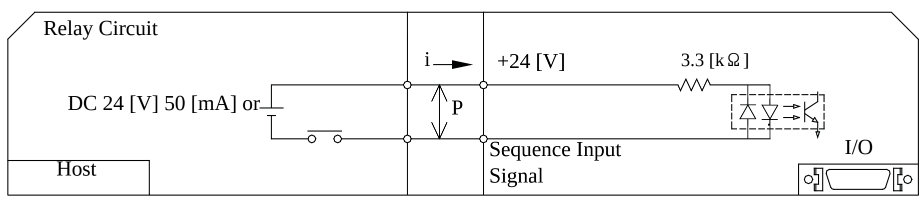


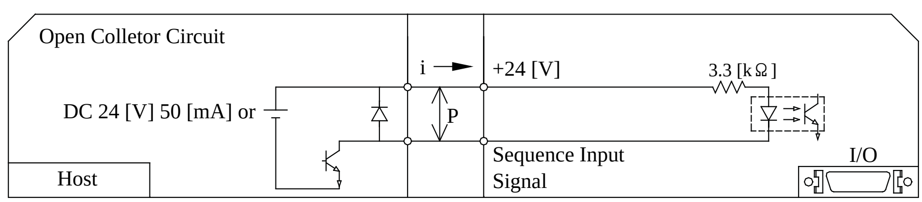


Sequence Input Circuit

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

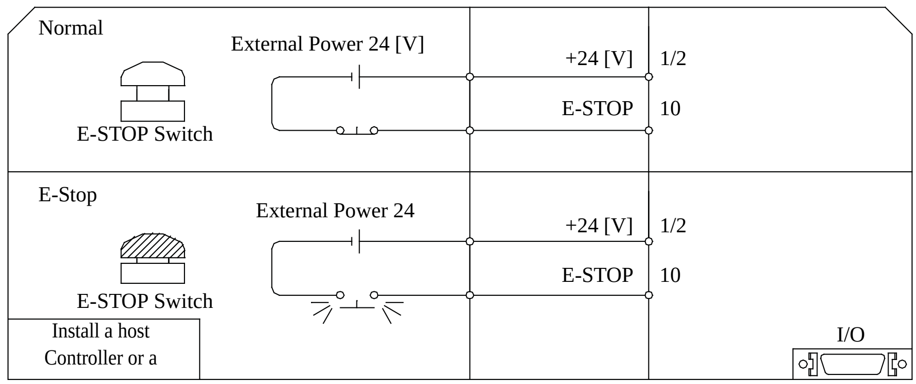
This drive has a built-in circuit for the emergency stop situation.

To quickly respond to the equipment failure or dangerous situation, it receives the emergency stop signal from #10 pin of I/O.

Emergency stop input can be done by the relay contact output of host controller and installing a separate switch.

Whether to use the emergency stop input can be set by the parameter [Ft-0.05]; the initial value is set as not to use.

#10 pin of I/O 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 8-3 page "Protection Function" more information on the servo alarm.

... If the emergency stop is released, reset the alarm by referring to the 7-49 page "Alarm Reset (run-08)".

... You can check the status of emergency stop signal through the monitor mode describe in the 7-52 page "Monitor Mode Function".

(I/O) Output Circuit and Interface

There are 2 types for the servo drive output circuits. Design the input circuit at the host controller suitable for the each output circuit.

... Line Drive Output
... Photo-Coupler output

Line Drive Output

Output signal (AM+, AM-, BM+, BM-) that converted the encoder serial data into 2 phase (A phase and B phase) pulse, zero point pulse signal (IM+, IM-) 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].

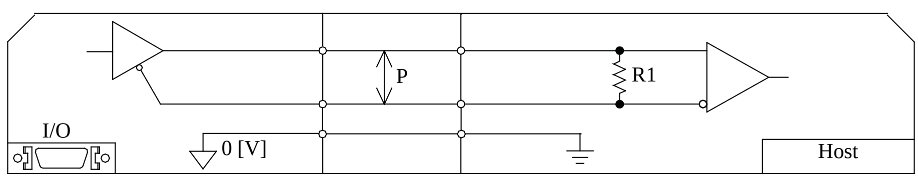
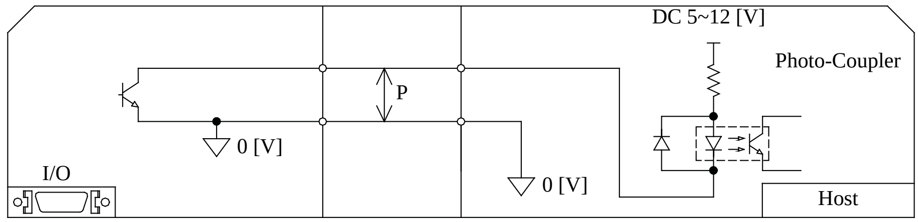


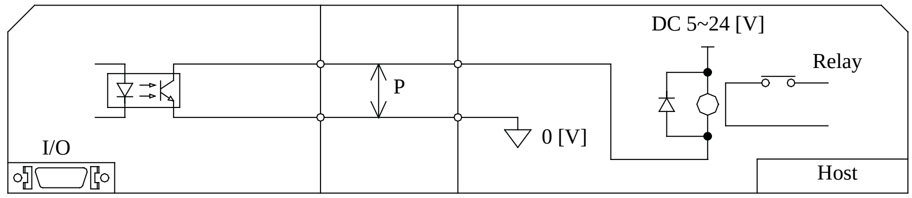
Photo-Coupler Output

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

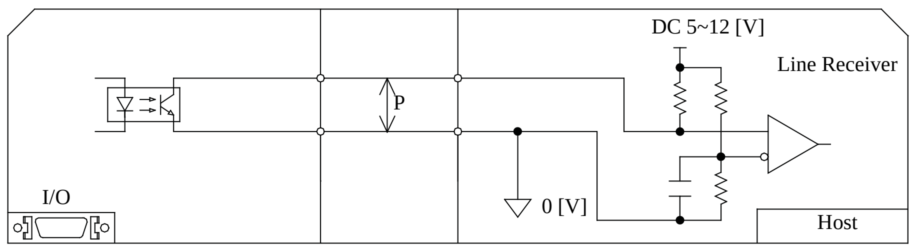
Connect to the photo-coupler circuit of the host controller:



Connect to the relay circuit of the host controller:



Connect to the line receiver circuit of the host controller:



Encoder Wiring (Motor Feedback)

Pin Arrangement of Motor Feedback

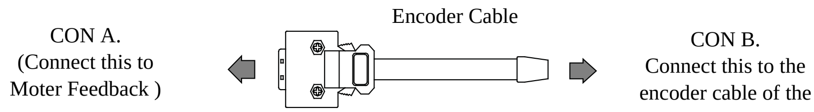
The table below shows the pin arrangement for each encoder.

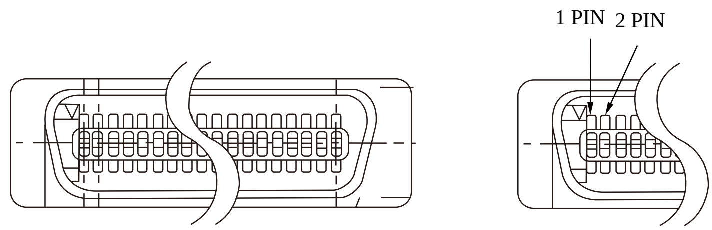
Table 3.12 Pin Arrangement for Encoder C onnector (Motor Feedback)

Drive		**Motors**				
No.	**Function**	**CSMT CSMR**	**RSMQ RSMZ**	**RSMS RSMD RSMH**	**CSMT CSMR RSMQ RSMZ**	**RSMS RSMD RSMH**
		9 wire Inc.	**9 wire Inc.**	**9 wire Inc.**	**17-bit Serial (Abs, Inc)**	**17-bit Serial (Abs, Inc)**
1	EO [V]	8	11	G	8	G
2	-	-	-	-	-	-
3	A	1	1	A	-	-
4	/A	2	2	B	-	-
5	B	3	3	C	-	-
6	/B	4	4	D	-	-
7	C	5	5	E	-	-
8	/C	6	6	F	-	-
9	LMT-	-	-	-	-	-
10	S1/SD+	-	-	-	4	K
11	-	-	-	-	-	-
12	-	-	-	-	-	-
13	SD-	-	-	-	5	L
14	S2	-	-	-	-	-
15	-	-	-	-	-	-
16	S3	-	-	-	-	-
17	LMT+	-	-	-	-	-
18	-	-	-	-	-	-
19	-	-	-	-	-	-
20	E5 [V]	7	10	H	7	H
FG		9	12	J	3	J

Terminal Type

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





Connector CON A for connection to Motor Feedback of servo drive:

One type regardless of motor model and encoder.

Model Number	Manufacturer
10120-3000PE 10320-52F0-008(LATCH) 10320-52A0-008(SCREW)	3M

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

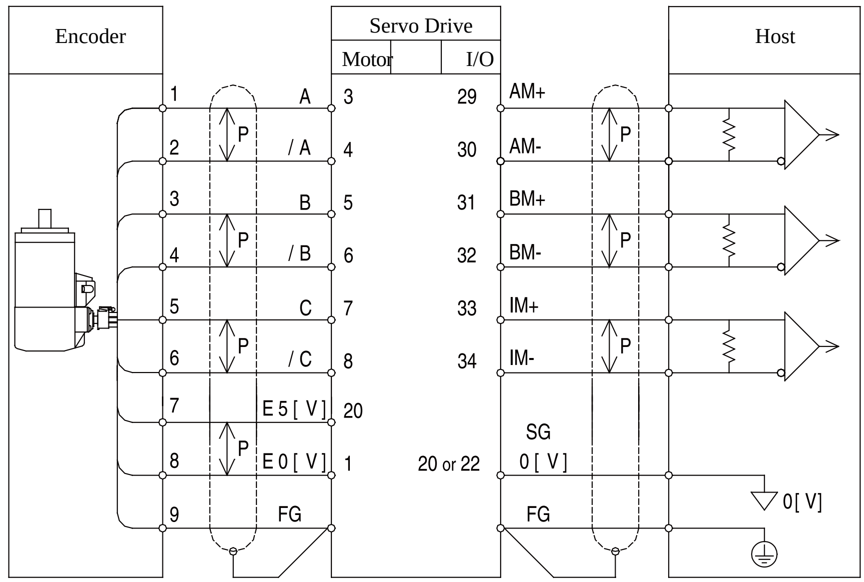
Motor	Type	Housing	Terminal	Manufacturer
CSMT, CSMR	9 wire Inc. Serial Absolute Serial Inc.	172161-1	170361-1 or 70365-1	AMP
RSMZ, RSMQ	9 wire Inc.	171162-1		
RSMS, RSMD, RSMH, RSMF, RSMK, RSML	9 wire Inc.	DMS 3108B20-29S or DMS 3106B 20-29S		DDK

Power cable connector for large capacity motor packed with the motor.

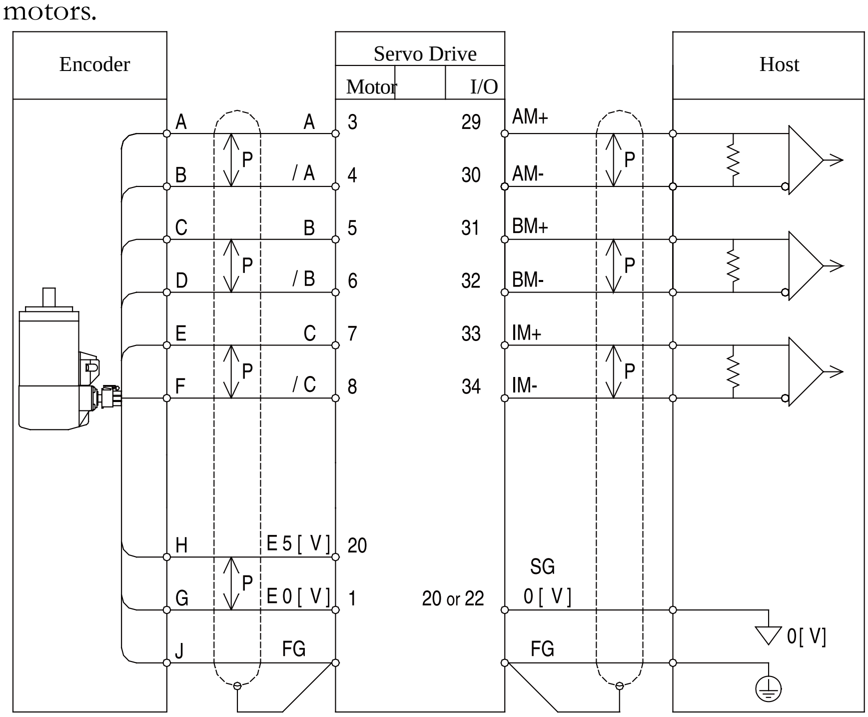
NOTE Do not connect FG of servo drive to host controller if GND and FG are common, or if there is no separate FG.

Encoder Signal Process

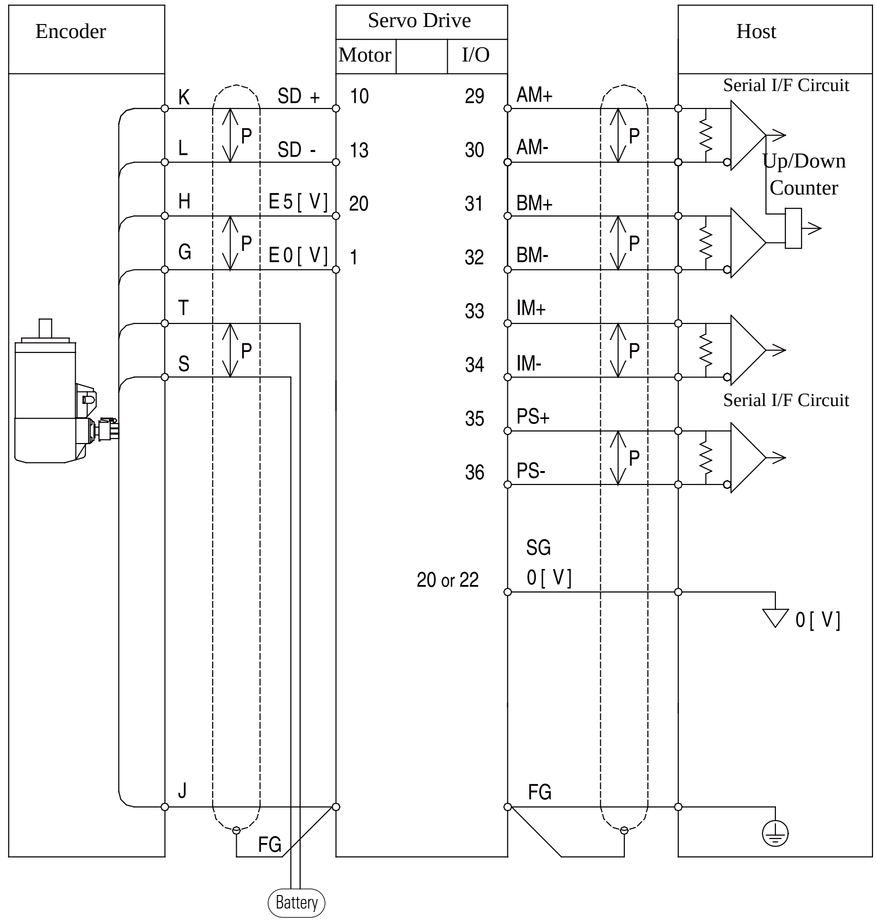
Incremental encoder (9 wire Inc.) connection of CSMT/R motors.



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

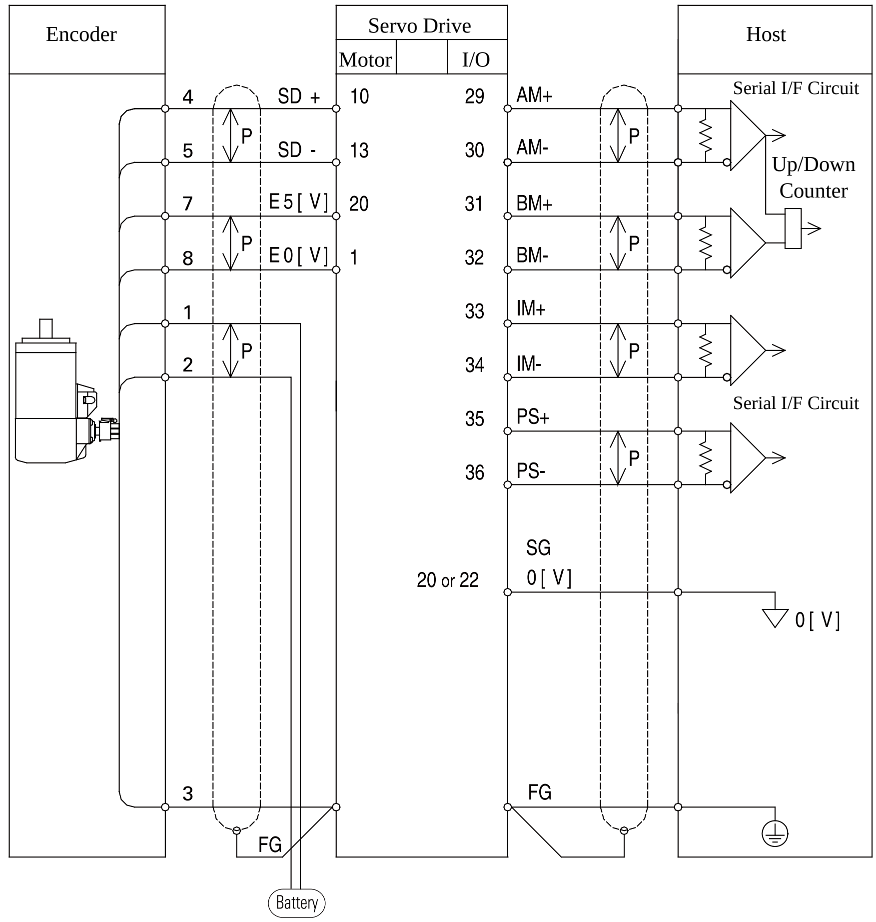


Serial encoder connection of RSMS/D/F/H/K/L motors.



* Connect when absolute encoder is used

Serial encoder connection of CSMT/R, RSMKQ/Z motors (Absolute, Incremental).



* Connect when absolute encoder is used

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 100 [Ω])
- 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, and 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.
- I/O (I/O signal connector) and Motor Feedback (encoder cable) should be twist pair wire and batch shield wire.
- 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.

NOTE Refer to the servo motor manual more information on the following cable Specifications and order code.

- Motor 3 phase power cable
- Encoder cable
- Motor brake cable
- I/O cable
- Communication cable

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.

Table 3.13 Fuse Specifications

Drive	Capacity	Power Capacity per 1 Drive [kVA]	MCCB or Fuse Power Capacity [Amps]
CSD5_A5BX1	50 W	0.25	4
CSD5_01BX1	100 W	0.40	4
CSD5_02BX1	200 W	0.75	4
CSD5_04BX1	400 W	1.2	8
CSD5_08BX1	800 W	2.3	8
CSD5_10BX1	1 kW	2.3	8
CSD5_15BX1	1.5 kW	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.

CAUTION

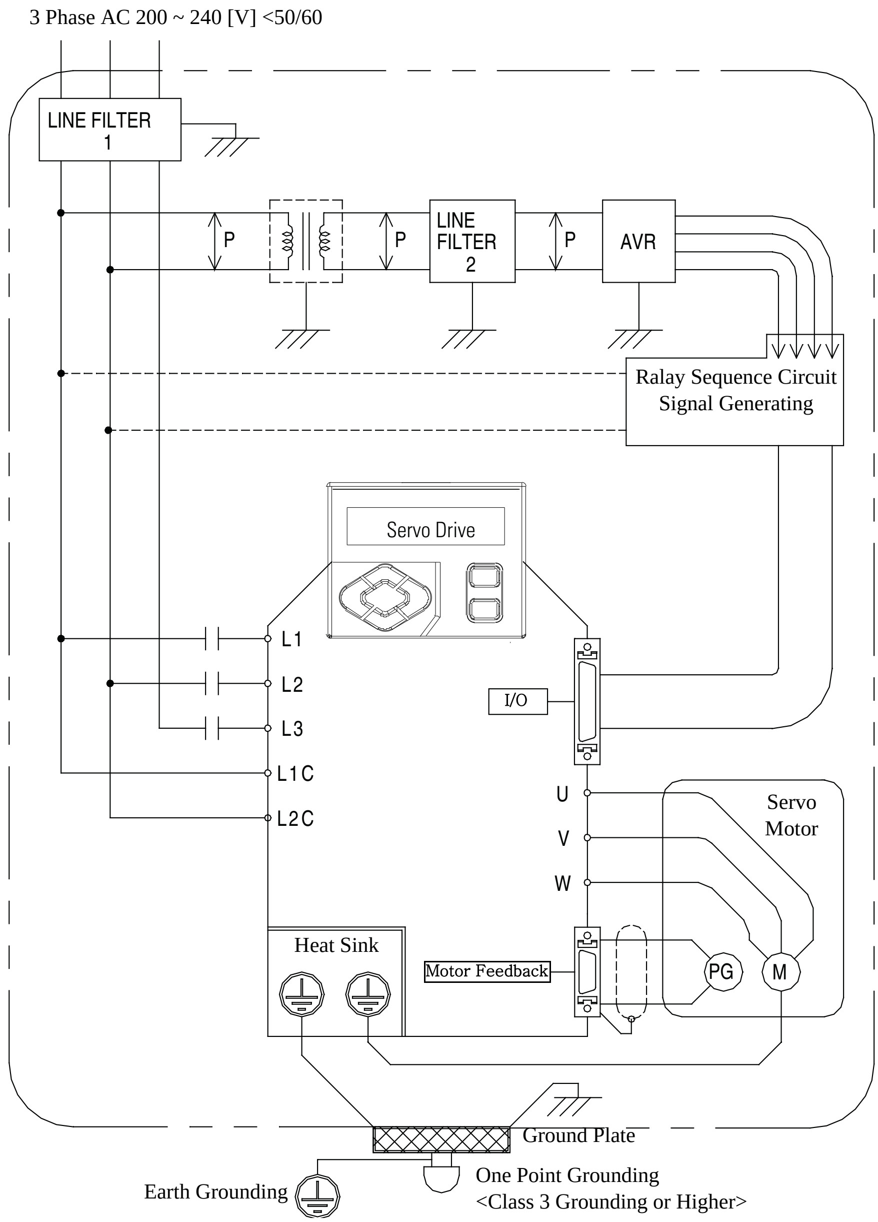
The high -speed cut-off fuse cannot be used. As the power of the drive is condenser input type, the fuse may be blown even during a normal situation if the high-speed cut-off fuse is used.

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.

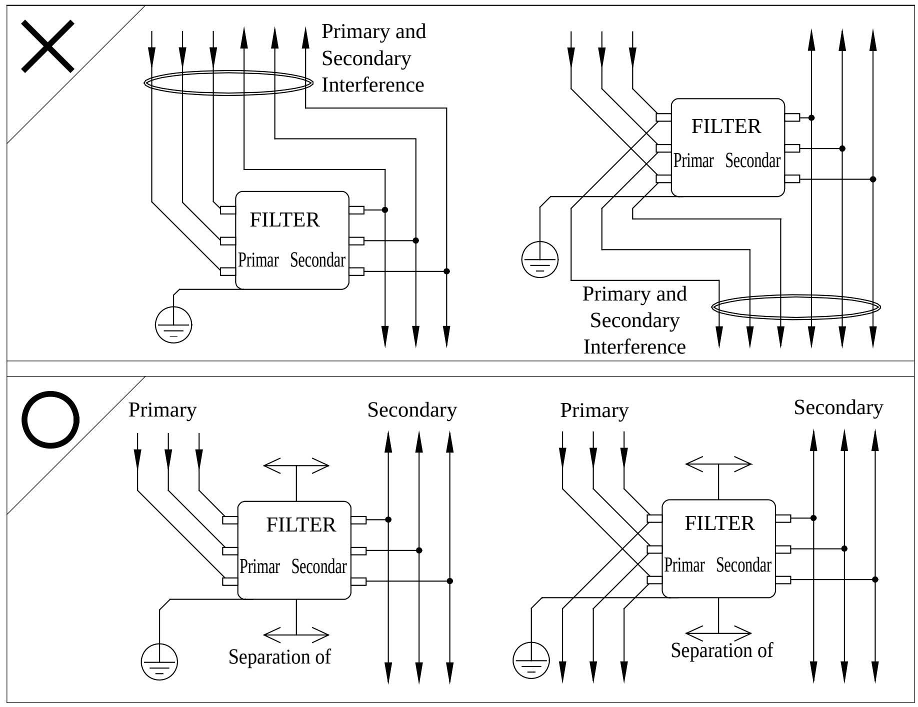
CAUTION

Use a wire of 3.5 [mm^2] or thicker for the earth wire. Separate the signal and power wiring.

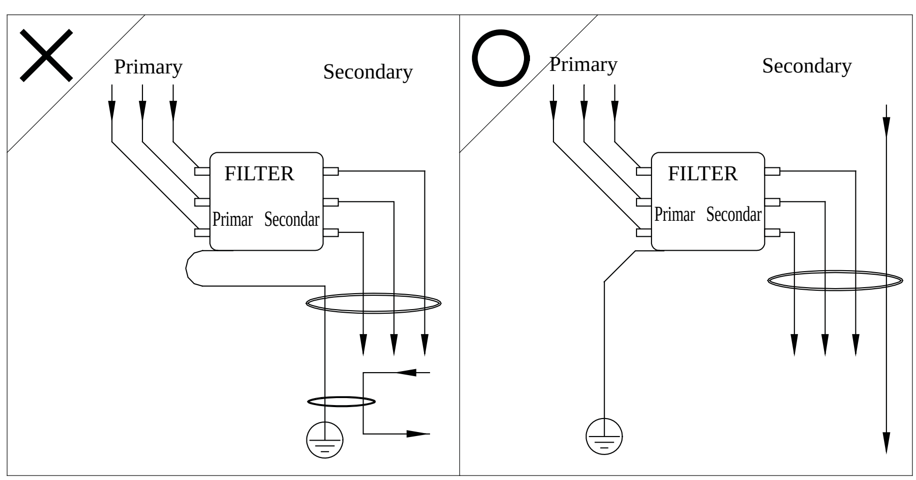


Extra caution is required when wiring the noise filter. The following figure describes precautions when wiring the noise filter. If the wiring is wrong, the performance of the noise filter falls.

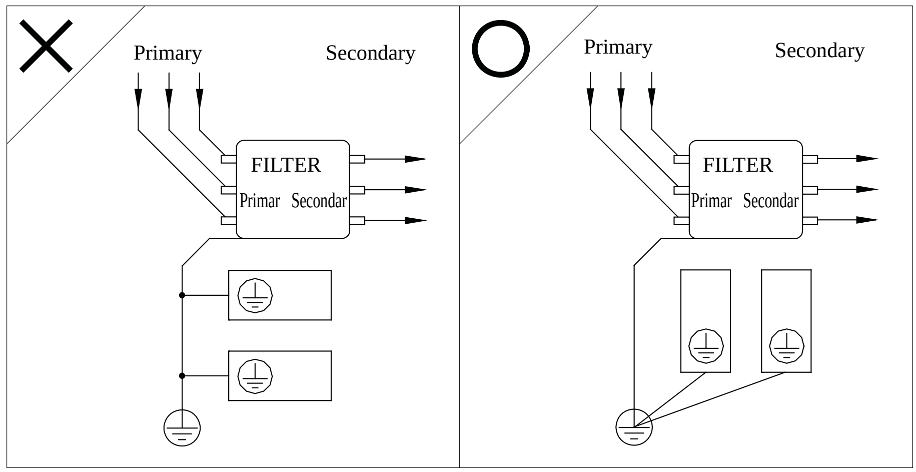
Separate the input and output wiring of the noise filter and do not tie up them together.



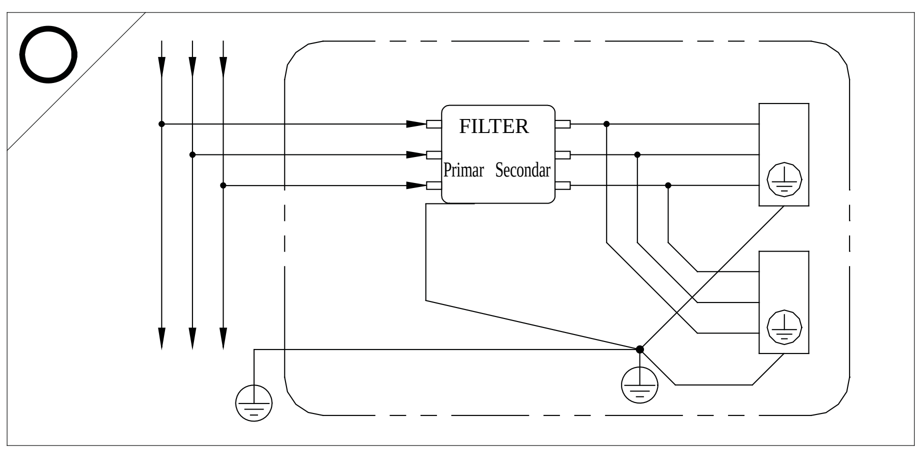
Earth wire of the noise filter should be wired in distance to the output wire and do not put other signal lines and earth wire in a same duct and tie up them together.



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.

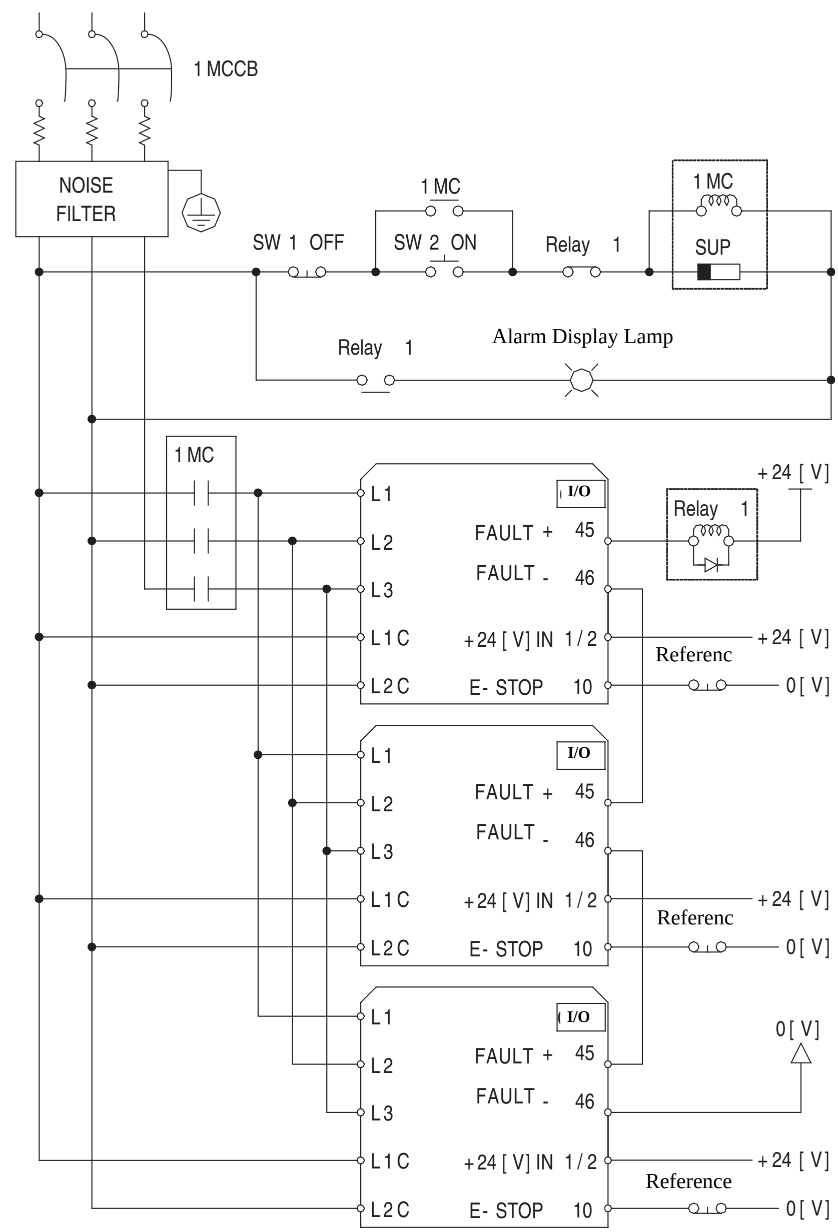


Wiring when Using Several Drives

This is an example of wiring when connecting several drives.

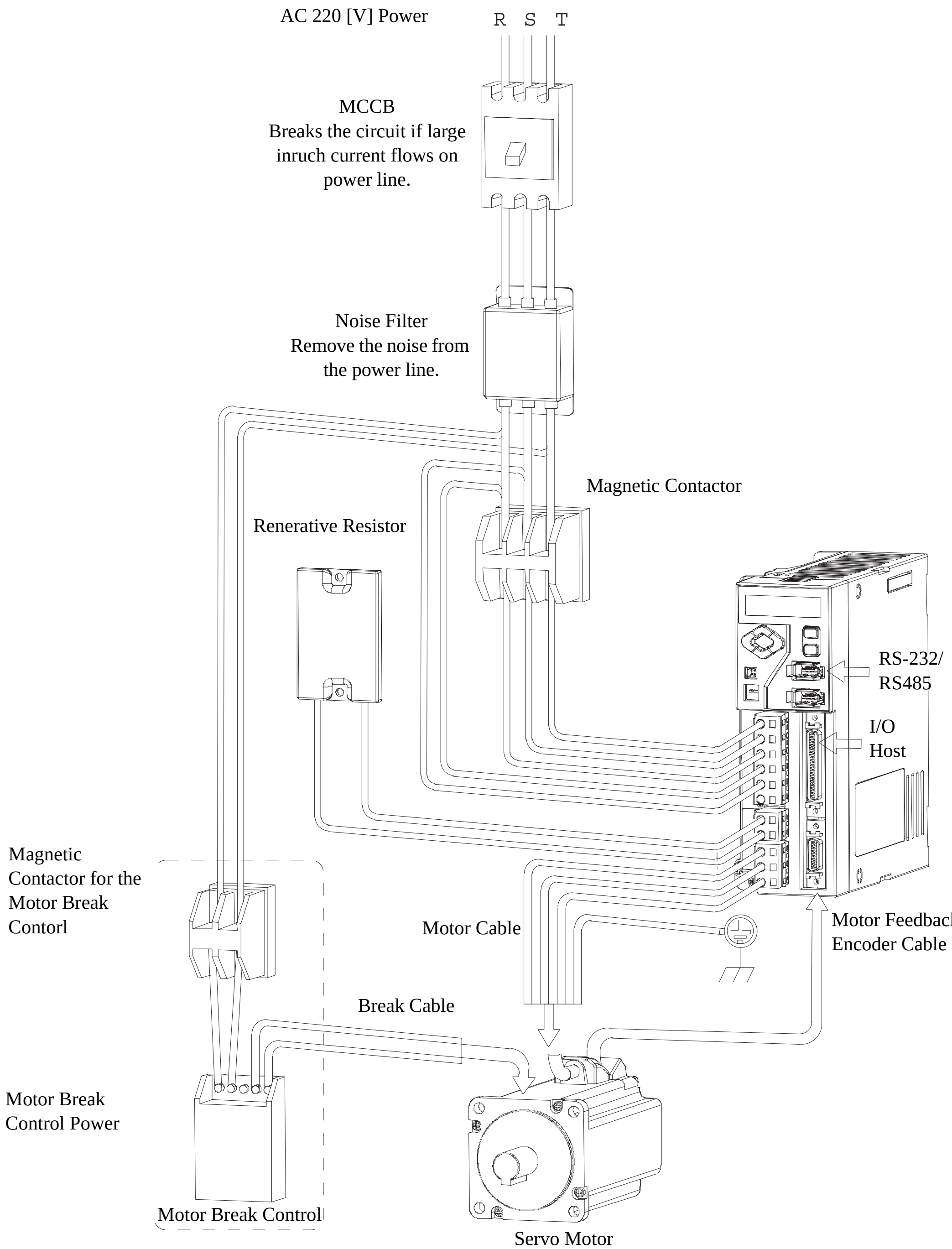
Connect the alarm output (SALM) signal of each servo drive in a series and run Relay 1 to detect the alarm. Normally, SALM+ and SALM- are interconnected, and with 24 [V] supplied to Relay1, the servo drive runs normally.

If the servo alarm is generated, 24 [V] supplied to Relay1 is cut off.



NOTE Whether to use the emergency stop input can be set by the parameter [Ft-0.05]; the initial value is set as not to use. Do not wiring when it does not using the emergency stop.

Connection to Peripheral Equipment



Operator, Basic Setting and Startup

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?

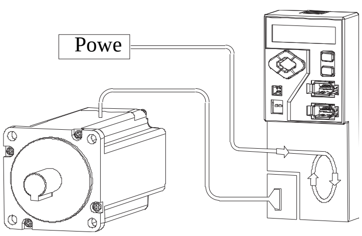
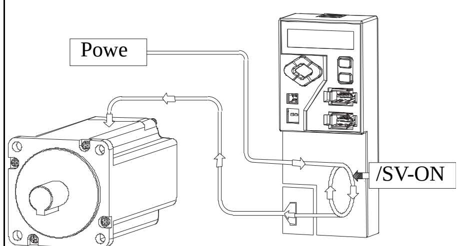
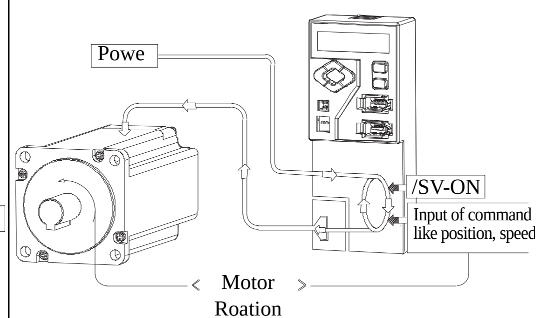
Audio or TV can select and play music and display channel that the users want from the moment the power switch is on.

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

Table 4.1 Servo-OFF and Servo-ON

Servo-OFF Status	**Servo-ON Status**	**Input of commands such as position, speed regarding servo-ON status and motor run**
• 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.	• 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.

Host	Apply power to the drive	Receive servo-On signal	Receive command such as position, speed	Motor rotate
Driver	Start automobile	Set transmission at position D.	Run accelerator	Automobil e runs

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.

Servo-ON/OFF Signal Indication

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 I/O. Refer to the 5-1 page "Sequence I/O (Input/Output) Signal" 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 makes itself Servo-ON for the operation.

TIP

... Refer to the 7-41 page "Operation Mode Function" for the operation mode (run-00) to (run-02). In addition, the operation mode (run-00) is described in the 4-21 page "Startup" 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 the7-49 page "Alarm Reset (run-08)". 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 8-3 page "Servo Warning" for the information of the servo alarm.

TIP

... All parameter setting after Chapter 4 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.

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.
- ... Provides all key manipulation function without a separate external operator.

The following figure shows the front side of the operator on the servo drive.

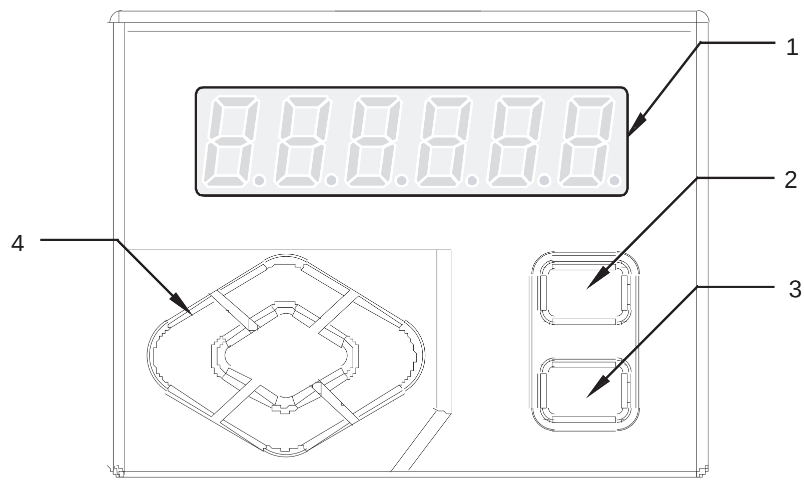


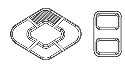
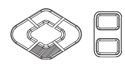
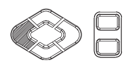
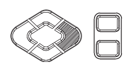
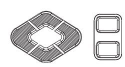
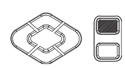
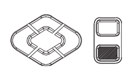
Table 4.2 Name and Function of Each Part

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	Top, Bottom, Left/Right Key	Moves the digit of 7-segment LED display and functions as the UP/DOWN of the number.

Icons for the Key Buttons

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

Table 4.3 Icons for the Key Buttons

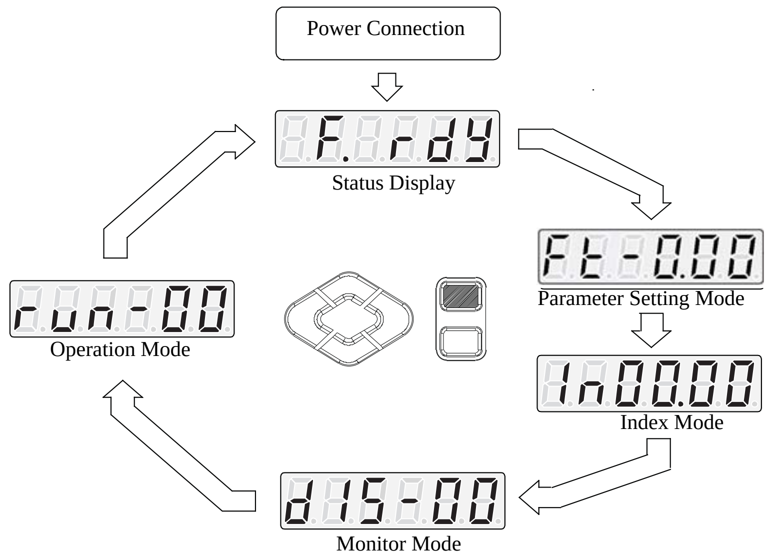
Key Button[1]	Name	Function
	Up	• Increases and decreases the value • Press and hold this icon to continuously increase/decrease the value
	Down	
	Left	• Shifts the digits
	Right	
	Direction Key	• Used to indicate up, down, left, right keys altogether
	MODE/ SET Key	• Changes the mode • Saves the setting value • Start running
	ENTER Key	• To enter/exit each setting window after changing the mode • Select setting value

(1) 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 5 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 5 mode types and read the following.



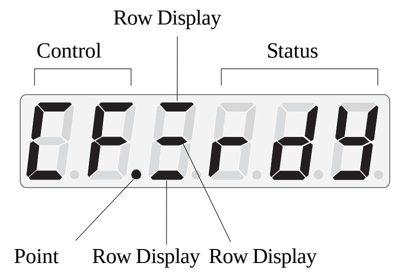
The displayed values in the above figure are the initial value of each mode.

If the value is changed in a mode and then returned, the changed value is shown instead of the initial value.

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. Refer to the table below for the meaning of each display.



Control Mode (Ft-0.00)

Displays control mode in use. In Servo-ON status (in operation), the display of the control mode flickers.

Table 4.4 Status Display Modes - Control Mode

	Display	Description
Basic Control Mode	F	Position mode
	S	Speed mode
	C	Torque mode
	P	Multi-step speed mode
	I	Index mode
Combinational Control Mode	SF	Speed + position mode
	CS	Torque + speed mode
	CF	Torque + position mode
	PF	Multi-step speed + position mode
	PS	Multi-step speed + speed mode
	PC	Multi-step speed + torque mode

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.

Status

Displays corresponding character upon servo warning.

Refer to the 8-3 page "Servo Warning" for details of the servo warning.

Table 4.5 Status Display Mode - Status

Display	Description
rdY	It means the preparation for the operation in Servo-OFF status.
run	Displays that it is running.
Pot	Displayed when forward operation prohibiting signal is input.
not	Displayed when reverse operation prohibiting signal is input.

Point Display

It is on if the power is applied.

Row Display

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

Table 4.6 Status Display Mode -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 [Ft-5.00] value, the servo drive can display (</P-COM> position completion detection) signal. It is on when </P-COM> signal is displayed.	page 5-28
	When using as a speed mode, if the difference between motor speed and speed command is smaller than [Ft-5.03] value, the servo drive can display (</V-COM> speed coincidence detection) signal. It is on when </V-COM> signal is displayed.	page 5-38
Row Display 2	When the rotation speed of the motor is higher than the setting value of rotation detection level [Ft-5.04], the servo drive can display (</TG-ON> rotation detection) signal. It is on when </ TG-ON > signal is displayed.	page 5-39
Row Display 3	It is on when Z-pulse output of the encoder is detected. In case of linear motor, it is on when first hall U signal 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 Appendix B "Table for Parameter Setting".

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.

The table below is to aid the understanding of parameter group.

Parameter range:

From 

To 

Table 4.7 Parameter Group

Parameter Group			Parameter Group Description
Group 0	Ft-0.00 ~ Ft-0.32	33	User parameter related to basic setting and I/O signal
Group 1	Ft-1.00 ~ Ft-1.42	43	User parameter related to gain and gain tuning
Group 2	Ft-2.00 ~ Ft-2.13	14	User parameter related to speed control mode
Group 3	Ft-3.00 ~ Ft-3.08	9	User parameter related to position control mode
Group 4	Ft-4.00 ~ Ft-4.06	7	User parameter related to torque control mode
Group 5	Ft-5.00 ~ Ft-5.16	17	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.

Monitor Mode Range:

From 

To 

Table 4.8 Monitor Mode

Item	Monitor Contents [Unit]
dIS-00	Speed feedback [rpm or mm/sec]
dIS-01	Speed command [rpm or mm/sec]
dIS-02	Speed error [rpm or mm/sec]
dIS-03	Torque command [%]
dIS-04	Position feedback [pulse]
dIS-05	Position command [pulse]
dIS-06	Position error [pulse]
dIS-07	Position command pulse frequency [kpps]
dIS-08	Electrical angle [°]
dIS-09	Mechanical angle [°]
dIS-10	Accumulated load rate of regenerative resistor [%]
dIS-11	DC Link voltage [V]
dIS-12	The number of rotation data of absolute encoder
dIS-13	Speed command offset [mV]
dIS-14	Torque command offset [mV]
dIS-15	I/O status
dIS-16	Alarm history
dIS-17	Firmware version
dIS-18	Motor & Encoder Type
dIS-19	Analog speed command vol [0.01V]
dIS-20	Analog torque command voltage [0.01V]

Table 4.8 Monitor Mode

Item	Monitor Contents [Unit]
dIS-21	Drive rated output
dIS-22	Absolute encoder 1-time rotation data
dIS-23	Encoder feedback counter

The items like Posiotn feedback, Potion Command, and Encoder Feedback Counter of the monitor mode Posiotn feedback, whose value is more than 6 digits, is not displayed at once by the 6-digit 7-segment LED display. Therefore, it is displayed seperatly by left and right key. Refer to the 7-52 page "Monitor Mode Function"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 7-41 page "Operation Mode Function"for details of operation mode.

The table below shows the brief functions of each item in the operation mode.

Operation Mode Range:

From 

To 

Table 4.9 Operation Mode

Item	Operation
run-00	Jog operation
run-01	Off-line auto tuning
run-03	Auto adjustment of the speed command offset
run-04	Auto adjustment of the torque command offset
run-08	Alarm reset
run-10	Absolute encoder reset
run-11	2-group gain storing
run-12	Parameter initialization

Refer to the 7-41 page "Operation Mode Function" 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.

- ... Other parameters can be set after the basic setting.
- ... The basic setting is possible only after connecting the control power of the servo drive.
- ... After all setting three types of basic setting, reapply the power.
- ... 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.
- ... To change basic setting value, change it directly from corresponding parameter and reapply the power.

As shown below, the basic setting uses two parameters to set 2 types.

Table 4.10 Basic Setting

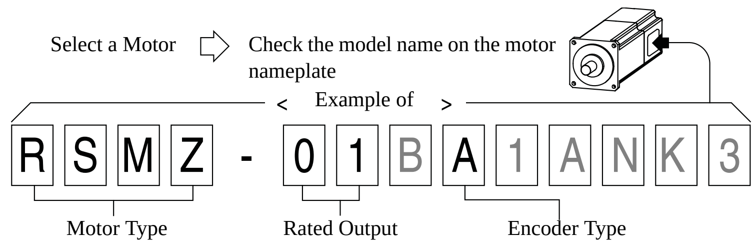
	Basic Setting Parameter		Setting
1	Ft-0.00	F	Control mode (optional) setting
2	Ft-0.01	-_04_b	Motor setting • Motor type setting • Motor capacity (rated output) setting • Encoder type setting

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 5 kinds of basic control modes and 6 kinds of associated control modes. The table below shows the control mode types. Refer to the Chapter 5 for function for each control mode.

Table 4.11 Contorl Mode Type

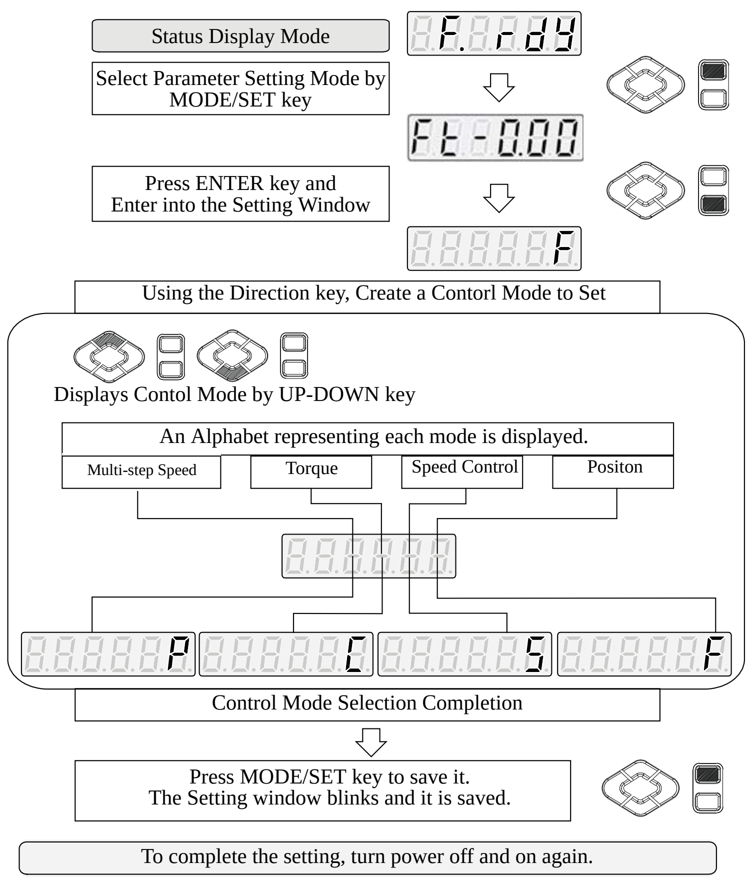
	Display	Description
Basic Contorl Mode	F	Position mode
	S	Speed mode
	C	Torque mode
	P	Multi-step mode
	1	Index mode
Associated Control Mode	SF	Speed + position mode
	CS	Torque + speed mode
	CF	Torque+ position mode
	PF	Multi-step speed + position mode
	PS	Multi-step speed + speed mode
	PC	Multi-step 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.

Flowchart of the Contorl Mode



Combinational Control Mode Setting

Combinational control mode should be set as below.

Table 4.12 Combinational Control Mode

Associated Control Mode	Setting Window Display
Speed + position control	SF
Torque + speed control	CS
Torque + position control	CF

Table 4.12 Combinational Control Mode

Associated Control Mode	Setting Window Display
Multi-step speed + position control	PF
Multi-step speed + speed control	PS
Multi-step speed +Torque control	PC

CAUTION

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.

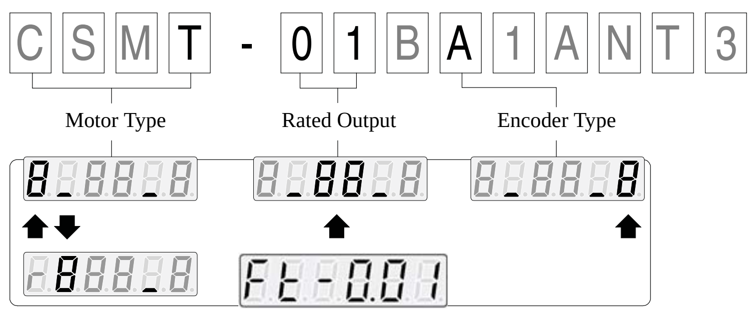
... If the setting is correctly entered, the setting window blinks once when MODE/SET key is used to save the data. However, if wrong setting is entered, it does not blink nor is saved.

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 [Ft-0.01]. As shown in the following figure, the setting window of [Ft-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. If first disit is displayed 'r', it sets RSMx motor serieses.

Table 4.13 Motor Type

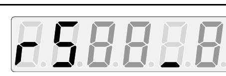
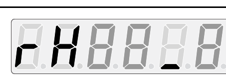
Display	Model
	CSMT
	CSMR
	CSMQ
	CSMZ
	RSMS(2004-RS**)
	RSMD(2004-RD**)
	RSMH(2004-RH**)
	RSMF(2004-RF**)

Table 4.13 Motor Type

Display	Model
	RSMK(2004-RK**)
	RSML(2004-RL**)
	RSMQ(2004-RQ**)
	RSMZ(2004-RZ**)

Rated output (Capacity)

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

Table 4.14 Motor Rated Output

Display	Capacity
	30 [W]
	50 [W]
⋮	⋮
	100 [W]
	200 [W]
⋮	⋮
	1 [kW]
	1.5 [kW]

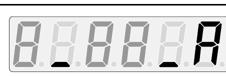
Encoder Type

In encoder type set, serial absolute encoder transmits encoder data to the drive and automatically performs setting as it is connected to the drive. The encoder type display is shown below.

Table 4.15 Encoder Type Group 1

Motor Series	Display	Number of Pulse/1 Rotation	Encoder Type
CSMT/R		131072 (resolution)	Serial Absolute
			Serial Inc.
CSMT, CSMR, CSMQ, CSMZ		2048	9 wire Inc.
		2500	11 wire Inc.(CSMQ/Z Only)
		2048	Compact Absolute (CSMQ/Z Only)

Table 4.16 Encoder Type Group 2

Motor Series	Display	Number of Pulse/1 Rotation	Encoder Type
RSMS/D/H/F/K/L RSMZ/Q		131072(resolution)	Serial Absolute
			Serial Inc.
		2500	9 wire Inc.
		2048	Compact Absolute (RSMZ Only)

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.

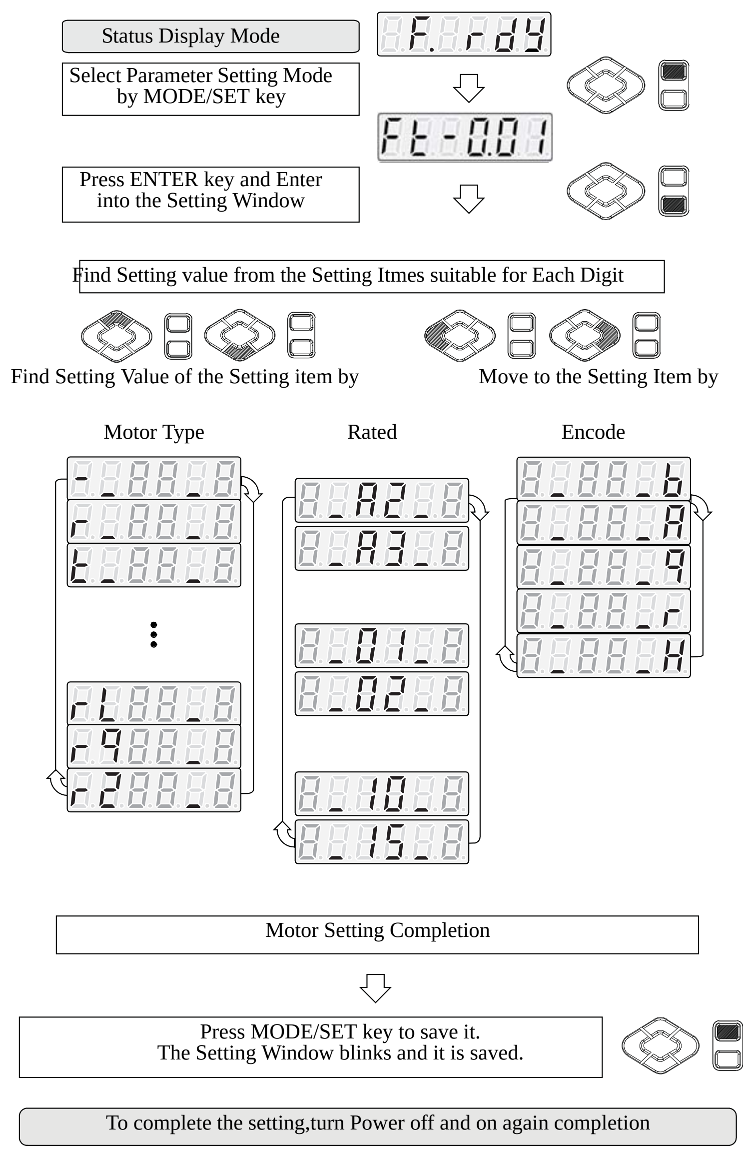
- ... In the following flowchart, the encoder type is in order of S, B, A, D, C, Q, and R.
- ... In case of using a model in encoder type 2, the encoder type is displayed in order of K, L, H, A, M, Q, and R .

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

Motor model number	setting
CSMT-04BQ1ANT3	t_04_9
RSMD-10BA1ASK3	rd10_A

Motor Setting Flowchart

Flowchart of Motor Setting Selection



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 7-51 page "Parameter Initialization (run-12)") .

... 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. Please be 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. Pereform basic setting in reference to the 4-12 page "Basic Setting".

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.

CAUTION

Caution when Startup

... 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 3-18 page "Emergency Stop Signal"for E-stop information.

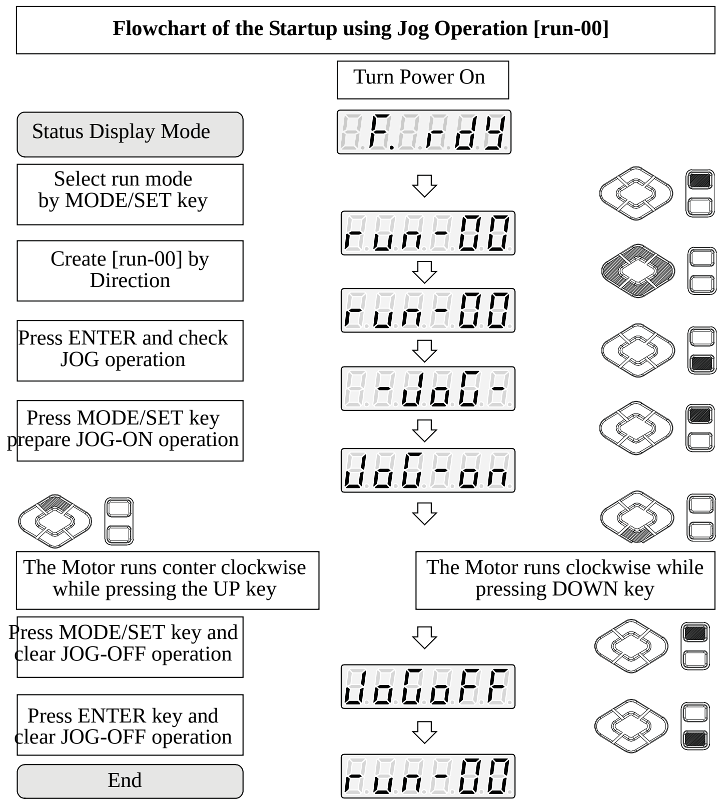
Startup

Start up 1: Start up the Drive by Using Jog Operation Function.

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 50 [rpm]. At startup 1, runs the drive at the factory setting speed, 50 [rpm].

Start up the drive according to the following flowchart.

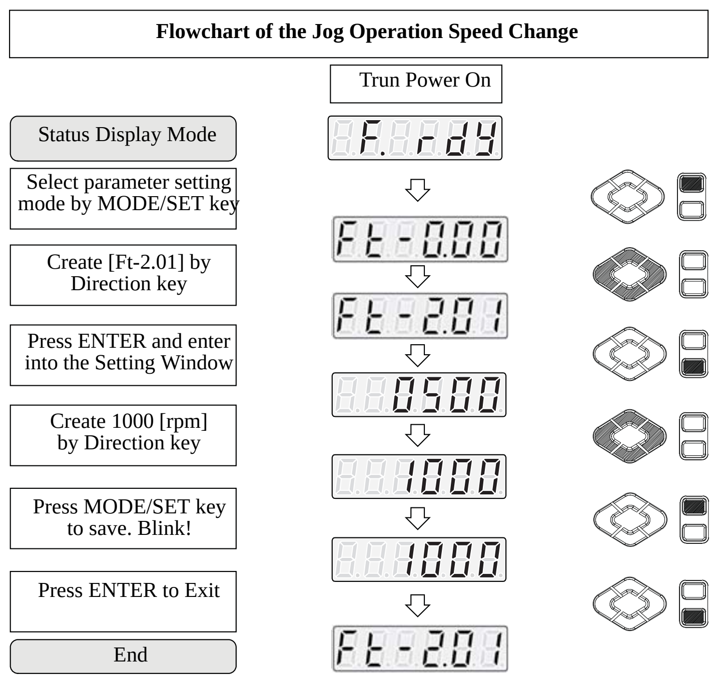


Start up 2: Start Up the Drive by Changing the Speed

Start up the drive by changing the speed from the initial value, 50 [rpm] to 1000 [rpm].

The change of Jog operation speed should be done at [Ft-2.01]. The speed set here is not related to other operation, and applied only upon the Jog operation. Setting range is 0 to 6000 [rpm]. Initial value is 50 [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 50 [rpm] to 1000 [rpm].

TIP

... At first, the drive is not tuned suitable for the load or motor.

... Upon startup, first perform off-line auto tuning(run-01) described in the 7-44 page "Off-line Auto Tuning Operation (run-01)" then startup the drive to run the motor more smoothly in a stable condition.

Function for Control Mode

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 I/O is used to allow the drive can input/output signals that have various functions.

Input provides 25 functions and you can freely allocate input signal of each function with 10 pins.

Output provides 16 functions and you can freely allocate output signal of each function with three pairs of pins such as (41, 42), (43, 44), (47, 48) and pin (37~40) of I/O.

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

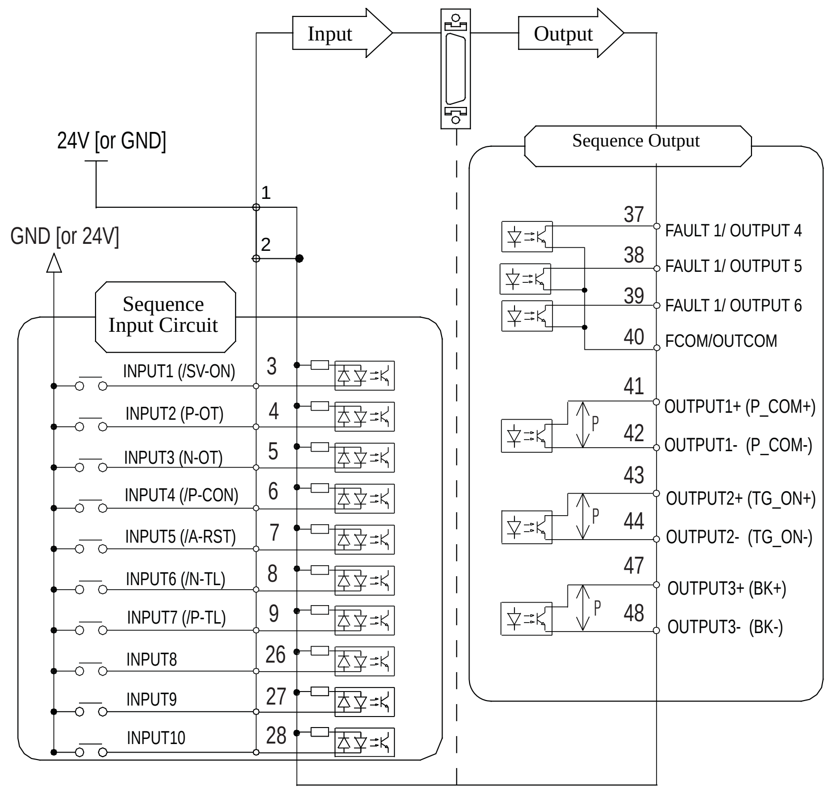
Sequence I/O signal is not to process input or output signal with the designated pin of I/O, but to select the function that the user requires in terms of circuit design of host controller and to directly allocate the selected functions to the designated pin.

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 I/O.

- Sequence Input is indicated as (INPUT#1) to(INPUT#10). (Digital Input Channel)
- Sequence Output (OUTPUT#1) to (OUTPUT#6). (Digital Output Channel)

I/O 50-Pin Connector <I/O>



Function of Input Signal

The following is the brief explanation on 25 functions of sequence input signal. Details for each signal are explained in the reference pages listed on the right side of the table.

Table 5.1 I/O Sequence Input Signal

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	page 4-1
</A-RST> Alarm reset	It releases the servo alarm.	All	page 7-49
</G-SEL> Gain gorup 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	page 6-36
</P-TL> Limit forward torque	When a signal is on, it limits forward torque by the setting value [Ft-4.03].	All	page 5-46

Table 5.1 I/O Sequence Input Signal

Type	Description	Mode	Reference
</N-TL> Reverse Torque Limit	When a signal is on, it limits reverse torque by the setting value [Ft-4.04].	All	page 5-46
<P-OT> Prohibit forward operation	It prohibits a motor from rotating forward when the load part reaches to the limit of available section.	All	page 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	page 7-2
</P-CON> P Control Conversion	It converts the Seed Controler from PI type controller to P type controller. It is used to suppress the overshoot of the excessive response and complete a faster response.	F, S, P, I	page 6-30
</C-SEL> Control mode conversion	It is used to convert the control mode when using Mixed control mode.	Combinational Control Mode Only	page 5-57
</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 [Ft-2.05 to Ft-2.11]. Rotation speed of </ C-SP4> is set by analog speed command voltage. </C-DIR> is used to change motor rotation direction in speed control mode.	P	page 5-52
</Z-CLP> Zero clamp	When analog command value in the speed control is lower than the setting value of speed zero clamp level [Ft-5.05], the input value is ignored.	S	page 5-35
</INHIB> Inhibit pulse command	It ignores position command pulse in the section where the signal is on.	F	page 5-25
</ABS-DT> Absolute encoder data transmission	Transmits absolute encoder data to host controller through EA and EB when the signal is ON.	F, I	page 7-50
</PCLR> Position Error Clear	Clear position command, position feedback, and position error.	F, I	page 5-25
</START> Start	Control motor rotation start or stop by using terminal signal in speed or terminal speed control mode.	S, P	page 5-37
</GEAR> Electronic Gear Rate Shift	In position control mode, the 2nd electronic gear parameters [Ft-3.05] and [Ft-3.06] are used when input is ON. The basic electronic gear parameters [Ft-3.01] and [Ft-3.02] are used when input is OFF. Switch between two electronic gear ratios.	F	page 5-27
</R_ABS> Absolute encoder multi-rotation data reset	Reset the multi-rotation data of the absolute motor.	All	page 7-34
</BANK_SEL> Gain bank select	Uses the 3rd and the 4th Gain Bank when it is set to ON. Uses the 1st and 2nd Gain Bank when it is set to OFF.	All	page 6-37
</A-CL> Analog torque limit	The Current Limit Function is activated by the analog torque command input values when it is set to ON.	S, P	
</H_SENS> Home sensor	When activated, the sensor indicates the Return to Home sequence that is detected.	I	
</SHOME> Start homing	When activated, the system starts returning to home.	I	
</PAUSE> Index pause	When activated, it decelerates until stop and pause the index sequence. It decides whether to stop or to continue the motion by constantly monitoring the input status.	I	
</STOP> Index stop	When activated, index movement ends.	I	

Table 5.1 I/O Sequence Input Signal

Type	Description	Mode	Reference
</I_SEL0> Index selection 0 Input </I_SEL1> Index selection 1 Input </I_SEL2> Index selection 2 Input </I_SEL3> Index selection 3 Input </I_SEL4> Index selection 4 Input </I_SEL5> Indexselection 5 Input	Used for the combinations to allocate indexes.	I	
</H_STOP> Stop homing	Stops Homing operation when it is set to ON.	I	
</START_I> Start indexing	Start Indexing operation when it is set to ON.	I	
</ABS-MD> Absolute Position Data Transfer Mode	Absolute Data transfered to host contoller by photo coupler output which output Fault Code when it is set to ON.	F	

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.

Table 5.2 I/O Sequence Output Signal

Type	Description	Mode	Reference
</S_ALM> Alarm	It is on when the servo warning is detected.	All	page 8-5
</P-COM (+, -)> Positioning Completion detection	It is on when the position error is within the output width of position completion signal [Ft-5.00].	F, I	page 5-28
</NEAR (+, -)> Positioning approach detection	It is on when the position error is within the output width of position approach signal [Ft-5.02].	F, I	page 5-28
</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 [Ft-5.03].	F, S, P, I	page 5-38
</TG-ON (+, -)> Rotation detection	It is ON when the motor rotates with the speed more than the setting value of rotation detection level [Ft-5.04].	All	page 5-39
</T-LMT (+, -)> Torque limit detection	It is on when motor torque is reached the setting value of torque limit.	All	page 5-46
</V-LMT (+, -)> Speed limit detection	It is on when motor speed is reached the setting value of speed limit.	All	page 5-41
<BK (+, -)> Breaker control	It is the signal for control of the brake that is mounted inside and outside of the servo motor.	All	page 7-6
</A_VLD> Absolute position valid	Turns to ON when the absolute position data is valid while using the absolute motor.	All	
</RDY> Drive ready	Means getting the operation ready while in the Servo-OFF status.	All	

Table 5.2 I/O Sequence Output Signal

Type	Description	Mode	Reference
</WARN (+, -)> Warning	Turns to ON when a Servo warning is detected.	All	page 8-3
</HOMC(+,-)> Axis homing	When activated, it shows the completion of the Homing operation.	I	
</IMO (+,-)> In motion	Turns to ON when in motion.	I	
</I_DW> In dwell	When activated, it indicates that the motor is on the hold position in the index movement and on stand-by for the dwell time assigned.	I	
</O_ISEL0> Index selection 0 Output </O_ISEL1> Index selection 1 Output </O_ISEL2> Index selection 2 Output </O_ISEL3> Index selection 3 Output </O_ISEL4> Index selection 4 Output </O_ISEL5> Index selection 5 Output	Used to output the index number in use in the selected indexing operation.	I	
</E_SEQU> Sequence operation completion	Turns to ON when the index movement is complete.	I	

TIP 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 I/O pin by searching the function that is suitable for your condition.

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 A’ except ‘0’ to the setting position.

For example, if you want to put certain function to I/O 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.

Enter ‘0’ when the function of input signal is not used. If you want to make input signal ‘ON’ all the time regardless of the wiring, set as ‘b’.

Table 5.3 I/O Sequence Input Signal

Setting Value	**b**	**A**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Input Channel No.	Always valid	INPUT #10	INPUT #9	INPUT #8	INPUT #7	INPUT #6	INPUT #5	INPUT #4	INPUT #3	INPUT #2	INPUT #1	Always invalid
I/O Pin No.		28	27	26	9	8	7	6	5	4	3	

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.

Table 5.4 7-Segment Number Position of Input Signal Parameter

Parameter	7-Segment Position			
	3	2	1	0
Ft-0.10	</P-CON> Initial value: 4	<N-OT> Initial value: b	<P-OT> Initial value: b	</SV-ON> Initial value: 1
Ft-0.11	</C-SEL>	</P-TL> Initial value: 7	</N-TL> Initial value: 6	</A-RST> Initial value: 5
Ft-0.12	</C-SP3>	</C-SP2>	</C-SP1>	</C-DIR>
Ft-0.13	</PCLR>	</G-SEL>	</INHIBIT>	</Z-CLP>
Ft-0.14	</GEAR>	</C-SP4>	</START>	</ABS-DT>
Ft-0.15	</ABS-MD>	</A-CL>	</BANK_SEL>	</R_ABS>
Ft-0.16	</PAUSE>	</STOP>	</SHOME>	<H_SENS>
Ft-0.17	<I_SEL3>	<I_SEL2>	<I_SEL1>	<I_SEL0>
Ft-0.18	</START_I>	</H_STOP>	<I_SEL5>	<I_SEL4>

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

Example			
Ft-0.10 7	Enter '7' in the 3rd position in setting window of the parameter [Ft-0.01]. This value is set to use </P-CON> function. It means that the I/O INPUT#7 pin is used as an input pin.		
Applicable Models	All	Other Details	Drive Disable > Configure > Completed

Output Signal Allocation Method

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

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

Sequence output is displayed when situation that is meets the condition of each ouput in drive was produced.

Table 5.5 I/O Output Signal Allocation

Setting Value	6	5	4	3	2	1	0
Input Channel No.	OUTPUT #6	OUTPUT #5	OUTPUT #4	OUTPUT #3	OUTPUT #2	OUTPUT #1	Always Invalid
I/O Pin No.	39.40	38.40	37.40	47, 48	43, 44	41, 42	

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.

Table 5.6 7-Segment Number Position of Output Signal Parameter

	7-segment Position			
Parameter	3	2	1	0
Ft-0.22	</V-COM>	</BK> Initial value: 3	</TG-ON> Initial value: 2	</P-COM> Initial value: 1
Ft-0.23	</WARN>	</NEAR>	</V-LMT>	</T-LMT>
Ft-0.24	Reserved	Reserved	</RDY>	</A_VLD>

Table 5.6 7-Segment Number Position of Output Signal Parameter

Ft-0.25	</O_ISEL0>	</HOMC>	</I_DW>	</IMO>
Ft-0.26	</O_ISEL4>	</O_ISEL3>	</O_ISEL2>	</O_ISEL1>
Ft-0.27	Reserved	Reserved	</E_SEQU>	</O_ISEL5>

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

Example			
Ft-0.23 3	Set ‘3’ in the 3st position in setting window of the parameter [Ft-0.23]. It is set to use </WARN> function and it means that we will use I/O No. Output#47,48 pin as output pin.		
Applicable Models	All	Other Details	Drive Disable > Configuration> Completed

Notice for Signal Allocation

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

Ft-0.11 4	Set ‘4’ in the 2nd position in setting window of the parameter [Ft-0.11]. It is set to use </N-TL>function and it means that I/O No. INPUT#4 pin is used as an input pin
Ft-0.13 4	Set ‘4’ in the 2nd position in setting window of the parameter [Ft-0.13]. It is set to use </INHIB> function and it means that I/O No. INPUT#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 F.¯PIn	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 I/O.

TIP

... Through monitor mode in the 7-52 page "Monitor Mode Function", you can check if the sequence I/O signal is input.

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

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

... Servo drive has self-diagnostic function.

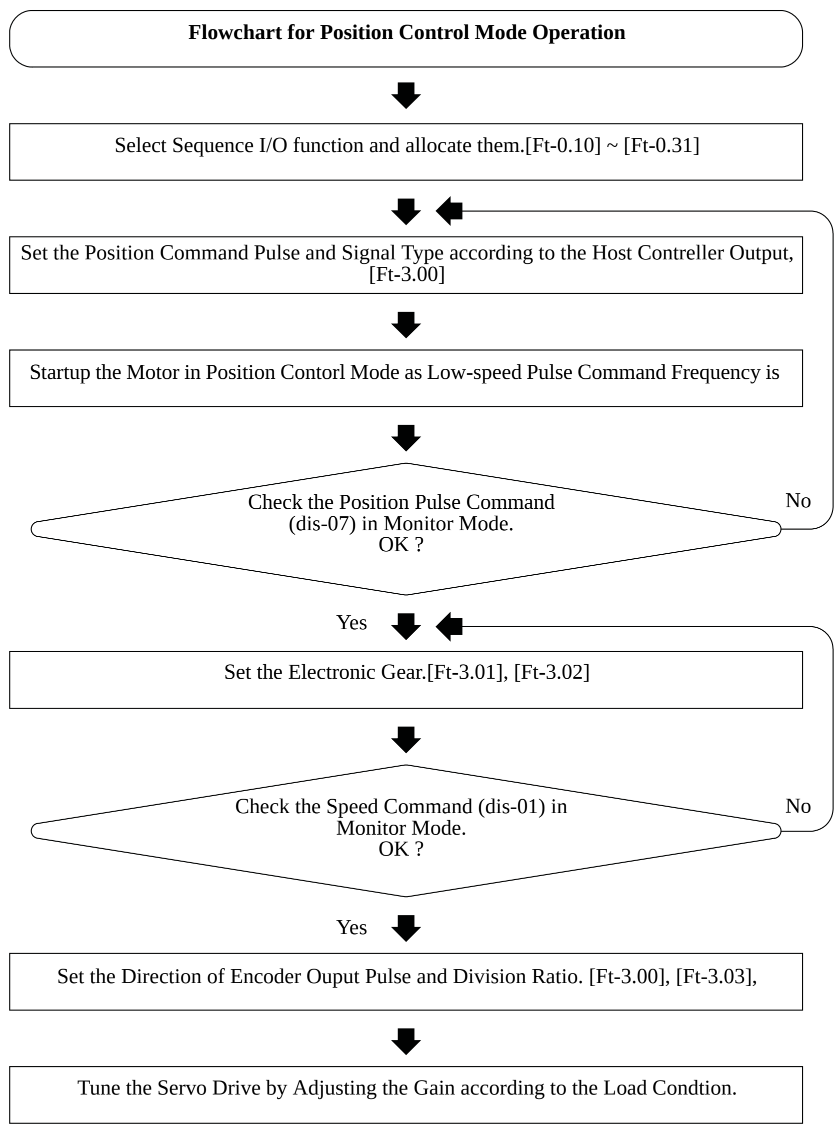
... The (servo alarm) and (servo warning) is divided according to the importance of error diagnostic. For the details, see Chapter 8.

Position Control Mode

Overview

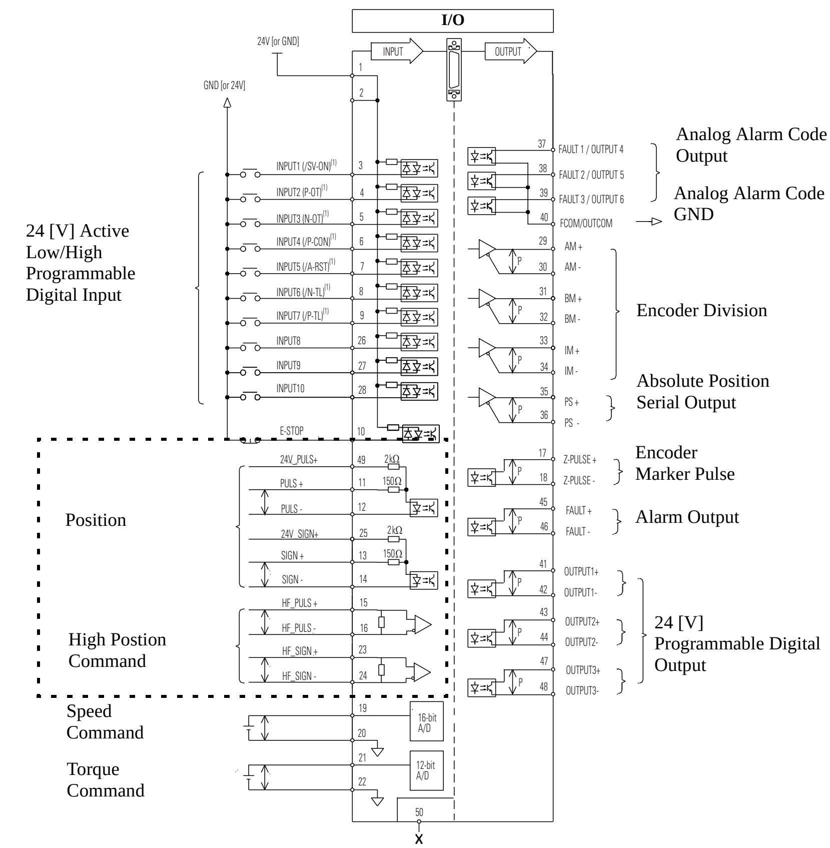
The position control mode is used when the position command pulse is received from the host controller to move the load to a target position.

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 and set as follows.



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

10 pins of I/O receive 3 kinds of commands related to the position control mode.

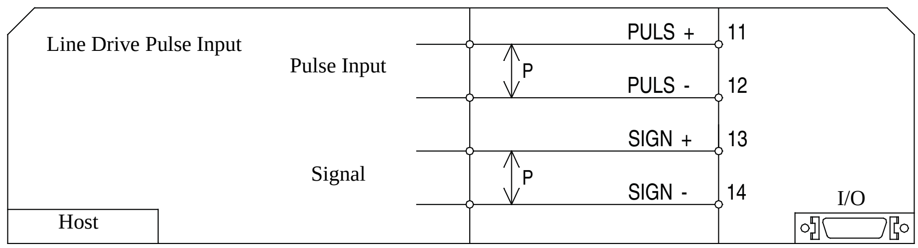
Host controller sends the position command with the pulse input and sign input.

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

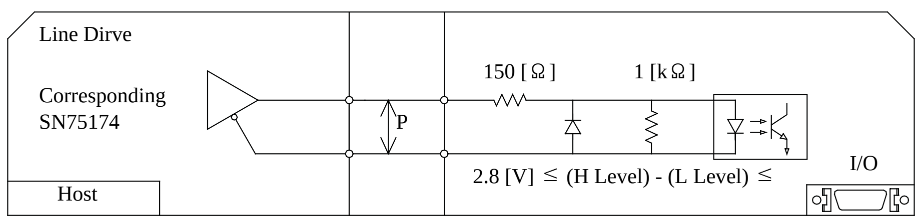
When It is Line Drive Output

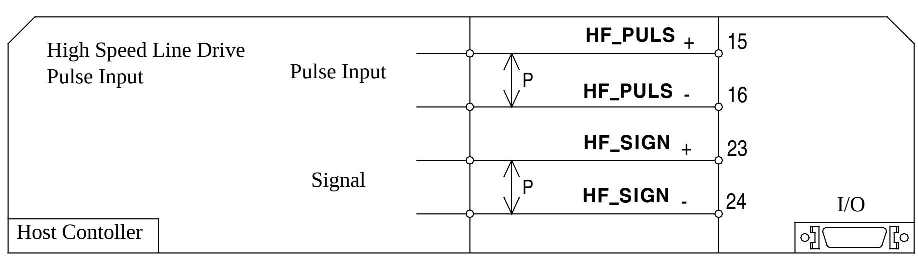
Maximum allowable frequency

- For the line drive output : 900 [kpps]
- For the high speed line drive output : 3 [Mpps]



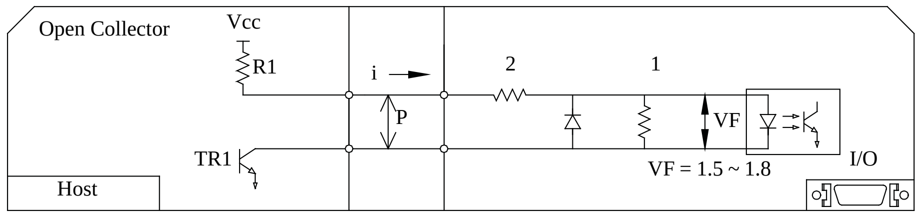
Following circuit shows above figure.





When It is Open Collector Output

Maximum allowable frequency: 250 [kpps]



- 5 [V], 12 [V] open collectors, connect the external resistance R1 in the middle of the general line drive input (Pin No. 11, 12, 13, and 14).

- For the 24 [V] open collector, directly connect it to Pulse (Pin No. 49, 12) Sign (Pin No. 25, 14) without the pull up resistance R1.

IMPORTANT Caution is needed on the highest allowed frequency. (When the duty ratio for Pulse is 50:50).

... For the general line drive input: 900 [kpps]

... For the high-speed line drive input: 3 [Mpps]

... For the open collector input: 250 [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	R1
12 [V] ± 5 [%]	1.2 [kΩ]
5 [V] ± 5 [%]	270 [Ω]

TIP

- 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, 16and 24 of I/O 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.
- Position command wiring length
  - Line Drive : 5 [m] or less
  - Open Collector: 1 [m] or less

Set the Position Command Pulse Type for the Host Controller.

Refer to table below to set position command pulse of host controller.

Parameter	 
Parameter Name	Position Command Plulse Input Selection
Setting Value	• 0: Use the line drive ouput of the host contoller • 1: Use the open collector ouput of the host controller • 2 : Use the high speed line drive output of the host contorller
Initial Value	0
Applicable Mode	F
Others	Servo-OFF > Setting > End

IMPORTANT Maximum allowable frequency of pulse command of host controller is

... For the general line drive: 900 [kpps]

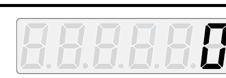
... For the high-speed line drive: 3 [Mpps]

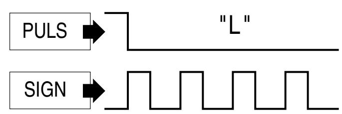
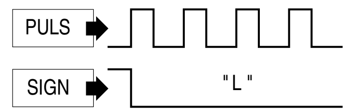
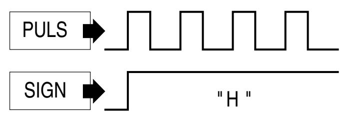
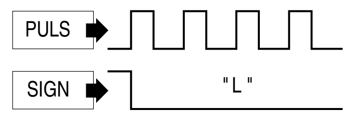
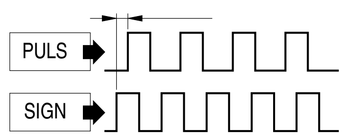
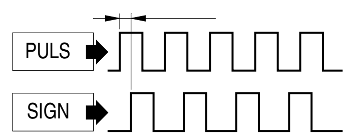
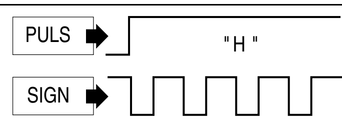
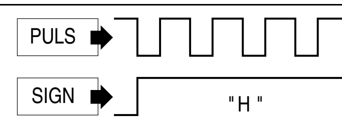
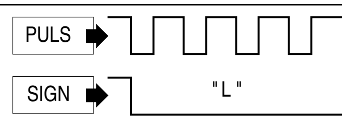
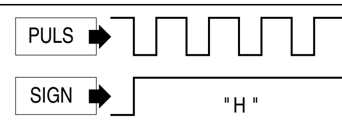
... For the open collector: 250 [kpps]

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.

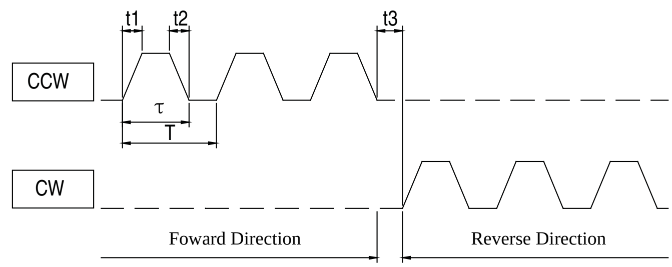
Parameter	 
Parameter Name	Position Command Pulse From Selection
Settomg Value	0 ~ 6 : Refer to the table below
Initial Value	0
Applicable Mode	F
Others	Servo-OFF > Setting > End

Setting Value	Logic	Command Pulse Form	Forward Direction Operation	Reverse Direction Operation	Input Muliplication
0	Positive Logic	CW + CCW			-
2		Pulse Train+ Sign			-
4		Phase A+ Phase B			1
5					Duple
6					Quadruple
1	Negative Logic	CW + CCW			-
3		Pulse Train+ Sign			-

TIP You can verify the data related to the position through monitor mode in the 7-52 page "Monitor Mode Function".

Electrical Specifications of Position Command Pulse

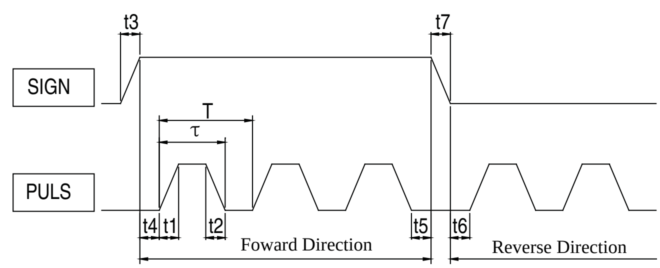
Table 5.7 Electrical Specifications of Position Command Pulse

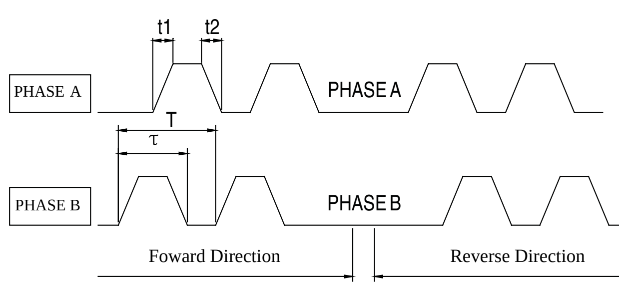
<table>
<tr><th>Command Pulse Form</th><th>Electrical Specification</th><th>Maximum Allowable Frequency</th></tr>
<tr><td>CW + CCW</td><td>

t1, t2 ≤ 0.1 us
τ ≥ 1.1 us
t3 > 3 us
τ/T x100 ≤ 50 %</td><td rowspan="3">Line Drive: 900 [kpps]

High Speed Line Drive: 3 [Mpps]

Open Collector: 250 [kpps]

(Duty ratio should be 50:50)</td></tr>
<tr><td>Pulse Train+ Sign</td><td>

t1, t2, t3, t7 ≤ 0.1 us
t4, t5, t6 > 3 us
τ ≥ 1.1 us</td></tr>
<tr><td>2 Phase Pulse Train of 90 Difference
A Phase + B Phase</td><td>

t1, t2 ≤ 0.1 us
τ ≥ 1.1 us
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 (Resolution 8192) 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 pulses)? -> 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 8192 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 8192 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

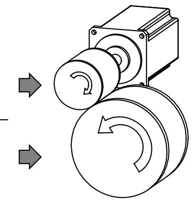
The following table explains the contents that you should know before setting the electronic gear

- Motor: Check the number of pulse of the encoder used. Refer to the 4-5 page "Structure of the Entire Mode".
- 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.

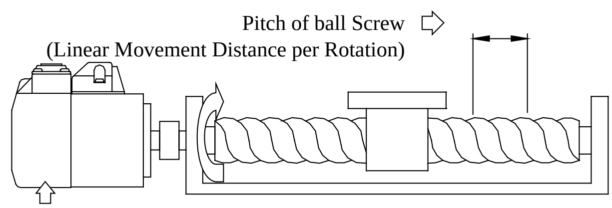
$$\text{Reduction Ratio} = \frac{\text{Number of Motor Rotation}}{\text{Rotation Number of the End Mechanical Part}}$$



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 1of Electronic Gear Setting

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



Boll 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] (Resolution 20,000), the reduction ratio is '1' because it is 1:1.

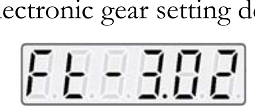
Electronic Gear Setting Numerator:

... Electronic gear setting numerator parameter:

... Electronic gear setting numerator parameter is as follows.
Resolution of Encoder × Reduction Ratio
Therefore, it is 20,000 (resolution)× 1 so that setting value is 20,000.

Electronical Gear Setting Denominator:

... Electronic gear setting denominator parameter:



... 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 boll screw rotates once with 1000 pulses, so the ball screw with the movement pitch of 10 [mm] moves 10 [µm].

... If you want to roate a motor once by the host contoller sending 10000 pulses to the servo drive, enter 10000 as a setting value. As a result, the ball screw rotates once with 10000 pulse, so the ball screw with the movement pitch of 10 [mm] moves 1 [µm].

CAUTION

When you set up the denominator as 10000, the ball screw moves 1 [µm] per pulse of the host controller so that it shows better resolution than set with 1000.

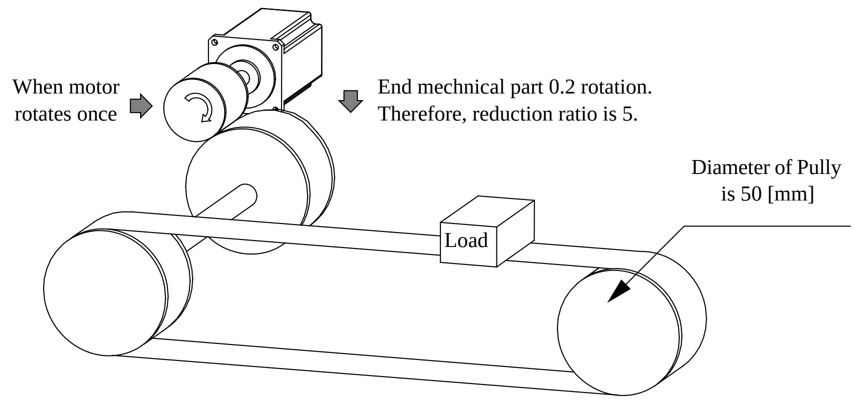
If so, can you realize much better the resolution is if the denominator is set as 40000 ? No, you cannot. The resolution of the encoder that is selected is2000. So the electronic gear has to satisfy the following formula because it is set according to the selected encoder.

Number of Encoder Pulse× Reduction Ratio× 4 ≥ Setting Valuen[Ft-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.



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 [μm] per pulse from the host controller.

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

Electronic Gear Setting Numerator:

... Electronic gear setting numerator parameter:

... Electronic gear setting numerator parameter is as follows.
Pulse of Encoder × Reduction Ratio
Therefore, it is 2048 × 4 × 5 so that setting value is 40960.

Electronic Gear Setting Denominator:

... Electronic gear setting denominator parameter:

... 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 [μm].

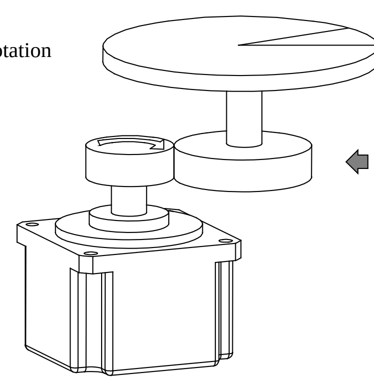
$$\frac{\text{Load Movement Amount per 1}}{\text{Movement Amont by 1 Pulse from the Host Controller}} = \frac{3.14 \times 50}{100} = 1570$$

... You can enter the numerator and denominator by reduction of fraction as the following.

$$\frac{\text{Electronic Gear Setting Numerator [Ft-3.01]}}{\text{Electronic Gear Setting Denominator [Ft-3.02]}} = \frac{40960}{1570} = \frac{4096}{157}$$

Example 3 of Electronic Gear Setting

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



Let's suppose the distance we want to rotate per command pulse from the host controller is 0.1 [°].

Let's suppose that the number of pulse of the encoder 2048 pulse (Resolution 8192) and the reduction ratio is '3'.

Electronic Gear Setting Numerator:

... Electronic gear setting numerator parameter:

... Electronic gear setting numerator parameter is as follows.
Pulse of Encoder × 4 × Reduction Ratio
Therefore, it is 2048 × 4 × 3 so that setting value is 24576.

Electronic Gear Setting Denominator:

... Electronic gear setting denominator parameter:

... 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 [°].

$$\frac{\text{Load Movement Amount per 1 Load Shaft Rotation}}{\text{Movement Angle by 1 Pulse from the Host Controller}} = \frac{360\ [°]}{0.1\ [°]} = 3600$$

TIP

... 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 eletronic gear.

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

– Check the number of pulse of encoder. Refer to the 4-5 page "Structure of the Entire Mode".

– 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.

Parameter	
Parameter Name	Electronic gear setting (Numerator)
Description	Pulse of Encoder× 4 (Resolution) × Reduction Ratio
Setting Value	1~ 65535
Initial Value	4

Unit	pulse
Applicable Mode	F
Others	Servo-OFF > Setting > End

Parameter	Ft-3.02
Parameter Name	Electronic gear setting (Denominator)
Description	The number of position command pulse of the host controller to rotate the load (Load shaft) once
Setting Value	1 ~ 65535
Initial Value	1
Unit	pulse
Applicable Mode	F
Others	Servo-OFF > Setting > End

TIP 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. If the relationship below is not formed, you can use it as pulse command but the resolution is not guaranteed.

Number of Pulse per 1/4 Rotation of Motor × Reduction Ratio × 4 ≥ Setting Value of [Ft-3.02]

Maximum resolution is 1 / (Number of Pulse Rotation of Motor× Reduction Ratio × 4).

If the setting value of [Ft-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 [Ft-3.02] divided by 4, or increase the reduction ratio.

TIP

- Position control resolution of CSD5 Servo drive is ± 1 pulse.
- In the example 1 on ball screw load, [Ft-3.01]=20000 and the maximum value for [Ft-3.02] is 5000 × 4=20000. Therefore, the minimum unit which moved by 1 command is 10 [mm] / 20000 = 0.5 [µm].
- When actually applying, design with sufficient amount more than the minimum unit.
- Servo drive can output the encoder by the host controller.
- Refer to the7-24 page "Postion Feedback to the Host Controller" (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, the position feedback, the 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.

It can be stop instantly when it receive signal during operation, so stop the motor before operating.

Position error clear input signal is assigned to sequence input, and the parameter is set in [Ft-0.13].

It clears just once at a falling edge of the position error clear signal.

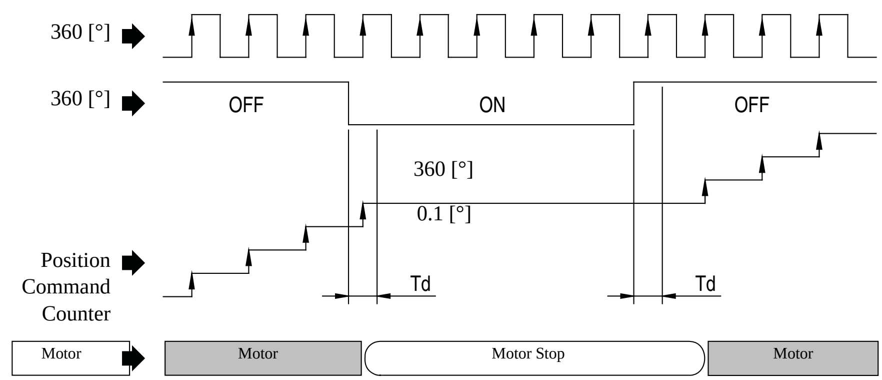
Pulse Command Inhibition</INHIB> Input

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 5-1 page "Sequence I/O (Input/Output) Signal".

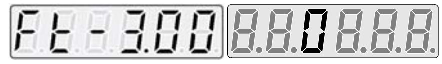
CAUTION

If the setting value is 'b' the setting signal is always valid regardless of the wiring, as shown in Input signal allocation method in the 5-5 page "Input Signal Allocation Method".

Therefore, when setting the pulse command inhibition <INHIB> input as 'b', 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 [Ft-3.01] and [Ft-3.02] When the </GEAR> input is OFF, the first group of electronic gear parameters in Ft-3.01 and Ft-3.02 will be used. The Details of the newly added second group of electronic gear parameters are shown below.

Parameter	
Parameter Name	Change the setting method of electronic gear parameters [Ft-3.01] and [Ft-3.02]
Setting Value	0 - Change electronic gear parameters only when Servo-OFF 1 - Change electronic gear parameters no matter what Servo-OFF or Servo-ON
Initial Value	0
Applicable Mode	F
Others	Servo-OFF > Setting > End

The Second Group of Electronic Gear </GEAR> Input

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 [Ft-3.01] and [Ft-3.02]. When the </GEAR> input is OFF, the first group of electronic gear parameters in [Ft-3.01] and [Ft-3.02] will be used. The Details of the newly added second group of electronic gear parameters are shown below.

Parameter	
Parameter Name	Second electronic gear setting (numerator)
Description	Pulse of Encoder x 4(Resolution) x Deceleration Ratio
Setting Value	1~65535
Initial Value	4
Unit	pulse
Applicable Mode	F
Others	Servo-OFF > Setting > End

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	1

Unit	pulse
Applicable Mode	F
Others	Servo-OFF > Setting > End

CAUTION

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 Sidth of Position Completion Signal

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

Parameter	
Parameter Name	Output width of position completion signal
Description	When the number of position error pulse is within the value above, position completion signal detection </P-COM> signal is generated.
Setting Value	0 ~ 2500
Initial Value	10
Unit	pulse
Applicable Mode	F
Others	Setting > End

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 </NEAR> 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.

Parameter	Ft-5.02
Parameter Name	Output Width of Position Approach Signal
Description	When the number of position error pulse is within the value above, position Approach Signal detection </NEAR> signal is generated.
Setting Value	0 ~ 2500
Initial Value	20
Unit	pulse
Applicable Mode	F
Others	Setting > End

Other Explanation

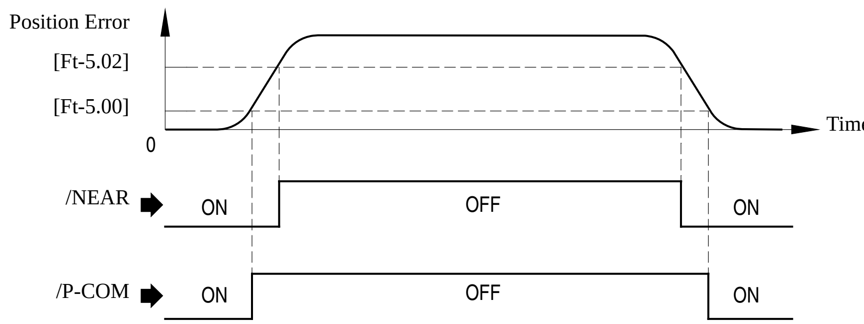
Position approach signal detection </NEAR> signal with position completion signal detection </P-COM> signal is useful to reduce the necessary operation at the position completion signal time. First, check the approach signal and preparing the next sequence before the host controller verifies the position 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 [Ft 5.00] and [Ft-5.02].

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. However, the position pulse command frequency should be 100 [pps] and less.

... Position Error < Setting valuen of [Ft-5.00]: /P-COM Output

... Position Error < Setting valuen of [Ft-5.02]: /NEAR Output

CAUTION

When [Ft-5.00] is set with high value during the low-speed operation (less 100 [pps]), </P-COM> output signal remains ON.

TIP

... </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 5-1 page "Sequence I/O (Input/Output) Signal".

... You can use </P-COM> and </NEAR> signal as the reference signal for the next operation of the system with </V-COM> of speed control mode.

... When the 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 4-7 page "Status Display Mode".

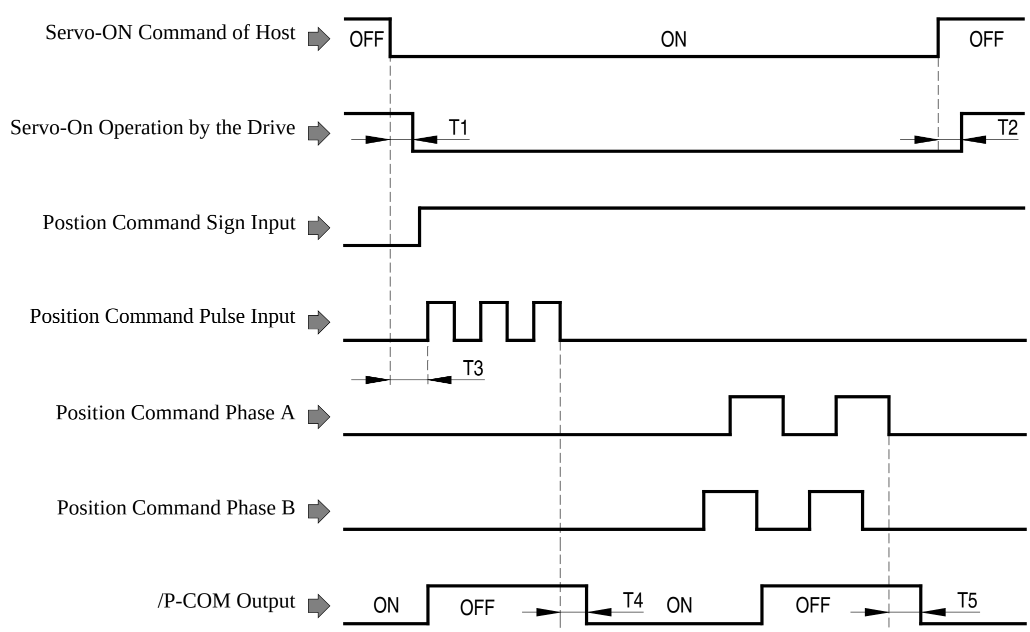
Output Width of Allowable Position Error

Set allowable position error limit.

Parameter	
Parameter Name	Output width of allowable position error
Description	If position error is bigger than setting value, the position error overflow servo alarm [E.PoSEr] occurs.
Setting Value	0 ~ 2147483647
Initial Value	99999
Unit	pulse
Applicable Mode	F
Others	Setting > End

Input / Output Signal Timing Diagram

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



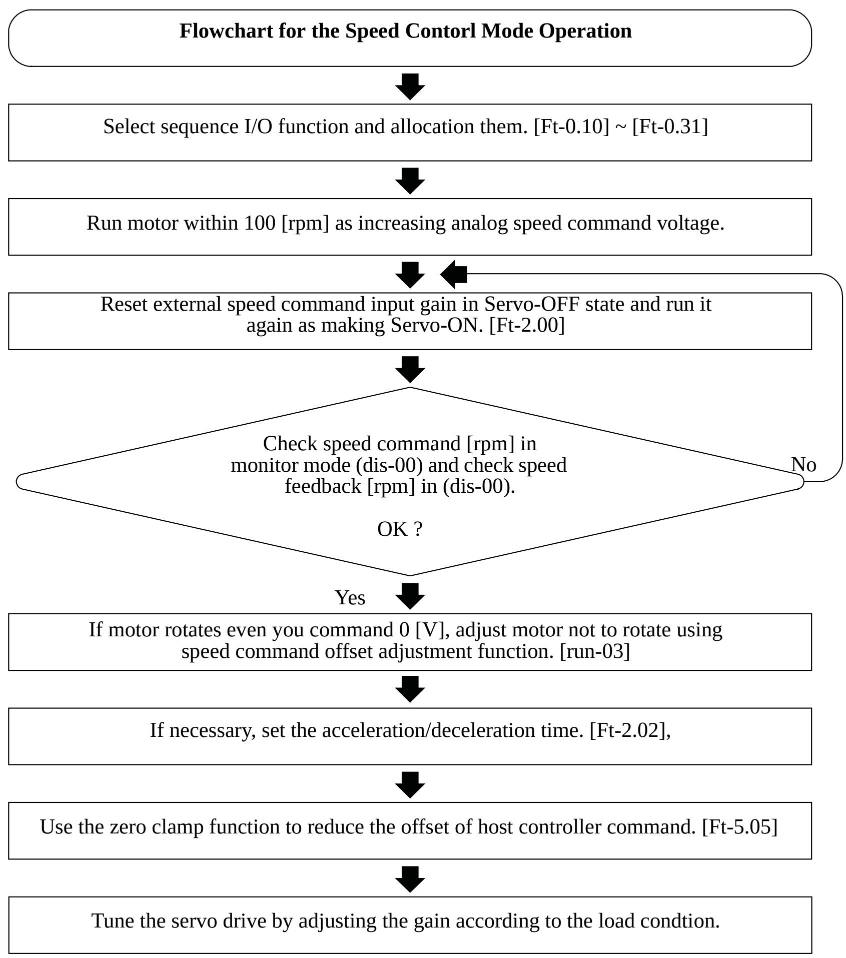
T1	T2	T3	T4	T5
Max. 40 [ms]	Max. 6 [ms]	Min. 40 [ms]	Min. 2 [ms]	Min. 2 [ms]

Speed Control Mode

Overview

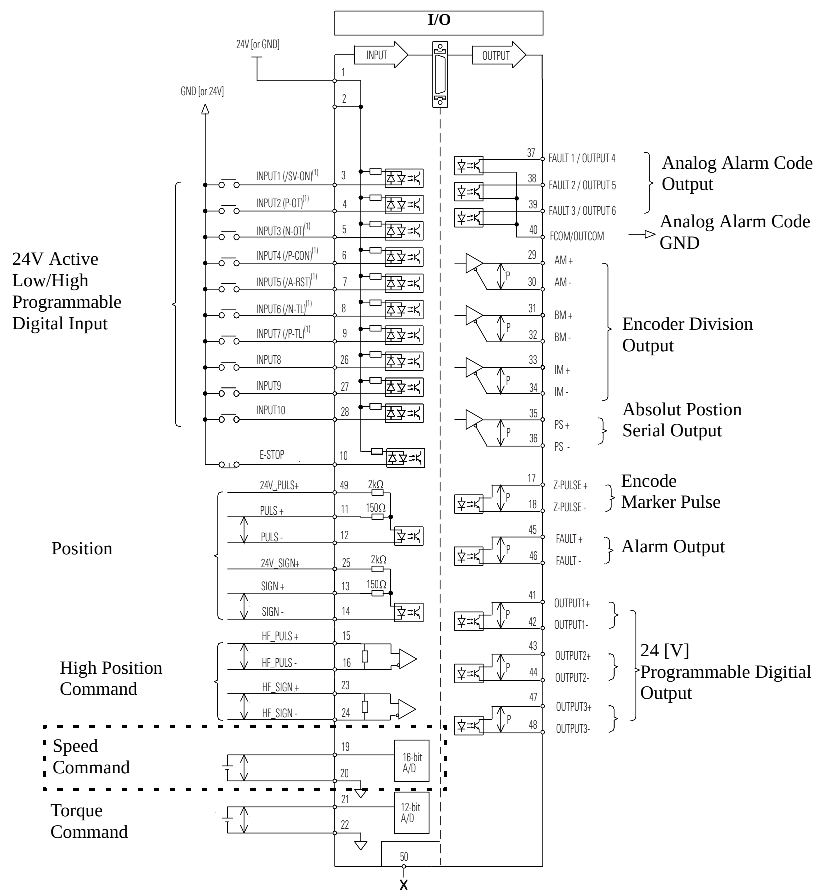
The speed control mode is used to control the speed as inputting speed command of analogue voltage type that is generated by the host controller to servo drive even if the position control loop is formed in the host controller or not.

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.



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.



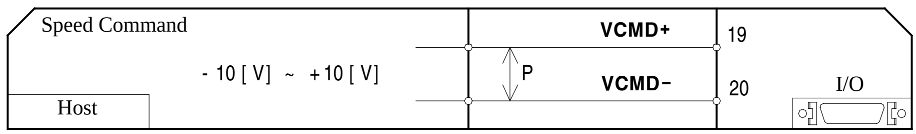
TIP Whether to use the emergency stop input can be set by the parameter [Ft-0.05]; the initial value is set as not to use.

Speed Command Input

Speed Command

Two pins of I/O (19, 20) 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.

Parameter	
Parameter Name	External speed command gain
Description	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 7-6 page.
Setting Value	10.0 ~ 2000.0
Initial Value	500.0
Unit	Rotate Motor: [rpm/V]; Liner Motor: [mm/sec]
Applicable Mode	S
Others	Servo-OFF > Setting > End

Speed command is given according to the following relationship.

Speed Command (rpm) = Setting Value of [Ft-2.00](rpm/V) ?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.

TIP

- 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.
- 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). Refer to the 7-41 page “Operation Mode Function”. 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 5-35 page "Zero Clamp </Z-CLP> Input".

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.

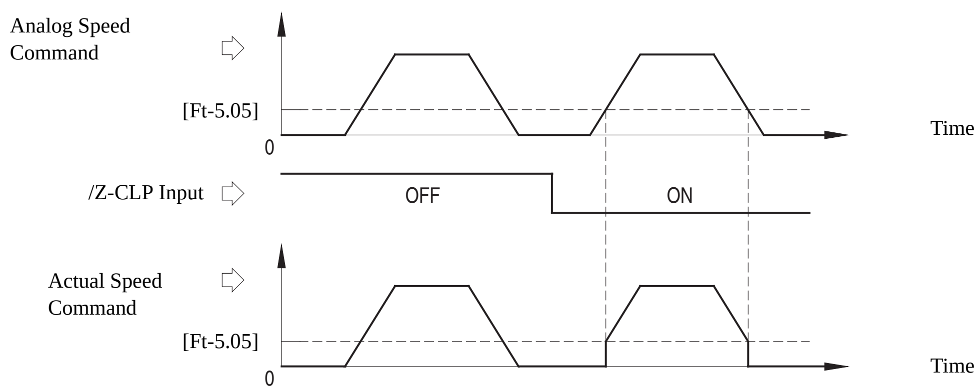
</Z-CLP> is a sequence input signal. To use </Z-CLP> function, allocate </Z-CLP> by referring to the sequence input/output signal in the 5-1 page "Sequence I/O (Input/Output) Signal".

Set speed zero clamp level to the parameter below.

Parameter	Ft-5.05
Parameter Name	Speed sero clamp level
Description	Speed command that is below the value is ignored.
Setting Value	0 ~ 5000
Initial Value	0
Unit	[rpm]
Applicable Mode	S
Others	Setting > End

If you turn the signal on or off to the pin of I/O where the zero clamp function is allocated, the voltage command less than the zero clamp level [Ft-5.05] 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 'b' with the reference of the input signal allocation method in the 5-5 page "Input Signal Allocation Method", the zero clamp function is always valid and if it is set as '0', the zero clamp function is not processed.



CAUTION

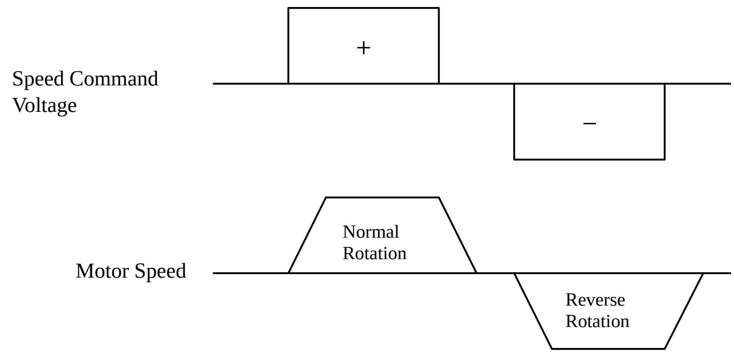
... Although /Z-CLP input is not allocated, the drive automatically clamps the speed command as '0' in case any value is in [Ft-5.05] except '0'.

... Do not use when you configure position control loop by host controller.

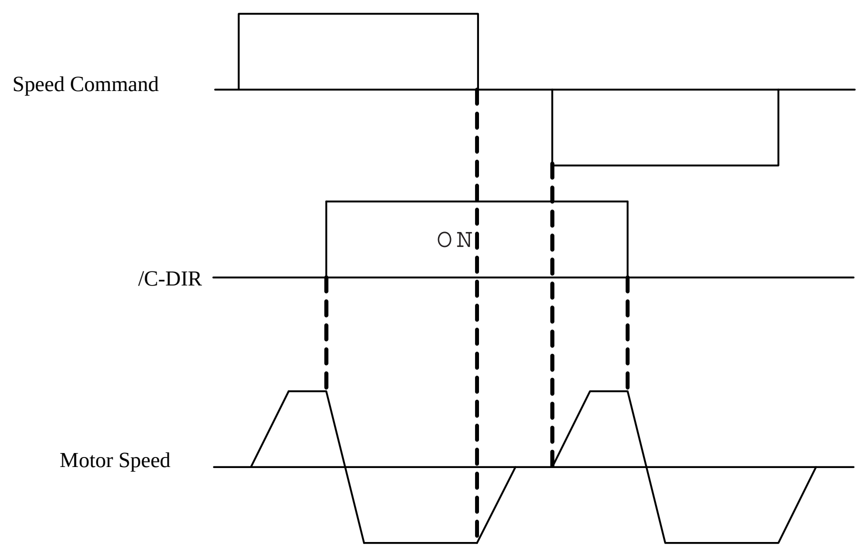
... The position loop may malfunction. Set the acceleration time and deceleration time of [Ft-2.02] and [Ft-2.03] as '0' in this case.

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.



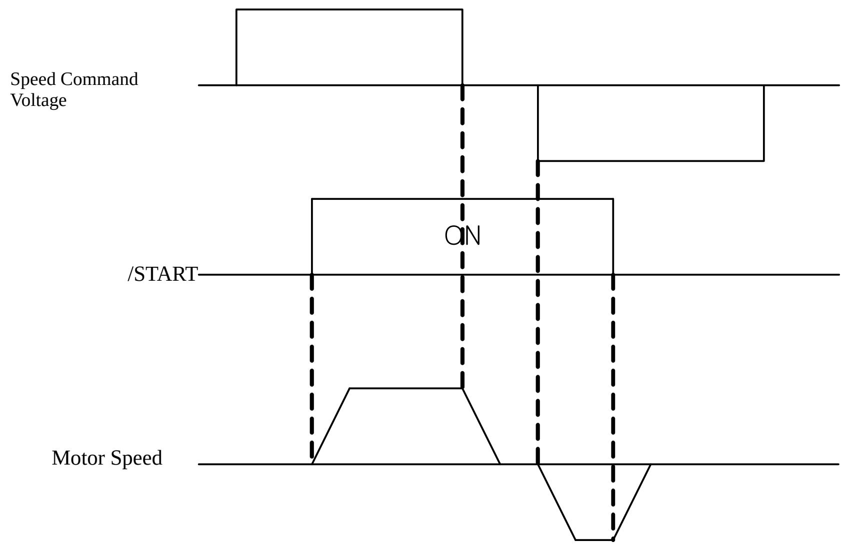
You can control the rotation direction using input </C-DIR>, which is also used in Multi-step Speed Control Mode. When input </C-DIR> is ON, the rotational direction of the motor will be inverted.



Motor Rotation Start/Stop Input</START>

Generally, the motor begins to rotate when the speed command is entered after Servo-ON in the Speed Control Mode. You can control the motor rotation srat and stop using contact point input signal with setting </START>input.

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.
Control mode can be applied: Speed Contorl Mode, Multi-step speed mode



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 5-1 page "Sequence I/O (Input/Output) Signal".

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

Parameter	
Parameter Name	Output width of speed coincidence signal
Description	If speed error is within setting value, speed coincidence detection </ V-COM> signal is generated.
Setting Value	0 ~ 1000
Initial Value	10
Unit	[rpm]
Applicable Mode	All
Others	Setting > End

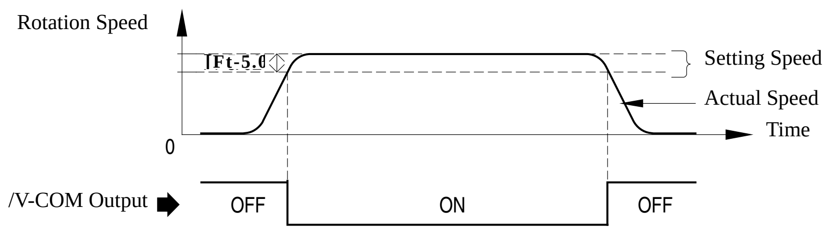
Speed coincidence detection </V-COM> output is ON when the following conditions are satisfied.

Speed Error < Setting Value of [Ft-5.03]: /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 [Ft-5.03].

Output width of speed coincidence signal [Ft-5.03] setting does not have influence on the final speed control.

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



TIP

- </V-COM> is ON to the allocated sequence output channel when the output width of speed coincidence signal is Ft-5.03 = 100, the speed command is 2000 [rpm], and the actual rotation speed is in 1900 to 2100 [rpm].
- 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 4-7 page "Status Display Mode".

Rotation Detection </TG-ON> Output

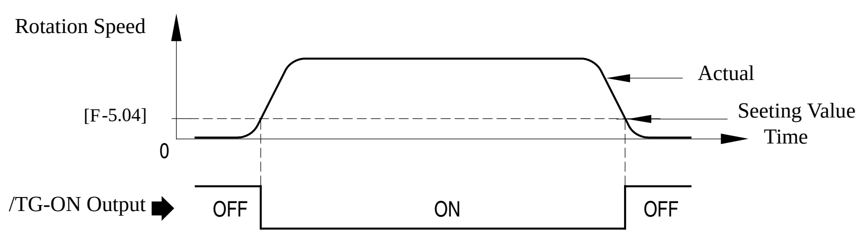
It indicates that the servo motor rotates at a speed higher than the set speed. It can be used as one condition to check the motor status when you change the control mode in mixed control mode, or before you change one sequence to other sequence among sequences.

</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 5-1 page "Sequence I/O (Input/Output) Signal".

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

Parameter	Ft-5.04
Parameter Name	Rotation Detection Level
Description	</TG-ON> signal is output if the motor rotates at a speed higher than the set value.
Setting Value	1 ~ 5000
Initial Value	20
Unit	[rpm]
Applicable Mode	All
Others	Setting > End

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



TIP

... If you set ration detection level [Ft-5.04] 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.

Parameter	Ft-2.12
Parameter Name	Speed Limit
Description	It limits the rotation speed of motor to keep below the speed of set value.
Setting Value	1 ~ 6000
Initial Value	5000
Unit	[rpm]
Applicable Mode	F, S, P
Others	Servo-OFF > Setting > End

Even though you set the speed limit [Ft-2.12] as 1500 [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 5-1 page "Sequence I/O (Input/Output) Signal".

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

Rotation Speed ≥ Setting value of [Ft-2.12]: /V-LMT Output

TIP

... 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 4-12 page "Basic Setting".

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

... Except the speed limit method by setting of speed limit [Ft-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 [Ft-2.13].

... If you do not select the method by [Ft-2.12] in speed limit selection [Ft-2.13], setting value of speed limit [Ft-2.12] becomes invalid.

... For details on speed limit, refer to the 7-21 page "Speed Limiting Function".

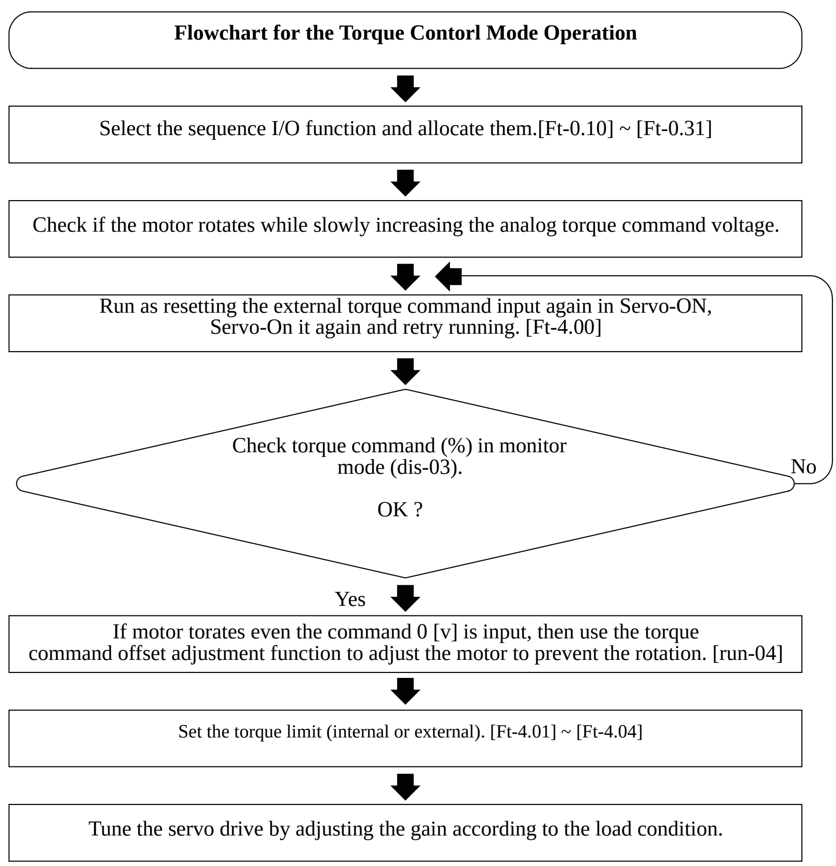
Torque Control Mode

Overview

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

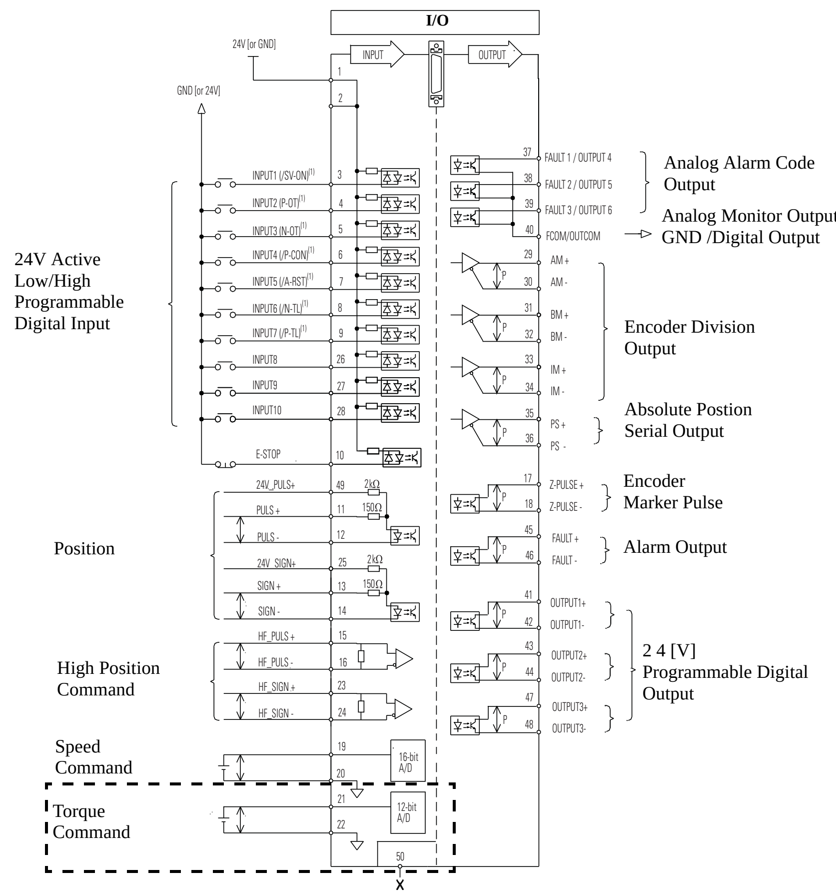
Enter the voltage related to the desired torque from the host controller. Various setting values related to operation torque limit of motor are generally applied to the position or the speed control mode.

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.



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.



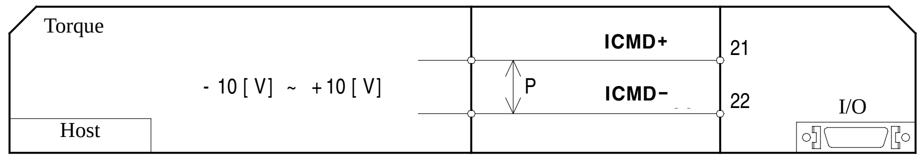
TIP Whether to use the emergency stop input can be set by the parameter [Ft-0.05]; the initial value is set as not to use..

Torque Command Input

Torque Command

Two pins of I/O (21, 22) receive one command related to torque control mode.

Host controller outputs the voltage command of the analog type.



External Torque Command Gain Setting

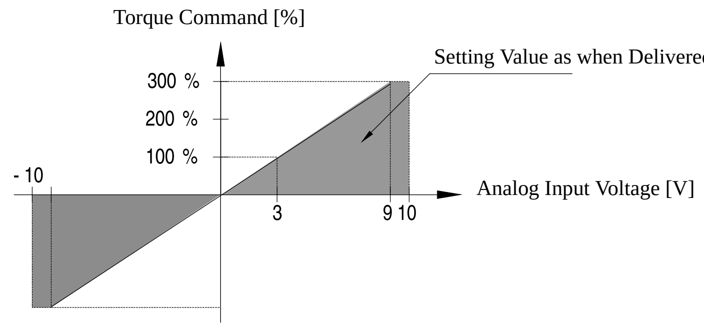
Set the relationship between the analog voltage value and torque command value to the parameter below.

Parameter	Ft-400
Parameter Name	External Torque Command Input Gain
Description	Set the gain of torque command value [%] related to analog voltage 1 [V].
Setting Value	0.0 ~ 1000
Initial Value	333
Unit	[%]/10 [V]
Applicable Mode	C
Others	Servo-OFF > Setting > End

Speed command is given according to the following relationship.

$$\text{Torque} = \frac{\text{Setting Value of} \times \text{Input Voltage} \times \text{Rated Torque}}{10}$$

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.)



TIP

- ... 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.
- ... 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.
- ... 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) function. For the automatic (manual) adjustment of the torque command offset, refer to the 7-41 page "Operation Mode Function".

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.

Internal torque limit setting

Set the following two parameters for the internal torque limit.

Parameter	Ft-4.01
Parameter Name	Forward Rotation Torque Limit (Internal Limit))
Description	It limits positive torque in [%] unit related to rated torque.
Setting Value	0 ~ 500
Initial Value	300
Unit	[%]
Applicable Mode	All
Others	Setting > End

Parameter	Ft-4.02
Parameter Name	Reverse Rotation Torque Limit (Internal Limit)
Description	It limits negative torque in [%] unit related to rated torque.
Setting Value	0 ~ 500
Initial Value	300
Unit	[%]
Applicable Mode	All
Others	Setting > End

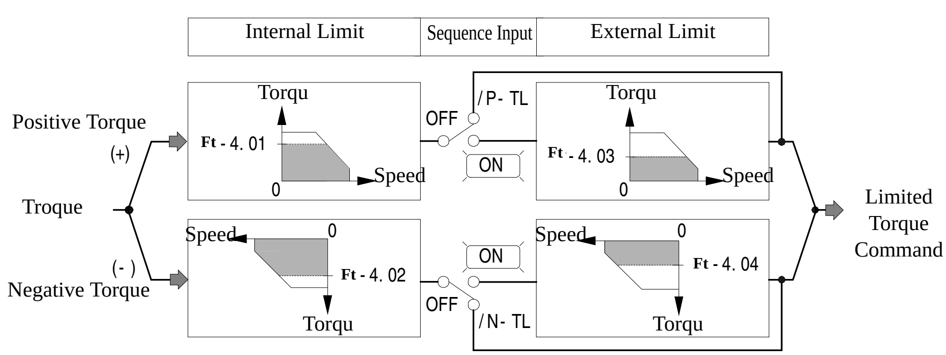
External torque limit setting

Set the following two parameters for the external torque limit.

Parameter	Ft-4.03
Parameter Name	External Torque Limit of Reverse Rotation </P-TL>
Description	If </P-TL> is ON, it limits positive torque in [%] unit related to rated torque.
Setting Value	0 ~ 500
Initial Value	100
Unit	[%]
Applicable Mode	All
Others	Setting > End

Parameter	Ft-4.04
Parameter Name	External Forward Rotation Torque Limit </N-TL>
Description	If </N-TL> is ON, it limits negative torque in [%] unit related to rated torque.
Setting Value	0 ~ 500
Initial Value	100
Unit	[%]
Applicable Mode	All
Others	Setting > End

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 5-1 page "Sequence I/O (Input/Output) Signal".

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

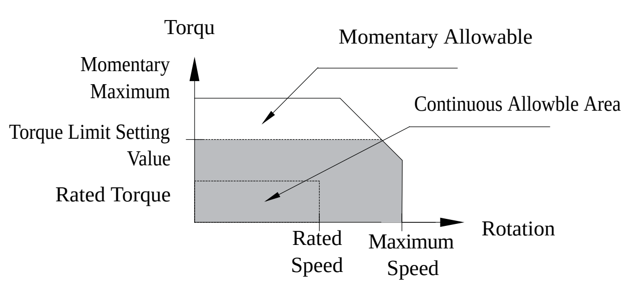
Torque limit by internal limit [Ft-4.01] and [Ft-4.02] are prior to external torque limit </P-TL> and </N-TL> signal.

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 [Ft-4.01] and [Ft-4.02] are set as shown in the following figure, torque of motor is limited as the lined area in the figure.



TIP

Depending on the motor type, there is a maximum instantaneous torque that is less than 300 [%]. If you set [Ft-4.01] and [Ft-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 the7-2 page "OverTravel <P-OT>, <N-OT>".

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.

Parameter	Ft-4.05
Parameter Name	Rotation Prohibition Torque Limit <P-OT>, <N-OT>
Description	Both forward and reverse rotation are limited by the same setting value.
Setting Value	0 ~ 500
Initial Value	300
Unit	[%]
Applicable Mode	All
Others	Setting > End

TIP

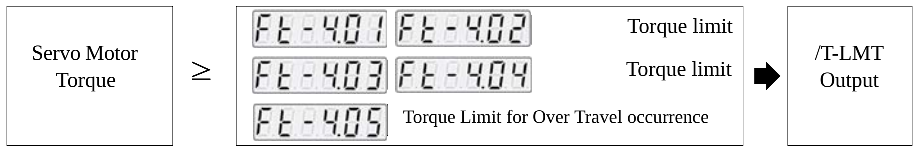
Internal torque limit is always valid. So if setting values of external torque limit and rotation prohibition torque limit are bigger than the setting value of internal torque limit, setting value of external torque limit and rotation prohibition torque is meaningless. So be careful of setting.

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 5-1 page "Sequence I/O (Input/Output) Signal".

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



TIP

Internal and external torque limits can be set separately when the rotation direction of the motor is forward and reverse.

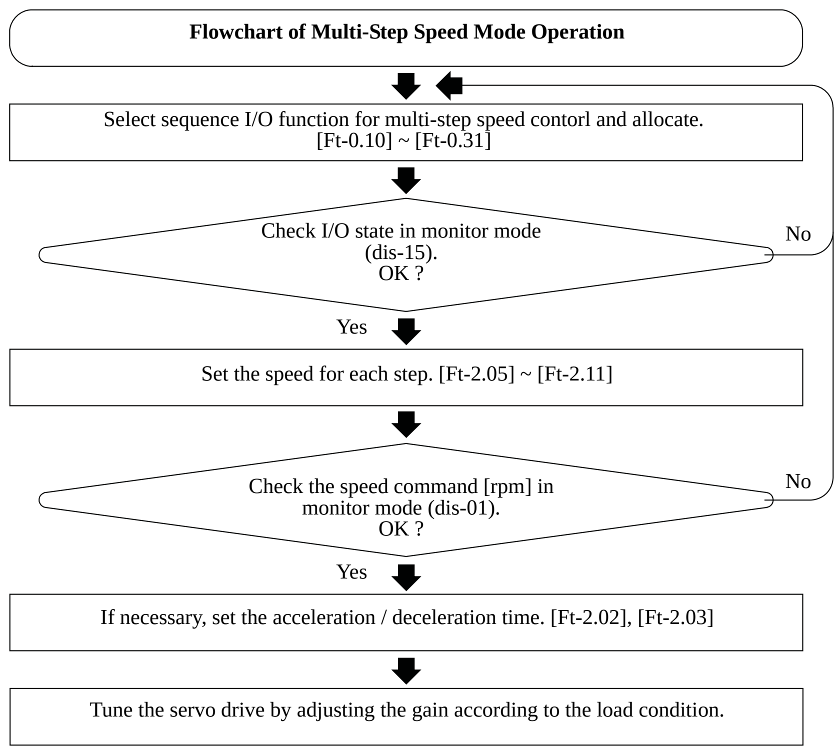
However, for torque limit by over travel </P-OT> and </N-OT> signal input, torque is limited by one setting value of rotation prohibition torque [Ft-4.05] regardless of rotation direction of motor.

Multi-Step Speed Mode

Overview

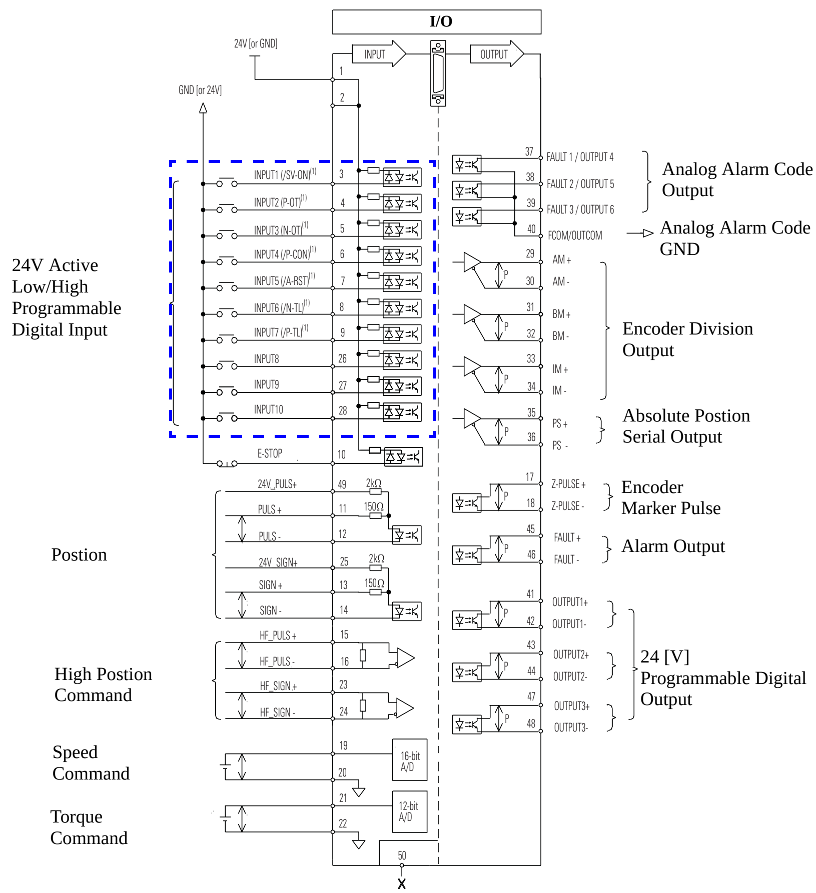
Multi-step speed mode is one of speed control method. It is to operate according to sequence input after setting operation speed in advance by parameter setting. It does not require separate speed command input or offset adjustment because it operates only with parameter and sequence input.

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



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.



TIP	Whether to use the emergency stop input can be set by the parameter [Ft-0.05]; the initial value is set as not to use..

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.

Table 5.8 </C-DIR> Signal to Determine Rotation Direction of Motor

	</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..

Table 5.9 Rotation Speed According to </C-SP1>, </C-SP2>, </C-SP3> Signal

Multi-step speed	**Speed Setting Parameter**	**Initial Value (rpm)**	**</C-SP3>**	**</C-SP2>**	**</C-SP1>**
Stop Command	0 [rpm]		0	0	0
Speed Command 1	Ft-2.05	0000	0	0	1
Speed Command 2	Ft-2.06	0000	0	1	0
Speed Command 3	Ft-2.07	0000	0	1	1
Speed Command 4	Ft-2.08	0000	1	0	0

Table 5.9 Rotation Speed According to </C-SP1>, </C-SP2>, </C-SP3> Signal

Multi-step speed	**Speed Setting Parameter**	**Initial Value (rpm)**	**</C-SP3>**	**</C-SP2>**	**</C-SP1>**
Speed Command 5	Ft-2.09	0000	1	0	1
Speed Command 6	Ft-2.10	0000	1	1	0
Speed Command 7	Ft-2.11	0000	1	1	1

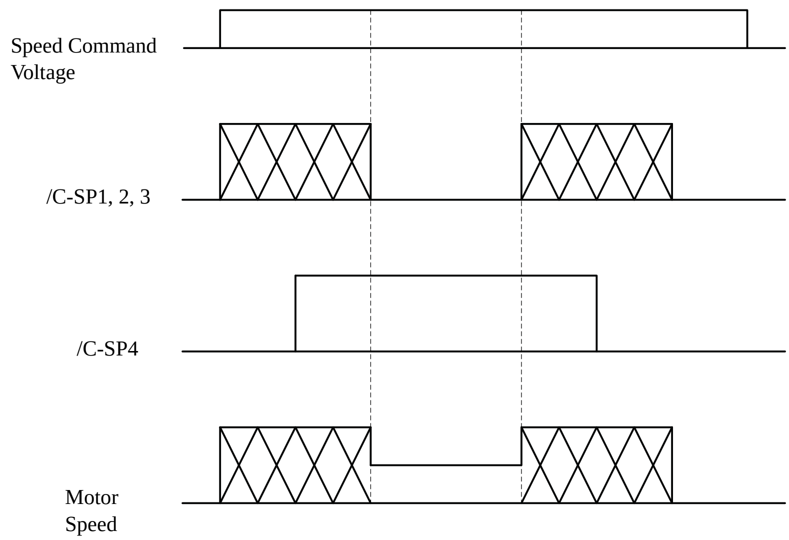
Table 5.10 </C-SP1>, </C-SP2>, </C-SP3> Parameter Data

Setting Value	-6000 ~ 6000
Initial Value	0
Unit	[rpm]
Applicable Mode	P
Others	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 (Ft-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 5-1 page "Sequence I/O (Input/Output) Signal".

TIP

... If you do not change the rotation direction, you do not need to use </C-DIR> input.

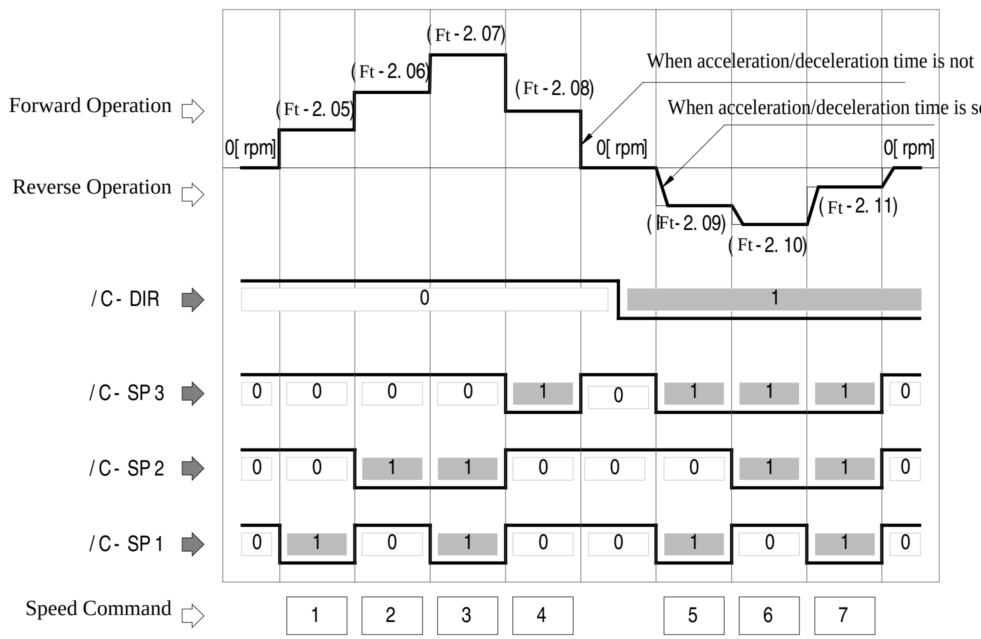
... In addition, you do not need to use all </C-SP1>, </ C-SP2> and </C-SP3>, and can adjust change level using only </C-SP1> or both </C-SP1> and </ C-SP2> according to your needs.

... If you set up 'b' when you allocate sequence input signal as described in sequence input/output signal in the 5-1 page "Sequence I/O (Input/Output) 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.



TIP

... 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 7-17 page "Setting for Smooth Operation".

Mixed 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 4-13 page "Control Mode Setting".

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 5-1 page "Sequence I/O (Input/Output) Signal".

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.

Table 5.11 Relationship Between </C-SEL> Input Signal and Control Mode Conversion

Mixed Control Mode Set in [Ft-0.00]		**Control Mode & Display**	
		</C-SEL> = OFF	**</C-SEL> = ON**
SF	Speed-Position	SF	SF
CS	Torque-Speed	CS	CS
CF	Torque-Position	CF	CF
PF	Multi-Step Speed+Position	PF	PF
PS	Multi-Step Speed+Speed	PS	PS
PC	Multi-Step Speed+Torque	PC	PC

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.

</C-SEL> is sequence input that is used only for combinational control mode. If you set combinational control mode in [Ft-0.00] and do not allocate </C-SEL> to sequence input, Servo drive indicate Servo warning “PIN” in state indication mode.

P.‾PIn

Precautions

Caution is needed when changing the control mode in the combination control mode.

If the control mode is changed by solely using the </C-SEL> signal in the combination control mode, the operation of the servo drive can become unstable or the load can be damaged under certain circumstances.

While programming a higher control device, be sure to change the control mode using </C-SEL> input signal after the sequence input/output conditions are properly met as the table below.

Table 5.12 Condition for Control Mode Convention

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> ~ </C-SP3> Input = All OFF 2. </TG-ON> Output = OFF

As described before, mixed control mode uses two basic control modes. 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.

TIP

Some parameter functions are valid in special control mode.

For example, acceleration/deceleration time setting [Ft-2.02] and [Ft-2.03], S-Curve Operation time setting [Ft-2.04] are valid in speed control mode but invalid in position or torque control mode.

Be careful when converting the control mode.

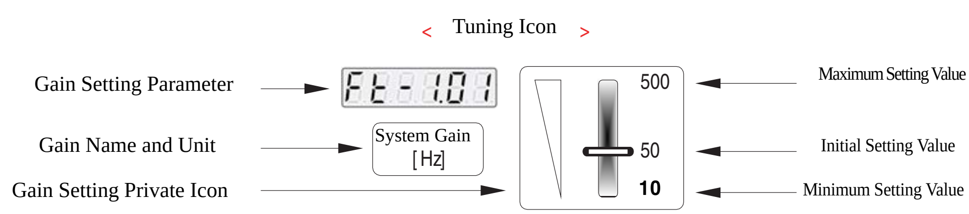
Tuning by Gain Setting

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

Before You Begin

Mark Description

The following icon is used for tuning.



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.

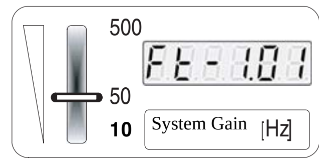
You should adjust servo drive to satisfy load condition in order to achieve optimum performance for each control.

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



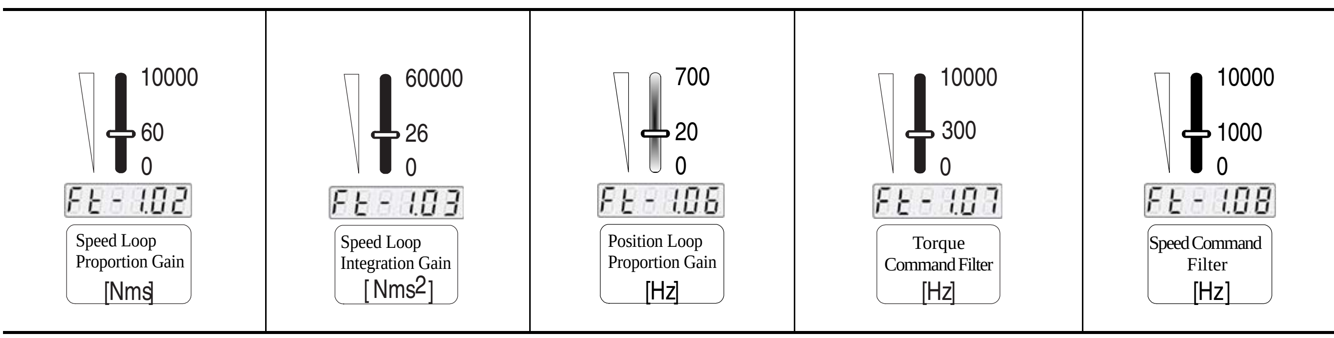
It is the same as the Bandwidth of overall speed control loop of the servo drive.

It can adjust five basic gains at the same time.

IMPORTANT In case of CSD5 servo drive, the system gain is limited to 10Hz at its minimum to guarantee a proper level of motion characteristics when speed response level [Ft- 1.00] is set too low. For more information about speed response level, refer to 6-8 page "Speed Response Level [Ft-1.00]".

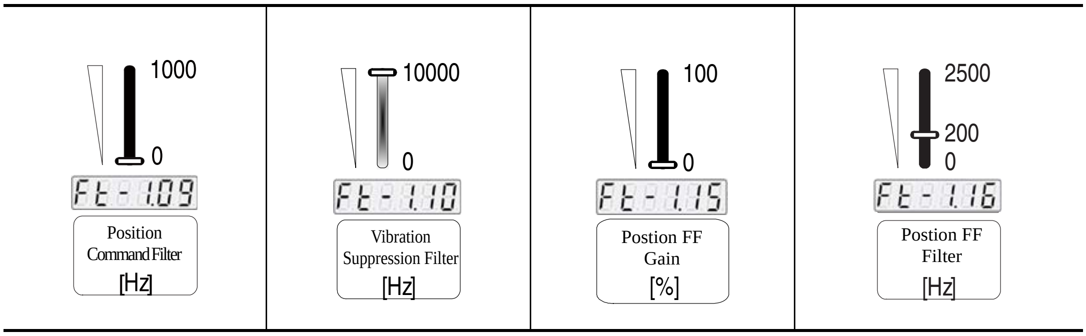
Basic Gain

They are five fundamental gains for tuning.



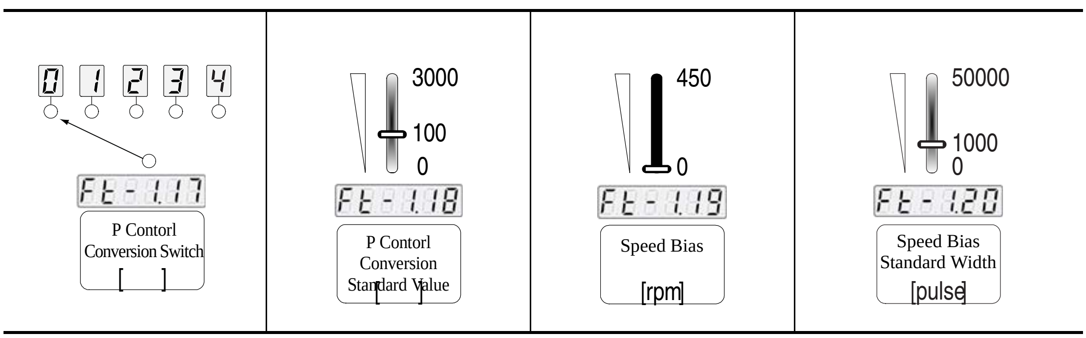
Applicable Gain

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.

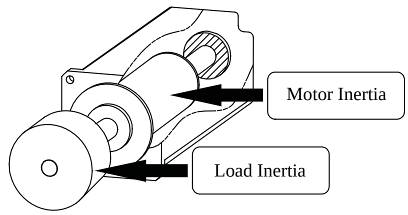
Parameter That is Most Important for Tuning, Inertia Ratio

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 ?

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

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

Setting Parameter

Set the Inertia Ratio to the following parameter.

Parameter	
Parameter Name	Inertia Ratio
Descirption	It can be automatically set by off-line auto tuning function in the 7-44 페이지의 "오프-라인 오토 튜닝 운전 (run-01)".
Setting Value	0.00~60.00
Initial Value	1.00

Unit	Times
Applicable Mode	All
Others	Setting > End

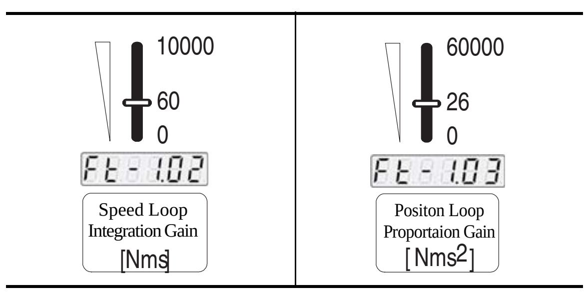
MPORTANT Based on the motor type and the rated output, the maximum allowed inertia ratio is as below. When the allowed inertia ratio exceeds the maximum, you cannot expect a fast response..

Motor	Capacity	Maximum Allowble Inertia Rotation
CSMT/R	less 100 [W]	30 [Times]
RSMQ/Z	less 1 [kW]	20 [Times]
	1 [kW]	10 [Times]
RSMS/D/H/F/K/L	All	10 [Times]

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, and 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	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	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	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.

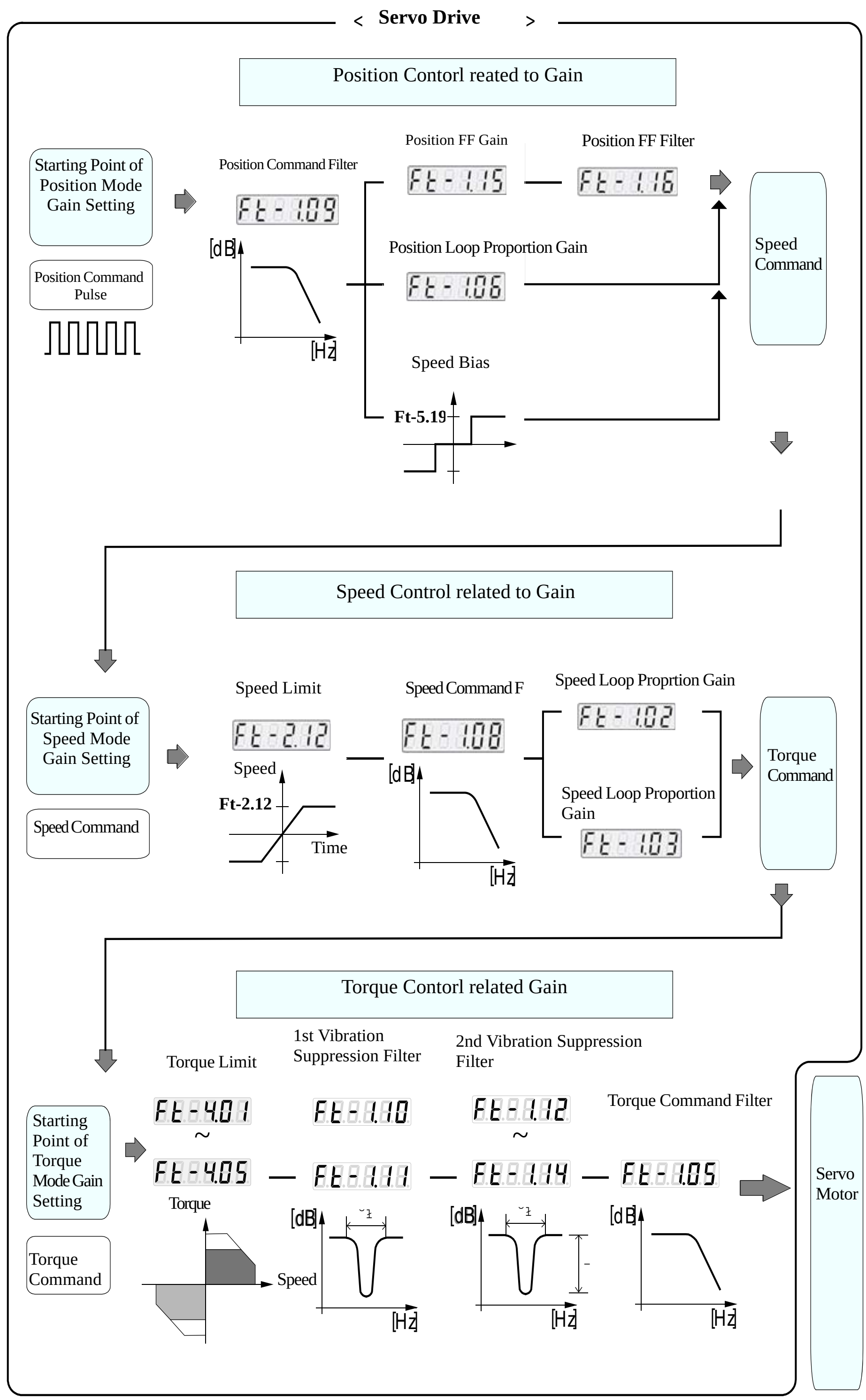
TIP

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.

For speed limit details, refer to the 7-21 page "Speed Limiting Function".

For torque details, refer to the 5-43 page "Torque Control Mode".

Gain Diagram releated to Position, Speed and Torque



Auto 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

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

Tuning Mode

There are inertial identification mode, inertia identification and resonance frequency detection mode, and resonance frequency detection mode.

The operation mode of run-01 is set by the Auto tuning Mode Setting [Ft-0.03] N0 [Ft-0.03] N0 = 2 (Resonance Frequency Detection). This is a function that looks for only the resonance frequency of the system in a stationary position unlike the inertia moment identification function. This function is for the users who are interested in finding only the resonance frequency, unlike [Ft-0.03] N0 = 1(inertia identification and resonance frequency detection). However, as this function also requires the system's inertia for an accurate operation, it can be useful when the vibration suppression filter needs to be corrected once more by feeling the vibration after performing [Ft-0.03] N0 = 0 (inertia moment identification) or [Ft-0.03] N0= 1 (inertia moment identification and resonance frequency detection).

Operation (Tuning) Method

For Operation method for off-line auto tuning, refer to Off-line Auto Tuning Operation (run-01) on page 7-44 page “Off-line Auto Tuning Operation (run-01)”.

Speed Response Level [Ft-1.00]

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 auto tuning, max. bandwidth is determined, and the system gain [Ft-1.01] is determined by [Ft-1.00].

Parameter	Ft-1.00
Parameter Name	Speed response level
Description	Define max. system gain % recommended by a system based on inertia measured from auto tuning
Setting Value	1 ~ 150
Initial Value	50
Unit	[%]
Applicable Mode	All
Others	Setting > End

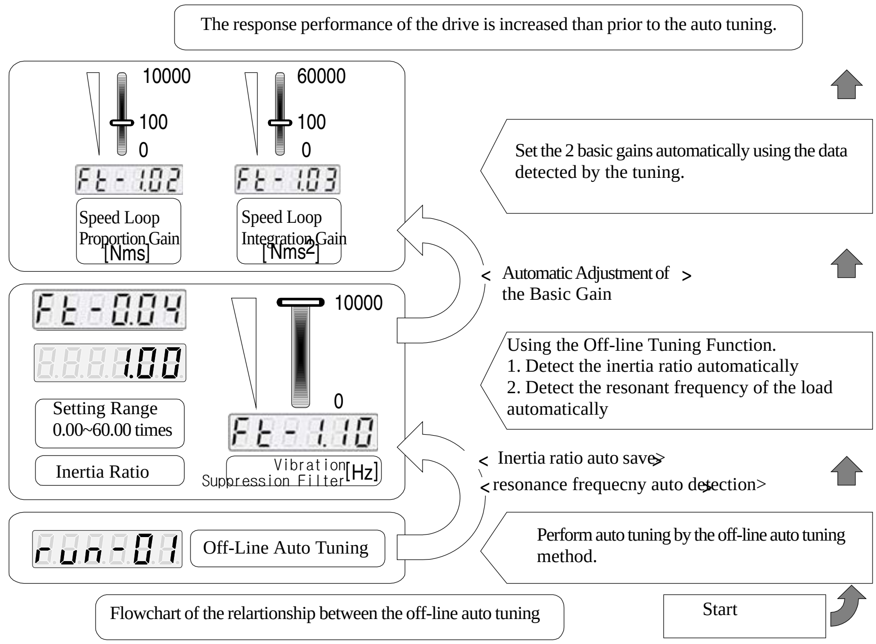
This parameter defines max. system gain [%] recommended by a system after execution of “Nertia Identification”. or ‘nertia identification and resonance frequency’ according to [Ft-0.03.N0] setting. For example, if ‘max. available frequency’ of a system is ‘100 [Hz]’ after auto tuning, its system gain [Ft-1.01] 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 value is 50 [%] and the related gain values are automatially set to appropriate values when it is changed, and the related Gain Values are automatically set to appropriate values when it is changed. However, system gain [Ft-1.01] is limited to 10 [Hz] at its minimum to guarantee a proper level of motion characteristics when speed response level [Ft-1.00] 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 [Ft-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 [Ft-1.10] and if you know the exact resonant frequency of the load, you can set it directly.



TIP 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 [Ft-0.04] and resonant suppression filter [Ft-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

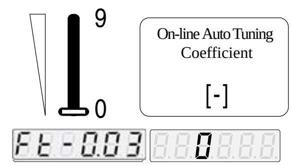
On-line Auto Tuning is used when load is continuously changed during the operation. It continuously changes the gain value according to load state in order to maintain the regular response quality of system even though load state is changed.

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 6-36 page "</G-SEL> Function".
- 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

Coefficient	
Coefficient Name	Speed response level
Description	If this value is not '0'. use on-line auto tuing function. The higher you set the value, the more delicately it responses to load change and respond quickly.
Applicable Mode	All
Others	Servo-OFF > 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 [Ft-1.01] and if noise or vibration occurs, reduce that value.

For system gain [Ft-1.01], refer to the 6-15 page "Basic Gain Setting".

On-line Vibration Suppression

Select Online Vibration Suppression Mode.

Three modes can be selected on the first 7 segment: Disable, Normal and High Speed Mode, and Slow Speed Mode without Initial Value.

Also, the second 7 segment supports Online Vibration Suppression Gain function.

On-line Vibration Suppression Mode Selection

... Ft-1.22.N0 = 0

Operates based on the value of the fixed vibration suppression filter in Ft-1.10 which is previously set by the offline tuning, and the online function does not work.

... Ft-1.22.N0 = 1

It is a function to suppress the vibration online in the most general motion conditions. However, for the online function to work properly, an initial offline tuning is necessary. The inertia ratio set by offline is essential for the maximum result of the online vibration suppression. Once the online function starts by this mode, the existing value of [Ft-1.10] becomes meaningless.

MPORTANT The suggested online function can adversely affect when the load condition is too great with a high strength or in no load status. It is strongly advised not to use this function and operate in Off-line Tuning Mode (its parameter setting value is 0 in [Ft-0.03]) for a better result in those cases..

Generally, the suggested load condition brings a good result when using a belt or a belt-incorporated system.

... Ft-1.22.N0 = 2

This function is used to detect the resonance frequency while in general motion when no proper value exists in [Ft-1.10] because only the inertia ratio was identified without measuring the resonance frequency in the initial offline tuning stage.

MPORTANT To use this function, it is extremely important that the system gain [Ft-1.01] should be set low between 10 ~15 [Hz], and the maximum speed for the motion should be lower than 100 [rpm].

Once the above conditions are met, while in general motion, and check what value [Ft-1.10] changes to. If the system cannot identify an appropriate resonance frequency, [Ft-1.10] does not change its initial value (10000).

Once the value is changed, it is difficult to increase the speed higher than 100 [rpm], but the gain can be increased within the bounds of the system; in that case [Ft-1.10] can change again.

Even if it changes to a certain value, when the [Ft-1.22] N0 is changed to another mode, the value of [Ft-1.10] that was measured online returns to the initial value, which was set in the Disable online Vibration Suppression mode in case [Ft-1.22] N0 is "0". That is because, the defined value of [Ft-1.22] N0 on "2"(Slow Speed mode without initial value) might not have the generality since it is a value guaranteed only in the low-speed operation mode. However, if a user decides that the device is always operated in the low-speed mode and wants to keep the value permanently, he can reset Ft-1.22.N0 = 0 and write the value measured online from [Ft-1.22] N0 "2" again onto Ft-1.10 then, the value is stored in the memory of the drive for good.

If only resonance (or vibration) frequency is needed, execution of [run-01] (offline auto tuning) after setting "[Ft-0.03] N0 =2 (Resonance Frequency Detection)" enables the normal operation after locating the vibration frequency.

The advantage of this function is that all the operation conditions are in the low-speed range mentioned above (within 100 [rpm]); in case the gain is also relatively low, the operation can be continued while adjusting for the optimum [Ft-1.10].

MPORTANT This function is available only when both the gain and the operation speed (within 100 rpm) are low.

Online Vibration Suppression Gain Setting

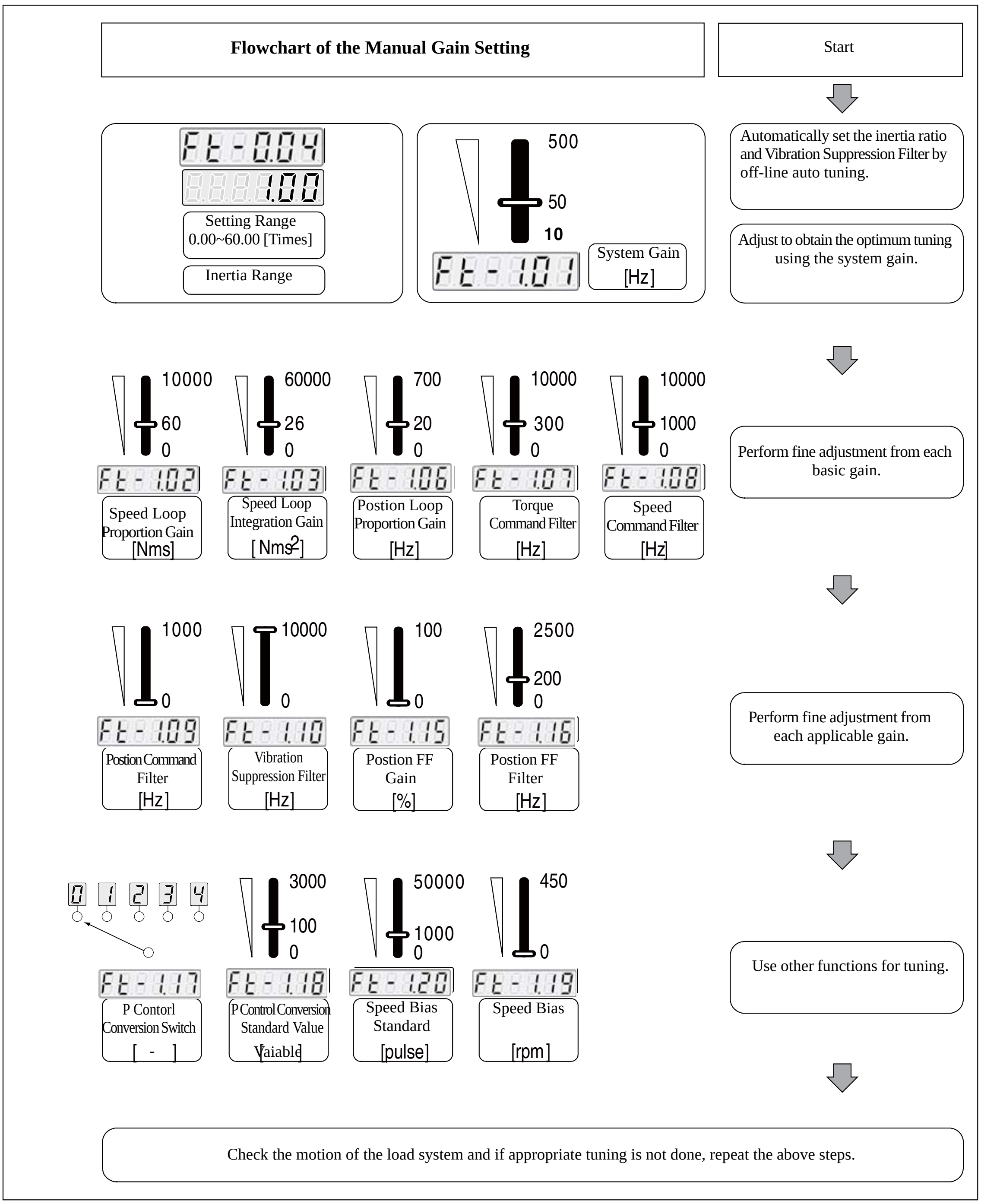
As mentioned above "[Ft-1.22] N0 = 1” is the most suitable online function to be used in general. However, this function may be vulnerable depending on the load condition. Such an example is when the structure is complicated with many belts connected. Initial value “[Ft-1.22] N1 = 0”can be applicable in most cases; if there is a functional problem, set [Ft-1.22] N1 value to "1" so the online vibration suppression gain could increase, and use the higher value of [Ft-1.07](Torque command filter) than 1000 [Hz] to get a good result.

In the meantime “[Ft-1.22] N1” affects only when “[Ft-1.22] N0 = 1”.

Manual Gain Setting

Gain Setting Flowchart

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



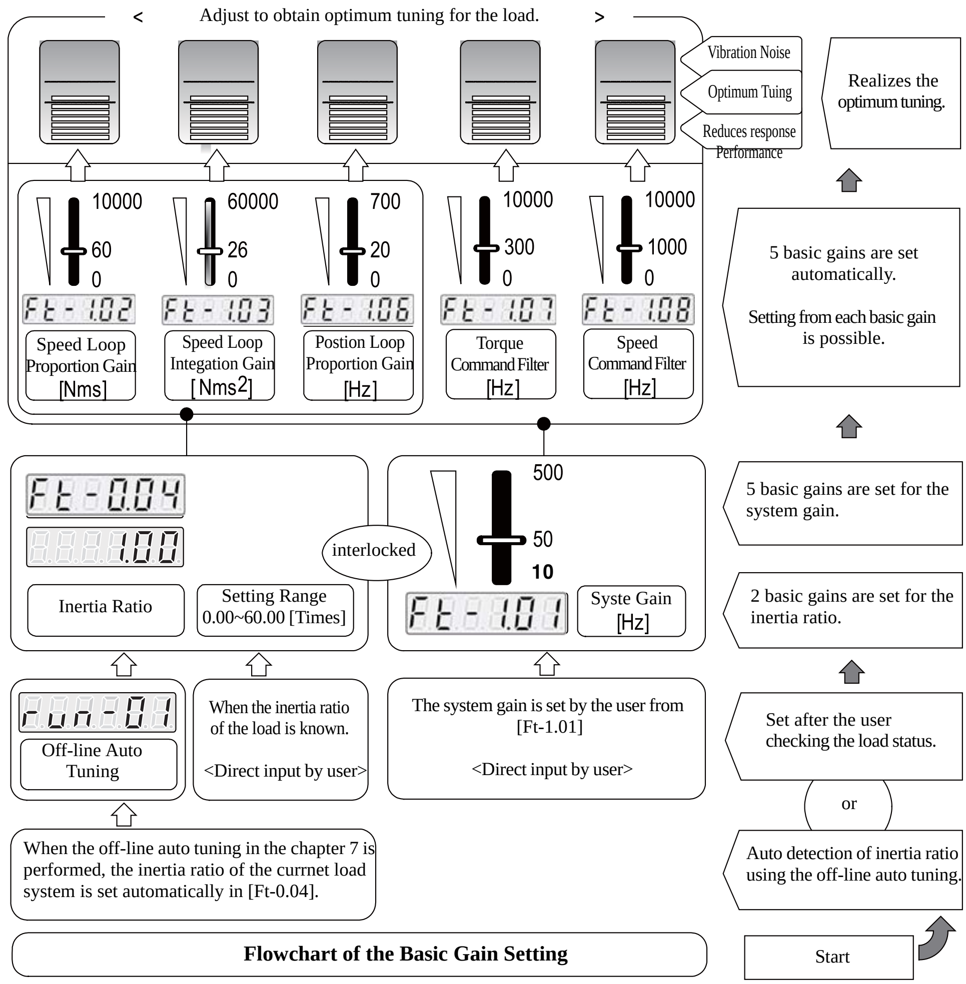
Basic Gain Setting

The following explains five Basic Gain Settings for Tuning.

Basic Gain Setting by System Gain and Inertia Ratio

- Firstly, execute the Off-line Auto Tuning for automatic setting of Inertia Ratio [Ft-0.04].
- Set system gain to optimum Tuning level. If vibration noise occurs in load system, reduce tuning level to prevent vibration noise.
- 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.



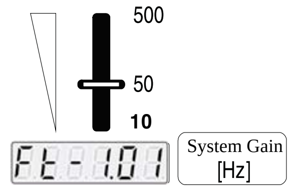
If response performance is decreased after Off-line Auto Tuning, increase the value of system gain [Ft-1.01], and do Off-line Auto Tuning again. We recommend securing the maximum response quality as increasing the value of system gain [Ft-1.01] until noise or vibration occurs.

When maximum response quality is guaranteed in the condition that the value of Inertia Ratio [Ft-0.04] is accurately set and there is no vibration noise in load system, (When you set the value of system gain [Ft-1.01] as high as you can), it becomes bandwidth of whole speed control loop.

As described above, as exactly set Inertia Ratio [Ft-0.04] and set basic gains using system gain [Ft-1.01], you can get response quality.

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

Parameter	
Parameter Name	Inertia Ratio
Description	This is the parameter to set load inertia ratio to motor inertia. When you change this value above, two basic gains [Ft-1.02, Ft-1.03] are changed by referring to the value [Ft-1.01].
Setting Value	0.00~60.00
Initial Value	1.00
Unit	[%]
Applicable Mode	All
Others	Setting > End

Parameter	
Parameter Name	System Gain
Description	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 [Ft-1.02, Ft-1.03, Ft-1.06, Ft-1.07, and Ft-1.08] are changed by referring to the Inertia Ratio [Ft-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 page "Position, Speed, Torque Related Gain Setting" . In addition, the Chapter 6-27 page "Tip to get fast response"will give you the detailed explanation on various functions to acquire fast response quality in gain setting.

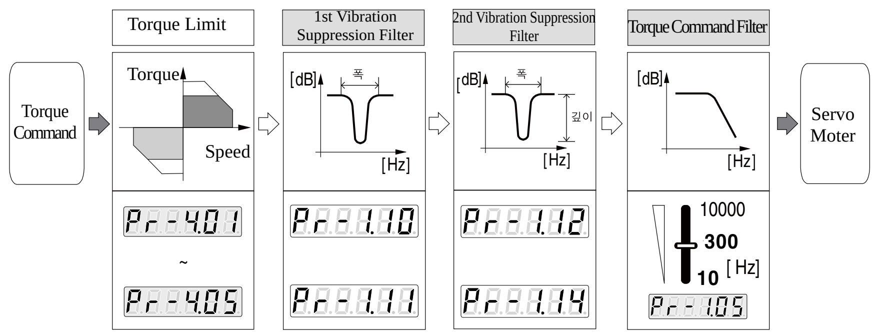
Position, Speed, Torque Related Gain Setting

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.

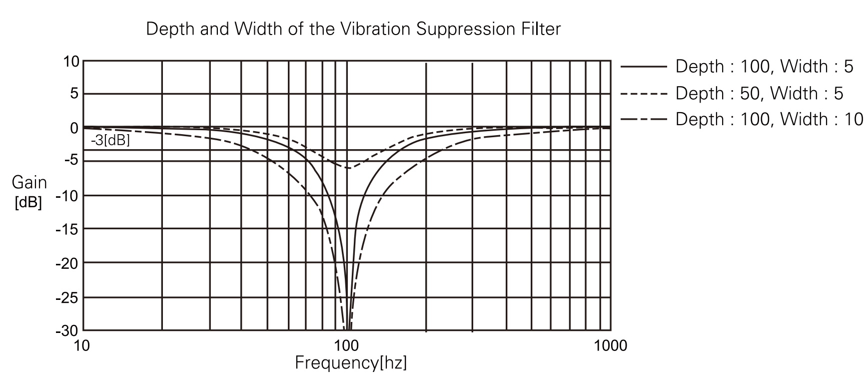
Torque Control Related Gain

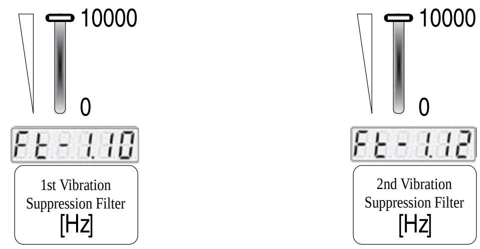


The 1st and 2nd Vibration Suppression Filter

If the vibration suppression filter is used in a ball screw or a belt system, it can suppress the mechanical vibration by decreasing the specific frequency that generates resonance. The frequency, depth, and width of the vibration suppression filter can be adjusted. The vibration suppression filter works the same way as a general notch filter.

The depth and width of the vibration suppression filter is as below.



Parameter	
Parameter Name	The 1st and 2nd Vibration Suppression Filter [Ft1.10], [Ft1.12]
Description	Two vibration suppression filters are provided. The width of the 1st vibration suppression filter, the width and the depth of the 2nd vibration suppression filter can be adjusted. The width range for the filter is 0~20, the depth is 0~100. For the 1st vibration suppression filter, the depth is fixed as 100; the depth and width of the 2nd vibration suppression filter can be adjusted. When the load system causes resonance in a specific frequency band, it suppresses the vibration caused by the resonance of the load. If properly set, it allows other gains to be raised, so that the stability and responsiveness of the overall system are improved enormously. But if it is set in a wrong way, it can cause vibration or noise.
Applicable Mode	All
Others	Setting > End

TIP

Resonance frequency of load = it is setting value of resonance suppression filter [Ft-1.07].

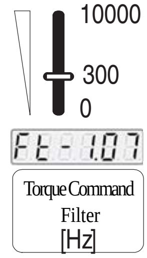
Resonance Suppression Filter [Ft-1.07] automatically find out resonance frequency and set the value by itself when you execute Off-line Auto Tuning.

For Off-line Auto Tuning, refer to the 6-8 page Off-line Auto Tuning.

If you know exactly mechanical resonance frequency range of load, you can directly enter the value.

Torque Command Filter

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

Parameter	
Parameter Name	Torque Command Filter
Description	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	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 [Ft-1.07] within about 100 [Hz].

TIP

For torque mode that host controller directly approves torque command through I/O of servo drive, you can indirectly adjust gain of whole control loop as adjusting external torque command input gain [Ft-4.00]. That is to say, if you increase [Ft-4.00], it has the same effect as increasing gain. And if you reduce [Ft-4.00], it has the same effect as reducing gain.

For external torque command input gain [Ft-4.00], refer to the 5-44 page "Torque Command Input".

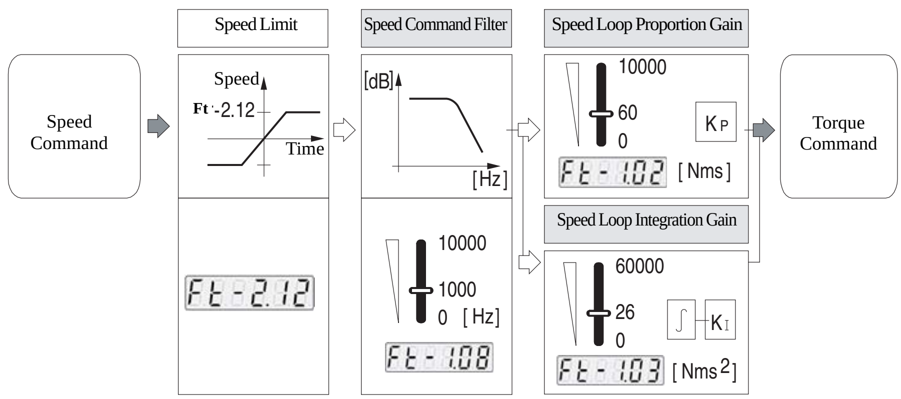
For torque limit, refer to th 5-43 page "Torque Control Mode".

Speed Control Related Gain

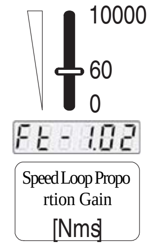
Speed related gain includes speed command filter, speed loop proportional gain and speed loop integration gain.

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

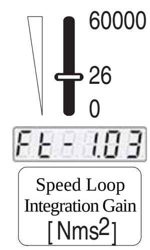
Speed Control Related Gain



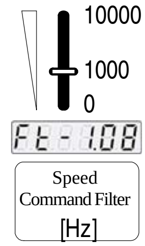
Speed Loop Proportion Gain

Parameter	
Parameter Name	Speed Loop Proportion Gain
Description	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

Parameter	
Parameter Name	Speed Loop Integration Gain
Description	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

Parameter	
Parameter Name	Speed Command Filter
Description	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 [Ft-1.02] to the limit that vibration noise does not occur.
- Confirm [Ft-1.02] as the value of 80 to 90 [%] of maximum setting value.
- Increase speed loop proportional gain [Ft-1.03] 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 [Ft-1.03] is as the following formula.

  $[\text{Ft-}1.03] \leq 300 \times [\text{Ft-}1.02]^2 \times$ 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 [Ft-1.08].
- It is better to set the value of torque command filter [Ft-1.07] as long as there is no vibration in load side.
- As repeating over response state, adjust gain in detail.

TIP

Value of [Ft-1.02] and [Ft-1.03] is scaled based on inertia value of motor.

Therefore, if Inertia Ratio [Ft-0.04] for 100 [W] motor or 1 [kW] motor is same as 10 [times], the appropriate gain of [Ft-1.02] and [Ft-1.03] becomes the same.

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

For external speed command input gain [Ft-2.00], refer to the 5-34 page "Speed Command Input".

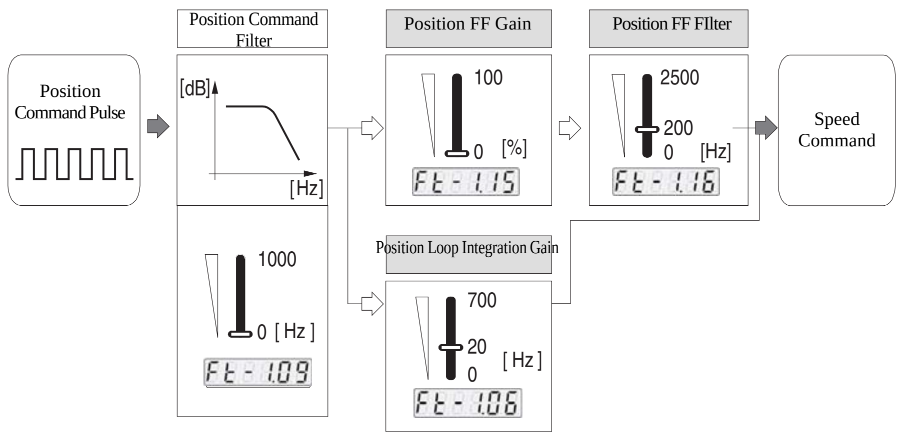
For speed limit, refer to the 7-21 page "Speed Limiting Function"and 5-41 page "Speed Limit Function and Speed Limit Detection </V-LMT> Output".

Position Control Related Gain

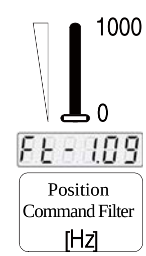
Position related gain includes position FF gain, position FF filter and position loop proportional gain.

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

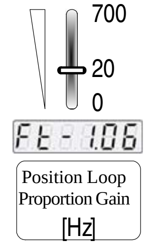
Position Control Related Gain



Position Command Filter

Parameter	
Parameter Name	Position Command Filter
Description	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. Max value is’1000’.
Applicable Mode	All
Others	Setting > End

Position Loop Proportion Gain

Parameter	
Parameter Name	Position Loop Proportion Gain
Description	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 [Ft-1.06] in the condition while the initial value of position loop proportional gain [Ft-1.02] is set.

... If there is vibration noise in load, reduce the value of [Ft-1.02] as 80 to 90[%] of that moment.

... Increase the value of [Ft-1.06] again up to the level that vibration noise does not occur in over response.

... Increase speed loop integration gain [Ft-1.03] 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 [Ft-1.03] is as the following formula.

$[Ft\text{-}1.03] \leq 300 \times [Ft\text{-}1.02]^2 \times$ Inertia of applied motor (Appendix)

... If necessary, you can suppress the excessive change of position command as reducing the value of position command filter [Ft-1.09].

... It is better to set torque command filter [Ft-1.07] as high as possible until vibration does not occur in load side.

... As repeating over response state, adjust gain in detail.

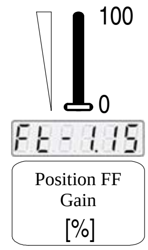
TIP Position FF gain, position FF filter and speed bias function are explained in the 6-27 page "Tip to get fast response".

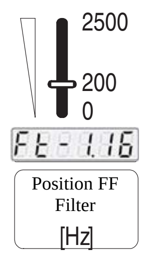
Tip to get fast response

Feedforward function

For position feed forward (FF) diagram, refer to the 6-25 page "Position Control Related Gain". 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.

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

Parameter	
Parameter Name	Position Feed forward Filter
Description	It makes position command itself smooth as suppressing high frequency that is included in position command. If torque command filter [Ft-1.15] is not ‘0’, it is valid. If this value is ‘0’, position FF filter is not used.
Applicable Mode	F
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 [Ft-1.07] as checking over response.

In addition, it is good method to suppress high frequency factor of position

FF using speed command filter [Ft-1.08] or making position command itself smooth using position command filter [Ft-1.09].

CAUTION

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

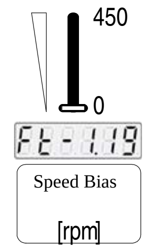
Speed Bias Function

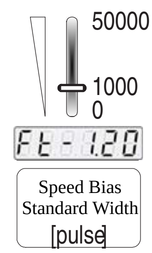
It provides to add bias to speed command according to position error as another method to reduce position completion time in position mode.

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.

Parameter	
Parameter Name	Speed Bias
Description	If position error is more than setting value of bias standard width [Ft-1.20], much bigger speed command that adds the setting value is sent. It is valid only when the value of [Ft-1.20] is not ‘0’.
Applicable Mode	F
Others	Setting > End

Parameter	
Parameter Name	Speed Bias Standard Width
Description	When the position error is bigger than the value set here, the speed bias amount [Ft-1.19] will be added to the speed command value. When the value is more than '0', the speed bias function works.
Applicable Mode	F
Others	Setting > End

For speed bias function, refer to the Chapter 6-25 page "Position Control Related Gain".

If absolute value of position error is more than the setting value of speed bias standard width [Ft-1.20], speed command as much as setting value of speed bias amount [Ft-1.19] is added to or reduced from the position control output.

Adjust [Ft-1.19] and [Ft-1.20] in turn while checking the over response.

TIP As reference, if you set the value of [Ft-1.19] too high or the value of [Ft-1.20] too low, vibration can occur.

P/PI Mode Setting Function

When you control speed or position, if you set speed loop integration gain [Ft-1.03], 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 [Ft-1.03] 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.

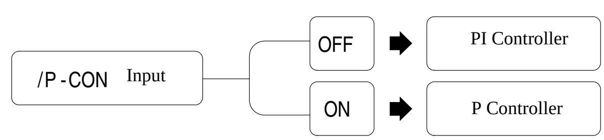
... Control by sequence input P control conversion </P-CON> signal.

... 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 5-1 page "Sequence I/O (Input/Output) Signal".

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



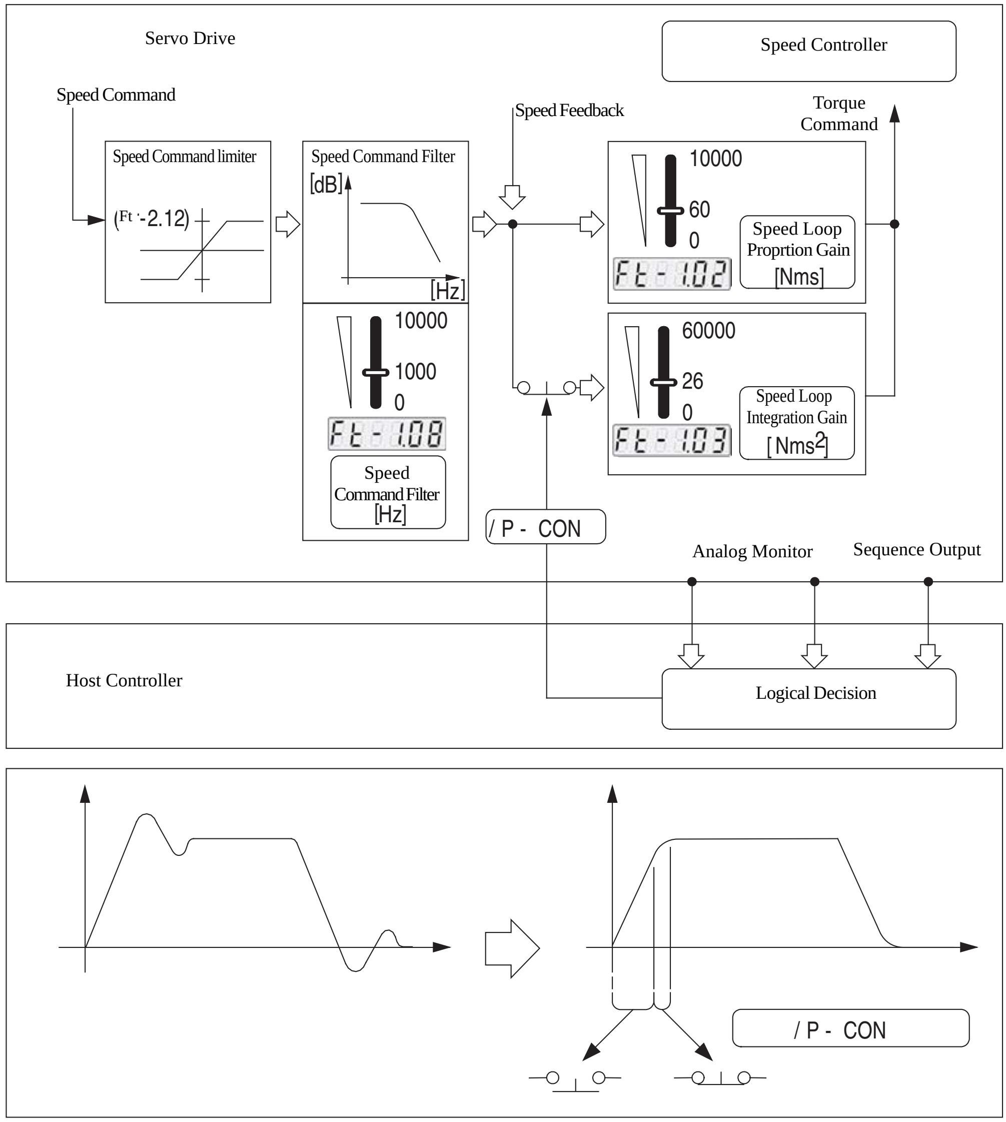
Therefore, host controller checks analog output such as speed or torque of servo drive and sequence output such as </P-COM>, < /V-COM>, </ TG-ON> and programs logics to convert controller from 'PI controller' type to 'P controller' type.

CAUTION

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 S etting

Meanwhile, you 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.

Parameter	Ft-1.17
Parameter Name	P control conversion switch
Description	0 : P/PI mode conversion is not used. 1 : If torque command is more than setting value of [Ft-1.18], PI -> P Control. 2 : If speed command is more than setting value of [Ft-1.18], PI -> P Control. 3 : If position error is more than setting value of [Ft-1.18], PI -> P Control. 4 : P/PI mode conversion automatically.
Applicable Mode	F, S, P
Others	Servo-OFF> Setting > End

Parameter	Ft-1.18
Parameter Name	P control conversion standard value
Setting Value	0~3,000
Description	Setting the P control conversion standard value is depending on the setting value of [Ft-1.17].
Initial Value	100
Unit	Variable
Applicable Mode	F, S, P
Others	Setting > End

TIP

Unit of P control conversion standard value [Ft-1.18] follow the unit of command that is selected in selected parameter of P control conversion switch [Ft-1.17].

... Position Error : [pulse]
... Speed Command : [rpm]
... Torque Command : [%]

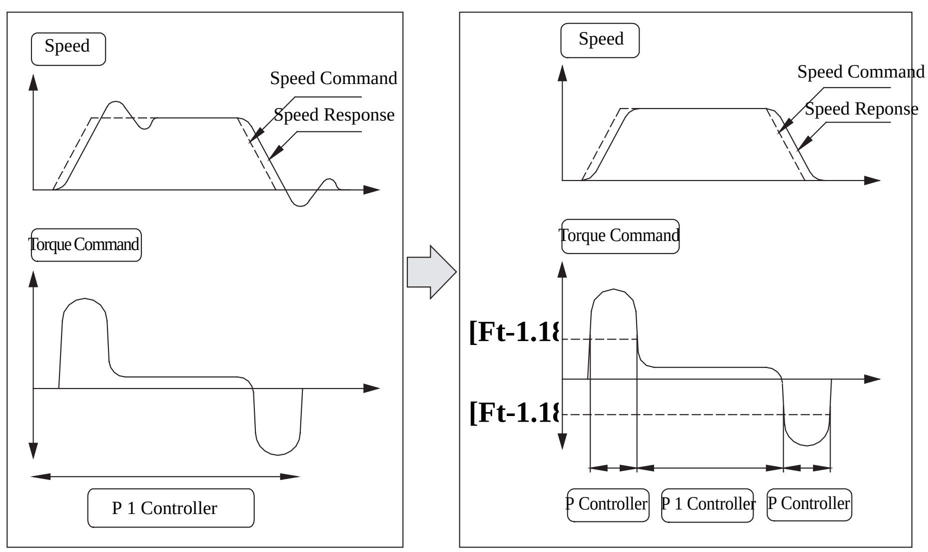
CAUTION

Sequence input </P-CON> signal is converted prior to setting of [Ft-1.17] and [Ft-1.18]. 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 [Ft-1.17 and [Ft-1.18]. 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 '1 controller' type to 'P controller' type in the over response condition.

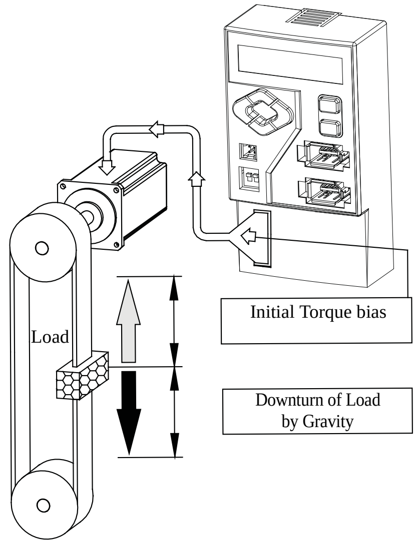
In the over response condition in acceleration-deceleration section, if torque command is higher than setting value of P/PI mode conversion standard value [Ft-1.18], it becomes 'P controller' type and the other section becomes 'PI controller' type.



Initial Torque Bias

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

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.

1. Check motor rotation direction (forward/reverse) and load direction (up/down).

2. Stop load in the special position using ? speed control or fixed location control.

3. If it remains without moving, check torque command value in (dis-03) of the Chapter 7-52 page "Monitor Mode Function"and set that value to [Ft-4.06] below.
Set positive value if the direction that the load goes up is forward direction of motor and negative value if the direction that the load goes up is reverse direction of motor. For definition on forward and reverse rotation, refer to the Chapter 7-11 page "Change the Motor Rotation Direction".

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.

Parameter	Ft-4.06
Parameter Name	Initial Torque Bias
Setting Value	-100 ~ 100
Description	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 the load drops. Therefore, you can suppress overshoot of speed response so that you can reduce position completion time.
Initial Value	0
Unit	[%]
Applicable Mode	All
Others	Setting > End

TIP For other method to control brake, refer to motor brake control in the Chapter 7-6 page "Motor Brake Contorl".

You can suppress the instant drop of the load only as setting brake control timing in the Chapter 7-6 page "Motor Brake Contorl".

CAUTION

If you set value of initial torque bias [Ft-4.06] too high, load can temporarily goes up.

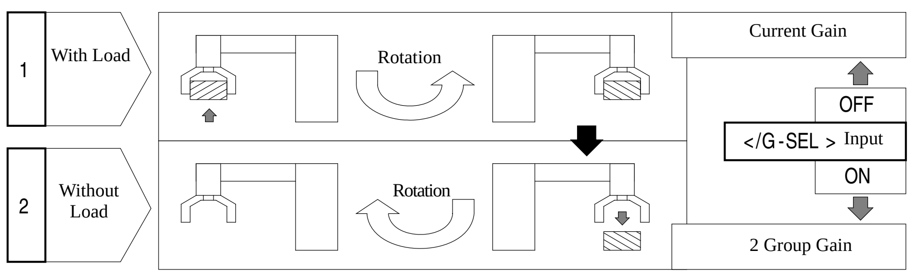
Be careful to make appropriate setting.

</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.

1. Set the optimum gain to fit for No. 2 condition in the figure above.

2. Save gain in No. 2 condition using gain storage function (run-11). At this moment, saved gains is 2nd group gain. Corresponding gain [Ft-1.02 ~ Ft-1.08([Ft-1.04, Ft-1.05] excluded)] is stored in 2nd group gain.
(For run-11 function, refer to the Chapter 7-41 page “Operation Mode Function”.)

3. Set the optimum gain to fit for No. 1 condition in the figure above. (current gain)

4. Allocate the input pin for sequence input </G-SEL> with reference to the Chapter 5-1 page "Sequence I/O (Input/Output) Signal".

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 5-1 page "Sequence I/O (Input/Output) Signal".

CAUTION

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

Gain Switching Function

CSD5 Servo Drive offers the following 4 gain groups to apply various movements.

1 Group Gain

No.	Name
Ft-1.02	Speed Loop Proportional Gain
Ft-1.03	Speed Loop Integral Gain
Ft-1.06	Position Loop Proportional Gain
Ft-1.07	Torque Command Filter
Ft-1.08	Speed Command Filter

2 Group Gain

No.	Name
Ft-1.28	The 2nd Speed Loop Proportional Gain
Ft-1.29	The 2nd Speed Loop Integral Gain
Ft-1.30	The 2nd Position Loop Proportional Gain
Ft-1.31	The 2nd Torque Command Filter
Ft-1.32	The 2nd Speed Command Filter

3 Group Gain

No.	Name
Ft-1.33	The 3rd Speed Loop Proportional Gain
Ft-1.34	The 3rd Speed Loop Integral Gain

Ft-1.35	The 3rd Position Loop Proportional Gain
Ft-1.36	The 3rd Torque Command Filter
Ft-1.37	The 3rd Speed Command Filter

4 Group Gain

No.	Name
Ft-1.38	The 4th Speed Loop Proportional Gain
Ft-1.39	The 4th Speed Loop Integral Gain
Ft-1.40	The 4th Position Loop Proportional Gain
Ft-1.41	The 4th Torque Command Filter
Ft-1.42	The 4th Speed Command Filter

</BANK_SEL> Function

Four gain groups are selectable for use through </BANK_SEL>(Gain Bank Selection).

</BANK_SEL> is set in [Ft-0.15] N1. When the set value is '0', Gain Bank 1 (1, 2 group gain), when the set value is '1', Gain Bank 2 (3, 4 group gain) is selected.

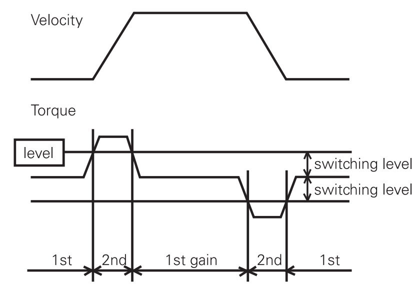
[Ft-0.15] N1	0	Gain Bank 1 (1, 2 group gain)
	1	Gain Bank 2 (3, 4 group gain)

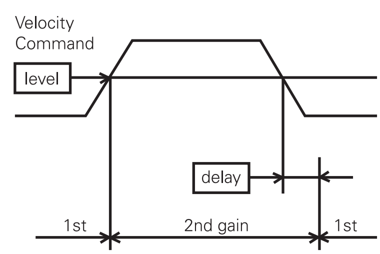
Gain Switching Mode

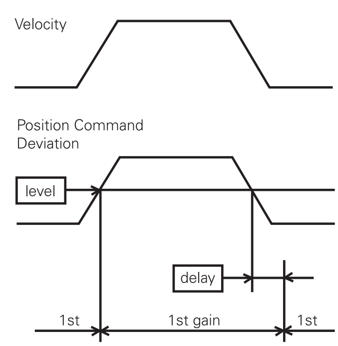
Gain Switching Mode can be chosen in [Ft-0.06] N2.

[Ft-0.06] N2	Gain Switching Mode

<table>
<tr><th>Category</th><th>Value</th><th>Description</th></tr>
<tr><td></td><td>0</td><td>The 1st gain value is fixed (1, 3 group gain).</td></tr>
<tr><td></td><td>1</td><td>The 2nd gain value is fixed (2, 4 group gain).</td></tr>
<tr><td></td><td>2</td><td>When the set external signal is input, the 2nd gain value is used.</td></tr>
<tr><td></td><td>3</td><td>When the torque command value is higher than the set value, the 2nd gain value is used.


</td></tr>
<tr><td></td><td>4</td><td>When the speed command value is higher than the set value, the 2nd gain value is used.


</td></tr>
<tr><td></td><td>5</td><td>When the position error is higher than the set value, the 2nd gain value is used.


</td></tr>
<tr><td></td><td>6</td><td>When the speed command value is higher than the set value, the 2nd gain value is used.</td></tr>
<tr><td></td><td>7</td><td>Before the completion of In-position the 2nd gain value is used.</td></tr>
<tr><td></td><td>8</td><td>When the motor speed value is higher than the set value, the 2nd gain value is used.</td></tr>
<tr><td></td><td>9</td><td>When the motor speed value is lower than the set value without any speed command, the 2nd gain value is used.</td></tr>
</table>

TIP

Gain Switching function uses the existing </G-SEL> function to enable the gain change in the 2 gain group change function, and by adding 3, 4 group gains, allows to choose between Gain Bank 1(1, 2 group gain) and Gain Bank 2 (3, 4 group gain) through </BANK_SEL>.

The gain value after the auto tuning is saved only in the 1 gain group same as before, and it can be manually copied to other groups and used after a fine tuning.

Applications

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

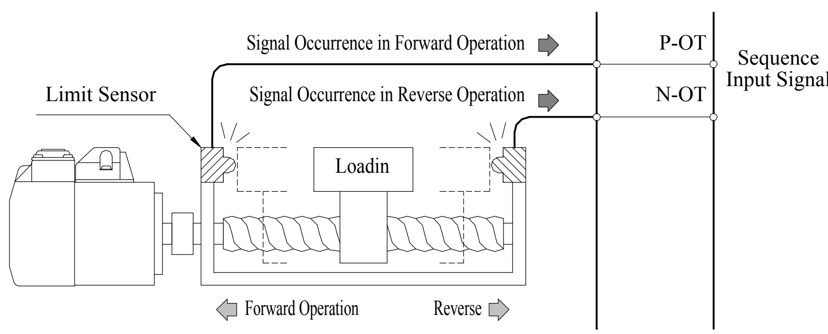
The content on servo alarm is described in detail in the Chapter 8-5.

OverTravel <P-OT>, <N-OT>

OverTravel(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 overtravel 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.

Overtravel 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 5-1 page "Sequence I/O (Input/Output) Signal" and allocated the <P-OT> and <N-OT> signals.

The No. 4 pin of I/O has the <P-OT> signal, and the No. 5 pin of I/O 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 4-7 page "Status Display Mode".

Selection of Stop Method in Overtravel Occurrence

Select the overtravel stop method from the below parameter. The information on dynamic brake is described in the following section.

Parameter	Ft-0.02 0
Parameter Name	Selection of an over travel stop method
Parameter Name	Set the stop method in an over travel occurrence.
Setting Value	• 0: Stop the motor while continuing the normal torque control. Refer to the Chapter 5-46 page "Torque Limit and Torque Limit Detection </T-LMT> Output" for the torque limit in an overtravel occurrence. • 1: It is stopped in the way described in the dynamic brake explained in the Chapter 7-3 page "Dynamic Brake".
Initial Value	0
Applicable Mode	All
Others	Servo OFF > Setting > End

NOTE

In case of an over travel incident, when the stop method N1 of [Ft-0.02] is set to '0' to stop through the normal torque control, the servo drive can limit the torque transmitted to the motor. Refer to the Chapter 5-46 page "Torque Limit and Torque Limit Detection </T-LMT> Output" for the torque limit in an over travel occurrence.

Dynamic Brake

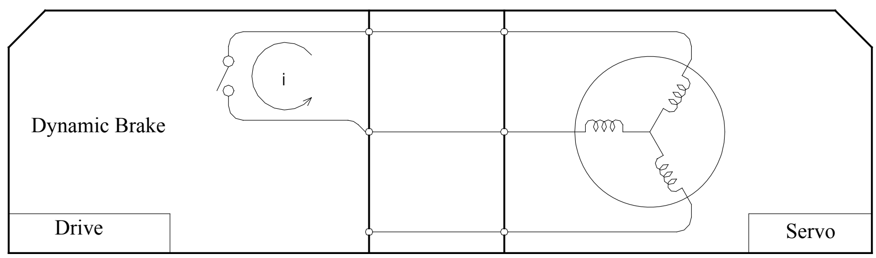
The CSD5 servo drive has the dynamic brake circuit.

Dynamic Brake (DB)

When the motor cable (U, V, and 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.



CAUTION

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.

Parameter	 
Parameter Name	Selection of DB Stop Method
Description	Set the stop method in an overtravel occurrence
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. • 3: Free Run stop. DB operation is maintained after the complete stop.
Initial Value	0
Applicable Mode	All
Others	Servo-OFF > Setting > End

Motor Brake Contorl

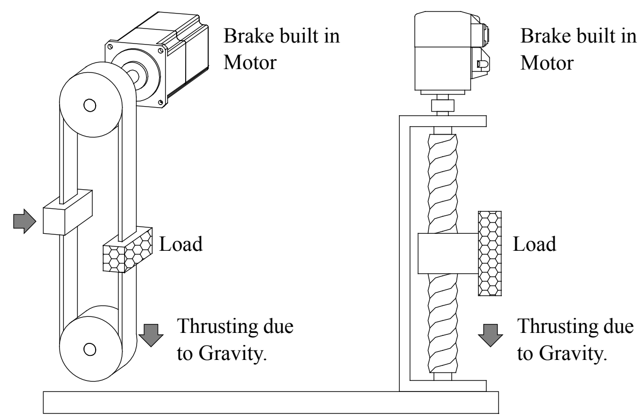
Motor Brake

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.

When using the vertical exis load, balance the weigh if it is mechanically possible.



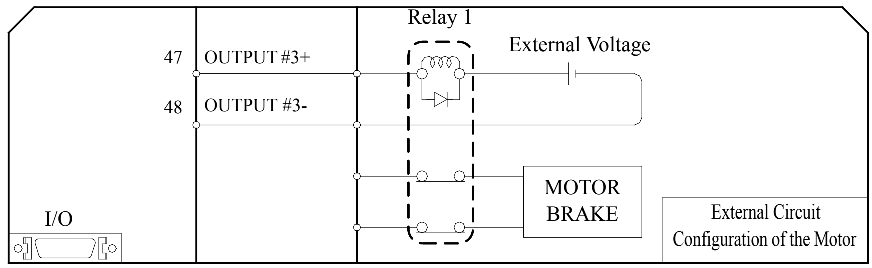
Sequence Signal Allocation

In order to use the motor brake, refer to the sequence input & output signal in the Chapter 5-1 page "Sequence I/O (Input/Output) Signal"first and allocate the <BK> sequence output signal. The signal for brake control is outputted with the allotted pin. The factory setting is OUTPUT#3 (No. 47 and No. 48 pins of I/O).

Circuit Configuration

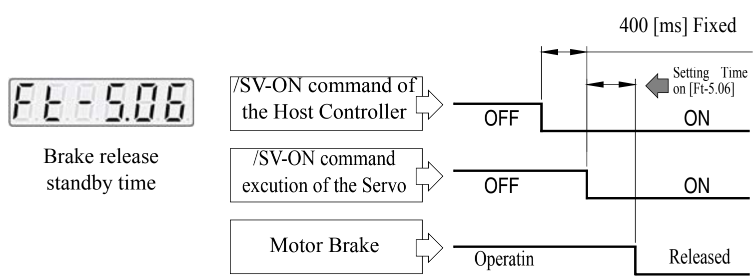
The drive cannot use the high voltage and current that can directly control the motor brake. Therefore, the motor brake cannot be connected directly to the drive and used. And it is possible to control the brake indirectly by configuring the external relay circuit. Refer to the indirect control circuit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

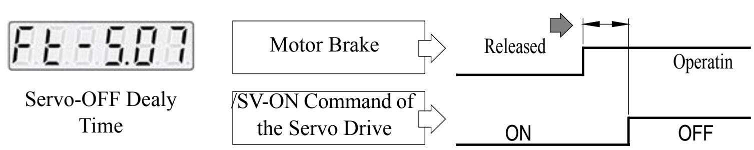
The output channel of I/O can be adjusted by the user according to the condition since the sequence output signal is used. The example below is based on a factory setting.

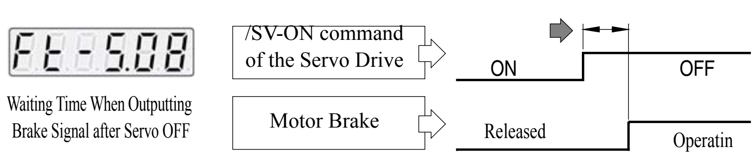


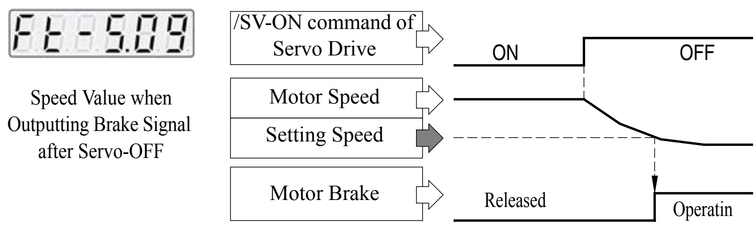
Motor Brake Control Setting

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.

Parameter	Ft-5.06
Parameter Name	Delay Time of Brake Output Signal after Servo ON
Description	Set delay time of brake ouput signal after servo on. 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. 
Setting Value	0 ~ 10000
Initial Value	0
Unit	[ms]
Applicable Mode	All
Others	Servo-OFF > Setting > End

Parameter	Ft-5.07
Parameter Name	Servo-OFF Delay Time
Description	Set Servo-OFF dely time. 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. 
Setting Value	0 ~ 10000
Initial Value	0
Unit	[ms]
Applicable Mode	All
Others	Serve-OFF > Setting > End

Parameter	Ft-5.08
Parameter Name	Waiting Time When Outputting Brake Signal after Servo OFF
Description	Set saiting time when outputting brake signal after Servo OFF. 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. 
Setting Value	0 ~ 10000
Initial Value	500
Unit	[ms]
Applicable Mode	All
Others	Serve-OFF > Setting > End

Parameter	
Parameter Name	Speed Value When Outputting Brake Signal after Servo OFF
Description	Set speed value when outputting brake signal after Servo OFF. Host Controller outputs the Servo-OFF command to drvice to stop the motor. The motor speed when the motor brake is operated, can be set. 
Setting Value	0 ~ 1000
Initial Value	100
Unit	Rotary Motor [rpm], Linear Motor [mm/sec]
Applicable Mode	All
Others	Servo-OFF > Setting > End

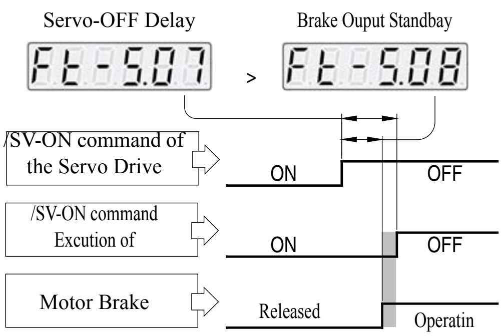
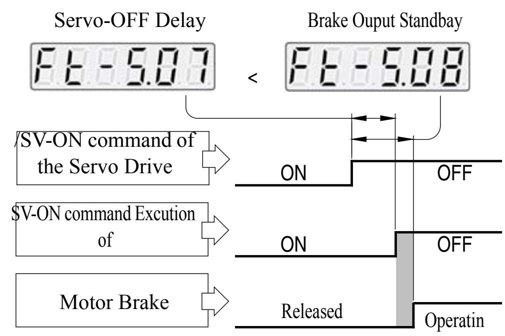
CAUTION

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 [Ft-5.08] and [Ft-5.09].

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 controlled 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 5-1 page "Sequence I/O (Input/Output) Signal".

Change the 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 (Clock Wise)

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

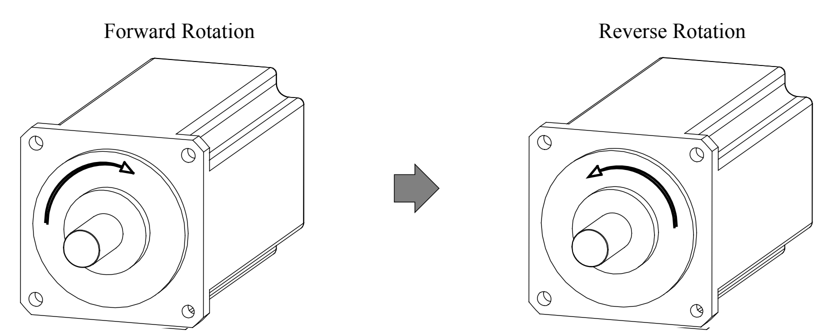
Definition of Reverse Rotation - CCW (Counter Clock Wise)

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

Rotation Direction Setting

Set the direction of the rotation in the below parameter.

Parameter	Ft-0.02 
Parameter Name	Sepection of Rotation Direction
Description	Set the rotation direction
Setting Value	• 0: Forward rotation is set as the CW direction. • 1: Forward rotation is set as the CCW direction.
Initial Value	0
Applicable Mode	All
Others	Servo-OFF > Setting > End



Reneration Resister

Regeneration Resister

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.

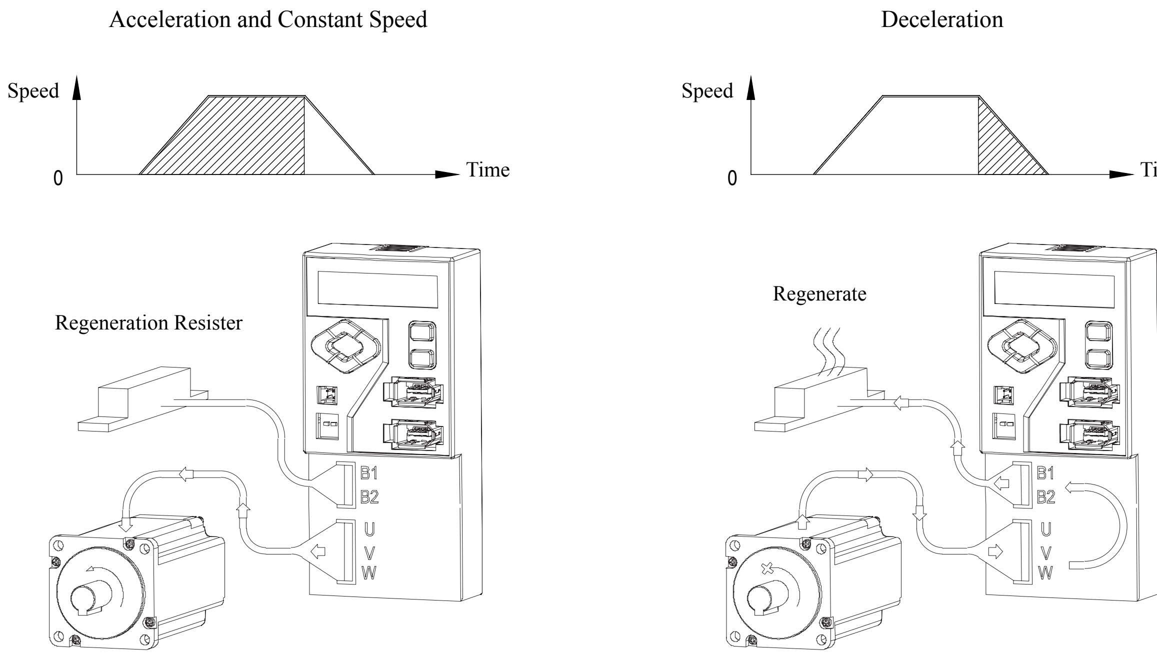
If there is excessive regeneration energy that causes the damage to the Servo Drive, but the Servo Drive is equipped with the protective circuit to shield off such phenomenon.

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 7-14 page "Regenerative Resistor Selection Standard" 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.



Specification of Regenerative Resistor Mounted on the Drive

The allowable power is 25 [%] of the rated power of the regenerative resistor mounted on the drive. But it is 50 [%] when using a cooling fan.

Table 7.1 Specification of regenerative resistor mounted on the drive

Servo Drive	Resistance (Ω)	Rated Power (W)	Allowble Power (W)	Cooling Fan
200 [W] or less	-	-	-	-
400 [W]	50	30	7.5	X
800 [W]	30	70	35	O
1 [kW]	30	70	35	O
1.5 [kW]	30	70	35	O

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.

CAUTION

- The resistance of the total regenerative resistor has to be 30~50 [Ω].
- 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 25 [%] of the rated power.
- 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.

$$\text{Allowble Repetition Frequency} = \frac{\text{Allowble Repetition Frequency in without load}}{1+n} \times \left(\frac{\text{Maximum Speed}}{\text{Setting Speed}}\right)^2 \text{[Cycles/Min]}$$

... Contents necessary in calculation shall be referred to the below.

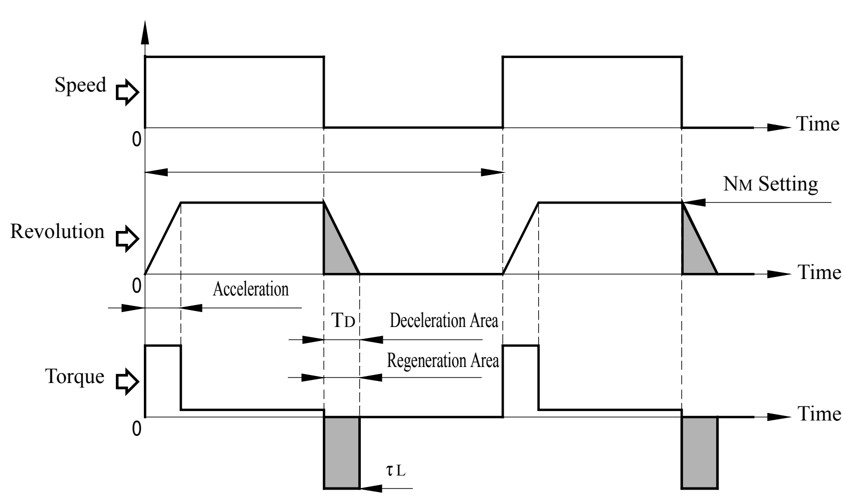
... n is the inertia ratio.

... The maximum speed shall be referred to the motor specifications of the appendix.

CAUTION

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

It shows the acceleration and deceleration of the motor in certain operation cycle in horizontal axis.



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

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.

Table 7.2 Allowble Repetition Frequency in Without Load [Cycles/Min]

Motor	**Motor Capacity [W]**									
	300	**400**	**500**	**600**	**750**	**800**	**900**	**1000**	**1200**	**1500**
CSMT		320		70		53		90		
CSMR		40								
RSMD					69			31		17
RSMF		35			19					9
RSMH			14					7		4
RSMK	54			76			40		14	
RSMQ		46			61					30
RSMS								43		27
RSMZ		88			63					

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 7-17 page "Setting for Smooth Operation" to set the possible deceleration time in long period of time.

... 5-46 page "Torque Limit and Torque Limit Detection </T-LMT> Output" Refer to The Chapter 5-46 page "Torque Limit and Torque Limit Detection </T-LMT> Output" 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

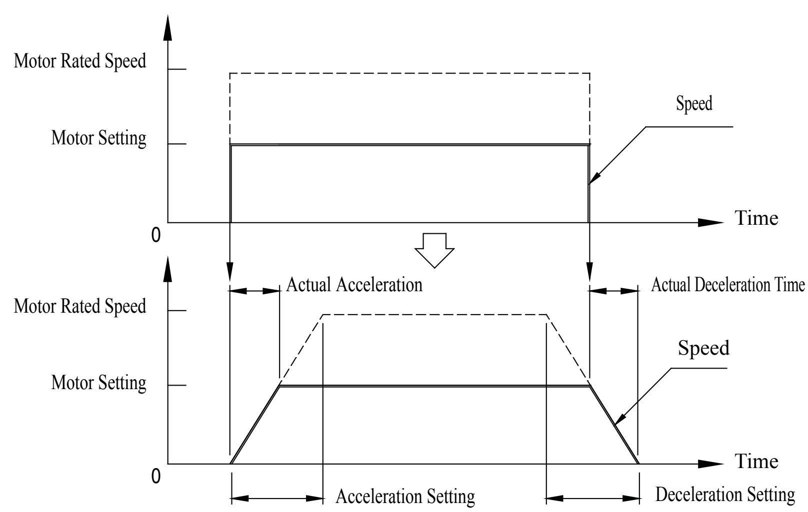
Acceleration is the rate of change in speed from stop to the motor's rated speed.

Definition of Deceleration

Deceleration is the rate of change in speed from the motor's rated speed to a stop.

Speed Command and Acceleration/Deceleration

The figure below shows the implementation of the speed command by the Servo drive after the Acceleration/Deceleration speed is set. It shows that the longer the deceleration time is, the longer the time for the implementation of the command becomes.



Acceleration/Deceleration Setting

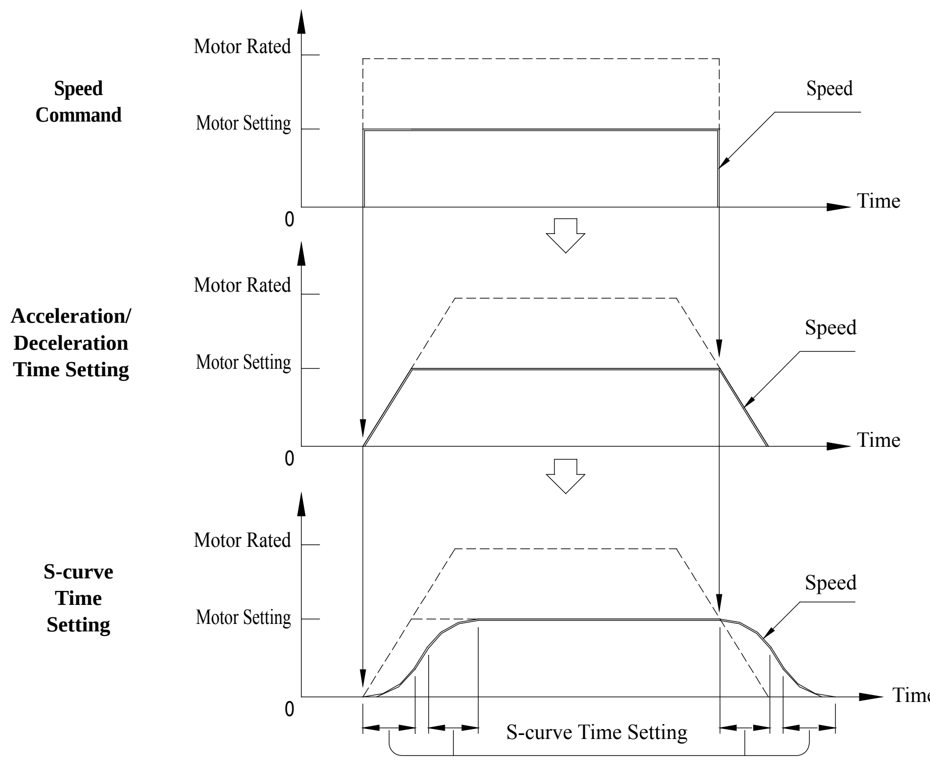
Set the acceleration/deceleration on the below parameter.

Parameter	Ft-2.02
Parameter Area	Acceleration
Description	Set motor acceleration speed
Setting Value	1 ~ 2,147,483,647
Initial Value	41667
Unit	Rotary Motor [10^{-2}xRev/sec^2], Linear Motor [mm/ sec^2]
Applicable Mode	All
Others	Setting > End

Parameter	Ft-2.03
Parameter Area	Deceleration
Description	Set motor deceleration speed
Setting Value	1 ~ 2,147,483,647
Initial Value	41667
Unit	Rotary Motor [10^{-2}xRev/sec^2], Linear Motor [mm/ sec^2]
Applicable Mode	All
Others	Setting > End

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.

Parameter	Ft-2.04
Parameter Area	S-curve Operation Time
Description	Set motor accelecation time
Setting Value	0 ~ 5000
Initial Value	0
Unit	[ms]
Applicable Mode	All
Others	Setting > End

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 + [Ft-2.03]). Also, the total time (10 seconds + [Ft-2.03] + [Ft-2.04]) of speed command performance after the S-curve time setting.

CAUTION

If the S-curve setting value is set as '0', the S-curve operation is not used.

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

Speed Limiting Function

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

2 Ways to Limit the Speed

There are 2 ways to limit the speed as below.

- 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.

Parameter	Ft-2.12
Paramter Name	Speed Limit
Description	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 4-12 page "Basic Setting".
Setting Value	1 ~ 6000
Initial Value	5000
Unit	[rpm]
Applicable Mode	All
Other	Servo-OFF > Setting > End

External Speed Limit Value

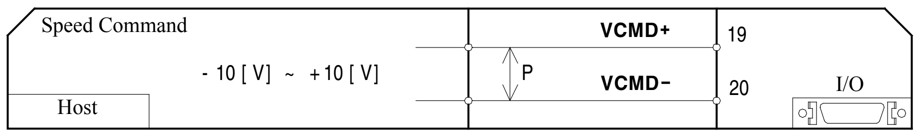
The below figure is the input of function to allow the servo drive to make the speed control by permitting the analog speed command at the host controller when the servo drive is used as the speed mode. Refer to the speed mode in the Chapter 5-32 page "Speed Control Mode".

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.

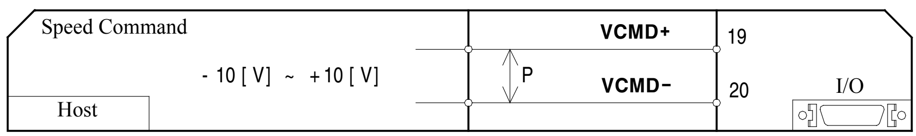
When it is used as speed mode, the external speed limit function may not be used and the speed may be limited by the internal speed limit.

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 contorller is



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.

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

External speed limit value is given by the following relationship.

External Speed Limit (rpm) = Speed Command Gain(rpm/V) × 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 VCMD (No. 19 pin of I/O) and VCMD-(No. 20 pin of I/O) 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 [Ft-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.

Paramter	Ft-2.13 0
Parameter Name	Speed Limit Selection
Description	Select the method of speed limit
Setting Value	• 0: The speed limit function is not used. • 1: It is limited by the internal speed limit [Ft-2.12]. • 2: It is limited by the external speed limit. • 3: Compare the internal speed limit [Ft-2.12] and external speed limit to limit in small value.
Initial Value	0
Unit	All
Applicable Mode	Servo-OFF > Setting > End

Postion 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.

Table 7.3 Encorder signal which is outputted to the host contoller

Signal	Function	Type
AM+, /AM-	Output on Encoder A(/A)	Line drive
BM+, /BM-	Output on Encoder B(/B)	Line drive
IM+, /IM-	Output on Encoder I(/I)	Line drive
PS+, /PS-	Absolute Encoder Position Data Output	Line drive
/Z-PULSE+,/Z-PULSE-	Open Collector Output of Encoder Z (+/ -)	Open Collector

Example of Wiring with Host Controller

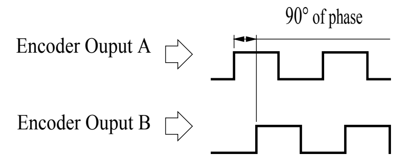
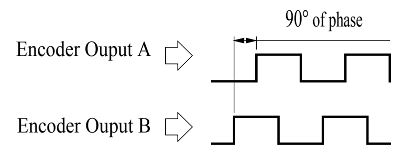
Refer to the Chapter 3-22 page "Encoder Wiring (Motor Feedback)" for the example of wiring of the host controller and servo drive.

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.

Parameter	Ft-3.00	0
Parameter Name	Encoder Output Pulse Direction	
Description	Set the direction of output pulse	

Setting Value	• 0: In forward rotation, the encoder output A phase have a lead of 90°over A phase.  • 1: In forward rotation, the encoder output A phase have a lead of 90°over B phase. 
Initial Value	0
Applicable Mode	All
Other	Servi-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

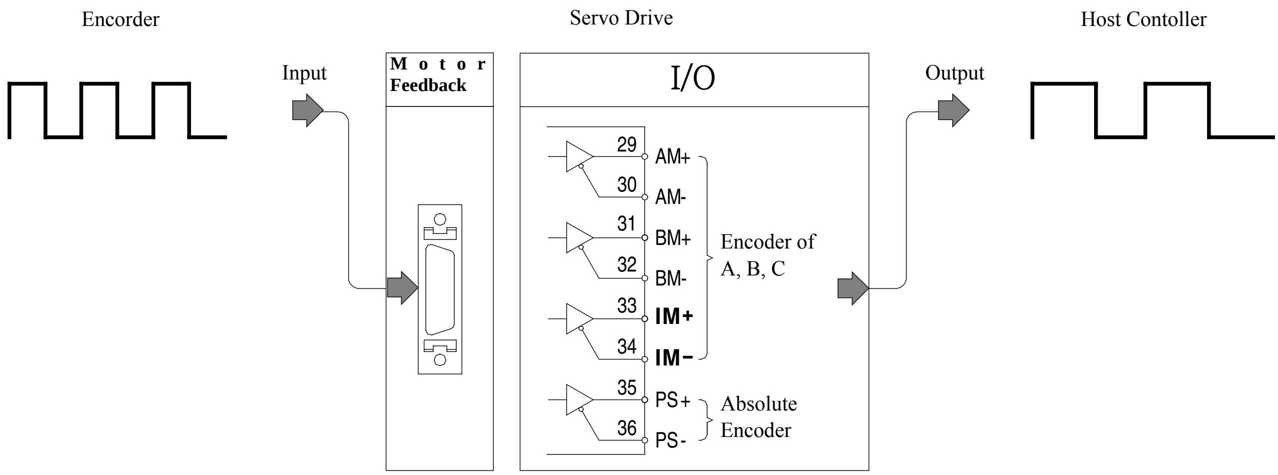
The number of output pulse is adjusted by the formula below.

([Ft-3.03]/[Ft-3.04]) × Number of Encoder Pulse= Ouput to Host Controller

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.

$(1000/2048) \times 2048 = 1000$

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



Setting

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

Parameter	Ft-3.03
Parameter Name	Number of Encoder Pulse per 1 Rotation (Numerator)
Description	Set the pulse dividing circuit numerator
Setting Value	1 ~ 32768
Initial Value	1
Unit	pulse
Applicable Mode	All
Other	Servi-OFF > Setting > End

Parameter	Ft-3.04
Parameter Name	Number of Encoder Pulse per 1 Rotation (Denominator)
Description	Set the pulse dividing circuit denominator.
Setting Value	1 ~ 32768
Initial Value	1
Unit	pulse
Applicable Mode	All
Other	Servo-OFF > Setting > End

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 #4-5 at the same time.

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

CAUTION

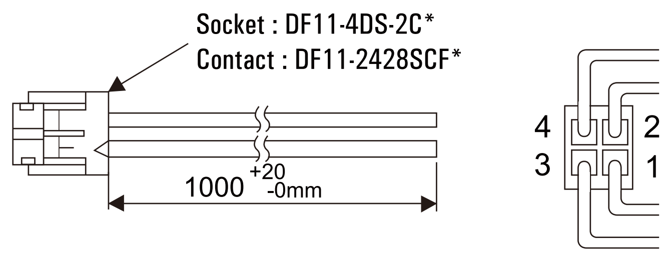
Make sure to comply with the following condition in the setting of alternative circuit. Therefore, numerator [Ft-3.03] should be same or less than denominator [Ft-3.04].

Analog Monitor Output

Overview

The drive includes two analog outputs that a user can allocate for the variables of the internal drive. A 4-pin connector, DF11-4DP-2DSA, is provided for two analog outputs.

Analog Monitor Cable



The figure above shows when the connector is installed from the front; the pin numbers are from the pins in the connector.

Pin	Description
1	Analog Output Ch 2
2	Analog GND
3	Analog Output Ch 1
4	Analog GND

Setting

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

Parameter	Ft-5.13 Ft-5.14 0000
Parameter Name	Analog Monitor Output CH1, CH2 Selection
Setting Value	0~28(Except 15, 23, 25, 26)
Initial Value	0, 1
Applicable Mode	All
Other	Setting > End

Parameter	Ft-5.15 Ft-5.16 0000
Parameter Name	Analog Monitor Output CH1, CH2 Scaling
Description	Input signal amplitude of Channel 1 and 2 to display on oscilloscope
Setting Value	1~99999
Initial Value	500
Applicable Mode	All
Other	Setting > End

Table 7.4 Types and Unit of Analog Monitor Ouput

Selection No. of [Ft-5.15](CH1) [Ft-5.16](CH2)	**Type**	**Unit**	**Range of [Ft-5.15](CH1) [Ft-5.16] (CH2)**
0	Velocity Feedback	[rpm]	1~99999
1	Velocity Command	[rpm]	1~99999
2	Velocity Error	[rpm]	1~99999
3	Follower Position	[pulse]	0.001~99.999
4	Current Command	[pulse]	1~99999
5	Master Position	[pulse]	1~99999
6	Position Error	[pulse]	1~99999
7	Position Command Count Frequency	[kpps]	0.1~9999.9
8	Commutation Angle	[°]	0.1~9999.9
9	Mechanical Angle	[°]	0.1~9999.9
10	Shunt Power Limit Ratio	[%]	1~99999
11	Bus Voltage	[V]	1~99999
12	Absolute Rotations	-	-
13	Velocity Command Offset	[mV]	0.1~9999.9
14	Current Command Offset	[mV]	0.1~9999.9
15	Reserved	-	-
16	U Phase Current	[A]	0.001~99.999
17	V Phase Current	[A]	0.001~99.999
18	W Phase Current	[A]	0.001~99.999
19	Motor Utilization	[%]	1~99999
20	Analog Command - Velocity	[0.01V]	0.001~99.999

Table 7.4 Types and Unit of Analog Monitor Ouput

Selection No. of [Ft-5.15](CH1) [Ft-5.16](CH2)	**Type**	**Unit**	**Range of [Ft-5.15](CH1) [Ft-5.16] (CH2)**
21	Analog Command - Current	[0.01V]	0.001~99.999
22	Current Feedback	[A]	0.001~99.999
23	Reserved	-	-
24	Position Feedback Position	[pulse]	1~99999
25	Reserved	-	-
26	Reserved	-	-
27	Instantaneous Shunt Power	[W]	1~99999
28	Drive Utilization	[%]	1~99999

Monitoring Sample

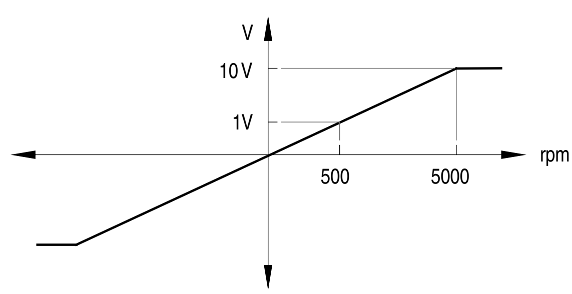
The below figures are the monitoring samples.

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

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].



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.

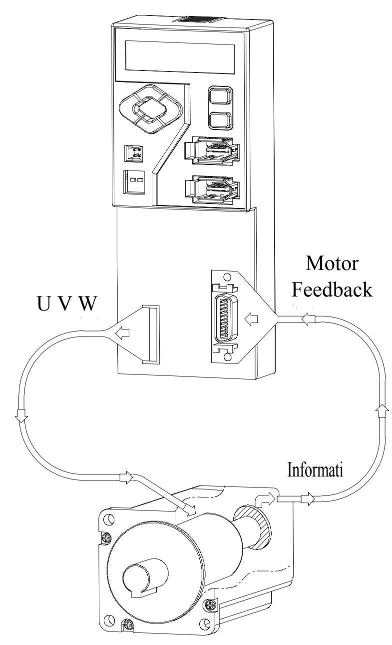
Absolute encoder can store and memorize the absolute position information of the load system by using the battery power if the power of servo drive is cut off. Absolute encoder does not accumulate the error by the noise during the signal transmission. Also, if the power is cut off as in the incremental 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.

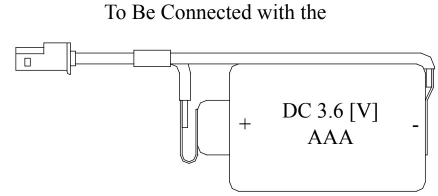
When the host controller needs the absolute position of load system in the power cut off, the motor that is equipped with the absolute encoder has to be used.

Types of Absolute Encoder:

• A, H Type Absolute Encoder(11bit Absolute Encoder)
... Q Type Absolute Encoder(17bit Serial Absolute Encoder)

Drive Output and Encoder Information Flow:





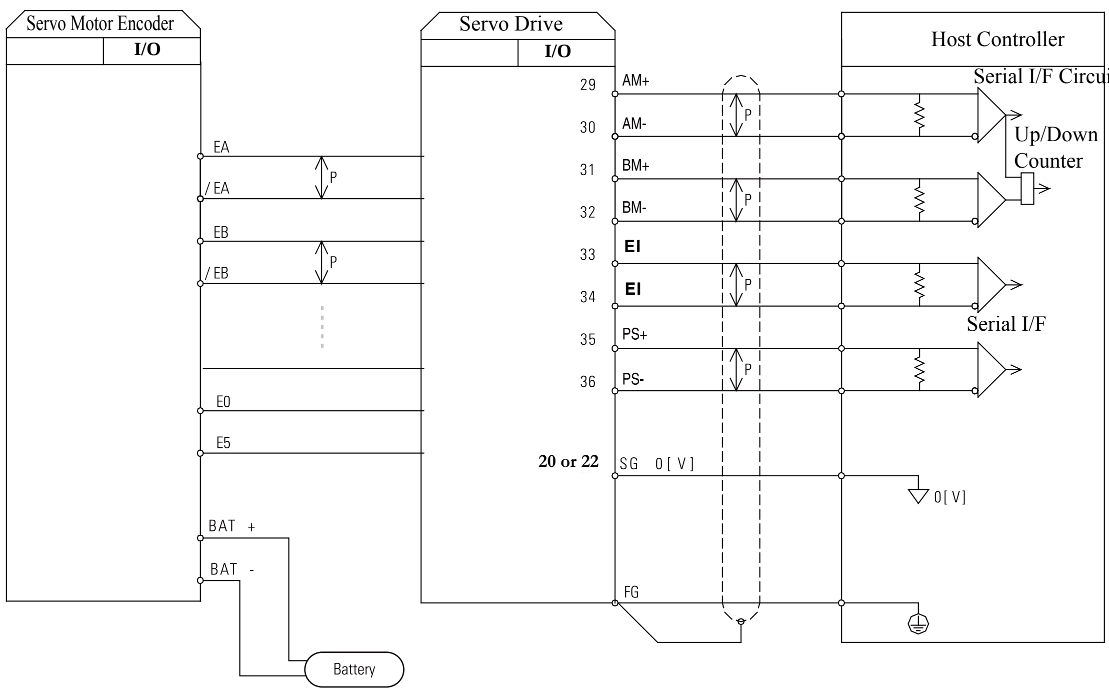
Absolute Encoder has to be connected with the Battery. The battery memorizes and maintains the absolute position of load system when the servo drive power cut off.

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 motor encoder cable.



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 : 3.6 [V]

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 Voltage Diagnosis

The voltage monitored with encoder is displayed for servo warning and alarm depending on the following situation.

... Servo Warning

When the voltage of battery for absolute encoder is 3.2 [V] or less, ?bsolute 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.

... Servo Alarm

When the capacitor voltage of encoder inside is about 2.7 [V] or less, the ?ow voltage alarm for inside of absolute encoder. occurs. At this time, the servo drive stops the operation.

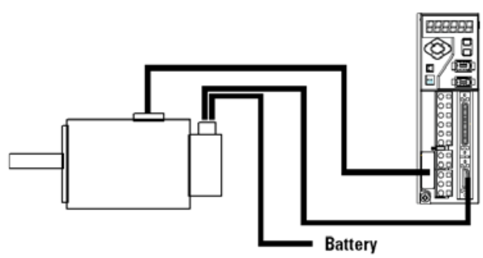
When ‘low voltage alarm for inside of absolute encoder. occurs’ the saved information on encoder may be damaged.

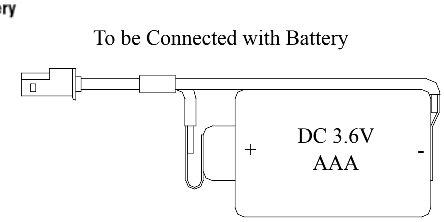
NOTE

- When 'absolute encoder battery low voltage warning' occurs, the A, H 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 Encoder

The below figure is how to connect the battery to encoder of servo motor.





1. Prepare the proper battery for specification.

2. 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 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.

Table 7.5 Absolute Encoder Reset and Alarm Reset according to Encoder Type

Command	A 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

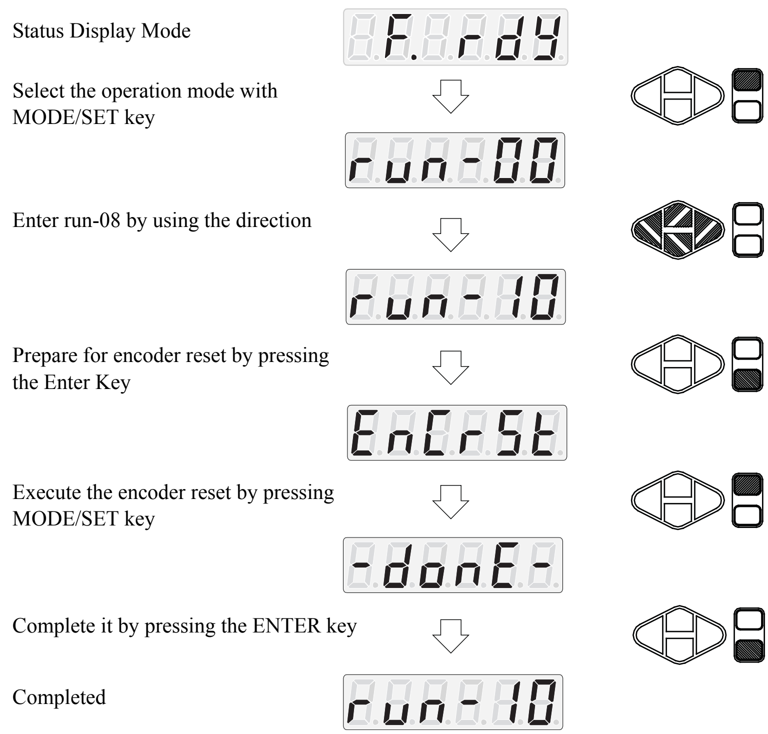
NOTE

... A 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.

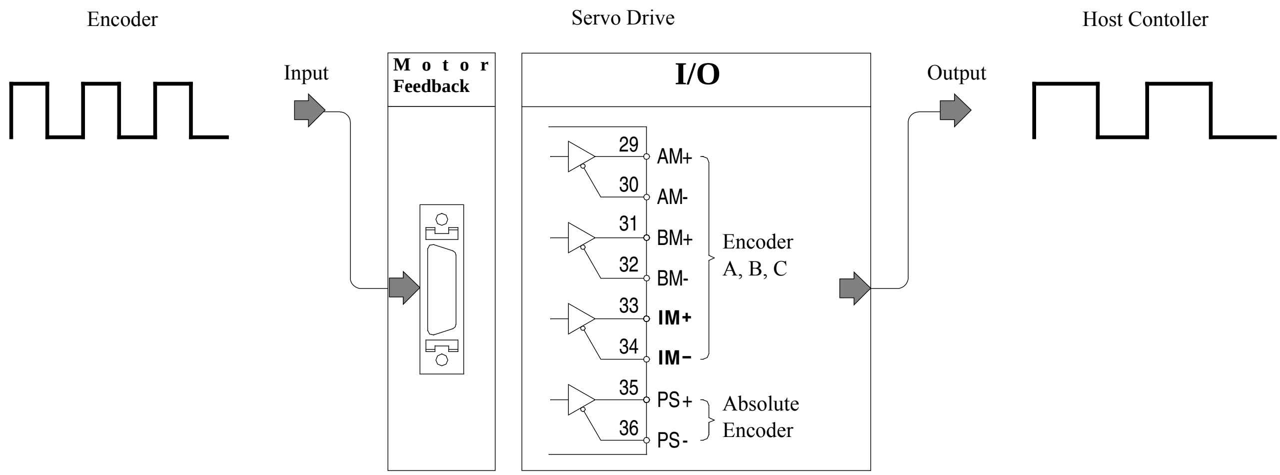
Flow Chart of the Absolute Encoder Reset



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 (+,-), AM (+,-), and BM (+,-) 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.

Table 7.6 PS Output Data of Encoder

Absolute Encoder	The Number of Rotation Data	1 Rotation Data	Transmission Cycle
A, H Type Absolute Encoder	13 bits	11 bit	About 50 [ms]
Q Type Absolute Encoder	16 bits	17 bit	About 50 [ms]

Structure of transmission frame is like below.

Structure of transmission frame (A, H type absolute encoder):

<table>
<tr><td rowspan="2">STX</td><td colspan="2">Absolute Data (Variable digit)</td><td rowspan="2">&</td><td rowspan="2">Data (3bit) (Alarm Contnet)</td><td rowspan="2">BCC</td><td rowspan="2">ETX</td></tr>
<tr><td>Multi-Ration Data (0~8191)</td><td>1 Rotation Data (0~2047)</td></tr>
</table>

Structure of transmission frame (Q type absolute encoder):

<table>
<tr><td rowspan="2">STX</td><td colspan="3">Absolute Data (Variable digit)</td><td rowspan="2">&</td><td rowspan="2">Data (3bit) (Alarm Contnet)</td><td rowspan="2">BCC</td><td rowspan="2">ETX</td></tr>
<tr><td>Multi-Ration Data (0~65535)</td><td>&</td><td>1 Rotation Data (0~131071)</td></tr>
</table>

Table 7.7 Data Transmission Format

Item	**Description**
Data Transmission Method	Asynchronous
Baud rate	9600 bps
Start Bit	1 bit
Stop Bit	1 bit
Parity	None
Character Code	ASCII
Data Format	10 - 19 Characters

NOTE

Through the monitor mode (dis-12) of The Chapter 7-52 page "Monitor Mode Function" 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).

Cautions

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) and +/- indicates rotation direction (The parenthesis is applicable to A, H Type encoder).

Serial Data Transmission for AM (+, -) and BM (+, -)

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 AM and BM, the incremental encoder output signal. At this time, the pulse ouputted at a speed of 1 [Mpps]. From the absolute dta, send the 1 rotation data first, and then send the multi-rotation data. The host controller multiplexes the received pulses by 4 times.

Sequence of receiving the absolute serial data through AM and BM.

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. (For Sequence Input Signal/ABS-DT Signal Distribution, refer to Chapter 5-1 page "Sequence I/O (Input/Output) Signal".)
3. After 100 [ms] since /ABS -DT OFF is off, receive the multi-ration data transmitted from the drive.
4. Receive multi-rotation data , and receive the 1 rotation data transmitted after 100 [ms].
5. AM and BM of drive are operated in normal incremental encoder output signal after the lapse of about 50 [ms] after thransmitting the 1 rotation data to which division ratiro is applied.

PAO Serial data reception sequence:
For the meaing of each signal, refer to table below.

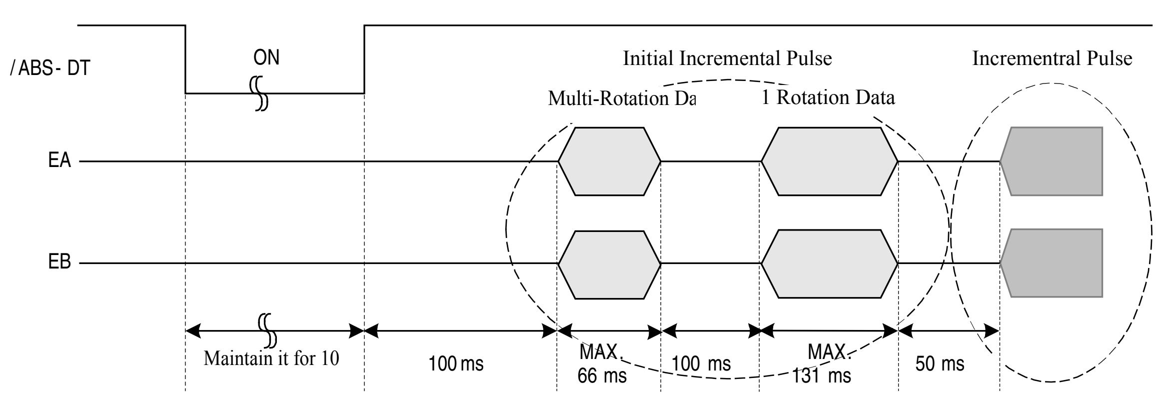


Table 7.8 Content of Each Signal

Signal	Status	Pulse
AM (+,-)	When initialize it by turning on the power	Initial incremental pulse
	In normal operation after the initialization	Incremental pulse
BM (+,-)	When initialize it by turning on the power	Initial incremental pulse
	In normal operation after the initialization	Incremental pulse
IM (+,-)	Always	Original Pulse
PS (+,-)	Always	Serial data of absolute encoder

When Using the Absolute Encoder Without a Battery

A, H Type Absolute Encoder can be used without a bettery for memory backup.

1. When the power is connected initially, the internal low voltage alarm (E.AbSbE) of the absolute encoder will go off.

2. After the elapsed time for a full charge of the internal capacitor of the encoder, run multi-rotation data rest (run-10) and then, rerun the alarm rest (run-08).

3. After a normal reset, the internal low voltage alarm of the absolute encoder will go off. The alarm will continue until the battery is connected, but the servo drive can still be operated.

NOTE

... While operating, if the power cut-off time is prolonged until the internal capacitor of the encoder totally discharges, [E.AbSbE] will go off again. In this case, repeat the above process.

... The internal multi-rotation data of the encoder may be damaged when the power is cut off while operating without a backup battery.

The serial absolute encoder (Q type) checks if the battery is connected and sends the data to the drive; [E.AbSbE] error will continue if there is no a battery. At this time, adjusting the parameter so the serial absolute encoder can be recognized as a serial incremental encoder will enable the operation of the motor.

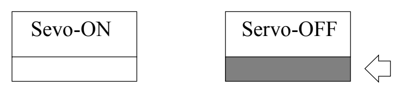
Operation Mode Function

Things to Know First

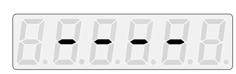
First understand the below content before reading the description of the operation mode.

- From the flow chart content, the content of display of status display mode may be different from the actual condition.
- The content displayed in the flow chart and the key operation sequence is the same with the actual condition.
- The black part of key button mark on the right means to press.
- The upper left side with servo-ON, servo-OFF means the status of servo drives status in setting.
- It describes to the order from (run-00) to (run-12).
- 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

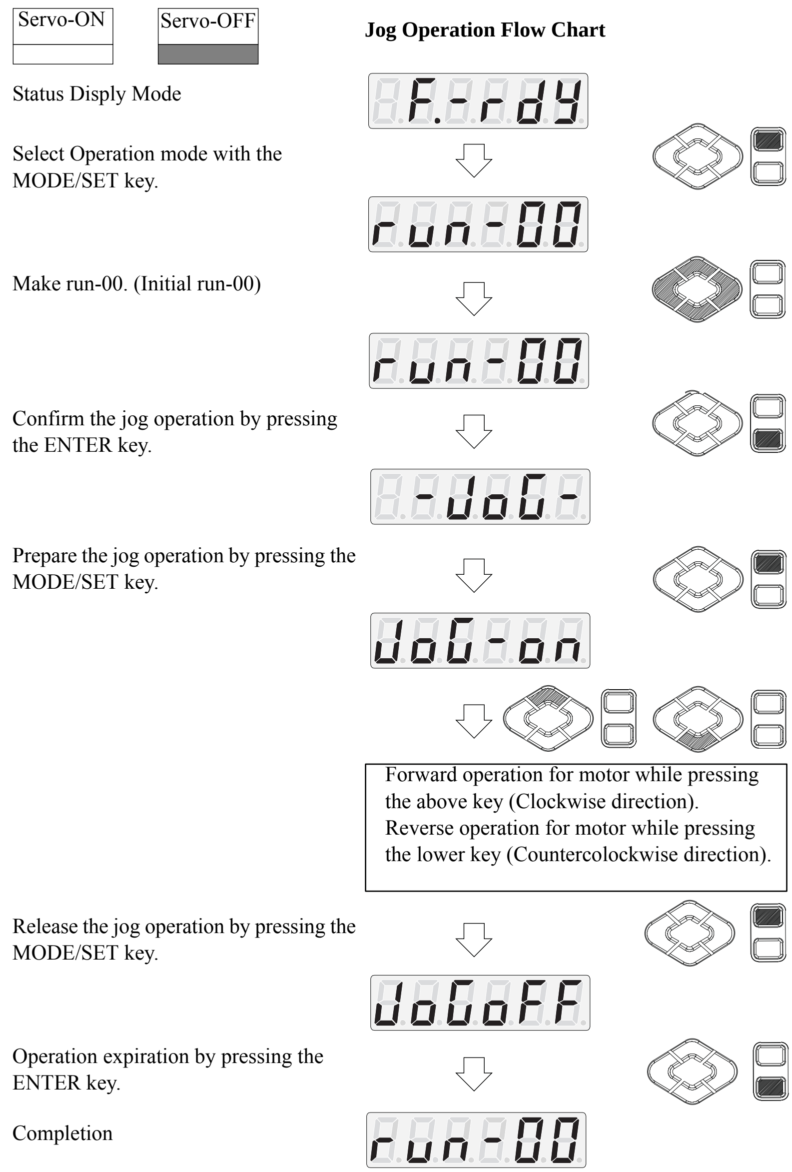
By using the direction key of the operator, the motor can be made for forward rotation or reverse rotation.

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 [Ft-2.01]. Confirm the setting value of [Ft-2.01] in advance before operation and adjust it for situation. The operation can be possible in the range of 0 to 6000 [rpm] and the initial setting speed is 50 [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 6-8 page "Auto Gain Setting" for detailed description on off-line auto tuning.

Caution

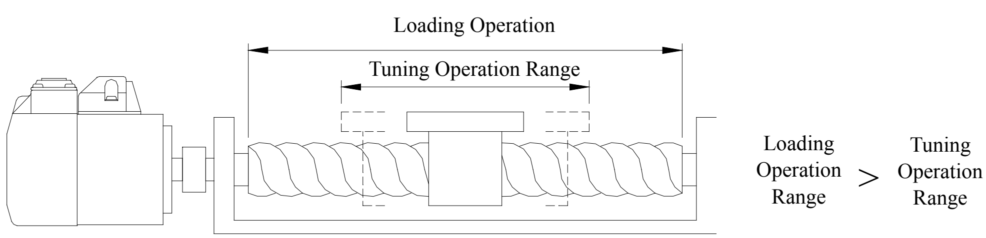
The following shall be carefully reviewed before operation.

CAUTION

... With the jog operation of the Chapter 7-41 page "Jog Operation (run-00)".

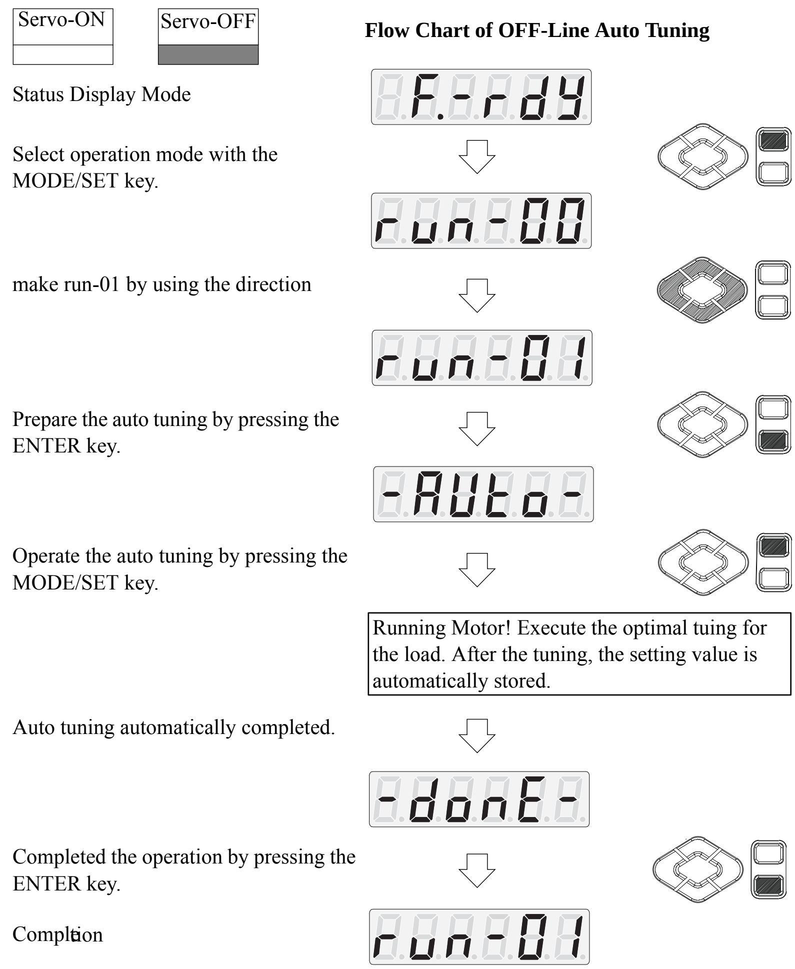
... The motor rotates 3 times in 360° forward and reverse direction.

... Confirm the loading not to exceed the operation range during tuning.



How to Operate

Refer to the below flow chart to operate.



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 I/O 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.

Others

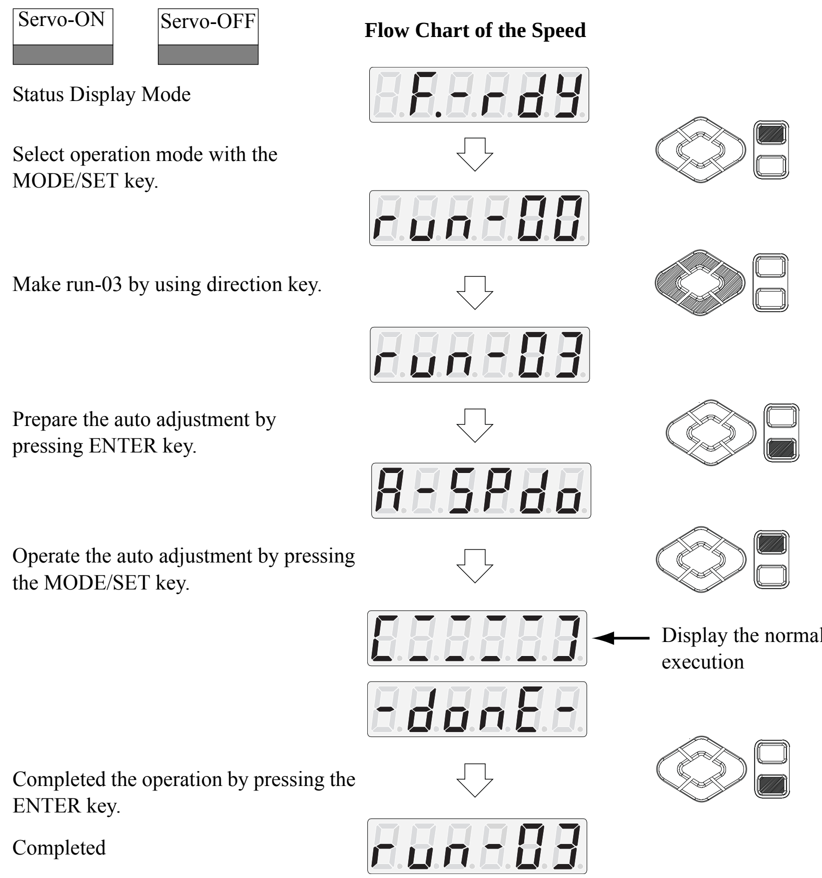
The voltage range that is possible for offset adjustment is .1 [V] to +1 [V]. The voltage exceeding the range cannot be adjusted, and there is no showing in the display during the normal operation in the below figure.

The size of actually offset voltage can be confirmed in [dis-13] of The Chapter 7-52 page "Monitor Mode Function".

Understand the speed zero-clamp function of speed mode of the Chapter 5-35 page "Zero Clamp </Z-CLP> Input" 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 I/O 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.

Others

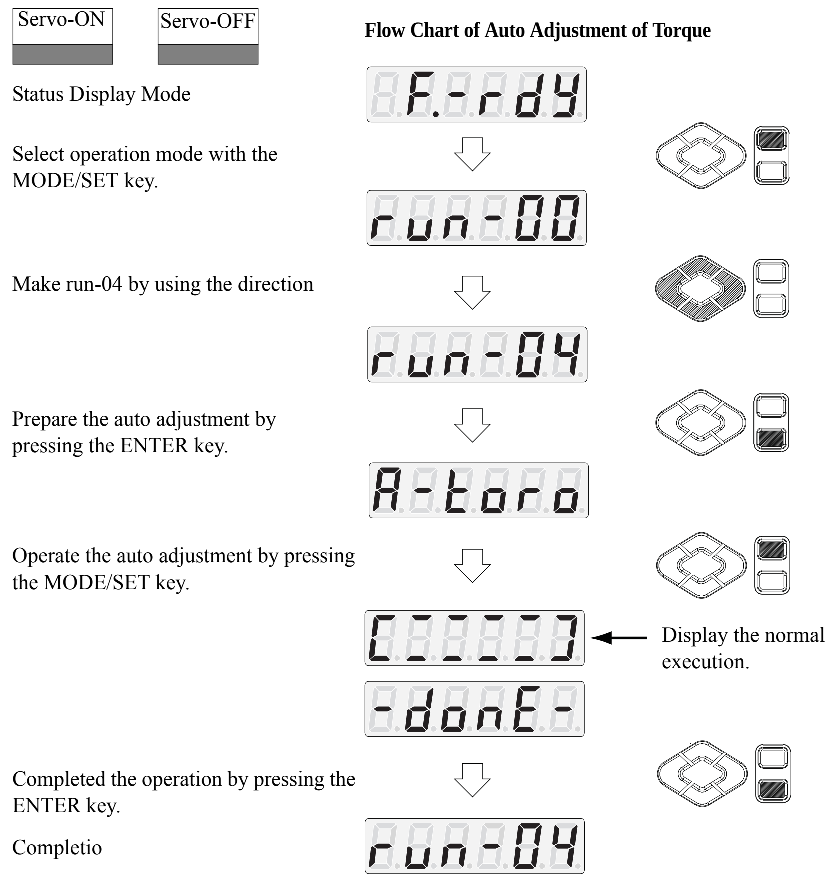
The voltage range that is possible for offset adjustment is -1 [V] to +1 [V]. The voltage exceeding the range cannot be adjusted, and there is no showing in the display during the normal operation in the below figure.

The size of actually offset voltage can be confirmed in [dis-13] of the Chapter 7-52 page “Monitor Mode Function”.

How to Operate

Refer the below flow chart and operate.

Flow Chart of Auto Adjustment of Torque



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Alarm Reset (run-08)

Servo drive may reset the servo alarm detected by the independent error diagnostic function.

Function Description

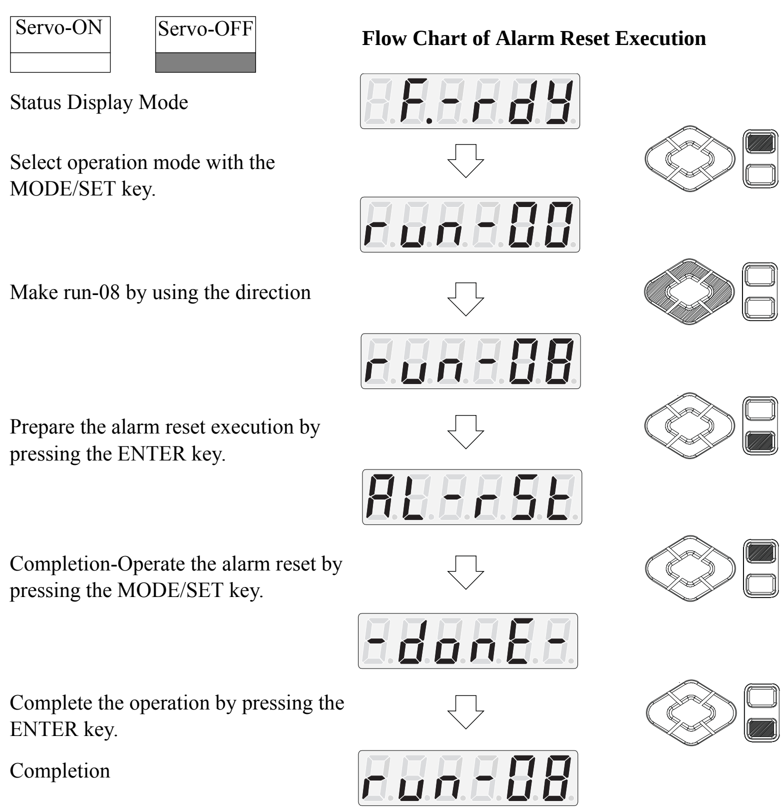
The drive monitor the system with the independent error diagnosis function from the moment the power is connected. At this time, if there is an error in the servo drive, it displays the servo alarm.

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.



Flow Chart of Alarm Reset Execution

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 5-1 page "Sequence I/O (Input/Output) Signal".

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 7-52 page "Monitor Mode Function".)

Absolute Encoder Reset (run-10)

The reset of absolute encoder refers to the Chapter 7-50 page "Absolute Encoder Reset (run-10)".

2-Group Gain Storing (run-11)

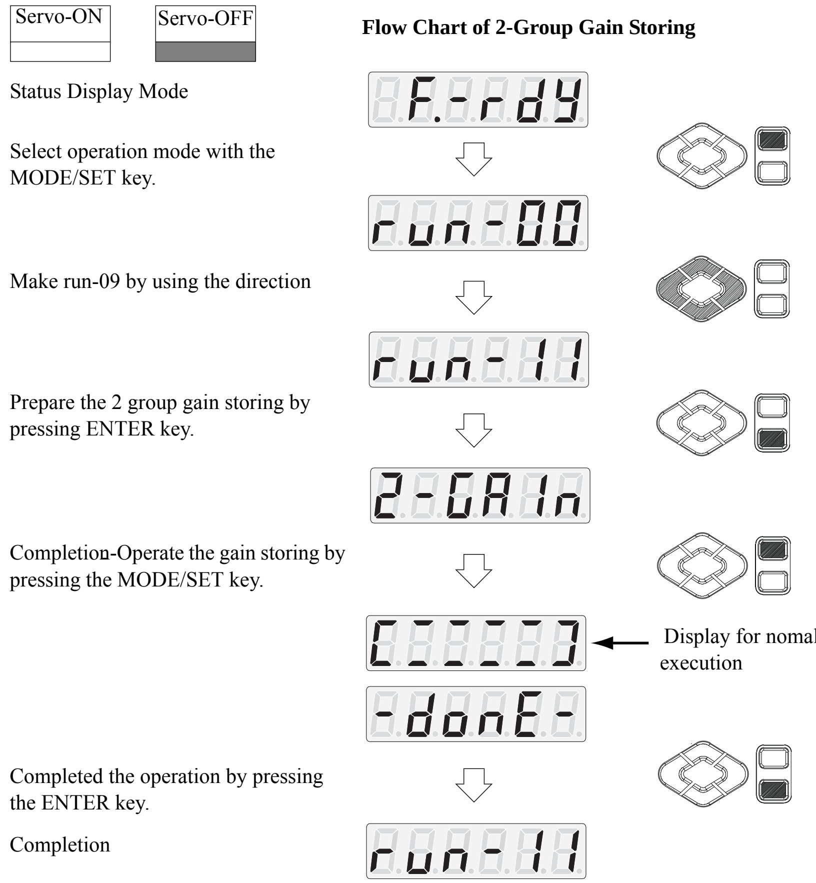
Function Description

Understand the content of the Chapter 6-36 page "</G-SEL> Function" 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.



Flow Chart of 2-Group Gain Storing

NOTE

When the </G-SEL> function of the Chapter 6-36 page "</G-SEL> Function" is not used, the main storage function meaningless. Understand the contents of the 6-36 page "</G-SEL> Function" first.

Parameter Initialization (run-12)

This function is to initialize the user parameter to the same status as the factory setting values.

General Matter

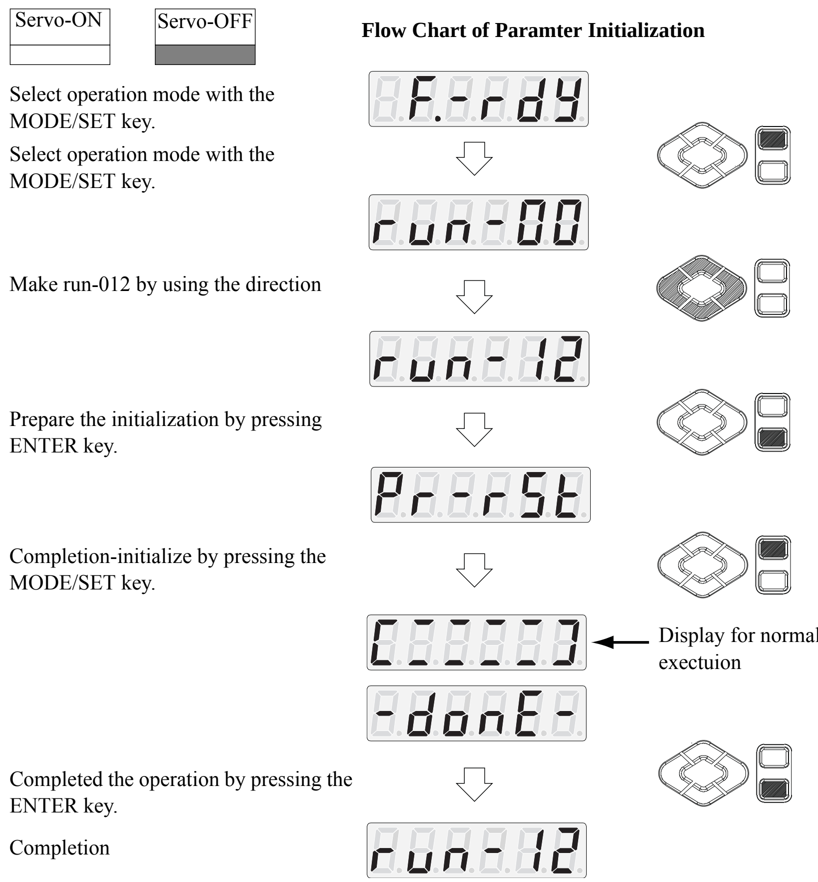
The initialization of parameter is operated carefully. After initializing parameter, the parameter has to be reset in meeting the load.

The below parameter is still maintained after initializing parameter. For changing the below parameter, directly change from the parameter.

... [Ft-0.00] Control mode setting (optional)
... [Ft-0.01] Motor setting

How to Operate

Refer to the flow chart below and operate.



Monitor Mode Function

Monitor Mode Function

The below chart describes the function expressed in each monitor.

Table 7.9 Monitor Mode

Monitor Mode Item	Name	Unit
dIS-00	Speed Feedback	[rpm]
dIS-01	Speed Command	[rpm]
dIS-02	Speed Error	[rpm]
dIS-03	Torque Command	[%]
dIS-04	Position Feedback	[pulse]
dIS-05	Position Command	[pulse]
The [dis-04] and [dis-05] are displayed each upper and lower digits (5 digits each, total 10 digits) separately by left and right key in case of overflowing count data.		
dIS-06	Position Error	[pulse]
dIS-07	Position Pulse Command Frequence	[kpps]
dIS-08	Electronic Angle	[°]
dIS-09	Mechanical Angle	[°]
dIS-10	Regeneration Accumulation Loading Rate	[%]
dIS-11	DC Link Voltage	[V]
dIS-12	Multi-rotation Data of Absolute Encoder	-
dIS-13	Speed Command Offset	mV
dIS-14	Torque Command Offset	mV
dIS-15	Input & Output Signal Confirmation	

Table 7.9 Monitor Mode

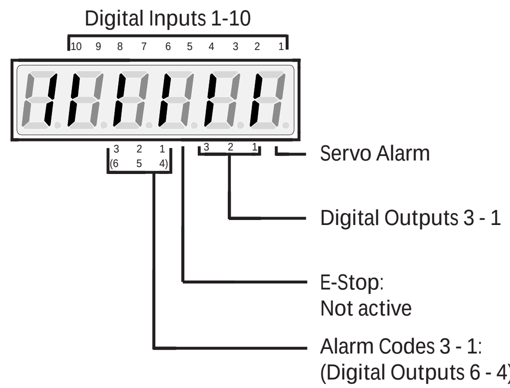
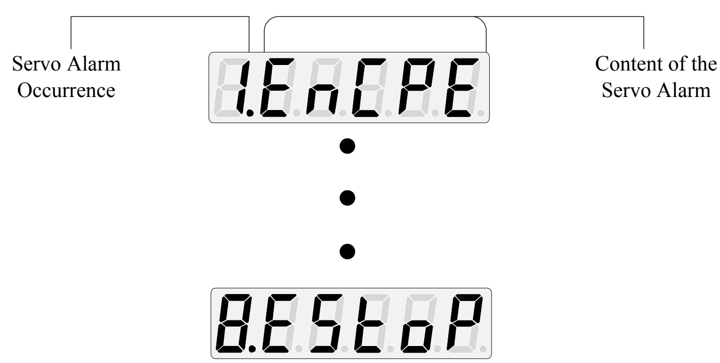
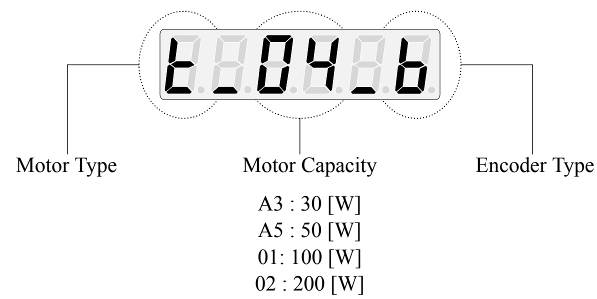
Monitor Mode Item	Name	Unit
When the sequence input & output, emergency stop and servo alarm signal are on, the applicable displays of each position are lit.  		
	Up to 8 Servo alarms are stored.	
The alarm that occurs most recently is the number 1 servo alarm occurrence. If all 8 alarms are stored, the alarm occurring thereafter is stored as number with the earliest alarm (No. 8 alarm) is deleted. Refer the Chapter 8-3 page "Servo Warning".  		
	It displays the software version of servo drive. Example of Version Display:  	
	Motor and Encoder Type	

Table 7.9 Monitor Mode

Monitor Mode Item	Name	Unit
Example of CSMZ Motor, 400W, A(11wire Inc.) Type Encoder		



Monitor Mode Item	Name	Unit
dIS-19	Analog Speed Command Voltage	[V]
dIS-20	Analog Torque Command Voltage	[V]
dIS-21	Drive Rated Output	-
dIS-22	Absolute Encoder 1 Rotation Data	
dIS-23	Encoder Feedback Data	[pulse]
When the number of digits increases, 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

Status Display Mode

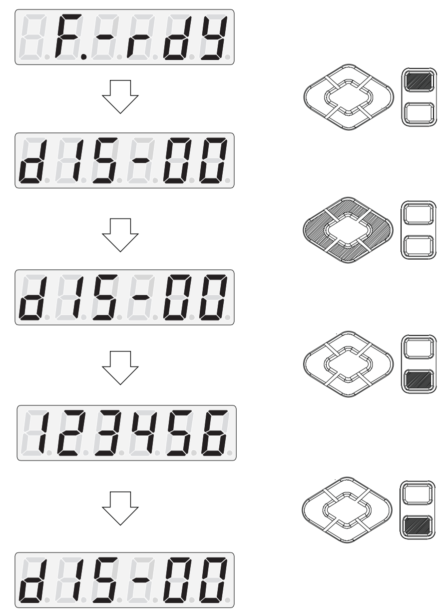
Select monitor mode with the MODE/ SET key

Enter dis-00 (-17) by using the direction key.

Confirm the content of each monitor by pressing the ENTER key.

Exit the monitor window by pressing the ENTER key.

Completion



Inspection and Protection Functions

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.

Table 8.1 Motor Inspection

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 [MΩ]	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

CAUTION

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).

Table 8.2 Servo Drive Inspection

Item	**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

CAUTION

In the event of disassemble the servo drive for repair or inspection; a care shall be taken for A/S not available..

Part Inspection

The part below may have mechanical abrasion or material degradation. A regular inspection is needed for prevention and preservation.

The life of parts is as below if the ambient temperature annual average is 30 [℃], load rate is less then 80 [%], and operation rate is less than 20 hours/day.

Table 8.3 Servo Dirve's parts life

Part	**Use Period**
Capacitor	3 Yeas
Cable	3 Yeas (based on flexible cable)
Power Device	3 Yeas
Regeneration Resister	2 Yeas
Dynamic Break Resister	2 Yeas
Fan	2 Yeas
Cooling Fan	4 - 5 Yeas
Fuse	10 Yeas

Battery Inspection for Absolute Encoder

Refer to Chapter 7-33 page "Battery" 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.

- Servo warning: It displays a minimal abnormality that does not require the suspension of operation when occurred.
- Servo alarm: It displays the very serious abnormality that requires the suspension of operation when occurred.

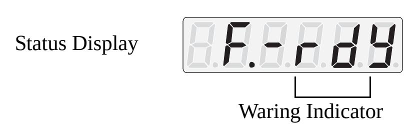
It is classified depending on the importance, but when an abnormality occurs, remove the cause immediately and use the servo drive in normal condition.

Servo Warning

There is a servo warning that displays a minimal abnormality as the protection function by the self-diagnosis.

Servo Warning Indication

It displays the mark that is applicable to a warning through the Status Display Mode.



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.

Servo Warning Types

Servo drive displays the warning characters for the following 7 situations.

Indicator	**Cause**	**Action**
Cnt Absolute Encoder Counter Overflow	In the event the Q Type Absolute Encoder is rotated forward or reverses over 32768 revolutions, it is displayed.	Reset the Absolute Encoder.
bAt Low Voltage of Absolute Encoder Battery	It occurs when the voltage of battery or external power supply of absolute encoder is 3.2 [V] or less.	Replace the battery or external power supply to make sure. [1]
PrE Abnormal Initial Status of Absolute Encoder	During the drive motor for moving the control power has been applied.	After making sure that the motor stops turning off the control power.
oCC Over (external) Current Command	Analog current scale setting Inadequate.	Check if the scale constant is suitable for range of the analog signal.
	The system does not support the motion profile.	• Check the speed loop tuning. • Check the capacity of the system.
	Current limit setting is inappropriate.	Check if the current limit lower than the current limited capacity of the system.
oSC Over(external) Speed Command	Analog current scale setting inadequate.	Check if the scale constant is suitable for range of the analog signal.
	The system does not support the motion profile.	• Check the position loop tuning. • Check the capacity of the system.
PIn Allocation Error of Sequence Input and Output	Digital input or output of the allocation is inappropriate.	• When working in the preset mode, check if it is allocated for preset. • When working in the normal / override mode, check if it is allocated for override function.
CAP Over Motor Capacity	It occurs when motor power is set higher than the drive rated output.	• Use a motor suitable to the drive or set the torque limit below the drive capacity.

1 When replacing a battery, absolute position is lost. Homing may be required.

Servo Alarm

For protection function by the self-diagnosis, there is the servo alarm that displays the important errors.

Table 8.4 Servo Alarm Types

Alarm Code	Text Message	Cause	Action
E.004 Motor overheating	E.Mtrot	Occurs when the motor overheat switch trips by the following causes. ¤ High ambient temperature surrounding the motor ¤ Excessive current	... Operate within the continuous torque rating (not exceeding) according to the ambient temperature. ... Lower the ambient temperature or increase the motor cooling.
		Motor wiring error	... Check the wiring of the motor.
		Unsuitable motor selection	... Check if the motor selected is suitable.
E.005 IPM Error	E.IPMFt	Motor cable shorted	... Check if the motor power cable and the connector are not shorted.
		Occurs when the winding wire of the motor is shorted internally.	... Disconnect the motor power cable from the motor. If the motor will not be rotated by hand, a replacement may be needed.
		Occurs when exceeding the continuous power rating while operating.	... Check if the ambient temperature is too high. ... Operate within the continuous power rating. ... Decrease the acceleration rate.
		Occurs when an unsuitable IPM output, short circuit or over current exist in the drive.	... Check the wiring connections that go from ... U, V, and W motor terminals to the DC BUS after disconnecting the power and the motor. If the connections are normal, check the wires between terminals or have the drive repaired.
E.009 BUS Low Voltage	E.UdutG	AC line/AC power input is low.	... Check the voltage level of the incoming AC power. ... Check the noise pulse of the AC power or for a voltage drop. ... Install an Uninterruptible Power Supply (UPS) to the AC input.
		Attempted to activate the drive without turning on the main power.	... Before activating the drive, turn on the main power.
E.010 BUS Over Voltage	E.ouutG	Occurs when the power regeneration is excessive. That is, the drive generates an error to protect itself from the overload when its main power supply regenerates excessive peak energy while the motor is run by the external mechanical power.	... Check the regenerative circuit. ... Adjust the motion profile and keep the regeneration resistance within the limit. ... Replace the regenerative transistor. ... Replace the drive.
		Excessive AC input voltage	... Confirm the input value.

Table 8.4 Servo Alarm Types

Alarm Code	Text Message	Cause	Action
E.012	E.HFAIL Home Searching Failed	Homing is incomplete within the time assigned in Homing Time Limit (IN-01.11).	... Increase the time assigned in Homing Time Limit (IN-01.11). ... Set the value other than '0' in Homing Speed (IN-01.02) and Creep Speed (IN-01.03). ... Check for an obstruction in homing. ... Check the homing related parameter setting and mechanical parts.
E.018	E.ouSPd Motor Over Speed	Motor speed exceeds the maximum.	... Check the wiring of the encoder. ... Retune the drive system. ... Check the input gain of the torque or the external speed command.
E.019	E.PoSEr Over the Position Error Limit	Occurs when the position error exceeds the allowed value.	... Increase the Following Error Limit value. ... Check the position loop tuning.
E.022	E.ConoL Motor Continuous Current Overload	Occurs when the internal filter that protects the motor from overheating trips.	... Decrease the acceleration rate. ... Decrease the duty cycle (ON/OFF) of the motion assigned. ... Increase the time for the motion allowed. ... Use a drive or motor with bigger capacity. ... Check the tuning.
E.023	E.druoL Drive Overload	Occurs when the drive average current exceeding the rated capacity is needed for the motion application.	... Decrease the acceleration rate. ... Decrease the duty cycle (ON/OFF) of the motion assigned. ... Increase the time for the motion allowed. ... Use a drive or motor with bigger capacity. ... Check the tuning.
E.024	E.AbSto Absolute Position Transfer Timeout	/ABS-DT input is not turned on within 5s from Absolute Position Transfer Ready-On during Absolute Position Transfer Mode using photo coupler output.	Verify the sequential timing of Absolute Position Transfer Ready & /ABS-DT, Absolute Position Transfer Mode input. Verify continuity of I/O cable and connector.
		/ABS-DT input is not turned off within 5s from Absolute Position Transfer Ready-Off during Absolute Position Transfer Mode using photo coupler output.	
		Absolute Position Transfer Mode input is not turned off within 5s after absolute data transfer completion.	
E.027	E.notHM Homing Incomplete	Occurs when an axis didn't return to home before the drive can operate an absolute coordinate index.	
E.028	E.EnCdE Encoder Date Range Error	Occurs when the encoder is not properly programmed.	... Replace the motor.
		Occurs when the memory of the encoder is damaged.	
E.030	E.EnCoP Encoder Cable Open	Occurs when the communication with the interactive encoder cannot be established.	... Check the motor selected. ... Check whether the motor supports an auto detection. ... Check the wiring of the encoder.
		Hall Error	

Table 8.4 Servo Alarm Types

Alarm Code	Text Message	Cause	Action
E.031	E.EnCPE Encoder Date Parameter Error	Occurs when the encoder is not properly programmed.	... Replace the motor.
		Occurs when the memory of the encoder is damaged.	
E.036	E.drvot Drive Overheating	Occurs when the drive overheats..	... Check if the cooling pan is working (only applicable to CSD5_08BX1, CSD5_10BX1 and CSD5_15BX1). ... Check the tuning. ... Decrease the acceleration rate. ... Decrease the duty cycle (ON/OFF) of the motion assigned. ... Increase the time for the motion allowed. ... Use a drive or motor with bigger capacity.
E.037	E.ACoFF AC line Loss	Occurs when the power is low.	... Increase the instant outage compensation time.
		Attempted to activate the drive without turning on the main power.	... Before activating the drive, turn on the main power.
		A phase is not connected.	... Disconnect the power and check all mechanical connections.
		The alarm delay parameter is set too short.	... Increase the Alarm delay parameter value.
E.053	E.PInIt User Parameter Initialization Error	An error exists in the parameter saved in the memory.	... Initialize the parameter. ... Reset the values of the drive to the factory.
E.054	E.oFSEt Current Feedback Offset	Defective Hardware	... Replace the drive.
E.055	E.CHSUM User Parameter Checksum Error	Checksum Error	... Check the parameter and reset. ... Reset the values of the drive to the factory settings.
E.056	E.CPUFt Watchdog Timeout	Excessive System Noise	... Check the wiring and the installation method.
		Defective Hardware	... Replace the drive.
E.057	E.HWArE PWM Hardware Error	Defective Hardware	... Contact your nearest dealer.
E.058	E.rAnGE User Parameter Range Error	Parameter range is invalid.	... Input the parameter within the range. ... Reset the values of the drive to the factory settings.
E.060	E.dInIt Drive Initialization Error	Hardware Error	... Replace the drive.
E.075	E.SHtoL Regenerative Overload Protection	Exceeds the value allowed by the voltage of the regeneration resistance.	... Adjust the motion profile and keep the regeneration resistance within the limit.
		Regeneration resistance is separated or damaged.	... Check the connection of the regeneration resistance. ... Check the values of the regeneration resistance.

Table 8.4 Servo Alarm Types

Alarm Code	Text Message	Cause	Action
E.079	E.SHtoC Regenerative Over current Protection	The regenerative current exceeds the allowable instant value.	... Check if the regeneration resistance is shorted or damaged. ... Check if the overload energy is excessive while decelerating.
E.083	E.AbSbE Regenerative Over current Protection	The constant of the encoder backup battery is set as 'installed,' but the battery is not installed.	... Set the constant of the encoder backup battery as 'not installed.'
		The battery voltage is detected under 2.7 [V] DC.	... Check the battery voltage and the connections. ... Replace the battery.
E.084	E.AbSoS Absolute Encoder Over Speed	The encoder rotates mechanically at high speed while turning off the drive, when it is powered by the battery.	... Remove the motor from the system. ... Turn off and on the drive and reset the Warning.
E.085	E.AbSCt Absolute Encoder Multi-turn Count Error	Noise from Encoder	... Turn off and on the drive and reset the Warning.
		Defective Encoder	... Replace the motor.
E.100	E.SEtUP Drive Setting	The drive operation mode and the motor selection are not compatible.	... Change the operation mode and/or motor selection, and reset the drive.
E.101	E.CAbLE Motor Power Cable Open	The motor cable is not connected.	... Check the power connection between the motor and the drive.
E.102	E.InSOL Motor continuous current overload	The motion profile requires peak current for a lengthy time.	... Check the wiring of the motor. ... Adjust the acceleration/deceleration time. ... Check if the motor selected is suitable.
		There is a defect in the current feedback detection.	... Check the phase current.
E.103	E.MAtCH Motor Mismatch Fault	The dynamic control current of the selected motor exceeds double the value of the drive peak current rating.	... Install a different motor.
E.105	E.EnCtP Encoder Type Mismatch	The motor encoder signal does not match the drive configuration.	... Check the motor selected.
		Defective Encoder	... Replace the motor.
E.106	E.EnCCE Encoder Communication Error	The wiring between the drive and the encoder is cut off or problematic. Or encoder signals are interrupted by the EMI (noise).	... Check the wiring of the encoder. ... Contact your nearest dealer.
E.107	E.SErCE Serial Communication Error	Communication error between the host and the drive (noise)	... Check the serial communication cable. ... Check the noise of the serial communication interface.
E.108	E.CdFrE Position Command Frequency Error	The input frequency value exceeds that limit.	... Check if the hardware type selected in the drive matches the physical hardware. ... Change from an open collector to a line drive. ... Decrease the speed command. ... Manipulate the gear.
E.112	E.EStoP Emergency Stop	Emergency Stop (E-STOP) is detected.	... Remove the emergency stop condition.. ... Erase E-STOP signal.
E.113	E.IrAnG Index Position Range Overflow	The constant of the index position deviate the range.	... Use a value in the range between -2,147,483,647 ~ +2,147,483,647.

Table 8.4 Servo Alarm Types

Alarm Code	Text Message	Cause	Action
E.114	E.ouCUr Motor Phase Over current	... When the error occurs while turning on the power, there is a problem in the control or main power circuit. ... When this error occurs while in operation, over current exists. (Current that is 300 [%] over the rated current is supplied to the motor at more than 250 [ms]).	... Check the wiring and the power. ... Check the power and set or adjust the acceleration/deceleration time.

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.

Table 8.5 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 (Ft-0.10) shall be confirmed for setting.
	The selection of command pulse is wrong.	Refer to Chapter 5-10 page "Position Control Mode" 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 [Ft-1.01]. Heighten the speed loop integration gain [Ft-1.03].
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 [Ft-0.01], and 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 Group

Parameters control CSD5 Servo drive operations. They are grouped by the type of drive, Standard or Indexing, and the settings they define.

Parameter Description

Standard Group 0

No.	Name	Modbus Address	Digit No.	Range	Init.	Note
Ft-0.00	Operation Mode	0000	N/A	1~12(F~I)	1(F)	-
Ft-0.01	Motor Configuration	0001,0002	N/A			
	Encoder Type		0	0x0~0xF	0x1(9 Line)	-
	Rated Power		1~2	A5,01,02,04, 08,10,15	04(400W)	Power
	Motor Type		3~4		0x11(CSMT)	Motor ID
Ft-0.02	Selection of 4 Basic Mode	0003	N/A			Bit Field
	Fault and Disable Braking		0	0~3	0(Brake and Hold)	-
	Over Travel stop method		1	0~1	0(Current control)	1: Dynamic Brake
	Command Polarity		2	0~1	0(Normal)	1: Inverted
	AC Lime Loss Check		3	0~2	0(Enable)	-
Ft-0.03	Selection of Auto Tuning Function	0004	N/A			Bit Field
	Off-line Tuning Mode		0	0~2	1(Inertia Moment and RFD)	-
	Auto Tuning Speed		2	2~9	7(700 [rpm])	Value*100 [rpm]
Ft-0.04	Inertia Ratio	0005	N/A	0~6000	100	Value/100
Ft-0.05	Auxiliary Funtion Selection 1	0006	N/A			Bit Field
	Encoder Backup Battery		0	0~1	0(Installed)	-
	Selection of Speed Observer		1	0~1	0(Disabled)	-
	Gain Change Enable		2	0~1	0(Disabled)	-
	Emergency Stop Input		3	0~1	0(Disabled)	-

Ft-0.06	Auxiliary Function Selection 2	0007	N/A			Bit Field
	Automatic Motor Identification		0	0~1	1(Enable)	-
	Incremental Feedback Loss		1	0~1	0(Monitored)	-
	Mode of Gain Change		2	0~9	0	-
	Absolute Feedback Conversion		3	0~2	0	
Ft-0.07	Drive Address	0008	N/A	1~247	1	-
Ft-0.08	Password	0009	N/A	0~9999	0	-
Ft-0.09	Serial Port Configuration	0010	N/A			Bit Field
	RS-232,485 Communication Speed (Baud rate)		0	0~5	5(57600 [bps])	-
	Data bits, Parity, Stop bit		1	0~5	0(88bits, No parity, 1 stop)	-
	Protocol		2	0~1	0(ASCII)	-
	Communication Method		3	0~1	0(RS232)/ 1(RS485)	-
Ft-0.10	Allocation of Input Signal 1	0011	0x0000~0xab bb	-	0x4bb1	Bit Field
Ft-0.11	Allocation of Input Signal 2	0012	0x0000~0xaaa a	-	0x0765	Bit Field
Ft-0.12	Allocation of Input Signal 3	0013	0x0000~0xaaa a	-	0x0000	Bit Field
Ft-0.13	Allocation of Input Signal 4	0014	0x0000~0xaaa a	-	0x0000	Bit Field
Ft-0.14	Allocation of Input Signal 5	0015	0x0000~0xaaa a	-	0x0000	Bit Field
Ft-0.15	Allocation of Input Signal 6	0016	0x0000~0xaaa a	-	0x0000	Bit Field
Ft-0.16	Allocation of Input Signal 7	0017	0x0000~0xaaa a	-	0x0000	Bit Field
Ft-0.17	Allocation of Input Signal 8	0018	0x0000~0xaaa a	-	0x0000	Bit Field
Ft-0.18	Allocation of Input Signal 9	0019	0x0000~0xaaa a	-	0x0000	Bit Field
Ft-0.19	Reserved	0020	-	-	-	-

Ft-0.20	Reserved	0021	-	-	-	-
Ft-0.21	Reserved	0022	-	-	-	-
Ft-0.22	Allocation of Output Signal 1	0023	0x0000~0x6666	-	0x0321	Bit Field
Ft-0.23	Allocation of Output Signal 2	0024	0x0000~0x6666	-	0x0000	Bit Field
Ft-0.24	Allocation of Output Signal 3	0025	0x0000~0x0066	-	0x0000	Bit Field
Ft-0.25	Allocation of Output Signal 4	0026	0x0000~0x6666	-	0x0000	Bit Field
Ft-0.26	Allocation of Output Signal 5	0027	0x0000~0x6666	-	0x0000	Bit Field
Ft-0.27	Allocation of Output Signal 6	0028	0x0000~0x0066	-	0x0000	Bit Field
Ft-0.28	Reserved	0029	-	-	-	-
Ft-0.29	Reserved	0030	-	-	-	-
Ft-0.30	Reserved	0031	-	-	-	-
Ft-0.31	Reserved	0032	-	-	-	-
Ft-0.32	I/O Control Authority	0033	0x00~0x12	-	0x00	Bit Field

Standard Group 1

No.	Name	Modbus Address	Digit No.	Range	Init.	Note
Ft-1.00	Speed Regulator Response Level	0100	N/A	1~150	50	[%]
Ft-1.01	System Gain	0101	N/A	10~500	50	[Hz]
Ft-1.02	Velocity Regulator P Gain	0102	N/A	0~10000	60	-

Ft-1.03	Velocity Regulator I Gain	0103	N/A	0~60000	26	-
Ft-1.04	Velocity Regulator D Gain	0104	N/A	0~1000	0	-
Ft-1.05	Velocity Error Filter	0105	N/A	0~2500	30	[Hz]
Ft-1.06	Position Regulator Kp Gain	0106	N/A	0~700	20	[Hz]
Ft-1.07	Current Command Lowpass Filter Bandwidth	0107	N/A	0~10000	300	[Hz]
Ft-1.08	Velocity Command Lowpass Filter Bandwidth	0108	N/A	0~10000	1000	[Hz]
Ft-1.09	Position Command Lowpass Filter Bandwidth	0109	N/A	0~1000	0	[Hz]
Ft-1.10	1st Resonant Frequency Suppression Filter	0110	N/A	0~10000	10000	[Hz]
Ft-1.11	1st Resonant Frequency Suppression Filter Width	0111	N/A	1~20	10	-
Ft-1.12	2nd Resonant Frequency Suppression Filter	0112	N/A	0~10000	10000	[Hz]
Ft-1.13	2nd Resonant Frequency Suppression Filter Width	0113	N/A	1~20	10	-
Ft-1.14	2nd Resonant Frequency Suppression Filter Depth	0114	N/A	0~100	100	-
Ft-1.15	Position Regulator Kff Gain	0115	N/A	0~100	0	%
Ft-1.16	Position Regulator Kff Bandwidth	0116	N/A	0~2500	200	[Hz]
Ft-1.17	Velocity Regulator I Gain mode	0117	N/A	0~4	0 (PI Mode)	Bit Field
Ft-1.18	Velocity Regulator I Gain disable threshold	0118	N/A	0~3000	100	-
Ft-1.19	Position Regulator High Error Output Offset	0119	N/A	0~450	0	[rpm] or [mm/sec]
Ft-1.20	Position Regulator High Error Output Threshold	0120	N/A	0~50000	1000	pulse

Ft-1.21	Current Regulator Bandwidth	0121	N/A	0~2	1	Bit Field
Ft-1.22	On-line Vibration Mode	0122	N/A	-	-	-
	On-line Vibration Suppression Mode		0	0~2	0 (Disable)	-
	On-line Vibration Suppression Gain		1	0~1	0 (Low)	-
Ft-1.23	Velocity Command Filter on Follower	0123	1	0~1	0 (Disable)	Bit Field
Ft-1.24	Delay Time of Gain Switching	0124	N/A	0~10000	0	-
Ft-1.25	Level of Gain Switching	0125	N/A	0~10000	0	-
Ft-1.26	Hysteresis of Gain Switching	0126	N/A	0~10000	0	-
Ft-1.27	Position Gain Switching Time	0127	N/A	0~10000	0	-
Ft-1.28	2nd Velocity Regulator P Gain	0128	N/A	0~10000	60	-
Ft-1.29	2nd Velocity Regulator I Gain	0129	N/A	0~60000	26	-
Ft-1.30	2nd Position Regulator Kp Gain	0130	N/A	0~700	20	[Hz]
Ft-1.31	2nd Current Command Lowpass Filter Bandwidth	0131	N/A	0~10000	300	[Hz]
Ft-1.32	2nd Velocity Command Lowpass Filter Bandwidth	0132	N/A	0~10000	1000	[Hz]
Ft-1.33	3rd Velocity Regulator P Gain	0133	N/A	0~10000	60	-
Ft-1.34	3rd Velocity Regulator I Gain	0134	N/A	0~60000	26	-
Ft-1.35	3rd Position Regulator Kp Gain	0135	N/A	0~700	20	[Hz]
Ft-1.36	3rd Current Command Lowpass Filter Bandwidth	0136	N/A	0~10000	300	[Hz]
Ft-1.37	3rd Velocity Command Lowpass Filter Bandwidth	0137	N/A	0~10000	1000	[Hz]

Ft-1.38	4th Velocity Regulator P Gain	0138	N/A	0~10000	60	-
Ft-1.39	4th Velocity Regulator I Gain	0139	N/A	0~60000	26	-
Ft-1.40	4th Position Regulator Kp Gain	0140	N/A	0~700	20	[Hz]
Ft-1.41	4th Current Command Lowpass Filter Bandwidth	0141	N/A	0~10000	300	[Hz]
Ft-1.42	4th Velocity Command Lowpass Filter Bandwidth	0142	N/A	0~10000	1000	[Hz]

Standard Group 2

No.	Name	Modbus Address	Digit No.	Range	Init.	Note
Ft-2.00	Velocity Scale	0200	N/A	10.0~2000.0	500.0	[rpm/V] or [mm/sec/V]
Ft-2.01	Jog Velocity Command	0201	N/A	0~6000	50	[rpm] or [mm/sec]
Ft-2.02	Acceleration	0202, 0203	N/A	1~2147483647	41667	10^{-2}xRev/sec^2, or mm/sec^2
Ft-2.03	Deceleration	0204, 0205	N/A	1~2147483647	41667	10^{-2}xRev/sec^2, or mm/sec^2
Ft-2.04	S-Curve Time	0206	N/A	0~5000	0	[ms]
Ft-2.05	Preset Velocity 1	0207	N/A	-6000~6000	0	[rpm] or [mm/sec]
Ft-2.06	Preset Velocity 2	0208	N/A	-6000~6000	0	[rpm] or [mm/sec]
Ft-2.07	Preset Velocity 3	0209	N/A	-6000~6000	0	[rpm] or [mm/sec]
Ft-2.08	Preset Velocity 4	0210	N/A	-6000~6000	0	[rpm] or [mm/sec]
Ft-2.09	Preset Velocity 5	0211	N/A	-6000~6000	0	[rpm] or [mm/sec]
Ft-2.10	Preset Velocity 6	0212	N/A	-6000~6000	0	[rpm] or [mm/sec]

Ft-2.11	Preset Velocity 7	0213	N/A	-6000~6000	0	[rpm] or [mm/sec]
Ft-2.12	Manual Velocity Limit	0214	N/A	1~6000	5000	[rpm] or [mm/sec]
Ft-2.13	Velocity Limit Mode	0215	N/A	0~3	0	Bit Field

Standard Group 3

No.	Name	Modbus Address	Digit No.	Range	Init.	Note
Ft-3.00	Command Type	0300	0	0~6	0 (Step Up/Step Down)	-
	Controller Output Type		1	0~2	0 (Line Drive)	-
	Encoder Output Forward Direction		2	0~1	0 (A lead B at Fwd Dir)	-
	1st Gear Ratio Change		3	0~1	0 (Enable Only on Disabled)	-
Ft-3.01	1st Gear Ratio, Follower count (Numerator)	0301	N/A	1~65535	4	-
Ft-3.02	1st Gear Ratio, Master count (Denominator)	0302	N/A	1~65535	1	-
Ft-3.03	Encoder Output Ratio, Output (Denominator)	0303	N/A	1~32768	1	-
Ft-3.04	Encoder Output Ratio, Motor (Numerator)	0304	N/A	1~32768	1	-
Ft-3.05	2nd Gear Ratio, Follower count	0305	N/A	1~65535	4	-
Ft-3.06	2nd Gear Ratio, Master count	0306	N/A	1~65535	1	-
Ft-3.07	Reserved	0307	-	-	-	-
Ft-3.08	Digital Filter Cutoff Frequency	0308		N/A	-	Bit Field
	Line Drive		0	0~7	3 (1.00MHz)	-
	Open Collector		1	0~7	7 (0.525MHz)	-
	High Frequency Line Drive		2	0~7	0 (3.000MHz)	-

Standard Group 4

No.	Name	Modbus Address	Digit No.	Range	Init.	Note
Ft-4.00	Current Scale	0400	N/A	0~1000	333	[%] of motor rated/[V]
Ft-4.01	Positive Internal Current Limit	0401	N/A	0~500	300	[%] of motor rated
Ft-4.02	Negative Internal Current Limit	0402	N/A	0~500	300	[%] of motor rated
Ft-4.03	Positive External Current Limit	0403	N/A	0~500	100	[%] of motor rated
Ft-4.04	Negative External Current Limit	0404	N/A	0~500	100	[%] of motor rated
Ft-4.05	Over Travel Current Limit	0405	N/A	0~500	300	[%] of motor rated
Ft-4.06	Initial Current Bias	0406	N/A	-100~100	0	[%] of motor rated

Stand Group 5

No.	Name	Modbus Address	Digit No.	Range	Init.	Note
Ft-5.00	In Position Size	0500	N/A	0~2500	10	pulse
Ft-5.01	Reserved	0501	N/A	-	-	-
Ft-5.02	Near Position Size	0502	N/A	0~2500	20	pulse
Ft-5.03	Speed Window	0503	N/A	0~1000	10	pulse
Ft-5.04	Up to Speed	0504	N/A	0~5000	20	pulse
Ft-5.05	Zero Clamp	0505	N/A	0~5000	0	[rpm]
Ft-5.06	Brake Inactive Delay	0506	N/A	0~10000	0	[ms]
Ft-5.07	Disable Delay	0507	N/A	0~10000	0	[ms]
Ft-5.08	Brake Active Delay	0508	N/A	0~10000	500	[ms]

Ft-5.09	Disabled Braking Speed	0509	N/A	0~1000	100	[rpm]
Ft-5.10	Following Error Limit	0510, 0511	N/A	0~2147483647	99999	pulse
Ft-5.11	Reserved	0512	N/A	-	-	-
Ft-5.12	AC Line Loss Fault Delay	0513	N/A	20~1000	20	[ms]
Ft-5.13	Analog Output CH1 Selection	0514, 0515	N/A	0~28	0 (Velocity Feedback)	-
Ft-5.14	Analog Output CH2 Selection	0516, 0517	N/A	0~28	1 (Velocity Command)	-
Ft-5.15	Analog Output CH1 Scale	0518, 0519	N/A	1~99999	500	Depend on [Ft-5.13]
Ft-5.16	Analog Output CH2 Scale	0520, 0521	N/A	1~99999	500	Depend on [Ft-5.14]

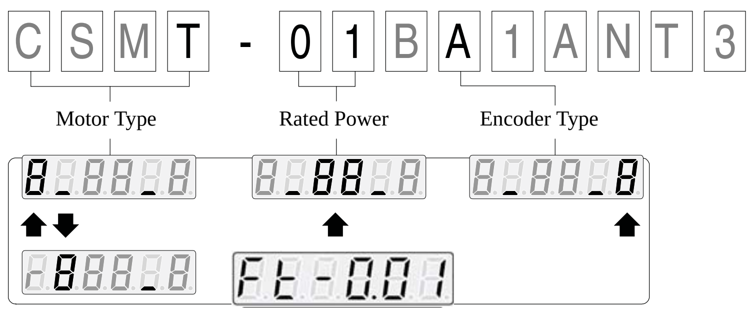
Parameter Description

Standard Group 0

Ft-0.00	**Operations Mode** RSWare : Drive - Operation Modes (Main/Override)	
Description	Set control mode (Optional)	
Display (Value)	Operating Mode	RSWare Name
F(1)	Position Control Mode	Follower/None
S(2)	Speed Contorl Mode	Analog Velocity Input/ None
C(3)	Torque Contorl Mode	Analog Current Input/ None
SF(4)	Speed+Position Contorl Mode	Analog Velocity Input/ Follower
CF(5)	Torque+Speed Contorl Mode	Analog Velocity Current/ Follower
CS(6)	Torque+Speed Contorl Mode	Analog Current Input/Analog Velocity Input
P(7)	Multi-Step Speed + Speed Contorl Mode	Preset Velocity / None
PF(8)	Multi-Step Speed + Position Contorl Mode	Preset Velocity / Follower
PS(9)	Multi-Step Speed + Torque Control Mode	Preset Velocity/ Analog Velocity Input
PC(10)	Multi-Step Speed + Torque Contorl Mode	Preset Velocity/ Analog Current Input
I(12)	Indexing	Indexing Input/ None

Initial Value	1(F)
Applicable Operating Mode	All
When Enabled	Servo-Off > Setting > After Power Cycle

<table>
<tr><td></td><td>Motor Configuration

RSWare : Drive - Motor - Motor Model</td></tr>
<tr><td>Applicable Operating Mode</td><td>All</td></tr>
<tr><td>Description</td><td>Set motor type</td></tr>
<tr><td>Setting Value</td><td>• Set items such as motor type, motor rated output, and encoder type.
• Check out model name attached motor nameplate.
• With Up/Down direction key, Alphabet and Mumbers of item are displayed.
Example displays of model attached motor nameplate is as follow. Fill correct information in corresponding position according to following picture.
</td></tr>
</table>

<table>
<tr><td></td><td>Selection of 4 Basic Mode</td></tr>
<tr><td>Applicable Operating Mode</td><td>All</td></tr>
<tr><td>Data Size</td><td>4 digits</td></tr>
<tr><td>Digit 0</td><td>Fault and Disable Braking

RSWare : Drive - Stopping Functions - Fault and Disable Braking</td></tr>
<tr><td>Range</td><td><table>
<tr><td>Value</td><td>Description</td><td>RSWare Name</td></tr>
<tr><td>0</td><td>Keep DB after DB stop</td><td>Brake and hold</td></tr>
<tr><td>1</td><td>DB is released after DB stop</td><td>Brake and release</td></tr>
<tr><td>2</td><td>Stop Free run (operation) without DB stop</td><td>Free Stop</td></tr>
<tr><td>3</td><td>Keep DB after stop Free run</td><td>Free Stop and hold</td></tr>
</table></td></tr>
<tr><td>Initial Value</td><td>0</td></tr>
<tr><td>Digit 1</td><td>Overtravel stop method

RSWare : Drive - Stopping Functions - Overtravel Stop Method</td></tr>
</table>

Range	Value	Description	RSWare Name
	0	Stop by normal torque contorl during overtravel. At this monent,can contorl torque by setting overtravel torque linit [Ft-4.05].	Current Control
	1	Stop by the method set at the DB stop method selection in [Ft-0.02] when overtravel occurs.	Dynamic Brake
Initial Value	0		
Digit 2	Motor Forward Dir. RSWare : Drive - Command Polarity		
Range	Value	Description	RSWare Name
	0	The command signal is not inverted so that a positive command value results in CW Rotation, (as viewed from shaft end).	Normal
	1	The command signal is inverted so that a positive command value results in CCW Rotation, (as viewed from shaft end).	Inverted
Initial Value	0		
Digit 3	Power Input RSWare : Drive - AC Line Loss Check		
Range	Value	Description	RSWare Name
	0	Check input power 50~400W Servo Drive: Enable single-phase open check 800~1.5kW Servo Drive: 3-phase open check	Enable
	1	Do not check the input power	Disable
	2	Single-phase input	Single phase input
Initial Value	0		

	**Selection of Auto Tuning Function**		
Applicable Operating Mode	All		
Data Size	4 digits		
Digit 0	Off-Line Tuning Mode RSWare : Drive - Tuning - Autotuning - Off-Line Tuning Mode		
Range	Value	Descirption	RSWare Name
	0	Inertia Moment Estimation	Inertia Moment Estimation
	1	Inertia Moment Estimation and Resonant Frequency Detection	Inertia Moment Estimation and Resonant Frequency Detection
	2	Resonance frequency Detection	Resonant Frequency Detection
Initial Value	1		
Digit 1	Reserved		
Digit 2	Autotuning Speed RSWare : Drive - Tuning - Autotuning - Autotuning Speed		
Range	Value	Description	
	2-9	The larger the setting value, the higher speed.	
Initial Value	7		

Unit	Setting value* 100 [rpm]	
Digit 3	Dynamic Tuning Response RSWare: Online Tuning Response	
Range	Value	Description
	0	Off
	1	Slowest
	2	Slowest
	3	Slow
	4	Medium-Slow
	5	Medium
	6	Medium-Fast
	7	Fast
	8	Faster
	9	Faster
Initial Value	0	
When Enabled	Servo-Off > Setting	

	**Inertia Ratio** RSWare : Drive - Motor - Inertia Ratio
Description	Inertial Ratio shows Load Inertia to Motor
Range	0 ~ 6,000
Initial Value	100
Unit	(Load inertia/Motor inertia) / 100
When Enabled	Immediately

	**Auxiliary Function Selection 1**	
Applicable Operation Mode	All	
Data Size	4 digits	
Digit 0	Encoder Backup Battery RSWare : Drive - Encoder - Encoder Backup Battery	
Range	Value	Description
	0	Backup Battery Installed
	1	Backup Battery Not Installed
Initial Value	0	
Digit 1	Velocity Observer RSWare : Drive - Auxiliary Function Selection 1 - Velocity Observer	

Range	Value	Description	RSWare Name
	0	Disable	Disable
	1	Enable	Enable
Initial Value	0		
Digit 2	Gain Change Enable RSWare : Drive - Tuning - Gain Change Enable		
Range	Value	Description	RSWare Name
	0	Disable	Disable
	1	Enable	Enable
Initial Value	0		
Digit 3	Emergency Stop Input RSWare : Drive - Auxiliary Function Selection 1 - Emergency Stop Input		
Range	Value	Description	RSWare Name
	0	Disable	Disable
	1	Enable	Enable
Initial Value	0		
When Enabled	Servo-Off > Setting > After power cycle		

	**Auxiliary function Selection 2**		
Applicable Operation Mode	All		
Data Size	2 digits		
Digit 0	Automatic Motor Identification RSWare : Drive - Auto Motor Iden		
Range	Value	Description	RSWare Name
	0	Disabled	Disable
	1	Enabled	Enable
Initial Value	1		
Digit 1	Incremental Feedback Loss RSWare : Drive - Encoder - Incremental Feedback Loss		
Range	Value	Description	RSWare Name
	0	Monitored	Monitored
	1	Ignored	Ignored
Initial Value	0		
Digit 2	Mode of Gain Switching RSWare : Drive - Tuning - Mode of Gain Switching		

Range	Value	Description	RSWare Name
	0	Fixed to the 1st gain.	1st Gain Fix
	1	Fixed to 2nd gain.	2nd Gain Fix
	2	2nd gain selection when the gain switching input is turned on.	Digital Input (G-SEL)
	3	2nd gain selection when the toque command is larger than the setups (level of gain control switching and hysteresis of control switching).	Torque Command
	4	2nd gain selection when the command speed is larger than the setups (level of gain control switching and hysteresis of control switching).	Velocity Command
	5	2nd gain selection when the positional deviation is larger than the setups (level of gain control switching and hysteresis of control switching).	Position Error
	6	2nd gain selection when more than one command pulse exists between 200usec.	Position Command
	7	2nd gain selection when the positional deviation counter value exceeds the setup of Positioning completer range.	In-Position
	8	2nd gain selection when the motor actual speed exceeds the setup (level of gain control switching and hysteresis of control switching). Switches to the 2nd gain while the position command exists.	Velocity
	9	Switches to the 1st gain when no-position command status lasts for the setup of delay time of gain switching [x 200usec] and the speed falls slower than the setups of gain control switching level and hysteresis of control switching.	Position command and Speed
Initial Value	0		
Digit 3	Absolute Feedback Transfer Type RSWare : Drive - Absolute Feedback Transfer Type		
Range	Value	Description	RSWare Name
	0	Same as Command Polarity	Same as Command Polarity
	1	Always CCW	Always CCW
	2	Always CW	Always CW
Initial Value	0		
When Enabled	Immediately		

	**Drive Address** RSWare : Drive - Communications - Drive Address
Applicable Operating Mode	All
Range	1-247
Initial Value	1
When Enabled	Immediately

	**Password** RSWare : Drive Password
Applicable Operating Mode	All
Range	0~9999 Usage Note. Unprotected Code: "777"
Initial Value	0
When Enabled	Immediately

	**Serial Port Configuration** RSWare : Drive - Communications		
Applicable Operating Mode	All		
Data Size	4 digits		
Digit 0	RS-232C, RS-485 Baud Rate RSWare : Drive - Communications - Baudrate		
Range	Value	Descriptions	RSWare Name
	0	9600bps	9600bps
	1	14400bps	14400bps
	2	19200bps	19200bps
	3	38400bps	38400bps
	4	56000bps	56000bps
	5	57600bps	57600bps
Initial Value	5		
Digit 1	Data bits, Parity, Stop bit RSWare : Drive - Communications - Frame Format		

Range	Value	Description	RSWare Name
	0	8, No, 1	8 Data, No Parity, 1 Stop bit
	1	8, Even, 1	8 Data, Even Parity, 1 Stop bit
	2	8, Odd, 1	8 Data, Odd Parity, 1 Stop bit
	3	8, No, 2	8 Data, No Parity, 2 Stop bit
	4	8, Even, 2	8 Data, Even Parity, 2 Stop bit
	5	8, Odd, 2	8 Data, Odd Parity, 2 Stop bit
Initial Value	0		
Digit 2	Protocol RSWare : Drive - Communications - Protocol		
Range	Value	Description	RSWare Name
	0	ASCII	ASCII
	1	MODBUS-RTU	MODBUS-RTU
Initial Value	0		
Digit 3	Communication Method		
Range	Value	Description	RSWare Name
	0	RS232	RS232
	1	RS485	RS485
Initial Value	0		
When Enabled	Immediately		

	**Allocation of Input Signals 1** RSWare : Drive - Digital Inputs			
Rage for All Digits	0-B, Where 0 is Off, B is On, and 1-A are digital input			
Data Size	4 digits			
Digit	Description	Init.	Unmapped IO Status	RSWare Parameter
0	Drive Enable (/SV-ON)	1	ON	Drive Enable
1	Positive Over-travel (P-OT)	b	ON	Overtravel - Positive
2	Negative Over-travel (N-OT)	b	ON	Overtravel - Negative
3	Integrator Inhibit (/P-CON)	4	OFF	Integrator Inhibit
Applicable Operating Mode	All			
When Enabled	Seveo Off > Setting			

Ft-0.11	**Allocation of Input Signals 2** RSWare : Drive - Digital Inputs			
Range for All Digits	0-B, Where 0 is Off, B is On, and 1-A are digital input			
Data Size	4 digits			
Digit	Description	Init.	Unmapped IO Status	RSWare Name
0	Fault Reset (/ A-RST)	5	OFF	Fault Reset
1	Negative Current Limit (/N-TL)	6	OFF	Current Limit - Negative
2	Positive Current Limit (/P-TL)	7	OFF	Current Limit - Positive
3	Operation Mode Override (/C-SEL)	0	OFF	Operation Mode Override
Applicable Operating Mode	All			
When Enabled	Seveo Off > Setting			

Ft-0.12	**Allocation of Input Signals 3** RSWare : Drive - Digital Inputs			
Range for All Digits	0-B, Where 0 is Off, B is On, and 1-A are digital input			
Data Size	4 digits			
Digit	Description	Init.	Unmapped IO Status	RSWare Name
0	Preset Direction (/C-DIR)	0	OFF	Preset Direction
1	Preset Select 1 (/C-SP1)	0	OFF	Preset Select 1
2	Preset Select 2 (/C-SP2)	0	OFF	Preset Select 2
3	Preset Select 3 (/C-SP3)	0	OFF	Preset Select 3
Applicable Operating Mode	All			
When Enabled	Seveo Off > Setting			

Ft-0.13	**Allocation of Input Signals 4** RSWare : Drive - Digital Inputs			
Range for All Digits	0-B, Where 0 is Off, B is On, and 1-A are digital input			
Data Size	4 digits			
Digit	Description	Init.	Unmapped IO Status	RSWare Name
0	Zero Speed Clamp Enable (/Z-CLP)	0	OFF	Zero Speed Clamp Enable
1	Pause Follower (/INHIBIT)	0	OFF	Pause Follower

2	Alternate Gain Select (/G-SEL)	0	OFF	Alternate Gain Select
3	Position clear (/PCLR)	0	OFF	Position Clear
Applicable Operating Mode	All			
When Enabled	Seveo Off > Setting			

Ft-0.14	**Allocation of Input Signals 5** RSWare : Drive - Digital Inputs			
Range for All Digits	0-B, Where 0 is Off, B is On, and 1-A are digital input			
Data Size	4 digits			
Digit	Description	Init.	Unmapped IO Status	RSWare Name
0	Position Strobe (/ABS-DT)	0	OFF	Position Strobe
1	Start (/START)	0	OFF	Motor Moving Enable
2	Analog Speed Command Select 4 (/C-SP4)	0	OFF	Analog Speed Command Enable
3	2^{nd} Electronic Gear Bank Selection (/GEAR)	0	OFF	2^{nd} Electronic Gear Bank Selection
Applicable Operating Mode	All			
When Enabled	Seveo Off > Setting			

Ft-0.15	**Allocation of Input Signals 6** RSWare : Drive - Digital Inputs			
Data Size	4 digits			
Digit	Description	Init.	Unmapped IO Status	RSWare Name
0	Reset multi-turn data of Absolute Encoder (/R-ABS)	0	OFF	Reset Multiturn Data
1	Gain Bank Select (/BANK_SEL)	0	OFF	Gain Bank Select
2	Analog Current Limit (/A-CL)	0	OFF	Analog Current Limit
3	Absolute Position Data Transfer Mode (/ABS-MD)	0	OFF	Absolute Position Transfer Mode
Applicable Operating Mode	All			
When Enabled	Seveo Off > Setting			

Ft-0.16	**Allocation of Input Signals 7** RSWare : Drive - Digital Inputs			
Data Size	4 digits			
Digit	Description	Init.	Unmapped IO Status	RSWare Name
0	Home Sensor (/H_SENS)	0	OFF	Home Sensor
1	Start Homing (/SHOME)	0	OFF	Start Homing
2	Stop Indexing (/STOP)	0	OFF	Stop Indexing
3	Pause Indexing (/PAUSE)	0	OFF	Pause Indexing
Applicable Operating Mode	I			
When Enabled	Seveo Off > Setting			

Ft-0.17	**Allocation of Input Signals 8** RSWare : Drive - Digital Inputs			
Data Size	4 digits			
Digit	Description	Init.	Unmapped IO Status	RSWare Name
0	Index Select 0 Input (/I_SEL0)	0	OFF	Indexing Select 0 Input
1	Index Select 1 Input (/I_SEL1)	0	OFF	Indexing Select 1 Input
2	Index Select 2 Input (/I_SEL2)	0	OFF	Indexing Select 2 Input
3	Index Select 3 Input (/I_SEL3)	0	OFF	Indexing Select 3 Input
Applicable Operating Mode	I			
When Enabled	Seveo Off > Setting			

Ft-0.18	**Allocation of Input Signals 9** RSWare : Drive - Digital Inputs			
Data Size	4 digits			
Digit	Description	Init.	Unmapped IO Status	RSWare Name
0	Index Select 4 Input (/I_SEL4)	0	OFF	Indexing Select 4 Input
1	Index Select 5 Input (/I_SEL5)	0	OFF	Indexing Select 5 Input
2	Stop Homing (/H_STOP)	0	OFF	Stop Homing

3	Start Indexing (/START_I)	0	OFF	Start Index
Applicable Operating Mode	I			
When Enabled	Seveo Off > Setting			

Ft-0.19	**Allocation of Input Signals 10** RSWare : Drive - Digital Inputs		
Data Size	4 digit		
Digit	Description	Init.	Unmapped IO Status
0	Reserved	0	OFF
1	Reserved	0	OFF
2	Reserved	0	OFF
3	Reserved	0	OFF
Applicable Operating Mode	Reserved		
When Enabled	Reserved		

Ft-0.20	**Allocation of Input Signals 11**		
Data Size	4 digit		
Digit	Description	Init.	Unmapped IO Status
0	Reserved	0	OFF
1	Reserved	0	OFF
2	Reserved	0	OFF
3	Reserved	0	OFF
Applicable Operating Mode	Indexing		
When Enabled	Reserved		

Ft-0.21	**Allocation of Input Signals 12**		
Data Size	4 digit		
Digit	Description	Init.	Unmapped IO Status
0	Reserved	0	OFF
1	Reserved	0	OFF
2	Reserved	0	OFF
3	Reserved	0	OFF

Applicable Operating Mode	Reserved
When Enabled	Seveo Off > Setting

Setting Value (Ft-0.10~21)	B	A	9	8	7	6	5	4	3	2	1	0
Input Channel No.	Input Signal On	10	9	8	7	6	5	4	3	2	1	Input Signal Off
I/O Pin No.		28	27	26	9	8	7	6	5	4	3	

	Allocation of Output Signals 1 RSWare : Drive - Digital Outputs		
Range for All Digits	0-3, Where 0 is Off, and 1-6 are digital output		
Data Size	4 digits		
Digit	Description	Init.	RSWare Name
0	Within Position Window (/ P-COM)	1	Within Position Window
1	Up to Speed (/TG-ON)	2	Up to Speed
2	Brake Contorl (BK)	3	Brake
3	Within Speed Window (/ V-COM)	0	Within Speed Window
Applicable Operating Mode	All		
When Enabled	Servo Off > Setting		

	Allocation of Output Signals 2 RSWare : Drive - Digital Outputs		
Range for All Digits	0-3, Where 0 is Off, and 1-6 are digital output		
Data Size	4 digits		
Digit	Description	Init.	RSWare Name
0	Current Limited (/T-LMT)	0	Current Limited
1	Velocity Limited (/V-LMT)	0	Velocity Limited
2	Within Near Window (/ NEAR)	0	Within Near Window
3	Warning (/WARN)	0	Warning

Applicable Operating Mode	All
When Enabled	Servo Off > Setting

	**Allocation of Output Signals 3** RSWare : Drive - Digital Outputs		
Range for All Digits	0-3, Where 0 is Off, and 1-6 are digital output		
Data Size	4 digits		
Digit	Description	Init.	RSWare Name
0	Absolute Position Valid (/A-VLD)	0	Absolute Position Valid
1	Servo drive ready (/RDY)	0	Ready
2	Reserved	0	
3	Reserved	0	
Applicable Operating Mode	All		
When Enabled	Servo Off > Setting		

	**Allocation of Output Signals 4** RSWare : Drive - Digital Outputs		
Range for All Digits	0-3, Where 0 is Off, and 1-6 are digital output		
Data Size	4 digits		
Digit	Description	Init.	RSWare Name
0	In Motion (/IMO)	0	In Motion
1	In Dwell (/I-DW)	0	In Dwell
2	Axis Homed (/HOMC)	0	Axis Homed
3	Index Select 0 Out (/O_ISEL0)	0	Index Select 0 Out
Applicable Operating Mode	I		
When Enabled	Servo Off > Setting		

	**Allocation of Output Signals 5** RSWare : Drive - Digital Outputs		
Range for All Digits	0-3, Where 0 is Off, and 1-6 are digital output		
Data Size	4 digits		
Digit	Description	Init.	RSWare Name
0	Index Select 1 Out (/O_ISEL1)	0	Index Select 1 Out

1	Index Select 2 Out (/O_ISEL2)	0	Index Select 2 Out
2	Index Select 3 Out (/O_ISEL3)	0	Index Select 3 Out
3	Index Select 4 Out (/O_ISEL4)	0	Index Select 4 Out
Applicable Operating Mode	I		
When Enabled	Servo Off > Setting		

	**Allocation of Output Signals 6** RSWare : Drive - Digital Outputs		
Range for All Digits	0-3, Where 0 is Off, and 1-6 are digital output		
Data Size	4 digits		
Digit	Description	Init.	RSWare Name
0	Index Select 5 Out (/O_ISEL5)	0	Index Select 5 Out
1	End of Sequence (/E_SEQU)	0	End of Sequence
2	Reserved	0	
3	Reserved	0	
Applicable Operating Mode	I		
When Enabled	Servo Off > Setting		

	**Allocation of Output Signals 7** RSWare : Drive - Digital Outputs	
Digit	Description	Init.
0	Reserved	0
1	Reserved	0
2	Reserved	0
3	Reserved	0
Applicable Operating Mode	Reserved	
When Enabled	Reserved	

	**Allocation of Output Signals 8** RSWare : Drive - Digital Outputs	
Range for All Digits	0-3, Where 0 is Off, and 1-6 are digital output	
Data Size	4 digits	
Digit	Description	Init.

0	Reserved	0
1	Reserved	0
2	Reserved	0
3	Reserved	0
Applicable Operating Mode	Reserved	
When Enabled	Reserved	

	**Allocation of Output Signals 9** RSWare : Drive - Digital Outputs	
Range for All Digits	0-3, Where 0 is Off, and 1-6 are digital output	
Data Size	4 digits	
Digit	Description	Init.
0	Reserved	0
1	Reserved	0
2	Reserved	0
3	Reserved	0
Applicable Operating Mode	Reserved	
When Enabled	Reserved	

	**Allocation of Output Signals 10** RSWare : Drive - Digital Outputs	
Range for All Digits	0-3, Where 0 is Off, and 1-6 are digital output	
Data Size	4 digits	
Digit	Description	Init.
0	Reserved	0
1	Reserved	0
2	Reserved	0
3	Reserved	0
Applicable Operating Mode	Reserved	
When Enabled	Reserved	

	**I/O Contorl**

Description	Run & Input Control Selection It is used for selection of run-xx or Input function using Modbus. Input function on Hardware cannot be used in case that the input function is used by Modbus with this parameter. Run function cannot be used by key pad, similarly, if the run function is used by Modbus. 0x00 - Not use both Run and Input function by Modbus 0x01 - Use Input function only 0x10 - Use run function only 0x11 - Use both Run and Input function by Modbus 0x12 - Use Run nput , Input function and Special Function by Modbus	
Data Size	2 digits	
Digit 0	Drive -Communications-MODBUS Input Function Control RSWare: MODBUS Input Function Control	
Range	Value	RSWare Name
	0x0	Disable
	0x1	Enable
	0x11	Disable + Special Function
Unit	-	
Initial Value	0	
Digit 1	MODBUS Run Function Control RSWare: Drive -Communications-MODBUS Run Function Control	
Range	Value	RSWare Name
	0x0	Disable
	0x10	Enable
Initial Value	0	
Applicable Operation Mode	All	
When Enabled	Servo Off > Setting	

Standard Group 1

	**Velocity Regulator Response level** RSWare : Drive - Tuning - Velocity Regulator Response Level
Description	Set system gain in proportion to speed response level automatically by referring the estimated inertia ratio after auto tuning.
Range	1~150
Initial Value	50
Unit	[%]
Applicable Operating Mode	All
When Enabled	Immediately

	**System Gain** RSWare : Drive - Tuning - System Gain
Description	• 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 [Ft-1.02], [Ft-1.03], [Ft-1.06],[Ft-1.07], [Ft-1.08] are set automatically according to the control mode while referring to the inertia ratio parameter [Ft-0.04]. • The lower limit is 10 [Hz].
Range	10~500
Initial Value	50
Unit	[Hz]
Applicable Operating Mode	All
When Enabled	Immediately

	**Speed Regulator P Gain** RSWare : Drive - Tuning - Main Velocity Regulator Gains - P
Description	• Parameter which determines the responsiveness of speed control. • Value changed simultaneously with change of inertia ratio [Ft-0.04] or system gain [Ft-1.01].
Range	0~10000
Initial Value	60
Unit	-
Applicable Operating Mode	F, S, P

When Enabled	Immediately

Ft-1.03	**Speed Regulator I Gain** RSWare : Drive - Tuning - Main Velocity Regulator Gains - Integrator Gain
Description	• Removes steady state speed tolerance. • Overshoot in speed response can occur if set value is too large. • Value changed by change in inertia ratio [Ft-0.04] or system gain [Ft-1.00].
Range	0~60000
Initial Value	26
Unit	-
Applicable Operating Mode	F, S, P
When Enabled	Immediately

Ft-1.04	**Speed Regulator D gain** RSWare : Drive - Tuning - Main Velocity Regulator Gains - D
Description	The larger the setting value, the higher speed. Excessive values can result in noise and vibration.
Range	0~1000
Initial Value	0
Unit	-
Applicable Operating Mode	F, S, P
When Enabled	Immediately

Ft-1.05	**Speed Error Filter** RSWare : Drive - Tuning - Main Velocity Regulator Gains - Error Filter Bandwidth
Description	Suppresses high frequency components of speed tolerance.
Unit	0~2500
Initial Value	30
Unit	[Hz]
Applicable Operating Mode	F, S, P
When Enabled	Immediately

Ft-1.06	**Position Regulator Kp Gain** RSWare : Drive - Tuning - Main Position Regulator Gains - Kp

Description	• Parameter which determines the responsiveness of position control. • Change set value according to rigidity of load. • Value changed according to system gain [Ft-1.01].
Unit	0~700
Initial Value	20
Unit	[Hz]
Applicable Operating Mode	F
When Enabled	Immediately

	**Current Command Low pass Filter Bandwidth** RSWare : Drive - Tuning - Main Current Regulator Gains - Low Pass Filter Bandwidth
Description	• Suppresses high frequency components of torque command. • Value changed according to system gain [Ft-1.01].
Unit	0~10000
Initial Value	300
Unit	Hz
Applicable Operating Mode	All
When Enabled	Immediately

	**Speed Command Low pass Filter Bandwidth** RSWare : Drive - Tuning - Main Velocity Regulator Gains - Low Pass Filter Bandwidth
Description	• Sets low pass cutoff frequency of speed command to suppress high frequency components. • Value changed according to system gain [Ft-1.01].
Unit	0~10000
Initial Value	1000
Unit	Hz
Applicable Operating Mode	F, S, P
When Enabled	Immediately

	**Position Command Low pass Filter Bandwidth** RSWare : Drive - Tuning - Main Position Regulator Gains - Low Pass Filter Bandwidth
Description	Sets low pass cutoff frequency of speed command to suppress high frequency components.
Unit	0~1000
Initial Value	0
Unit	[Hz]

Applicable Operating Mode	F
When Enabled	Immediately

	**1st Resonant Frequency Suppression Filter** RSWare : Drive - Tuning - Main Current Regulator Gains - 1st Resonant Frequency Suppression Filter
Description	Suppresses Vibration by cutting off Current Command in assigned frequency band.
Unit	0~10000
Initial Value	10000
Unit	[Hz]
Applicable Operating Mode	All
When Enabled	Immediately

	**1st Resonant Frequency Suppression Filter Width** RSWare : Drive - Tuning - Main Current Regulator Gains - 1st Resonant Frequency Suppression Filter Width
Description	Set up the notch width of the 1st resonance suppressing filter in 20 steps. Higher the setup, larger the notch width you can obtain.
Unit	1~20
Initial Value	10
Unit	-
Applicable Operating Mode	All
When Enabled	Immediately

	**2nd Resonant Frequency Suppression Filter** RSWare : Drive - Tuning - Main Current Regulator Gains - 2nd Resonant Frequency Suppression Filter
Description	Suppresses Vibration by cutting off Current Command in assigned frequency band.
Unit	0~10000
Initial Value	10000
Unit	[Hz]
Applicable Operating Mode	All
When Enabled	Immediately

Ft-1.13	**2nd Resonant Frequency Suppression Filter Width** RSWare : Drive - Tuning - Main Current Regulator Gains - 2nd Resonant Frequency Suppression Filter Width
Description	Set up the notch width of 2nd resonance suppressing filter in 20 steps. Higher the setup, larger the notch width you can obtain.
Unit	1~20
Initial Value	10
Unit	-
Applicable Operating Mode	All
When Enabled	Immediately

Ft-1.14	**2nd Resonant Frequency Suppression Filter Depth** RSWare : Drive - Tuning - Main Current Regulator Gains - 2nd Resonant Frequency Suppression Filter Depth
Description	Set up the 2nd notch depth of the resonance suppressing filter. Higher the setup, shallower the notch depth and smaller the phase delay you can obtain.
Unit	0~100
Initial Value	100
Unit	-
Applicable Operating Mode	All
When Enabled	Immediately

Ft-1.15	**Position Regulator Kff Gain** RSWare : Drive - Tuning - Main Position Regulator Gains - Kff
Description	• 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.
Unit	0~100
Initial Value	0
Unit	[%]
Applicable Operating Mode	F
When Enabled	Immediately

Ft-1.16	**Position Regulator Kff Bandwidth** RSWare : Drive - Tuning - Main Position Regulator Gains - Kff Low Pass Filter Bandwidth

Description	• Valid if position FF gain [Ft-1.15] is not '0'. • If a value other than '0' set for [Ft-1.15] results in overshoot or vibration, set this value to '0'.
Unit	0~2500
Initial Value	200
Unit	[Hz]
Applicable Operating Mode	F
When Enabled	Immediately

	Velocity Regulator I Gain Mode RSWare : Drive - Tuning - Main Velocity Regulator Gains - Integrator Mode		
Description	During transient response, Speed Response Overshoot can be suppressed by speed controller change from Proportion Integration (PI) Controller into Proportion (P) Controller. It reduces Position completion time during Position Control.		
Range	Value	Description	RSWare Name
	0	Do not use P/PI Mode Conversion.	Always On
	1	When Current Command exceeds Current Value in [Ft-1.18], Speed Controller is changed from PI Controller to P Controller.	High Current Disable
	2	When Speed Command exceeds Speed Value in [Ft-1.18], Speed Controller is changed from PI Controller to P Controller.	Velocity Command Disable
	3	When Position error exceeds Position error Value in [Ft-1.18], Speed Controller is changed from PI Controller to P Controller.	Position Error Disable
	4	Automatically velocity controller is changed from PI Controller to P Controller.	Automatic Disable
Initial Value	0		
Applicable Operating Mode	All		
When Enabled	Servo Off > Setting		

	Speed Regulator I Gain Disable Threshold RSWare : Drive - Tuning - Integrator Hold Threshold
Description	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.
Range	0~3000
Initial Value	100
Unit	If [Ft-1.17] = 1, units are [%] of rated continuous current If [Ft-1.17] = 2, units are [RPM] for rotary motors units are [mm/sec] for linear motors If [Ft-1.17] = 3, units are Counts
Applicable Operating Mode	F, S, P
When Enabled	Immediately

	Position Regulator High Error Output Offset RSWare : Drive - Tuning - Main Position Regulator Gains - High Error Output Offset
Description	In order to shorten the position decision time, if the position tolerance is larger than the value of [Ft-1.20], a speed bias equal to the value set here is applied.
Range	0~450
Initial Value	0
Unit	Rotary: [RPM], Linear: [mm/sec]
Applicable Operating Mode	All
When Enabled	Immediately

	Position Regulator High Error Output Threshold RSWare : Drive - Tuning - Main Position Regulator Gains - High Error Output Threshold
Description	[Ft-1.19] Speed bias value Position error standard value input to the speed controller.
Range	0~50000
Initial Value	1000
Unit	pulse
Applicable Operating Mode	All
When Enabled	Immediately

<table>
<tr><td></td><td colspan="3">Current Regulator Bandwidth Reduction Scale

RSWare : Drive - Tuning - Main Current Regulator Gains - Gain</td></tr>
<tr><td>Description</td><td colspan="3">Current control bandwidth</td></tr>
<tr><td rowspan="4">Range</td><td>Value</td><td>Description</td><td>RSWare Name</td></tr>
<tr><td>0</td><td>High bandwidth</td><td>High</td></tr>
<tr><td>1</td><td>Medium bandwidth (0.6667 * high)</td><td>Medium</td></tr>
<tr><td>2</td><td>Low bandwidth (0.3334 * high)</td><td>Low</td></tr>
<tr><td>Initial Value</td><td colspan="3">1</td></tr>
<tr><td>Applicable Operating Mode</td><td colspan="3">All</td></tr>
<tr><td>When Enabled</td><td colspan="3">Immediately</td></tr>
</table>

	**On-line Vibration Mode** RSWare : Drive - Tuning - Autotuning - On-Line Vibration Suppression Mode		
Data Size	1 digit		
Digit 0	On-line Vibration Suppression Mode RSWare : Drive - Tuning - Autotuning - On-Line Vibration Suppression Mode		
Range	Value	Description	RSWare Name
	0	Disable	Disable
	1	Normal Velocity Mode without Initial Value	Normal and High Velocity
	2	Slow Velocity Mode without Initial Value (below 100 [rpm])	Slow Velocity without Initial Value
Initial Value	0		
Digit 1	On-line Vibration Suppression Gain RSWare : Drive - Tuning - Autotuning - On-Line Vibration Suppression Gain		
Range	Value	Description	RSWare Name
	0	Low	Low
	1	High	High
Initial Value	0		
Applicable Operating Mode	All		
When Enabled	Servo Off > Setting		

	**Velocity Regulator Configuration** RSWare : Drive - Tuning - Velocity Regulator Configuration - Velocity Command Filter on Follower		
Description	Select whether to use a filter on the speed command value in Position Contorl Mode.		
Range	Value	Description	RSWare Name
	0	Disable	Disable
	1	Enable	Enable
Initial Value	0		
Applicable Operating Mode	All		
When Enabled	Servo Off > Setting		

	**Delay Time of Gain Switching** RSWare : Drive - Tuning - Gain Switching - Delay Time of Gain Switching
Description	When gain value is switched from Second gain to first gain, you can set delay time.

Range	0~10000
Initial Value	0
Unit	0.2[ms]
Applicable Operating Mode	F, S, P
When Enabled	Immediately

	**Level of Gain Switching** RSWare : Drive - Tuning - Gain Switching - Level of Gain Switching
Description	Set standard value for gain switching. The setting value is for Gain Switching Mode ([Ft-0.06]N1).
Range	0~10000
Initial Value	0
Unit	-
Applicable Operating Mode	F, S, P
When Enabled	Immediately

	**Hysteresis of Gain Switching** RSWare : Drive - Tuning - Gain Switching - Hysteresis of Gain Switching
Description	Operates Hysteresis based on operation level when gain switching. The setting value is for Gain Switching Mode ([Ft-0.06]N10).
Range	0~10000
Initial Value	0
Unit	-
Applicable Operating Mode	F, S, P
When Enabled	Immediately

	**Position Gain Switching Time** RSWare : Drive - Tuning - Gain Switching - Position Gain Switching Time
Description	Adjust as Position Gain Switching Time step by step when switching gain value from first gain to second gain.
Range	0~10000
Initial Value	0
Unit	0.2 [ms]
Applicable Operating Mode	F, S, P
When Enabled	Immediately

	**2nd Velocity Regulator P Gain** RSWare : Drive - Tuning - 2nd Regulator Gains - P
Description	Parameter which determines the responsiveness of speed control.
Range	0~10000
Initial Value	60
Unit	-
Applicable Operating Mode	F, S, P
When Enabled	Immediately

	**2nd Velocity Regulator I Gain** RSWare : Drive - Tuning - 2nd Regulator Gains - Integrator Gain
Description	• Removes steady state speed tolerance. • Overshoot in speed response can occur if set value is too large.
Range	0~60000
Initial Value	26
Unit	-
Applicable Operating Mode	F, S, P
When Enabled	Immediately

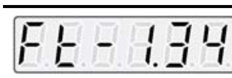
	**2nd Position Regulator Kp Gain** RSWare : Drive - Tuning - 2nd Regulator Gains - Kp
Description	• Parameter which determines the responsiveness of position control. • Change set value according to rigidity of load.
Range	0~700
Initial Value	20
Unit	[Hz]
Applicable Operating Mode	F
When Enabled	Immediately

	**2nd Current Command Low pass Filter Bandwidth** RSWare : Drive - Tuning - 2nd Regulator Gains - Lowpass Filter Bandwidth (IReg)
Description	Suppresses high frequency components of torque command.

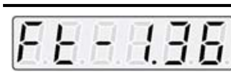
Range	0~10000
Initial Value	300
Unit	[Hz]
Applicable Operating Mode	All
When Enabled	Immediately

	**2nd Velocity Command Low pass Filter Bandwidth** RSWare : Drive - Tuning - 2nd Regulator Gains - Lowpass Filter Bandwidth (VReg)
Description	Sets low pass cutoff frequency of speed command to suppress high frequency components.
Range	0~10000
Initial Value	1000
Unit	[Hz]
Applicable Operating Mode	All
When Enabled	Immediately

	**3rd Velocity Regulator P Gain** RSWare : Drive - Tuning - 3rd Regulator Gains - P
Description	Parameter which determines the responsiveness of speed control.
Range	0~10000
Initial Value	60
Unit	-
Applicable Operating Mode	F, S, P
When Enabled	Immediately

	**3rd Velocity Regulator I Gain** RSWare : Drive - Tuning - 3rd Regulator Gains - Integrator Gain
Description	• Removes steady state speed tolerance. • Overshoot in speed response can occur if set value is too large.
Range	0~60000
Initial Value	26
Unit	-
Applicable Operating Mode	F, S, P
When Enabled	Immediately

	**3rd Position Regulator Kp Gain** RSWare : Drive - Tuning - 3rd Regulator Gains - Kp
Description	• Parameter which determines the responsiveness of position control. • Change set value according to rigidity of load.
Range	0~700
Initial Value	20
Unit	[Hz]
Applicable Operating Mode	F
When Enabled	Immediately

	**3rd Current Command Low pass Filter Bandwidth** RSWare : Drive - Tuning - 3rd Regulator Gains - Lowpass Filter Bandwidth (IReg)
Description	Suppresses high frequency components of torque command.
Range	0~10000
Initial Value	300
Unit	[Hz]
Applicable Operating Mode	All
When Enabled	Immediately

	**3rd Velocity Command Low pass Filter Bandwidth** RSWare : Drive - Tuning - 3rd Regulator Gains - Lowpass Filter Bandwidth (VReg)
Description	Sets low pass cutoff frequency of speed command to suppress high frequency components.
Range	0~10000
Initial Value	1000
Unit	[Hz]
Applicable Operating Mode	All
When Enabled	Immediately

	**4th Velocity Regulator P Gain** RSWare : Drive - Tuning - 4th Regulator Gains - P
Description	Parameter which determines the responsiveness of speed control.

Range	0~10000
Initial Value	60
Unit	-
Applicable Operating Mode	F, S, P
When Enabled	Immediately

	**4^{th} Velocity Regulator I Gain** RSWare : Drive - Tuning - 4^{th} Regulator Gains - Integrator Gain
Description	• Removes steady state speed tolerance. • Overshoot in speed response can occur if set value is too large.
Range	0~60000
Initial Value	26
Unit	-
Applicable Operating Mode	F, S, P
When Enabled	Immediately

	**4^{th} Position Regulator Kp Gain** RSWare : Drive - Tuning - 4th Regulator Gains - Kp
Description	• Parameter which determines the responsiveness of position control.. • Change set value according to rigidity of load.
Range	0~700
Initial Value	20
Unit	[Hz]
Applicable Operating Mode	F
When Enabled	Immediately

	**4^{th} Current Command Low pass Filter Bandwidth** RSWare : Drive - Tuning - 4^{th} Regulator Gains - Lowpass Filter Bandwidth (IReg)
Description	Suppresses high frequency components of torque command.
Range	0~10000
Initial Value	300
Unit	[Hz]
Applicable Operating Mode	All
When Enabled	Immediately

Ft-1.42	**4th Velocity Command Low pass Filter Bandwidth** RSWare : Drive - Tuning - 4th Regulator Gains - Lowpass Filter Bandwidth (VReg)
Description	Sets low pass cutoff frequency of speed command to suppress high frequency components.
Range	0~10000
Initial Value	1000
Unit	[Hz]
Applicable Operating Mode	All
When Enabled	Immediately

Standard Group 2

Ft-2.00	**Velocity Scale** RSWare : Drive - Mode Configuration - Analog- Velocity Scale
Description	• Sets the speed command value[rpm] for the analog speed command input pin (Pin 19,20 of I/O). • Speed command [rpm] = Ft-2.00 [rpm/V] × Input Voltage [V]
Range	10.0~2000.0
Initial Value	500.0
Unit	Rotary Motor: [rpm/V], Linear Motor: [mm/sec/V]
Applicable Operating Mode	S
When Enabled	Servo Off > Setting

Ft-2.01	**Jog Velocity Command** RSWare : Drive - (Right Side)Velocity Control Panel - Velocity Command
Description	Sets speed for jog operation using (run-00).
Range	0~6000
Initial Value	50
Unit	Rotary Motor: [rpm], Linear Motor: [mm/sec]
Applicable Operating Mode	All
When Enabled	Immediately

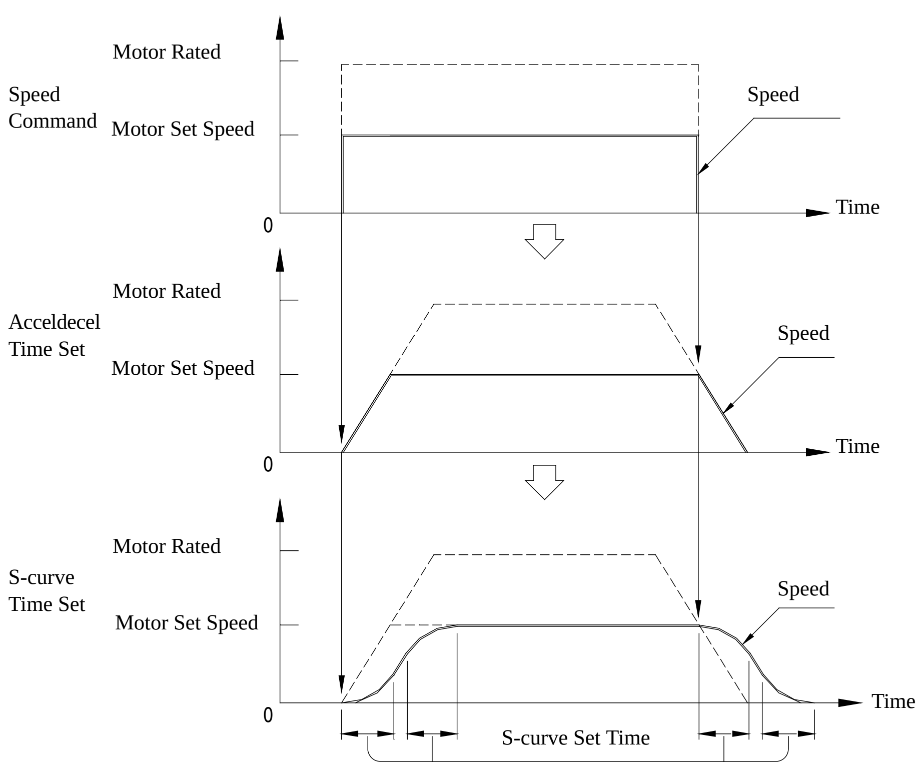
Ft-2.02	**Acceleration** RSWare : Drive - Acceleration Limits - Acceleration
Description	Acceleration means slope of the Speed Profile.

Range	1~2147483647
Initial Value	41667
Unit	Rotary Motor: [10^{-2}xRev/sec^2], Linear Motor: [mm/sec^2]
Applicable Operating Mode	S, P
When Enabled	Immediately

Ft-2.03	**Deceleration** RSWare : Drive - Acceleration Limits - Deceleration
Description	Deceleration means slope of the Speed Profile.
Range	1~2147483647
Initial Value	41667
Unit	Rotary Motor: [10^{-2}xRev/sec^2], Linear Motor: [mm/sec^2]
Applicable Operating Mode	S, P
When Enabled	Immediately

Ft-2.04	**S-Curve Time** RSWare : Drive - Acceleration Limits - S-Curve Time

- 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.



Range	0~5,000
Initial Value	0
Unit	[ms]
Applicable Operating Mode	All
When Enabled	Immediately

	**Preset Velocity 1** RSWare : Drive - Mode Configuration - Preset - Preset Velocity 1
Description	• Sets each contact speed commands for contact speed control mode. • The operation speed should be entered in advance into the relevant parameters </C-SP1>, </C-SP2>, </C-SP3>. • 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.
Range	-6000~6000
Initial Value	0
Unit	Rotary Motor: [rpm], Linear Motor: [mm/sec]
Applicable Operating Mode	P
When Enabled	Immediately

Table B.1 Seed Set according to </C-SP1>, </C-SP2>, and </C-SP3> Signal

Contact Speed	**Speed Set Parameter**	**</C-SP3>**	**</C-SP2>**	**</C-SP1>**
Halt 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

Table B.1 Seed Set according to </C-SP1>, </C-SP2>, and </C-SP3> Signal

Contact Speed	**Speed Set Parameter**	**</C-SP3>**	**</C-SP2>**	**</C-SP1>**
Speed Command 5	Ft-2.09	1	0	1
Speed Command 6	Ft-2.10	1	1	0
Speed Command 7	Ft-2.11	1	1	1

Ft-2.06	**Preset Velocity 2** RSWare : Drive - Mode Configuration - Preset - Preset Velocity 2
Description	Refer to description of [Ft-2.05]
Range	-6000~6000
Initial Value	0
Unit	Rotary Motor: [rpm], Linear Motor: [mm/sec]
Applicable Operating Mode	P
When Enabled	Immediately

Ft-2.07	**Preset Velocity 3** RSWare : Drive - Mode Configuration - Preset - Preset Velocity 3
Description	Refer to description of [Ft-2.05]
Range	-6000~6000
Initial Value	0
Unit	Rotary Motor: [rpm], Linear Motor: [mm/sec]
Applicable Operating Mode	P
When Enabled	Immediately

Ft-2.08	**Preset Velocity 4** RSWare : Drive - Mode Configuration - Preset - Preset Velocity 4
Description	Refer to description of [Ft-2.05]
Range	-6000~6000
Initial Value	0
Unit	Rotary Motor: [rpm], Linear Motor: [mm/sec]
Applicable Operating Mode	P
When Enabled	Immediately

	**Preset Velocity 5** RSWare : Drive - Mode Configuration - Preset - Preset Velocity 5
Description	Refer to description of [Ft-2.05]
Range	-6000~6000
Initial Value	0
Unit	Rotary Motor: [rpm], Linear Motor: [mm/sec]
Applicable Operating Mode	P
When Enabled	Immediately

	**Preset Velocity 6** RSWare : Drive - Mode Configuration - Preset - Preset Velocity 6
Description	Refer to description of [Ft-2.05]
Range	-6000~6000
Initial Value	0
Unit	Rotary Motor: [rpm], Linear Motor: [mm/sec]
Applicable Operating Mode	P
When Enabled	Immediately

	**Preset Velocity 7** RSWare : Drive - Mode Configuration - Preset - Preset Velocity 7
Description	Refer to description of [Ft-2.05]
Range	-6000~6000
Initial Value	0
Unit	Rotary Motor: [rpm], Linear Motor: [mm/sec]
Applicable Operating Mode	P
When Enabled	Immediately

	**Manual Velocity Limit** RSWare : Drive - Velocity Limits - Manual Velocity limit

Description	• 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 [Ft-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.
Range	1~6000
Initial Value	5000
Unit	Rotary Motor: [rpm], Linear Motor: [mm/sec]
Applicable Operating Mode	F, S, P
When Enabled	Servo Off > Setting

	**Velocity Limit Mode** RSWare : Drive - Velocity Limits - Velocity Limit Mode		
Description	Select velocity limit mode.		
Range	Value	Description	RSWare Name
	0	Disabled	Disabled
	1	Limit by [Ft-2.12].	Manual Limit
	2	Limited by Analogue Speed Command Value (except Analog Speed Mode).	Analog Input
	3	Limited by lesser one between [Ft-2.12] and Analogue Speed Command..	Manual and Analog
Initial Value	0		
Applicable Operating Mode	All		
When Enabled	Servo Off > Setting		

Standard Group 3

	**Follower** RSWare : Drive - Mode Configuration - Follower
Data Size	4 digits
Ditig 0	Command Type RSWare : Drive - Mode Configuration - Follower - Command Type

Range	Value	Description	RSWare Name
	0	Step Up/Step Down, Positive logic	Step Up/Step Down. Positive Logic
	1	Step Up/Step Down, Negative logic	Step Up/Step Down. Negative Logic
	2	Step/Direction, Positive Logic	Step/Direction. Positive Logic
	3	Step/Direction, Negative Logic	Step/Direction. Negative Logic
	4	A phase+B phase, x1	Auxiliary Encoder. x1
	5	A phase+B phase, x2	Auxiliary Encoder. x2
	6	A phase+B phase, x4	Auxiliary Encoder. x4
Initial Value	0		
Applicable Operating Mode	Follower		
Digit 1	Controller Output Type RSWare : Drive - Mode Configuration - Follower - Controller Output Type		
Range	Value	Descriptison	RSWare Name
	0	Use Low speed Line Drive Output in Host Controller for isolated electrical connection (Max.900 [kHz])	Line Drive
	1	Use Open Collector in Host Controlle (Max. 250 [kHz])	Open Collector
	2	Use High Frequency Line Drive Output in Host Controller (Max. 3 [MHz])	High Speed Line Drive
Initial Value	0		
Applicable Operating Mode	Follower		
Digit 2	Encoder Output Forward Direction RSWare : Drive - Encoders - Encoder Output Forward Direction		
Range	Value	Description	RSWare Name
	0	During Forward Rotation, Encoder Output Phase A have a lead of 90° over Phase B.	A Leads B
	1	During Forward Rotation, Encoder Output Phase B have a lead of 90° over Phase A.	B Leads A
Initial Value	0		
Applicable Operating Mode	All		
Digit 3	1^{st} Gear ratio change RSWare : Drive - Mode Configuration - Follower - 1^{st} Gear Ratio Change		
Range	Value	Description	RSWare Name
	0	Enable Only on Drive Disabled	Enable Only on Drive Disabled
	1	Always Enable	Always Enable
Initial Value	0		
Applicable Operating Mode	F		
When Enabled	Servo Off > Setting		

	**1st Gear Ratio, Follower Counts** RSWare : Drive - Mode Configuration - Follower - 1st Gear Ratio (Second number)
Description	• Numerator of Electronic gear. • 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 × Reduction ratio × 4 ≥ [Ft-3.02]". • Maximum resolution = 1 / ([No. of pulses per 1 motor rotation] × [Reduction ratio] × 4)
Range	1~65535
Initial Value	4
Unit	-
Applicable Operating Mode	F
When Enabled	Servo Off > Setting

	**1st Gear Ratio, Master Counts** RSWare : Drive - Mode Configuration - Follower - 1st Gear Ratio (First Nmuber)
Description	Denominator of Electronic gear.
Range	1~65535
Initial Value	1
Unit	
Applicable Operating Mode	F
When Enabled	Servo Off > Setting

	**Encoder Output Ratio, Output Counts (Denominator)** RSWare : Drive - Encoders - Output Ratio (First Number)
Description	• Numerator of Position output pulse adjustment. • 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 [Ft-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 [Ft-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 [Ft-3.03] ≤ [Ft-3.04] has to be satisfied. • For the No. of output pulses per rotation to the higher level controller: ([Ft-3.03]/[Ft-3.04]) × output pulses per rotation = Output to higher level controller

Range	1~32768
Initial Value	1
Unit	
Applicable Operating Mode	All
When Enabled	Servo Off > Setting

	**Encoder Output Ratio, Motor Counts (Numerator)** RSWare : Drive - Encoders - Output Ratio (Last Number)
Description	Denominator of Position output pulse adjustment.
Range	1~32768
Initial Value	1
Unit	-
Applicable Operating Mode	All
When Enabled	Servo Off > Setting

	**2nd Gear Ratio, Follower Counts** RSWare : Drive - Mode Configuration - Follower - 2nd Gear Ratio (Second Number)
Description	• Numerator of 2nd Gear Ratio. • 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 × Reduction ratio × 4 ≥ [Ft-3.02]". • Maximum resolution=1/ ([No.of pulses per 1 motor rotation] x [Reduction ratio] x 4)
Range	1~65535
Initial Value	4
Unit	-
Applicable Operating Mode	F
When Enabled	Servo Off > Setting

	**2nd Gear Ratio, Master Counts** RSWare : Drive - Mode Configuration - Follower - 2nd Gear Ratio (First Number)
Description	Denominator of 2nd Gear Ratio.
Range	1~65535
Initial Value	1
Unit	-
Applicable Operating Mode	F

When Enabled	Servo Off > Setting

Ft-3.07	Reserved
Parameter	Reserved
Description	Reserved
Range	Reserved
Initial Value	Reserved
Unit	Reserved
Applicable Operating Mode	Reserved

Ft-3.08	**Digital Filter Cut-off Frequency** RSWare : Drive - Mode Configuration - Follower - Digital Filter Cut-off Frequency		
Digit 0	Low Drive Input RSWare : Drive - Mode Configuration - Follower - Digital Filter Cut-off Frequency - Low Speed Line Driver Input		
Range	Value	Description	RSWare Name
	0	3.000 MHz	3.000
	1	1.750 MHz	1.750
	2	1.500 MHz	1.500
	3	1.000 MHz	1.000
	4	0.750 MHz	0.750
	5	0.625 MHz	0.625
	6	0.562 MHz	0.562
	7	0.525 MHz	0.525
Initial Value	3		
Applicable Operating Mode	F		
Digit 1	Open Collector Input RSWare : Drive - Mode Configuration - Follower - Digital Filter Cut-off Frequency - Open Collector Input		
Range	Value	Description	RSWare Name
	0	3.000 MHz	3.000
	1	1.750 MHz	1.750
	2	1.500 MHz	1.500
	3	1.000 MHz	1.000
	4	0.750 MHz	0.750
	5	0.625 MHz	0.625
	6	0.562 MHz	0.562
	7	0.525 MHz	0.525

Initial Value	7		
Applicable Operating Mode	F		
Digit 2	High Frequency Line Drive Input RSWare : Drive - Mode Configuration - Follower - Digital Filter Cut-off Frequency - High Speed Line Driver Input		
Range	Value	Description	RSWare Name
	0	3.000 MHz	3.000
	1	1.750 MHz	1.750
	2	1.500 MHz	1.500
	3	1.000 MHz	1.000
	4	0.750 MHz	0.750
	5	0.625 MHz	0.625
	6	0.562 MHz	0.562
	7	0.525 MHz	0.525
Initial Value	0		
Applicable Operating Mode	F		
When Enabled	Servo Off > Setting		

Standard Group 4

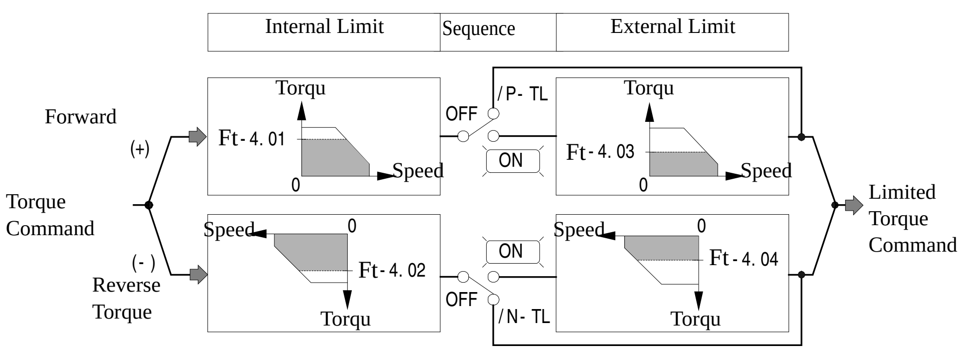
	**Current Scale** RSWare : Drive - Mode Configuration - Analog - Current Scale
Description	• Set the speed command value[%] for 1[V] on the analog torque command input pin(pin 21,22 of I/O). • Torque command[%] = [Ft-4.00] [%/V] x input voltage [V]
Range	0-1000
Initial Value	333
Unit	[%] of rated continuous current/V/10
Applicable Operating Mode	C
When Enabled	Servo Off > Setting

	**Positive Internal Current Limit** RSWare : Drive - Current Limits - Positive Internal
Description	Limits forward and reverse direction torque on motor separately. (internally limited)
Range	0~500
Initial Value	300
Unit	[%] of motor rated continuous current
Applicable Operating Mode	All

When Enabled	Immediately

Ft-4.02	**Negative Internal Current Limit** RSWare : Drive - Current Limits - Negative Internal
Description	Limits reverse direction torque on motor. (Internally limited)
Range	0~500
Initial Value	300
Unit	[%] of motor rated continuous current
Applicable Operating Mode	All
When Enabled	Immediately

Ft-4.03	**Positive External Current Limit** RSWare : Drive - Current Limits - Positive External
Description	• The torque imposed on the motor is internally limited automatically by the values set on [Ft-4.01], [Ft-4.02]. Additionally, it is also limited by the values set on [Ft-4.03], [Ft-4.04] when external </P-TL>,</N-TL> signals are input through sequence input. • The torque limit according to internal limit [Ft-4.01] and [Ft-4.01] takes precedence to external torque limit </P-TL> and </N-TL> signals.



Range	0~500
Initial Value	100
Unit	[%] of motor rated continuous current
Applicable Operating Mode	All
When Enabled	Immediately

Ft-4.04	**Negative External Current Limit** RSWare : Drive - Current Limits - Negative External
Description	Refer to description of [Ft-4.03]
Range	0~500
Initial Value	100
Unit	[%] of motor rated continuous current

Applicable Operating Mode	All
When Enabled	Immediately

	**Over-travel Current Limit** RSWare : Drive - Stopping Functions - Maximum Stopping Current
Description	• 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.
Range	0~500
Initial Value	300
Unit	[%] of motor rated continuous current
Applicable Operating Mode	All
When Enabled	Immediately

	**Initial Current Bias** RSWare : Drive - Initial Current Bias
Description	Initial torque value applied when the servo drive activated. This is to keep vertical axis load.
Range	-100~100
Initial Value	0
Unit	[%] of motor rated continuous current
Applicable Operating Mode	All
When Enabled	Immediately

Standard Group 5

Ft-5.00	**In Position Size** RSWare : Drive - Position Functions - In Position Size
Description	If position error < In Position Size for 1 ms and the In Position Size output signal is assigned, the In Position output is turned ON.
Range	0~2500
Initial Value	10
Unit	pulse
Applicable Operating Mode	F
When Enabled	Immediately

Ft-5.01	Reserved
Parameter	Reserved
Description	Reserved
Range	Reserved
Initial Value	Reserved
Unit	Reserved
Applicable Operating Mode	Reserved

Ft-5.02	**Near Position Size** RSWare : Drive - Position Functions - Near Position Size
Description	If position error < Near Position Size and the Near Position output signal is assigned, the Near Position output is turned ON.
Range	0~2500
Initial Value	20
Unit	pulse
Applicable Operating Mode	F
When Enabled	Immediately

Ft-5.03	**Speed Window** RSWare : Drive - Speed Functions - Speed Window
Description	If the speed error < Speed Window for 10 ms and the Within Speed Window output signal is assigned, then the Within Speed Window output is turned ON.
Range	0-1000
Initial Value	10
Unit	Rotary Motor: [rpm], Linear Motor: [mm/sec]

Applicable Operating Mode	F, S, P
When Enabled	Immediately

Ft-5.04	**Up to speed** RSWare : Drive - Speed Functions - Up to Speed
Description	If the motor speed > Up to Speed and the Up to Speed output signal is assigned, then the Up to Speed output is turned ON.
Range	1~5000
Initial Value	20
Unit	Rotary Motor: [rpm], Linear Motor: [mm/sec]
Applicable Operating Mode	All
When Enabled	Immediately

Ft-5.05	**Zero Clamp** RSWare : Drive - Speed Functions - Zero Clamp
Description	If the Analog Speed Command < Zero Clamp, then the analog speed command is ignored and the motor command speed is set to zero.
Range	0~5000
Initial Value	0
Unit	Rotary Motor: [rpm], Linear Motor: [mm/sec]
Applicable Operating Mode	S
When Enabled	Immediately

Ft-5.06	**Brake Inactive Delay** RSWare : Drive - Digital Outputs - Brake Inactive Delay
Description	Brake Inactive delay is the time from when the drive is enabled to when the brake is released.
Range	0~10000
Initial Value	0
Unit	[ms]
Applicable Operating Mode	All
When Enabled	Servo Off > Setting

Ft-5.07	**Disable Delay** RSWare : Drive - Stopping Functions - Disable Delay
Description	Disable Delay is the time from when Drive Disable command is received to when the Drive Disable command is actually executed.
Range	0~10000

Initial Value	0
Unit	[ms]
Applicable Operating Mode	All
When Enabled	Servo Off > Setting

	**Brake Active Delay** RSWare : Drive - Digital Outputs - Brake Active Delay
Description	The Braking Application Speed is the feedback speed below which the motor break is engaged, after disabling the drive.
Range	0~10000
Initial Value	500
Unit	[ms]
Applicable Operating Mode	All
When Enabled	Servo Off > Setting

	**Disabled Braking Speed** RSWare : Drive - Stopping Functions - Braking Application Speed
Description	The Braking Application Speed is the feedback speed below which the motor break is engaged, after disabling the drive.
Range	0~1000
Initial Value	100
Unit	Rotary Motor: [rpm], Linear Motor: [mm/sec]
Applicable Operating Mode	All
When Enabled	Servo Off > Setting

	**Following Error Limit** RSWare : Drive - Faults - Following Error Limit
Description	A following error fault occurs when the difference between position command and actual position is greater than this parameter.
Range	0~2147483647
Initial Value	99999
Unit	pulse
Applicable Operating Mode	F

	**AC Line Loss Fault Delay** RSWare : Drive - Faults - AC Line Loss Fault Delay
Description	The AC Line Loss Fault is inhibited for this amount of time, when a loss of AC power is detected.

Range	20~1000
Initial Value	20
Unit	ms
Applicable Operating Mode	All
When Enabled	Servo Off > Setting

Ft-5.13	**Analog Output CH1 Selection** RSWare : Drive - Analog Outputs - Analog Output 1 - Signal
Description	The drive signal assigned to channel 1 from the Channel Setup dialog box in the Oscilloscope window.
Range	0~28 (Except 15, 23, 25, 26)
Initial Value	0
Applicable Operating Mode	All
When Enabled	Immediately

Ft-5.14	**Analog Output CH2 Selection** RSWare : Drive - Analog Outputs - Analog Output 2 - Signal
Description	The drive signal assigned to channel 2 from the Channel Setup dialog box in the Oscilloscope window.
Range	0~28 (Except 15, 23, 25, 26)
Initial Value	1
Applicable Operating Mode	All
When Enabled	Immediately

Ft-5.15	**Analog Output CH1 Scale** RSWare : Drive - Analog Outputs - Analog Output 1 - Scale
Description	The amplitude of the channel 1 input signal to be displayed by the oscilloscope.
Range	1 - 99999
Unit	Units depend on the channel selection.
Initial Value	500
Applicable Operating Mode	All
When Enabled	Immediately

Ft-5.16	**Analog Output CH2 Scale** RSWare : Drive - Analog Outputs - Analog Output 2 - Scale
Description	The amplitude of the channel 2 input signal to be displayed by the oscilloscope.
Range	1 - 99999

Unit	Units depend on the channel selection.
Initial Value	500
Applicable Operating Mode	All
When Enabled	Immediately

Indexing Drive Parameters

Indexing Group 0 - Indexing System

No.	Name	Modubus Address	Digit No.	Range	Init.	Note
In00.00	Auto Start Indexing	5000	N/A	0~1	0	-
In00.01	Abort Index Deceleration	5001, 5002	N/A	1~2147483647	6250	Rotary Motor: [10^{-2}xRev/sec^2] , Linear Motor: [mm/sec^2]
In00.02	Positive Deceleration Distance	5003, 5004	N/A	0~2147483647	0	pulse
In00.03	Negative Deceleration Distance	5005, 5006	N/A	0~2147483647	0	pulse
In00.04	Enable Software Limits	5007	N/A	0~1	0	-
In00.05	Positive Software Limit	5008, 5009	N/A	- 2147483647 ~2147483647	2147483647	pulse
In00.06	Negative Software Limit	5010, 5011	N/A	- 2147483647 ~2147483647	- 2147483647	pulse

Indexing Group 1 - Homing

No.	Name	Modubus Address	Digit No.	Range	Init.	Note
In01.00	Homing Type	5200	N/A	0~8	1	-
In01.01	Auto Start Homing on Enable	5201	N/A	0~2	2	-
In01.02	Homing Velocity	5202	N/A	-6000~6000	100	Rotary Motor: [rpm] , Linear Motor: [mm/sec]

In01.03	Creep Velocity	5203	N/A	0~6000	20	Rotary Motor: [rpm] , Linear Motor: [mm/ sec]
In01.04	Homing Acceleration/ Deceleration	5204, 5205	N/A	1~2147483647	6250	Rotary Motor: [10^{-2}xRev/sec^2] , Linear Motor: [mm/sec^2]
In01.05	Offset Move Distance	5206, 5207	N/A	- 2147483647 ~2147483647	0	pulse
In01.06	Home Sensor Polarity	5208	N/A	0~1	0	-
In01.07	Home Position	5209, 5210	N/A	- 2147483647 ~2147483647	0	pulse
In01.08	Moving distance After Home Sensor	5211, 5212	N/A	0~2147483647	0	pulse
In01.09	Home Current	5213	N/A	1~250	100	[%]
In01.10	Home Current Time	5214	N/A	0~1000	0	[ms]
In01.11	Homing Time Limit	5215	N/A	0~65535	60	[sec]
In01.12	Stop Home Deceleration	5216, 5217	N/A	1~2147483647	6250	Rotary Motor: [10^{-2}xRev/sec^2] , Linear Motor: [mm/sec^2]

Indexing Group 2- Index Option

No.	Name	Modubus Address	Digit No.	Range	Init.	Note
In02.00	Index 0 Option	5400	0	0: Absolute 1: Incremental	0	-
			1	0: Stop 1: Start next index 2: Wait for Start	0	-
			2...3	Reserved		
In02.01	Index 1 Option	5401	0	0: Absolute 1: Incremental	0	-
			1	0: Stop 1: Start next index 2: Wait for Start	0	-
			2...3	Reserved		
⋮	⋮	⋮	⋮	⋮	⋮	⋮

In02.63	Index63 Option	5463	0	0: Absolute 1: Incremental	0	-
			1	0: Stop 1: Start next index 2: Wait for Start	0	-
			2...3	Reserved		

Indexing Gorup 4 - Index Position/Distance

No.	Name	Modubus Address	Digit No.	Range	Init.	Note
In04.00	Index 0 Position/ Distance	5800, 5801	N/A	- 2147483647 ~2147483647	0	pulse
In04.01	Index 1 Position/ Distance	5802, 5803	N/A	- 2147483647 ~2147483647	0	pulse
: : :	: : :	: : :	: : :	: : :	: : :	: : :
In04.63	Index 63 Position/ Distance	5926, 5927	N/A	- 2147483647 ~2147483647	0	pulse

Indexing Group 7 - Index Dwell

No.	Name	Modubus Address	Digit No.	Range	Init.	Note
In07.00	Index 0 Dwell	6400	N/A	0~65535	0	ms
In07.01	Index 1 Dwell	6401	N/A	0~65535	0	ms
: : :	: : :	: : :	: : :	: : :	: : :	: : :
In07.63	Index 63 Dwell	6463	N/A	0~65535	0	ms

Indexing Gorup 8 - Index Velocity

No.	Name	Modubus Address	Digit No.	Range	Init.	Note
In08.00	Index 0 Velocity	6600	N/A	0~6000	750	Rotary Motor: [rpm] , Linear Motor: [mm/ sec]
In08.01	Index 1 Velocity	6601	N/A	0~6000	750	Rotary Motor: [rpm] , Linear Motor: [mm/ sec]
: : :	: : :	: : :	: : :	: : :	: : :	: : :
In08.63	Index 63 Velocity	6663	N/A	0~6000	750	Rotary Motor: [rpm] , Linear Motor: [mm/ sec]

Indexing Group 10 - Index Acceleration

No.	Name	Modubus Address	Digit No.	Range	Init.	Note
In10.00	Index 0 Acceleration	7000, 7001	N/A	1~2147483647	6250	Rotary Motor: [10^{-2}xRev/sec^2] , Linear Motor: [mm/sec^2]
In10.01	Index 1 Acceleration	7002, 7003	N/A	1~2147483647	6250	Rotary Motor: [10^{-2}xRev/sec^2] , Linear Motor: [mm/sec^2]
: : :	: : :	: : :	: : :	: : :	: : :	: : :
In10.63	Index 63 Acceleration	7126, 7127	N/A	1~2147483647	6250	Rotary Motor: [10^{-2}xRev/sec^2] , Linear Motor: [mm/sec^2]

Indexing Gorup 11 - Index Deceleration

No.	Name	Modubus Address	Digit No.	Range	Init.	Note
In11.00	Index 0 Deceleration	7200, 7201	N/A	1~2147483647	6250	Rotary Motor: [10^{-2}xRev/sec^2] , Linear Motor: [mm/sec^2]
In11.01	Index 1 Deceleration	7202, 7203	N/A	1~2147483647	6250	Rotary Motor: [10^{-2}xRev/sec^2] , Linear Motor: [mm/sec^2]

Description	Causes the drive to begin the homing procedure automatically when the drive is enabled. 0 - Active: Automatically starts homing every time the drive is enabled. 1 - Active After Reset Only: automatically starts homing when a drive is enabled, if the drive has not already been homed. 2 - Inactive				
Range	0~2	Initial Value	2	Unit	N/A
Modbus Address	5201	Changeable Status	Always	When Enabled	Power Cycling
Applicable Operation Mode	I	-			

In01.02	**Homing Velocity** RSWare : Drive - Mode Configuration- Homing - Homing Velocity				
Description	The commanded velocity used during homing. The sign of this value (+/-) indicates the direction of motion during homing.				
Range	-6000~6000	Initial Value	100	Unit	Rotary Motor: [rpm] , Linear Motor: [mm/sec]
Modbus Address	5202	Changeable Status	Servo-OFF	When Enabled	Disable drive
Applicable Operation Mode	I	-			

In01.03	**Creep Velocity** RSWare : Drive - Mode Configuration- Homing - Creep Velocity				
Description	For the To Sensor, then Back to Marker Homing Type, the velocity used for all remaining homing motion after the motor decelerates to a stop when it finds the sensor edge.				
Range	0~6000	Initial Value	20	Unit	Rotary Motor: [rpm] , Linear Motor: [mm/sec]
Modbus Address	5203	Changeable Status	Servo-OFF	When Enabled	Disable drive
Applicable Operation Mode	I	-			

In01.04	**Homing Acceleration/Deceleration** RSWare : Drive - Mode Configuration- Homing - Homing Accel/Decel				
Description	The rate of acceleration and deceleration used during homing.				
Range	1~2147483647	Initial Value	6250	Unit	Rotary Motor: [10^{-2}xRev/sec^2] , Linear Motor: [mm/sec^2]
Modbus Address	5204, 5205	Changeable Status	Servo-OFF	When Enabled	Disable drive
Applicable Operation Mode	I	-			

In01.05	**Offset Move Distance** RSWare : Drive - Mode Configuration- Homing - Offset Move Distance				
Description	The distance the motor position will be from the marker edge (or sensor edge for Sensor only Homing Type) after the homing sequence is complete.				
Range	-2147483647~2147483647	Initial Value	0	Unit	pulse
Modbus Address	5206, 5207	Changeable Status	Servo-OFF	When Enabled	Disable drive
Applicable Operation Mode	I	-			

⋮	⋮	⋮	⋮	⋮	⋮	⋮
In11.63	Index 63 Deceleration	7326, 7327	N/A	1~2147483647	6250	Rotary Motor: [10^{-2}xRev/sec^2], Linear Motor: [mm/sec^2]

Indexing Gorup 12 - Index Next Index

No.	Name	Modubus Address	Digit No.	Range	Init.	Note
In12.00	Index 0 Next Index	7400	N/A	0~63	0	-
In12.01	Index 1 Next Index	7401	N/A	0~63	0	-
⋮	⋮	⋮	⋮	⋮	⋮	⋮
In12.63	Index 63 Next Index	7463	N/A	0~63	0	-

Indexing Parameter Gorup 0 - Indexing System

In00.00	**Auto Start Indexing** RSWare : Drive - Mode Configuration- Indexing - Auto Start Indexing				
Description	When this field is set to "on", the drive will begin executing the selected index whenever the drive enables. *0-Off* *1-On*				
Range	0~1	Initial Value	0	Unit	N/A
Modbus Address	5000	Changeable Status	Always	When Enabled	Power Cycling
Applicable Operation Mode	I	-			

In00.01	**Abort Index Deceleration** RSWare : Drive - Mode Configuration- Indexing - Abort Index Decel				
Description	The deceleration used to stop motion when the Stop Index input terminates an index move.				
Range	0~2147483647	Initial Value	6250	Unit	Rotary Motor: [10^{-2}xRev/sec^2], Linear Motor: [mm/sec^2]
Modbus Address	5001	Changeable Status	Always	When Enabled	Always

Applicable Operation Mode	I	-

	**Positive Deceleration Distance** RSWare : Drive - Mode Configuration- Indexing - Positive Deceleration Distance				
Description	The stopping distance used when the drive encounters a positive overtravel limit.				
Range	0~2147483647	Initial Value	0	Unit	pulse
Modbus Address	5003, 5004	Changeable Status	Always	When Enabled	Always
Applicable Operation Mode	I	-			

	**Negative Deceleration Distance** RSWare : Drive - Mode Configuration- Indexing - Negative Deceleration Distance				
Description	The stopping distance used when the drive encounters a negative overtravel limit.				
Range	0~2147483647	Initial Value	0	Unit	pulse
Modbus Address	5005, 5006	Changeable Status	Always	When Enabled	Always
Applicable Operation Mode	I	-			

	**Enable Software Limits** RSWare : Drive - Mode Configuration- Indexing - Enable Software Limits				
Description	Select: *0-Off*: Turns off software overtravel limit checking *1-On*: Causes the drive to compare the motor feedback position to the Positive and Negative Software Limits, below, to determine if the drive has exceeded an overtravel limit.				
Range	0~1	Initial Value	0	Unit	N/A
Modbus Address	5007	Changeable Status	Servo-OFF	When Enabled	Disable Drive
Applicable Operation Mode	I	-			

	**Positive Software Limit** RSWare : Drive - Mode Configuration- Indexing - Positive Software Limit				
Description	If the motor feedback position is greater than this value, the drive has exceeded the software overtravel limit.				
Range	-2147483647~2147483647	Initial Value	2,147,483,647	Unit	pulse
Modbus Address	5008, 5009	Changeable Status	Servo-OFF	When Enabled	Disable Drive
Applicable Operation Mode	I	-			

	**Negative S/W Limit** RSWare : Drive - Mode Configuration- Indexing - Negative Software Limit

Description	If the motor feedback position is less than this value, the drive has exceeded the software overtravel limit.				
Range	-2147483647~2147483647	Initial Value	- 2,147,483,647	Unit	pulse
Modbus Address	5010, 5011	Changeable Status	Servo-OFF	When Enabled	Disable Drive
Applicable Operation Mode	I	-			

	**User Defined Distance Per Motor Revolution** RSWare : Drive - Mode Configuration- Indexing - User Defined Distance Per Motor Revolution				
Description	Define user defined distance per motor revolution.				
Range	0~99999	Initial Value	0	Unit	User Defined
Modbus Address	5012	Changeable Status	Always	When Enabled	Disable Drive
Applicable Operation Mode	I	-			

Indexing Parameter Garoup 1 - Homing

	**Homing Type** RSWare : Drive - Mode Configuration- Homing - Homing Type				
Description	Select the type of homing operation the drive will perform. 0-Home to Present Position 1-To Home sensor/Back to Marker 2-To Limit/Back to Marker 3-To Home sensor/Fwd to Marker 4- To Limit/Fwd to Marker 5- Home to Current Value 6-Home to Current Value/Back to Marker 7-To Home sensor/Move/Back to Marker 8-Home to Marker 9- To Home Sensor 10-To Limit Sensor				
Range	0~10	Initial Value	1	Unit	N/A
Modbus Address	5200	Changeable Status	Servo-OFF	When Enabled	Disable Drive
Applicable Operation Mode	I	-			

	**Auto Start Homing on Enable** RSWare : Drive - Mode Configuration- Homing - Auto Start Homing on Enable

	**Home Sensor Polarity** RSWare : Drive - Mode Configuration- Homing - Home Sensor Polarity

Description	0-NORMAL CLOSE 1-NORMAL OPEN				
Range	0~1	Initial Value	0	Unit	N/A
Modbus Address	5208	Changeable Status	Servo-OFF	When Enabled	Disable drive
Applicable Operation Mode	I	-			

	**Home Position** RSWare : Drive - Mode Configuration- Homing - Home Position				
Description	The home position when a homing procedure is completed.				
Range	-2147483647~2147483647	Initial Value	0	Unit	pulse
Modbus Address	5209, 5210	Changeable Status	Servo-OFF	When Enabled	Disable drive
Applicable Operation Mode	I	-			

	**Moving distance After Home Sensor** RSWare : Drive - Mode Configuration- Homing - Moving Distance After Home Sensor				
Description	This value is distance that the drive ignores the marker inputs after the home sensor is detected.				
Range	0~2147483647	Initial Value	0	Unit	pulse
Modbus Address	5211, 5212	Changeable Status	Servo-OFF	When Enabled	Disable drive
Applicable Operation Mode	I	-			

	**Home Current** RSWare : Drive - Mode Configuration - Homing - Home Current				
Description	Specifies the torque feedback at which the drive stops moving the motor at the Homing Velocity. Unit : Percentages of a motor rating torque				
Range	0~250	Initial Value	100	Unit	[%]
Modbus Address	5213	Changeable Status	Servo-OFF	When Enabled	Disable drive
Applicable Operation Mode	I	-			

	**Home Current Time** RSWare : Drive - Mode Configuration- Homing - Home Current Time				
Description	The time to when the torque feedback is more than the home current to when the drive detects stopper.				
Range	0~1000	Initial Value	0	Unit	[ms]
Modbus Address	5214	Changeable Status	Servo-OFF	When Enabled	Disable drive
Applicable Operation Mode	I	-			

	**Homing Time Limit** RSWRSWare : Drive - Mode Configuration- Homing - Homing Timeout
Description	Drive fault occurs when time for homing is over the homing time limit.

Range	0~65535	Initial Value	60	Unit	[Sec]
Modbus Address	5215	Changeable Status	Servo-OFF	When Enabled	Disable drive
Applicable Operation Mode	I	-			

	**Stop Home Deceleration** RSWare : Drive - Mode Configuration- Homing - Stop Home decel				
Description	The rate of drive deceleration used when homing is stopped.				
Range	1~2147483647	Initial Value	6250	Unit	Rotary Motor: [10^{-2}xRev/sec^2] , Linear Motor: [mm/sec^2]
Modbus Address	5216, 5217	Changeable Status	Servo-OFF	When Enabled	Disable drive
Applicable Operation Mode	I	-			

Indexing Parameter Group 2 - Indexing Options

	Digit 0	**Index 0~63 Type** RSWare : Drive - Mode Configuration- Indexing - Index 0 ~63 Setup - Mode			
Description	Index 0 ~63 Setup Mode: 0-Absolute: moves from its starting position to the specified Position, below.. 1-Incremental: moves from its starting position the specified Distance, below. Note: The axis must be homed before the drive can execute any index.				
Range	0~1	Initial Value	0	Unit	N/A
Modbus Address	5400, 5463	Changeable Status	Always	When Enabled	Always
Applicable Operation Mode	I	-			

	Digit 1	**Index 0~63 Action When Complete** RSWare : Drive - Mode Configuration- Indexing - Index 0 ~63 Setup - Action When Complete			
Description	0: Stop: ends the execution of indexed move commands (default setting). 1: Start next index: commands execution of the Next Index move without additional input, but after the scheduled Dwell. 2: Wait for Start: commands execution of the Next Index move the next time the Start Index input becomes active.				
Range	0~2	Initial Value	0	Unit	N/A
Modbus Address	5400, 5463	Changeable Status	Always	When Enabled	Always
Applicable Operation Mode	I	-			

Indexing Parameter Group 4 - Index Position/Distance

	**Index 0~63 Position/Distance** RSWare : Drive - Mode Configuration- Indexing - Index 0 ~63 Setup - Distance or Position				
Description	• Position : For Absolute mode moves, the fixed position to which the motor will travel. • Distance : For Incremental and Registration mode moves, the relative distance the motor will travel.				
Range	-2147483647~2147483647	Initial Value	0	Unit	pulse
Modbus Address	5800 ~ 5927	Changeable Status	Always	When Enabled	Always
Applicable Operation Mode	I	-			

Indexing Parameter Group 7 - Index Dwell

	**Index 0~63 Dwell** RSWare : Drive - Mode Configuration- Indexing - Index 0 ~63 Setup - Dwell				
Description	Milliseconds to remain at current position before exec.				
Range	0~65535	Initial Value	0	Unit	[ms]
Modbus Address	6400 ~ 6463	Changeable Status	Always	When Enabled	Always
Applicable Operation Mode	I	-			

Indexing Parameter Group 8 - Index Velocity

	**Index 0~63 Velocity** RSWare : Drive - Mode Configuration- Indexing - Index 0 ~63 Setup - Velocity				
Description	Maximum velocity while in motion.				
Range	0~6000	Initial Value	750	Unit	Rotary Motor: [rpm] , Linear Motor: [mm/sec]
Modbus Address	6600 ~ 6663	Changeable Status	Always	When Enabled	Always
Applicable Operation Mode	I	-			

Indexing Parameter Group 10 - Index Acceleration

	**Index 0~63 Acceleration** RSWare : Drive - Mode Configuration- Indexing - Index 0 ~63 Setup - Acceleration
Description	Maximum acceleration while in motion.

Range	1~2147483647	Initial Value	6250	Unit	Rotary Motor: [10^{-2}xRev/sec^2] , Linear Motor: [mm/sec^2]
Modbus Address	7000 ~ 7127	Changeable Status	Always	When Enabled	Always
Applicable Operation Mode	I	-			

Indexing Parameter Group 10 - Index Deceleration

	**Index 0~63 Deceleration** RSWare : Drive - Mode Configuration- Indexing - Index 0 ~63 Setup - Deceleration				
Description	Maximum deceleration while in motion.				
Range	1~2147483647	Initial Value	6250	Unit	Rotary Motor: [10^{-2}xRev/sec^2] , Linear Motor: [mm/sec^2]
Modbus Address	7200 ~ 7327	Changeable Status	Always	When Enabled	Always
Applicable Operation Mode	I	-			

Indexing Parameter Group 12 - Index Next Index

	**Index 0~63 Next Index** RSWare : Drive - Mode Configuration- Indexing - Index 0 ~63 Setup -Next Index				
Description	The number (0 - 63) of the next indexed move to execute when Action When Complete is not set to "Stop”.				
Range	0~63	Initial Value	0	Unit	N/A
Modbus Address	7400 ~ 7463	Changeable Status	Always	When Enabled	Always
Applicable Operation Mode	I	-			

Run Parameter

Run	Name	Modbus Address
run-00	Jog Operation	2000
run-01	Off-Line Auto Tuning	2001
run-03	Auto Adjustment of Speed Command Offset	2003
run-04	Auto Adjustment of Current Command Offset	2004
run-08	Alarm Reset	2008
run-10	Absolute Encoder Reset	2010

Run	Name	Modbus Address
run-11	2-Group Gain Storing	2011
run-12	Parameter Initialization	2012
run-16	Hardware Reset	2016

Display Parameter

Drive	Name [Unit]	Modbus Addres
dIS-00	Velocity Feedback [rpm or mm/sec]	0
dIS-01	Velocity Command [rpm or mm/sec]	1
dIS-02	Velocity Error [rpm or mm/sec]	2
dIS-03	Torque Command [%]	3
dIS-04	Position Feedback [pulse]	4~5
dIS-05	Position Command [pulse]	6~7
dIS-06	Position Error [pulse]	8~9
dIS-07	Pulse Command Frequency [kpps]	10
dIS-08	Electrical Angle [°]	11
dIS-09	Mechnical Angle [°]	12
dIS-10	Regeneration Load Ratio [%]	13
dIS-11	DC Link Voltage [V]	14
dIS-12	Multi-Turn Data	15
dIS-13	Offset in Velocity Command [mV]	16~17
dIS-14	Torque Offset [mV]	18~19
dIS-15	Input / Output Signal Status	20~24
dIS-16	Display Error History	25~32
dIS-17	Display Software Version	33
dIS-18	Display Motor info	34~35
dIS-19	Analog Velocity Command Voltage [0.01V]	36
dIS-20	Analog Current Command Voltage [0.01V]	37
dIS-21	Drive Rated Output Power	38
dIS-22	Absolute Single Turn Data	39~40
dIS-23	Encoder Feedback Counter	41~42

Warning and DRive Display

Warnings or errors are displayed by the drive as shown and explained in the following tables.

... Warnings are drive abnormalities that allow motor control to continue. The Warning display uses only the last three digits of the six-digit display.

... Errors are serious abnormalities that do not allow motor control. The Error display alternates between a three-digit error code and a six-digit text message.

Table C

Overtravel Display	Possible Cause	Action/Soluction
 Positive Overtravel	A Positive Overtravel condition is detected.	Apply motion in a negative direction to back off limit.
 Negative Overtravel	A Negative Overtravel condition is detected.	Apply motion in a positive direction to back off limit.

Table D

Warning Display	Possible Cause	Action/Solution
 Absolute Encoder Counter Overflow	The Q Type Absolute Encoder is rotated forward or reverse over 32768 revolutions.	Reset the absolute encoder.
 Absolute Encoder Battery	3.2V or less output from encoder battery or external power supply.	Replace battery or verify external power supply. [1]
 Power Up Overspeed	Control power is applied to the drive while the motor is in motion.	After verifying motor has stopped, recycle control power.
 Over Current Command	Improper setting of analog current scale.	Verify scaling parameter corresponds to analog signal range.
	System cannot meet motion profile.	• Verify velocity loop tuning. • Verify system sizing.
	Incorrect current limit settings.	Verify current limits do not restrict current to less than system capabilities.
 Over Speed Command	Improper setting of analog velocity scale.	Verify scaling parameter corresponds to analog signal range.
	System cannot meet motion profile.	• Verify position loop tuning. • Verify system sizing.

Table D

Warning Display	Possible Cause	Action/Solution
 Digital I/O Assignment	Inappropriate assignment of digital inputs or outputs.	• If operated in preset mode, verify presets are assigned. • If operated in a normal/override mode, verify the override function is assigned..
 Over Motor Rated Output Power	Motor power is set higher than the drive rated output.	• Use a motor suitable to the drive or set the torque limit below the drive capacity.

1 Battery replacement causes loss of absolute position. Homing may be necessary.

Table E

Error Code	Text Message	Possible Cause	Action/Solution
 Motor Overtemperature		Motor thermal switch trips due to: • High motor ambient temperature, and/or • Excessive current	• Operate within (not above) the continuous torque rating for the ambient temperature. • Lower ambient temperature, or increase motor cooling.
		Motor cables shorted	Check motor wiring.
		Incorrect motor selection	Verify the proper motor has been selected.
 IPM Error		Motor cables shorted	Verify continuity of motor power cable and connector.
		Motor winding shorted internally.	Disconnect motor power cables from the motor. If the motor is difficult to turn by hand, it may need to be replaced.
		Operation above continuous power rating.	• Verify ambient temperature is not too high. • Operate within the continuous power rating. • Reduce acceleration rates.
		Drive has a bad IPM output, short circuit, or overcurrent.	Remove all power and motors connections, then perform a continuity check from the DC bus to the U, V, and W motor terminals. If continuity exists, check for wire fibers between terminals, or send drive in for repair.

Table E

Error Code	Text Message	Possible Cause	Action/Solution
E.009 Bus Undervoltage	E.UdutG	Low AC line/AC power input.	• Verify voltage level of the incoming AC power. • Check AC power sources for glitches or line drop. • Install uninterruptible power supply (UPS) on the AC input.
		Attempted to enable drive without main power active.	Apply main power before enabling drive.
E.010 Bus Overvoltage	E.ouutG	Excessive regeneration of power (i.e., When the motor is driven by an external mechanical force, it may regenerate too much peak energy through the drive's power supply and the drive faults to save itself from an overload.)	• Verify shunt circuit. • Adjust motion profile to stay within the range of the regenerative resistor. • Replace regenerative transistor. • Replace drive.
		Excessive AC input voltage	Verify input is within specification.
E.012 Home Search Failed	E.HFAIL	Homing is not complete until the time defined in Homing time limit (IN-01.10) is elapsed.	• Increase the time defined in Homing time limit(IN-01.10). • Set a value other than '0' in Homing Velcoity (IN-01.02) and Creep Velcoity(IN-01.03). • Check if there is any obstacle which disturbs Homing. • Check mechanical parts and parameter settings for Homing.
E.018 Motor Overspeed	E.ouSPd	Motor speed exceeds maximum.	• Confirm encoder wiring. • Retune drive system. • Verify input gain of external speed or torque command.
E.019 Excess Position Error	E.PoSEr	Position error exceeds permitted value.	• Increase following error limit. • Check position loop tuning.
E.022 Motor Continuous Current Overload	E.ConoL	The internal filter protecting the motor from overheating has tripped.	• Reduce acceleration rates. • Reduce duty cycle (ON/OFF) of commanded motion. • Increase time permitted for motion. • Use larger drive and motor. • Check tuning.
E.023 Drive Overload	E.druoL	The motion application requires average drive current in excess of rated capability.	• Reduce acceleration rates. • Reduce duty cycle (ON/OFF) of commanded motion. • Increase time permitted for motion. • Use larger drive and motor. • Check tuning.

Table E

Error Code	Text Message	Possible Cause	Action/Solution
E.024 Absolute Position Transfer Timeout	E.AbSto	/ABS-DT input is not turned on within 5s from Absolute Position Transfer Ready-On during Absolute Position Transfer Mode using photo coupler output.	Verify the sequential timing of Absolute Position Transfer Ready & / ABS-DT, Absolute Position Transfer Mode input. Verify continuity of I/O cable and connector.
		/ABS-DT input is not turned off within 5s from Absolute Position Transfer Ready-Off during Absolute Position Transfer Mode using photo coupler output.	
		Absolute Position Transfer Mode input is not turned off within 5s after absolute data transfer completion.	
E.027 Axis Not Homed	E.notHM	A user tries absolute indexing without homing operation completed.	Complete homing before absolute indexing.
E.028 Encoder Data Range Error	E.EnCdE	Encoder not programmed correctly.	• Replace motor.
		Encoder memory corrupted.	
E.030 Encoder Cable Open	E.EnCoP	Communication not established with an intelligent encoder.	• Verify motor selection. • Verify the motor supports automatic identification. • Verify encoder wiring.
		Hall error	
E.031 Encoder Data Parameter Error	E.EnCPE	Encoder not programmed correctly.	Replace motor.
		Encoder memory corrupted.	
E.036 Drive Overtemperature	E.drvot	Excessive heat exists in the drive.	• Verify cooling fan operation (CSD5_08BX1, CSD5_10BX1 and CSD5_15BX1 only). • Check tuning. • Reduce acceleration rate. • Reduce duty cycle (ON/OFF) of commanded motion. • Increase time permitted for motion. • Use large drive and motor.
E.037 AC Line Loss	E.ACoFF	Poor quality power.	Increase Ride Through time.
		Attempted to enable drive without main power active	Apply main power before enabling drive.
		Phase connection missing.	Remove power and verify all physical connections.
		Fault Delay parameter is set too short.	Increase the Fault Delay parameter setting.

Table E

Error Code	Text Message	Possible Cause	Action/Solution
E.053 User Parameter Initialization Error	E.PInIt	Error in parameter memory storage.	• Reinitialize parameter. • Reset drive to factory defaults.
E.054 Current Feedback Offset	E.oFSEt	Defective hardware	Replace drive.
E.055 User Parameter Checksum Error	E.CHSUM	Checksum error	• Confirm and reset parameter. • Reset drive to factory defaults.
E.056 Watchdog Timeout	E.CPUFt	Excessive system noise	Verify wiring and installation methods.
		Defective hardware	Replace drive.
E.057 PWM Hardware Error	E.HWArE	Defective hardware	Contact your close sales representatives.
E.058 User Parameter Range Error	E.rAnGE	Range of parameter is invalid.	• Enter parameter with value(s) within range. • Reset drive to factory defaults.
E.060 Drive Initialization Error	E.dInIt	Hardware error	Replace drive.
E.075 Shunt Overload Protection	E.SHtoL	Power at regenerative resistor exceeds the permitted value.	Adjust motion profile to stay within the range of the regenerative resistor.
		Shunt resistor is disconnected or damaged.	• Verify resistor connection. • Verify resistance of shunt resistor.
E.079 Shunt Overcurrent Protection	E.SHtoC	Shunt current exceeded allowable instantaneous value.	• Verify shunt is not shorted or damaged. • Verify load energy is not excessive during deceleration.
E.083 Absolute Encoder Battery Error	E.AbSbE	Encoder Backup Battery parameter is set to installed, but a battery is not installed.	Set Encoder Backup Battery parameter to Not Installed.
		Battery voltage is sensed below 2.7 V dc.	• Confirm battery voltage and connection. • Replace battery.
E.084 Absolute Encoder Overspeed	E.AbSoS	Battery powered encoder is mechanically rotated at high speed while drive is powered down.	• Mechanically disengage motor from system. • Cycle power to drive and reset alarm.
E.085 Absolute Encoder Multi-turn Count Error	E.AbSCt	Noise in the encoder	Cycle power to drive and reset alarm.
		Defective encoder	Replace motor.
E.100 Drive Set Up	E.SEtUP	The drive operating mode and motor selection are incompatible.	Change the operating mode and/or the motor selection, and reset the drive.

Table E

Error Code	Text Message	Possible Cause	Action/Solution
E.101 Motor Power Cable Open	E.CAbLE	Motor cable open.	Verify power connection between motor and drive.
E.102 Motor Instantaneous Current Overload	E.InSOL	Motion profile requires a peak current for an excessive time interval.	• Verify motor wiring. • Adjust accel/decel time. • Confirm motor selection.
		Defective current feedback sensing.	Verify phase currents.
E.103 Motor Mismatch	E.MAtCH	Dynamic braking current of the selected motor exceeds twice the drive peak current rating.	Install a different motor.
E.105 Encoder Type Mismatch	E.EnCtP	Motor encoder signals do not match drive configuration.	Verify motor selection.
		Defective encoder	Replace motor.
E.106 Encoder Communication Error	E.EnCCE	Wiring between drive and encoder is faulty or disconnected, or EMI (noise) disrupts encoder signals.	• Verify encoder wiring. • Contact your close sales representatives.
E.107 Serial Communication Error	E.SErCE	Communications error between host and drive (noise)	• Verify serial cable. • Check for noise on serial interface.
E.108 Position Command Frequency Error	E.CdFrE	Input frequency limit exceeded.	• Verify hardware type selected in the drive matches the physical hardware. • Change from open collector to line drive. • Reduce the speed command. • Apply gearing.
E.112 Emergency Stop	E.EStoP	Emergency stop (E-STOP) signal detected.	• Remove Emergency stop conditions. • Clear E-STOP.
E.113 Index Position Range Overflow	E.IrAnG	The value of a Position Parameter for indexing is out of the range.	• Use a value within the range of -2^{31}~$+2^{31}$.
E.114 Motor Phase Over Current	E.ouCUr	• Problem with control or main power circuitry if this error occurs when power is turned on. • Excessive current to the motor if this error occurs during operation (current more than 300% of the rated current to the motor more than 250 ms).	• Check wiring and power. • Check power and set/adjust acceleration/decceleration time.

Specification and Exterior Size

Drive Specification

Drive	**CSD5-**						
	A5BX1	**01BX1**	**02BX1**	**04BX1**	**08BX1**	**10BX1**	**15BX1**
Wight	0.9 kg (1.98 lbs)			1.2 kg (2.65 lbs)	2.1 kg (2.65 lbs)		
Temperature	0 ~50 ° C (32~122 ° F)						
Operating Shock and Vibration	- Shock 15g, 11ms half-sine pulse (3 positive and 3 negative pulses in each of 3 mutually perpendicular directions) - Vibration 5-55Hz @ 0.35 mm (0.014") double amplitude, continuous displacement, 55-500Hz @ 2g peak constant acceleration (10 sweeps in each of 3 mutually perpendicular directions)						
Short Circuit Current Rating with No Fuse Restrictions	Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 240 Volts maximum.						
Short Circuit Current Rating with Fuse Restrictions	Suitable for use on a circuit capable of delivering not more than 100,000 rms symmetrical amperes, 240 Volts maximum, when protected by high interrupt capacity, current limiting fuses UL248 (Class CC, G, J, L, R, T).						
Motor Overload Protection	Utilizes solid state motor overload protection which operates. • within 8 minutes at 200% overload. • within 20 seconds at 600% overload.						
Symbols Used on Drive	⏚ Protective ground conductor terminal						
Certification and Compliance	UL® listed to U.S. and Canadian safety standards (UL 508C File E226834) CE marked for all applicable directives						
Main Input Power							
Nominal Input Voltage (V_{rms}) [1,2]	200-240V, 1 phase, 50 or 60 Hz				200- 240V, 1or3 phase, 50 or 60 Hz	200- 240V, 3 phase, 50 or 60 Hz	
Input Current (A_{rms})	1.3 A	2.38 A	3.68 A	7.14 A	6.25 A (3 phase) 10.82 A (1 phase)	8.75 A	12.37 A
Maximum Inrush Current (0-peak)	22.6 A						
Maximum Power Cycles/ Minute	2 power cycle/1 minute interval						

Drive	**CSD5-**						
	A5BX1	**01BX1**	**02BX1**	**04BX1**	**08BX1**	**10BX1**	**15BX1**
DC Bus Discharge Time	5 minutes after removal of main AC power						
Main Input Power							
Nominal Input Voltage (V_{rms}) [1,2]	200-240V, 1 phase, 50 or 60 Hz						
Input Current (A_{rms})	0.1 A						
Maximum Inrush Current (0-peak)	31 A						
Inverter Output							
Continuous Output Current (A_{rms})	0.6 A	1.1 A	1.7 A	3.3 A	5.0 A	7.0 A	9.9 A
Intermittent Output Current (0-peak)	2.55 A	4.67 A	7.21 A	14.0 A	21.21 A	29.70 A	41.99 A
Continuous Output Power (@ 240 V_{ac})	160 VA	300 VA	460 VA	890 VA	1350 VA	1890 VA	2670 VA
Power Dissipation							
Maximum Power Dissipation	50 W	50 W	50 W	50 W+ 30 W[3]	100 W+ 70 W[3]	150 W+ 70 W[3]	

1 Nominal values are listed. Absolute range is 170 to 264 V_{rms}.

2 The AC input voltage between any two input power pins (L1, L2, L3, L1C, L2C, and CHASSIS) must not exceed this rating. This note also applies to the CHASSIS ground connection, which implies that transformer secondaries must be grounded.

3 Maximum Power Dissipation includes dissipative power of drive plus the Continuous Shunt Power rating of the drive's internal shunt.

Internal Shunt Power							
Continuous Shunt Power				30 W	70 W		
Instantaneous Shunt Power				3000 W	7000 W		
Digital Input/Output Specifications							
Type	Active Low, current sinking						
External Power Supply Requirements	Voltage: 21.6 to 26.4 V Maximum Current Draw: 64 mA Note: Digital I/O is not powered by an internal supply, customer must connect an external power supply.						
Analog Input/Output Specifications							
Inputs	Voltage range is -10 to +10 V Impedance of10 kZ A/D conversion with 16-bit resolution and 12-bit resolution						
Outputs	Voltage range is -10 to +10 V Current output of up to 10 mA into a resistive load D/A conversion with 12-bit resolution						

Drive	**CSD5-**						
	A5BX1	**01BX1**	**02BX1**	**04BX1**	**08BX1**	**10BX1**	**15BX1**
Motor Control Specifications							
Feedback Device Power	5V supplied by drive for incremental and serial encoder devices.						
Incremental Encoder Requirements	Differential drivers for A, B, Z, and single-ended Hall signals S1, S2, and S3. Maximum line frequency: 3,500,000 lines/second (14,000,000 counts second).						

Fuse and Contactor Recommendations

	CSD5				
Main Power Fuses [1]	**A5BX1, 01BX1**	**02BX1**	**04BX1**	**08BX1, 10BX1**	**15BX1**
Recommended Fuse Group 1 [2]	FNQ-R-7		FNQ -R-10	FNQ-R-20	FNQ-R-30
Recommended Fuse Group 2 [3]	N/A			LPJ-20	LPJ-30
Control Power Fuses [1]					
Recommended Fuse Group 1 [4]	FRS-R-2-1/2				
Recommended Fuse Group 2 [2]	FNQ-R-7-1/2				
Recommended Fuse Group 3 [3]	LPJ-6				
Contactor	100-M05N *xy*	100-M09N *xy*	100-M12N *xy*	100-C16*xy*	100-C23*xy*

1 Fuses specified are Bussmann® fuses.

2 FNQ-R fuses are described as Time-Delay Fuses, Class CC..

3 LPJ fuses are described as Dual-Element Time-Delay Fuses, Class J.

4 FRS-R fuses are described as Dual-Element Time-Delay Fuses, Class RK5.

5 For contactors: x represents coil voltage, and y represents number of contacts.

Accessaries

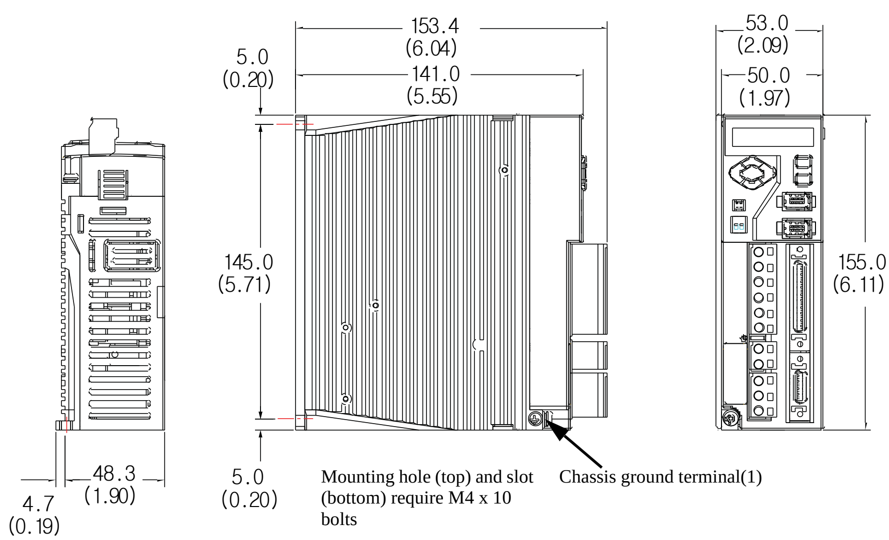
Catalogue Number or Items	Description or Specification		
AC Libe Filter	**CSD5_A5BX1** **CSD5_01BX1** **CSD5_02BX1** **CSD5_04BX1**	**CSD5_08BX1**	**CSD5_10BX1** **CSD5_15BX1**
	2090-XXLF-TC116 (Tesch NF310/16)	2090-XXLF-TC316/ 2090-XXLF-TC116 (1 Phase)	2090-XXLF-TC316 (Tesch NF210/16)

1 Cable length (xx) is in meters. For the usable lengths of xx = 01, 03, 09, refer to the Servo Motor User Manual(Publication GMC-SG001*x*-EN-P).

Drive Size and Exterial View

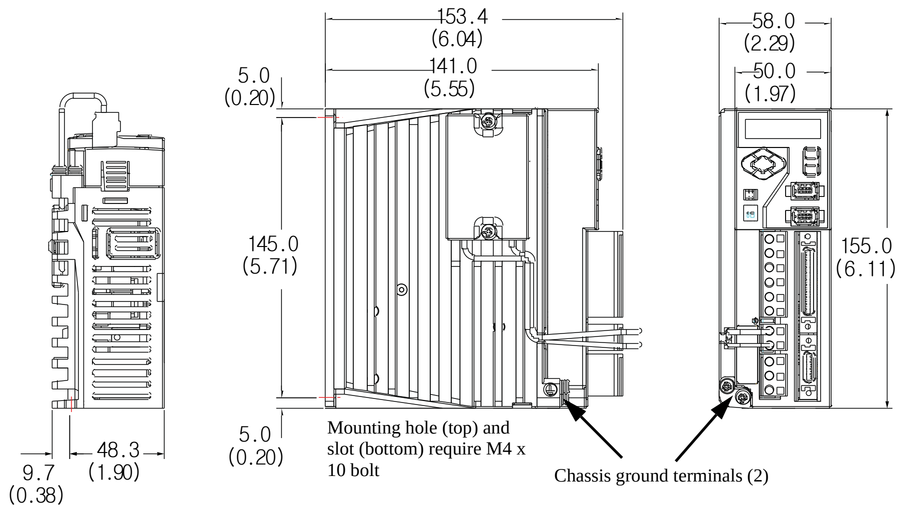
Drive dimensions are shown in the following diagrams.

Figure C.1 CSD5_A5BX1, CSD5_01BX1 and CSD5_02BX1 Size



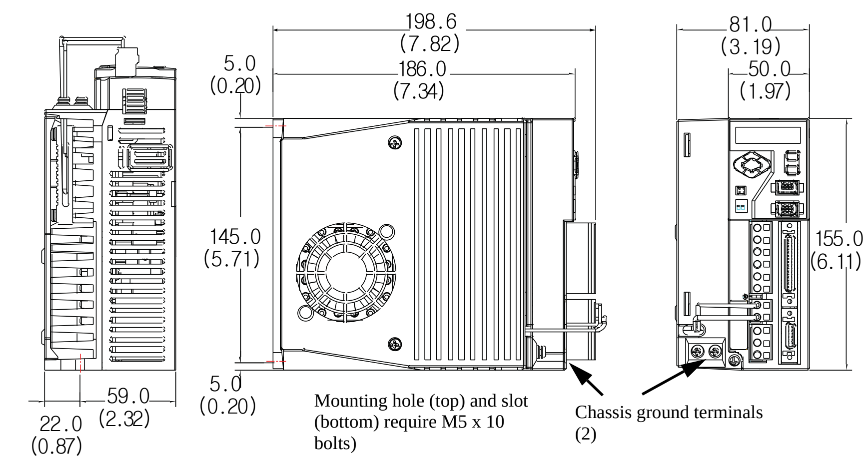
Dimensions are in millimeters (inches). Drives are designed to metric dimensions; inches are mathematical conversion

Figure C.2 CSD5_04BX1 Size



Dimensions are in millimeters (inches). Drives are designed to metric dimensions; inches are a mathematical conversio

Figure C.3 CSD5_08BX1, CSD5_10BX1 and CSD5_15BX1 Size



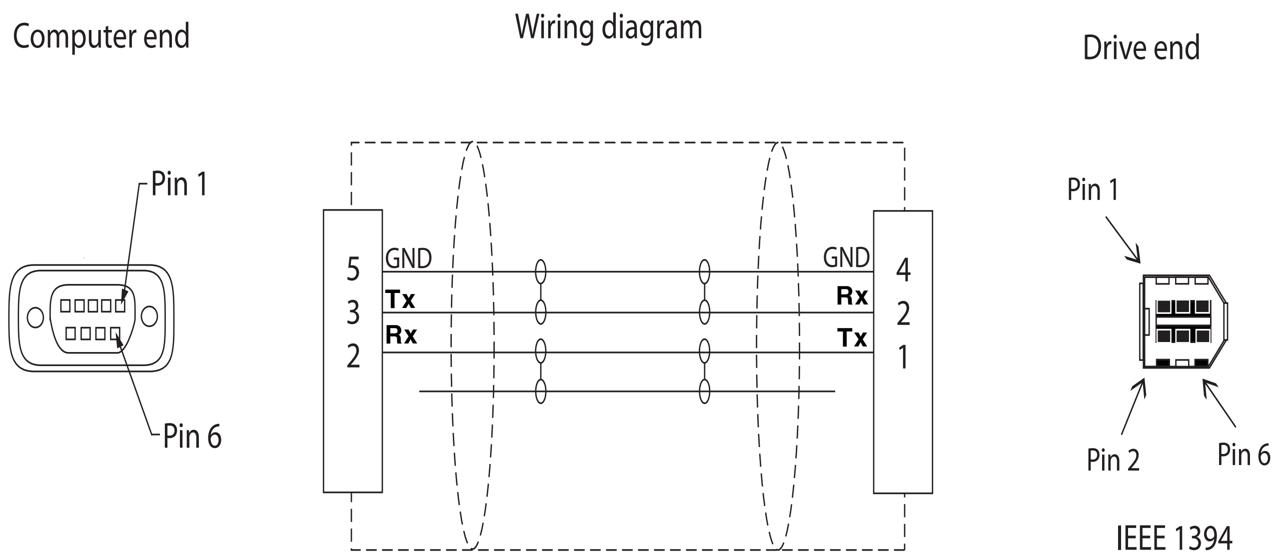
Dimensions are in millimeters (inches). Drives are designed to metric dimensions; inches are a mathematical conversion.

Cable Specification

PC Communication Cable

The next figure shows the communication cable assembly RS-232 that can be purchased from RS Automation to interface CSD5 Servo Drive and the host computer.

Figure D.1 CSD5 Servo Drive RS-232C PC Communication Cable Specifications



The table below shows the pins for RS-485.

Table D.1 RS-485 Pin Description

Drive Pin	Signal
5	DX+
6	DX-
4	GND

I/O Setting and Indexing

Overivew

'This chapter describes the I/O setting and the indexing of CSD5 Servo Drive.

I/O Input Signal

I/O Sequence Input Signal

CSD5 servo drive allows users to configure the I/O signals.

I/O Sequence Input Signal

Type	Description	Mode
</SV-ON> Servo-ON	When the servo is set to ON, voltage is applied to the servo motor; when it is set to OFF, voltage is cut off.	All
</A-RST> Alarm Reset	It disables the Servo's Alarm.	All
</G-SEL> Gain Group Conversion	Use 2-group gain where it is set to ON and use current gain where it is set to OFF. It converts gain of 2 groups.	All
</P-TL> Forward Torque Limit	When it is set to ON, limit the forward torque by the set value [Ft-4.03].	All
</N-TL> Reverse Torque Limit	When it is set to ON, limit the reverse torque by the set value [Ft-4.04].	All
<P-OT> Prohibit Forward Rotation	It prohibits the motor from rotating forward when the load device reaches the limit of the available section.	All
<N-OT> Prohibit Reverse Rotation	It prohibits the motor from rotating reversely when the load device reaches the limit of the available section.	All
</P-CON> P Control Conversion	It converts the Seed Controller from PI type controller to P type controller. It is used to suppress the overshoot of the excessive response and complete a faster response.	F, S, P, I(1)
</C-SEL> Control Mode Conversion	It is used to convert Control Mode when using it as Combination Control Mode.	Combinational Control Mode Only
</C-DIR> </C-SP1> </C-SP2> </C-SP3> </C-SP4> Contact Speed Command	At the Contact Speed Control Mode, these input combinations decide the rotation direction of the motor </C-DIR> and the rotation speed </C-SP1 ~ /C-SP4>. The rotation speed for </ C-SP1~/C-SP3> input is set in [Ft-2.05~Ft-2.11]. The analogue speed command voltage decides the rotation speed for </C-SP4>. </C-DIR> is used to change the motor rotation direction in Speed Control Mode.	P
</Z-CLP> Zero Clamp	Ignores the input value in the Speed Control when the command value is lower than the value set in the Speed Zero Clamp Level [Ft-5.05]..	S
</INHIB> Inhibit Pulse Command	Inhibits the position command pulse where it is ON.	F
</ABS-DT> Absolute Encoder Data Transmission	When it is set to ON, transmits the absolute encoder data to a higher level through AM, BM signals.	F, I

</PCLR> Position Error Clear	Clears position command, position feedback, and position error.	F, I
</START> Start	Set to start or stop the motor rotation by using the contact signal in Speed/Contact Speed Control Mode.	S, P
</GEAR> Electronic Gear Rate Shift	In the Position Control Mode, use the 2nd electronic gear parameter [<:fc 2>Ft<:/fc>-3.05]and [Ft-3.06] where it is ON, use the basic electronic gear parameter [Ft-3.01]and [Ft-3.02] where it is OFF. It shifts between two electronic gear ratios.	F
</R_ABS> Absolute Encoder Multi-rotation Data Reset	Reset the multi-rotation data of the absolute motor.	All
</BANK_SEL> Gain Bank Select	Uses the 3rd and the 4th Gain Bank when it is set to ON.	All
</A-CL> Analog Torque Limit	Current Limit Function is activated by the analogue torque command input values when it is set to ON.	S, P
</H_SENS> Home Sensor	When activated, the sensor indicates the Return to Home sequence that is detected.	I
</SHOME> Start Homing	When activated, the system starts returning to home.	I
</PAUSE> Index Pause	When activated, it decelerates until stop and pause the index sequence. it decides whether to stop or to continue the motion by consantly monitoring the input status.	I
</STOP> Index Stop	When activated, index movement ends.	I
</I_SEL0> Index Selection 0 Input </I_SEL1> Index Selection 1 Input </I_SEL2> Index Selection 2 Input </I_SEL3> Index Selection 3 Input </I_SEL4> Index Selection 4 Input </I_SEL5> Index Selection 5 Input	Used for the combinations to allocate indexes.	I
</H_STOP> Homing Stop	Stops Homing operation when it is set to ON.	I
</START_I> Start Indexing	Starts Indexing when it is set to ON.	I
</ABS-MD> Absolute Position Data Transfer Mode	Absolute Data transfered to host contoller by photo coupler output which output Fault Code when it is set to ON.	F

(1) F: Follower, S: Analog Speed, P: Preset Speed, I: Indexing

Sequence Output Signal

Type	**Description**	**Mode**
</S_ALM> Alarm	Outputs when Servo Alarm sets off.	All
</P-COM (+, -)> Position Completion Detection	Turns to ON, when the position error is within the set value of the position completion range [Ft-5.00].	F, I
</NEAR (+, -)> Position Proximity Detection	Turns to ON, when the position error is within the set value of the position completion range [Ft-5.02].	F, I
</V-COM (+, -)> Speed Match Detection	Turns to ON when the deviation between the speed command and the motor rotation speed is within the set value of the speed match decision range [Ft-5.03].	F, S, P, I
</TG-ON (+, -)> Rotation Detection	Turns to ON when the motor is rotating above the set value of the rotation detection level [Ft-5.04].	All
</T-LMT (+, -)> Torque Limit Detection	Turns to ON when torque reaches the set value of the torque limit.	All
</V-LMT (+, -)> Speed Limit Detection	Turns to ON when speed reaches the set value of the speed limit.	All
<BK (+, -)> Brake Control	It is the signal for the brake control installed inside or outside of the servo motor.	All
</A_VLD> Absolute Position Valid	Turns to ON when the absolute position data is valid while using the absolute motor.	All
</RDY> Drive Ready	Means getting the operation ready while in the Servo-OFF status.	All
</WARN (+, -)> Warning	Turns to ON when a Servo warning is detected.	All
</HOMC (+, -)> Axis Homing	When activated, it shows the completion of the Homing operation.	I
</IMO (+, -)> In Motion	Turns to ON when in motion.	I
</I_DW> In Dwell	When activated, it indicates that the motor is on the hold position in the index movement and on stand-by for the dwell time assigned.	I
</O_ISEL0> Index Selection 0 Output </O_ISEL1> Index Selection 1 Output </O_ISEL2> Index Selection 2 Output </O_ISEL3> Index Selection 3 Output </O_ISEL4> Index Selection 4 Output </O_ISEL5> Index Selection 5 Output	Used to output the index number in use in the selected indexing operation.	I
</E_SEQU> Sequence Operation Completion	Turns to ON when the index movement is complete.	I

Factory Default

Factory Default is the basic setting for the general servo functions and the indexing. Need to be configured properly before the indexing.

Factory Default

Pin No.	Input
3	INPUT #1 /SV-ON
4	INPUT #2 P-OT
5	INPUT #3 N-OT
6	INPUT #4 /P-CON
7	INPUT #5 /A-RST
8	INPUT #6 /N-TL
9	INPUT #7 /P-TL
26	INPUT #8
27	INPUT #9
28	INPUT #10

Pin No.	Output
41-42	OUTPUT #1 /P-COM
43-44	OUTPUT #2 /TG-ON
47-48	OUTPUT #3 /BK

The table below is a sample of the I/O configuration with a home sensor but without any limit switch. And the index is allocated by the I/O signal.

Pin No.	Input
3	INPUT #1 /SV-ON
4	INPUT #2 H_SENS
5	INPUT #3 /SHOME
6	INPUT #4 /START
7	INPUT #5 /I_SEL0
8	INPUT #6 /I_SEL1
9	INPUT #7 /I_SEL2
26	INPUT #8
27	INPUT #9
28	INPUT #10

Pin No.	Output
41-42	OUTPUT #1 /P-COM
43-44	OUTPUT #2 /HOMC
47-48	OUTPUT #3 /IMO

I/O Setting

Input Signal Allocation

Please refer to the table below to allocate the sequence input singal.

Setting Value	B	A	9	8	7	6	5	4	3	2	1	0
Input Channel No.	Always valid	INPUT #10	INPUT #9	INPUT #8	INPUT #7	INPUT #6	INPUT #5	INPUT #4	INPUT #3	INPUT #2	INPUT #1	Always invalid
I/O Pin No.		28	27	26	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 B’ except ‘0’ to the setting position..

For example, if you want to put certain function to I/O 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.

Enter ‘0’ when the function of input signal is not used.

If you want to make input signal ‘ON’ all the time regardless of the wiring, set as ‘B’..

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.

Parameter	Position			
	3	2	1	0
Ft-0.10	</P-CON> Initial Value: 4	<N-OT> Initial Value: b	<P-OT> Initial Value: b	</SV-ON> Initial Value: 1
Ft-0.11	</C-SEL>	</P-TL> Initial Value:7	</N-TL> Initial Value: 6	</A-RST> Initial Value: 5
Ft-0.12	</C-SP3>	</C-SP2>	</C-SP1>	</C-DIR>
Ft-0.13	</PCLR>	</G-SEL>	</INHIBIT>	</Z-CLP>
Ft-0.14	</GEAR>	</C-SP4>	</START>	</ABS-DT>
Ft-0.15	</ABS-MD>	</A-CL>	</BANK_SEL>	</R_ABS>
Ft-0.16	</PAUSE>	</STOP>	</SHOME>	</H_SENS>
Ft-0.17	</I_SEL3>	</I_SEL2>	</I_SEL1>	</I_SEL0>
Ft-0.18	</START_I>	</H_STOP>	</I_SEL5>	</I_SEL4>

Example

Enter ‘7’ in the 3th position in setting window of the parameter [Ft-0.01].

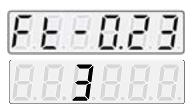
This is to use </P-CON> function and it means that the I/O No. DI#7 pin is used as an input pin..

Applicable operation Mode	All	Others	Drive Disable > Configure > End

Output Signal Allocation

'Allocate the sequence output signal referring to the table below.

	Position			
Parameter	3	2	1	0
Ft-0.22	</V-COM>	</BK> Initial Value: 3	</TG-ON> Initial Value: 2	</P-COM> Initial Value: 1
Ft-0.23	</WARN>	</NEAR>	</V-LMT>	</T-LMT>
Ft-0.24	Reserved	Reserved	</RDY>	</A_VLD>
Ft-0.25	</O_ISEL0>	</HOMC>	</I_DW>	</IMO>
Ft-0.26	</O_ISEL4>	</O_ISEL3>	</O_ISEL2>	</O_ISEL1>
Ft-0.27	Reserved	Reserved	</E_SEQU>	</O_ISEL5>

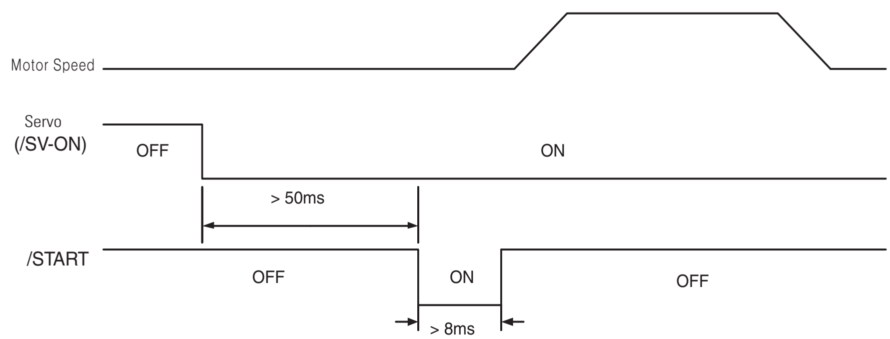
Example			
	Set ‘3’ in the 3st position in setting window of the parameter [Ft-0.23]. It is set to use </WARN> function and it means that we will use I/O No. Output #47and 48 pin as output pin.		
Applicable operation Mode	All	Others	Drive Disable > Configuration> End

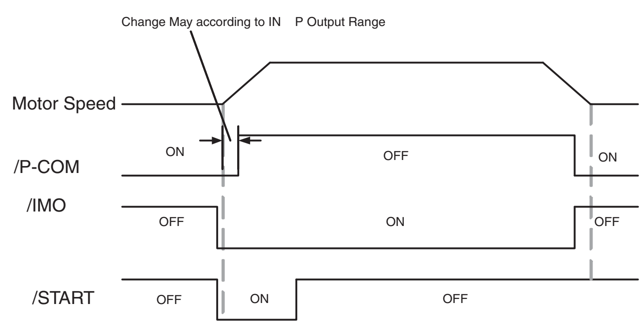
I/O Signal Description

START and IMO (In Motion)

START is an input signal to start indexing, and IMO is an output signal to show the index is in motion. When the active-going edge of START is detected, CSD5 Servo Drive starts indexing, and IMO provides the output. START is used to start the Wait for start or to override the Pause.

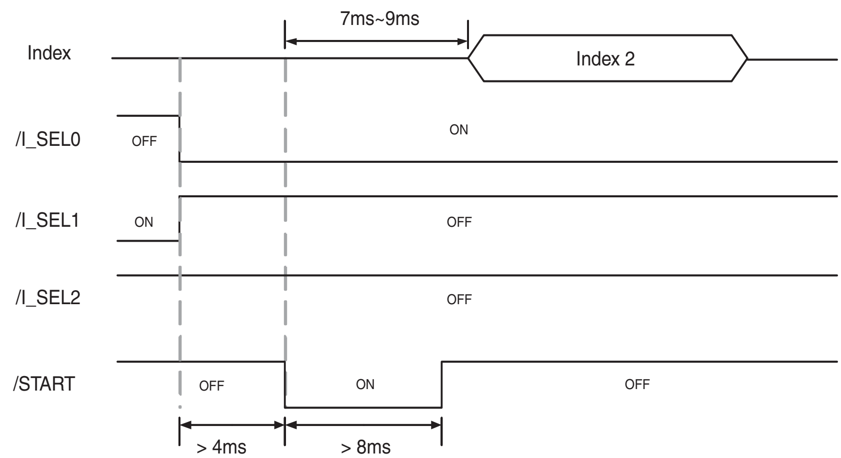
When CSD5 Servo Drive is in Homing or In Motion, START is inhibited.





I_SEL0~5 (Index Selection 0~5 Input)

I_SEL0~5 is the selection signal to define an index among the 64 indexes on the index table. In the selectable position travel mode, CSD5 Servo Drive uses the combinations of these signals at the active-going edge of START to set an index. I_SEL0~5 signal is valid only when the active-going edge of START maintains the status for at least 4ms before and for at least 8msec after. When I_SEL0~5 signal is detected while in motion, the corresponding signal is inhibited.



O_ISEL0~5(Index Selection 0~5 Output)

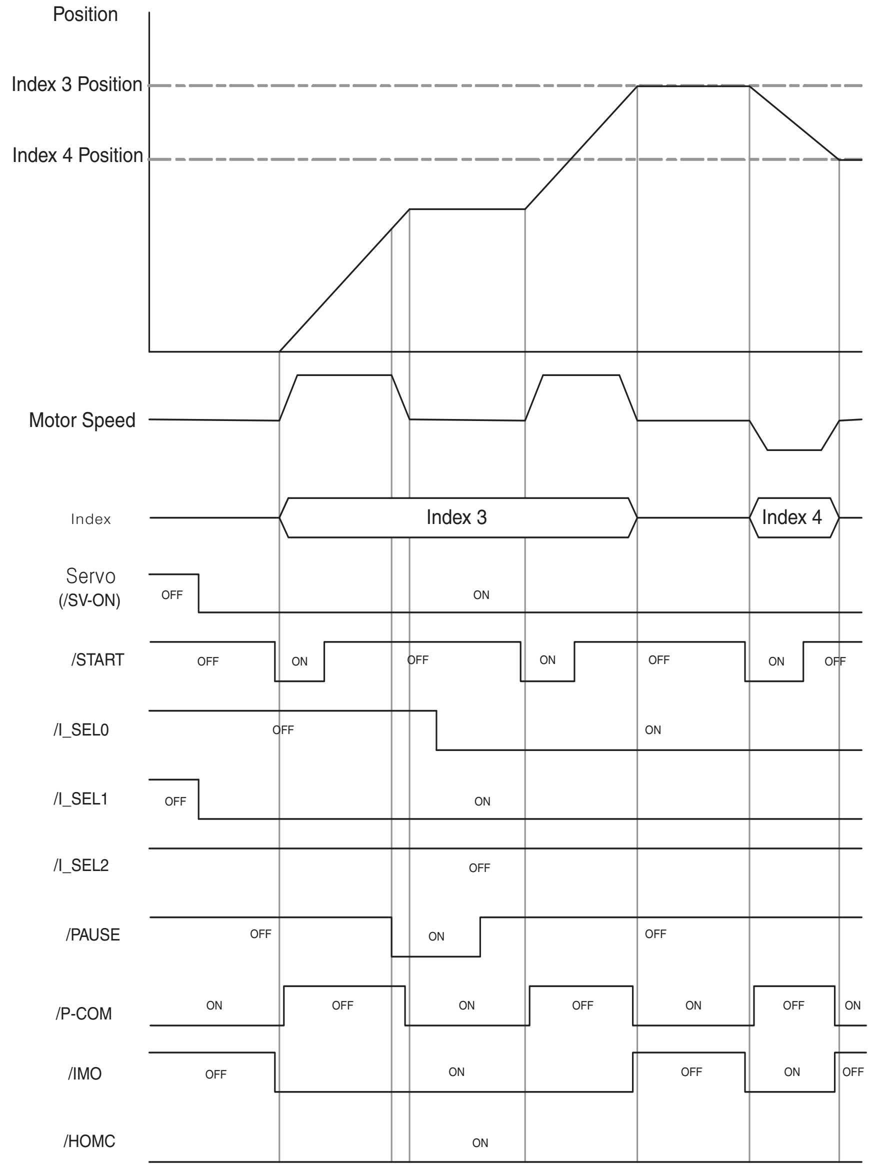
The drive outputs the operating index number while it's in motion. When the motor is stopped, the drive outputs the previously completed index number. from 0 to 5, 6 signals repeats ON and OFF, and shows one index combination out of 64 indexes.

PAUSE(Index Pause)

When the system detects the active-going edge of PAUSE while indexing, the motor remembers the index and starts decelerating until it completely stops within the predetermined deceleration time. Since the motion is not complete, IMO stays ON.

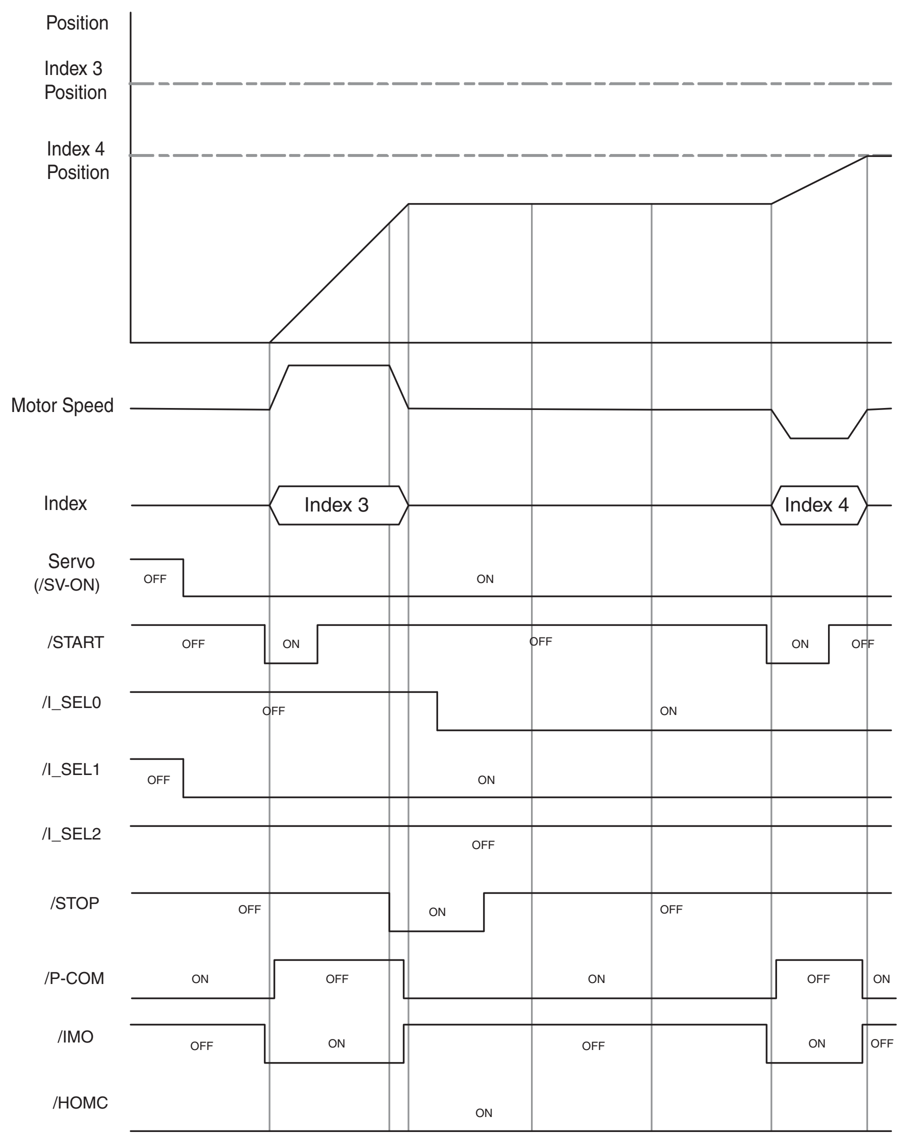
When CSD5 Servo derive detects the active-going edge of START while in Pause, the index is reactivated to reach the index position using the motion profiles such as Acceleration Time, Speed and Deceleration Time.

When the STOP turns to ON while in Pause, the indexing is cancelled and ends. Then, the system prepares a new indexing. Please see 'PAUSE' for more information. Pause is activated at the active-going edge of PAUSE; IMO (In Motion) is still activated in Pause.


Position
Index 3 Position
Index 4 Position
Motor Speed
Index
Index 3
Index 4
Servo
(/SV-ON)
OFF
ON
/START
OFF
ON
OFF
ON
OFF
ON
OFF
/I_SEL0
OFF
ON
/I_SEL1
OFF
ON
/I_SEL2
OFF
/PAUSE
OFF
ON
OFF
/P-COM
ON
OFF
ON
OFF
ON
OFF
ON
/IMO
OFF
ON
OFF
ON
OFF
/HOMC
ON

STOP (Index Stop)

STOP is a signal to cancel indexing. When the STOP turns to ON while indexing, the motor starts decelerating and stops. The indexing is cancelled. The IMO also turns to OFF. Cancel is activated at the active-going edge of STOP. STOP can be used only in the Operation Option because it is not a homing type. When STOP is activated, IMO (In Motion) turns to OFF.



SHOM (Start Home), HOME (Home Sensor), HOMC (Axis Home)

Homing begins in the presence of the active-going edge of the SHOM signal. All SHOM signals are inhibited while homing

When the second digit of the IN01.01 is set as 1, the SHOM signal is read.

HOME is an input signal from the Home Sensor.

HOMC is an output signal to indicate that the home search is complete.

HOMC turns to ON when the system returns to home.

Home Sensor Polarity Setting

Parameter	No.	Value	Details	Initial Value	Range	Unit
Home Sensor Polarity Setting	IN01.06	0	ActiveGoing Transition	0	0~1	N/A
		1	Inactive-Going Transition			

Index Operation Options

CSD5 Servo Drive stores 64 indexes and provides the operation settings after completing 3 index movement types for 64 indexes. The three types are: stop, start next index, wait for start. The 64 indexes are predefined by the memory.

CAUTION

The alarm goes off when a user tries indexing while the homing operation is incomplete. (e.d., HOMC (Axis Homing) is not activated). More information on the alarm E-30 page Axis not homed.

.

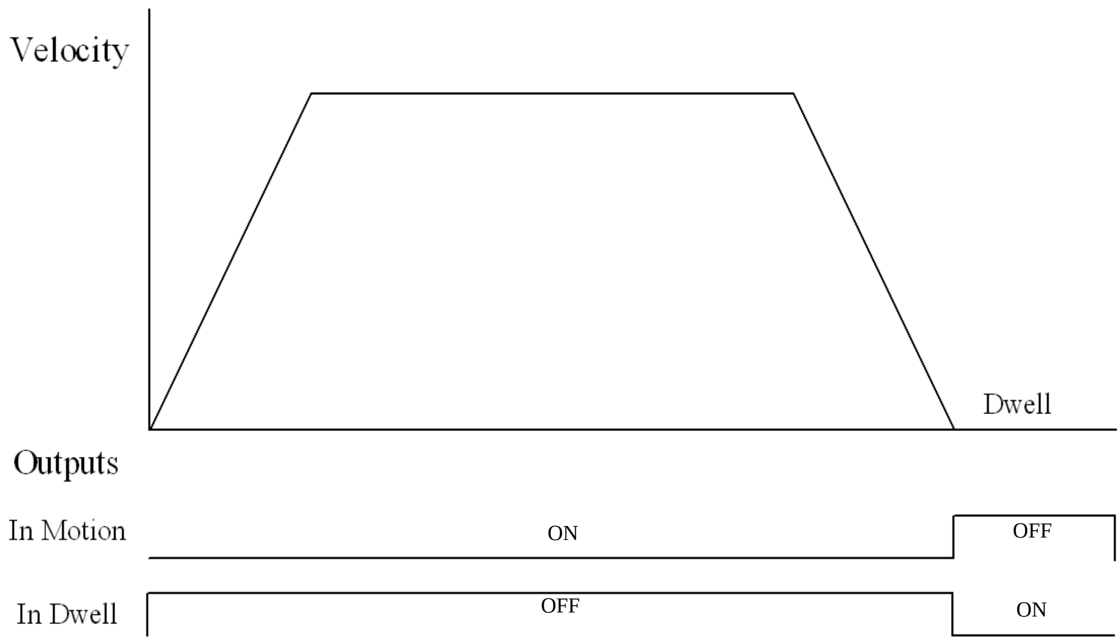
Parameter	No.	7 -Sgnment Digit	Value	Detals	Update Timing	Defaul t	Range	Unit
Indexing Mode	IN02.00 ~IN02.63	1	0	Absolute Value	When turning on the power	0	0~1	N/A
			1	Incremental Type				
		2	0	Stop		0	0~2	N/A
			1	Start Next Index				
			2	Wait for Start				

Operation Setting after Index Movement (Action When Complete)

An index operation after the index movement is limited to one operation from the following options.

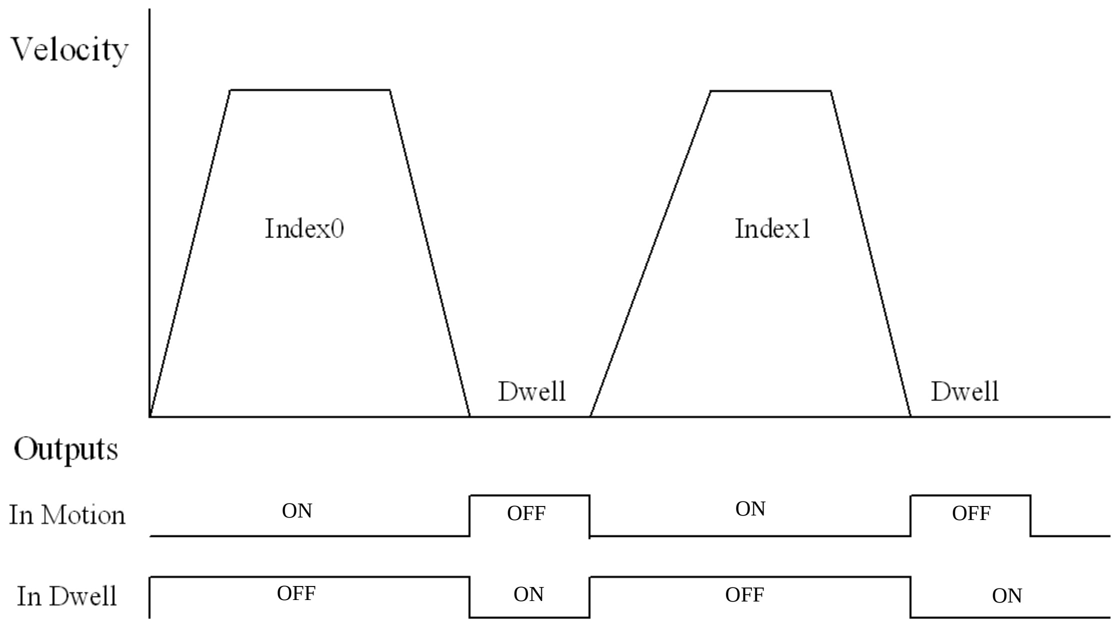
Stop [Set Value: 0]

Stops the movement and executes the move command defined in the index (default value).



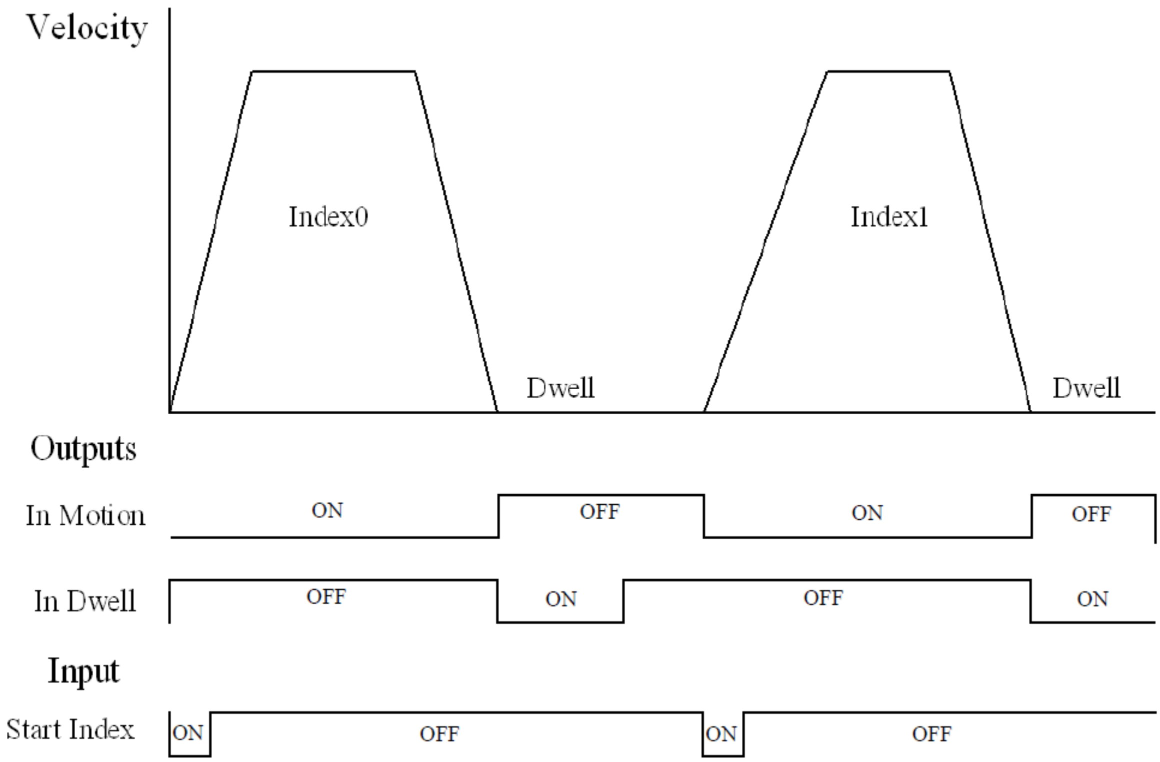
Start Next Index : [Set Value: 1]

Moves all sequentially set indexes with one Start signal. This command executes the next index movement without any additional input. However, there is a dwell time after the designated movement. The stop time at each index is determined by the dwell time defined by the index data. IMO turns to the active mode when the movement begins and maintains the initial status until it reaches the final index.

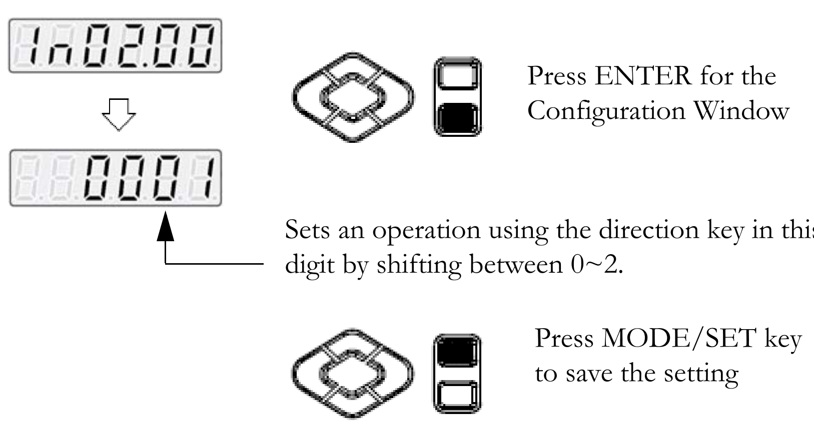


Wait for Start [Set Value: 2]

Unlike 'Start Next Index' which moves all designated indexes just with one START signal, Wait for Start needs a START for each movement to the next index. IMO turns to OFF whenever an index reaches to each position.



The operation setting after the index movement is set in the 1st digit of 7-segment in IN 02.00~63.



Homing

While indexing, all 64 indexes are defined by the standard position, HOME. Search for Home is a movement to find and set Home. After finding Home and defining it, set the home position as 0. Several ways are available to find Home, and CSD5 Servo Dirve provides 9 home search methods.

For a proper homing operation, the following parameters need to be set.

... Homing Type (IN01.00), the distnace to Home (IN01.02)

... Automatic Homing when activated (IN01.01)

... Homing Velocity (IN01.02)

... Creep Velocity (IN01.03)

... Home Current (IN01.09)

... Home Current Time (IN01.10)

... Moving Distance Sensor after Homing (IN01.08)

... Homing Offset (IN01.13)

Parameter	**No.**	**7 -Sgnment Digit**	**Value**	**Detals**	**Update Timing**	**Defaul t**	**Range**	**Unit**
Homing Type	IN01.0 0	1	0	Mode 0 : Return to current position	When turnning on the power	1	0~10	N/A
			1	Mode 1 : Return to Homing Sensor/ Marker				
			2	Mode 2 : to Limit/Marker				
			3	Mode 3 : Forward to Homing Sensor/Marker				
			4	Mode 4: Forward to Limit/Marker				
			5	Mode 5: Return to Current Value				
			6	Mode 6: Return to Current Value/ Marker				
			7	Mode 7: Return to Home Sensor/ Move/Marker				
			8	Mode 8: Return to Marker				
			9	Mode 9: Return to Homing Sensor				
			10	Mode 1o: Return to Limit Sensor				
Automatic Homing when activated	IN01.0 1	1	0	Reserved	When turnning on the power	1	0~2	N/A
			1	Activate only after resetting: In case the <:fc 2>drive<:/fc> is not home, automatically starts homing when the <:fc 2>drive<:/fc> is activated.				
			2	Inactive				

Time Limit for Homing	IN01.11	N/A	N/A	Time Limit for Homing	Drive Deactivated	60	0~65,535	[sec]
Homing Velocity	IN01.02	N/A	N/A	Homing Velocity		100	-6,000~ 6,000	[rpm]
Creep Velocity	IN01.03	N/A	N/A	Creep Velocity		20	0~6,000	[rpm]

When an incremental motor is used, the position feedback is set to 0 when the homing operation is complete. (when Offset is 0).

CAUTION

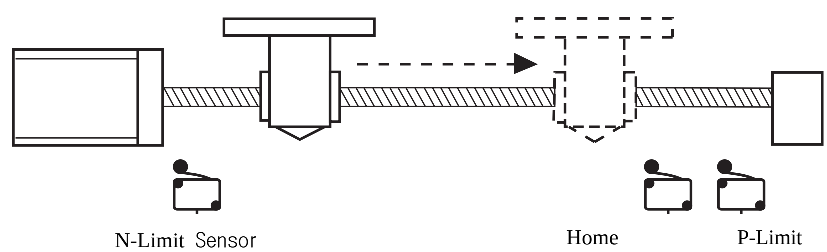
The alarm goes off when a user tries indexing while the homing operation is incomplete. (i.e., HOMC (Axis Homing) is not activated). Refer to the Index E-30 page Axis not homed for more information about Fault .

CAUTION

When an aboluste motor is used, the position feedback is set to 0 even when the Homing is complete and the multi-rotation data of the absolute encoder is not reset. The multi-rotation data of an abolute motor is not automatically reset. It can be reset only by a user.

CAUTION

A homing type that uses a sensor for homing does not complete a homing if the homing starts outside the sensor.



Homing types

The Index supports 9 homing types by using homing sensor, limit (+)/(-) sensor, stopper and marker.

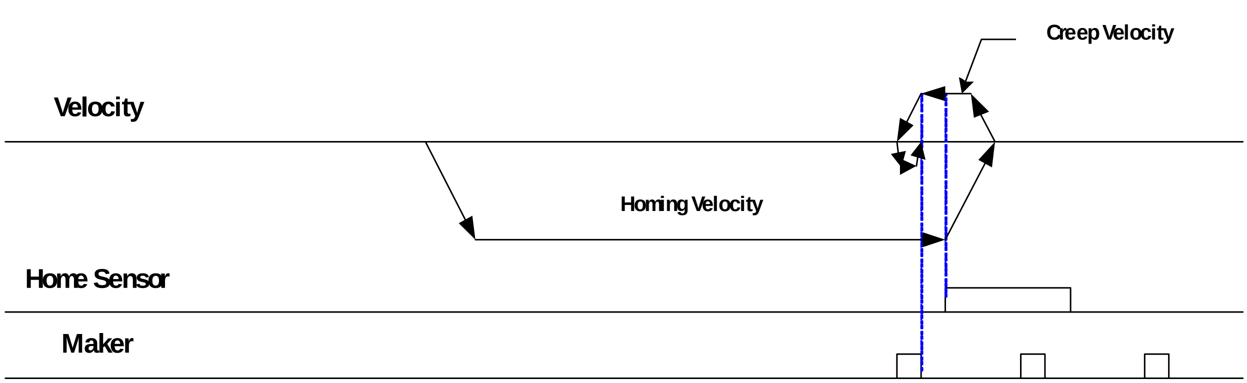
Homing Type 0: Return to current position

Homing type 0 does not allow home searching. If you set the automatic start homing to 0 when you activate IN01.01, CDS5 Servo Drive defines the current position as home when the drive is activated. If you set the automatic start homing to 1 when you activate IN01.01, SHOM's position is set as home.

Homing Type 1: Return to Home Sensor/Marker (Default)

Homing Type 1 defines home by using the home sensor and markers.

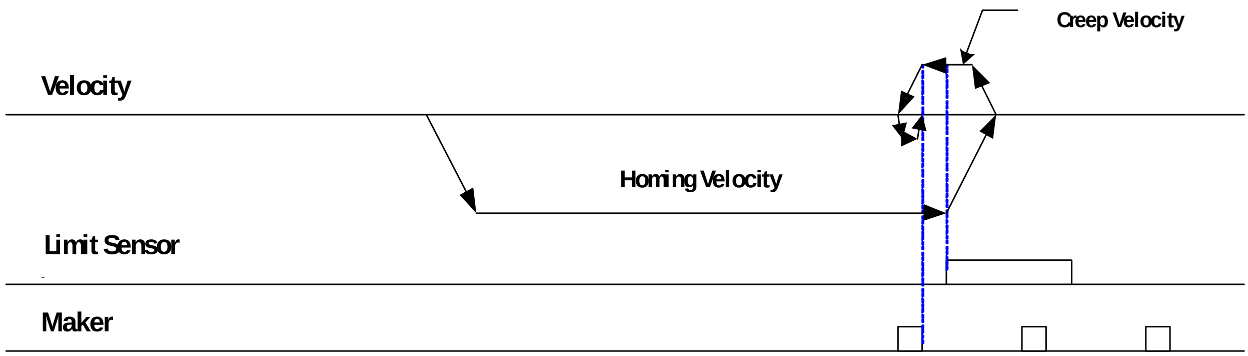
When the home searching begins, the motor moves to homing direction (IN01.01) with homing velocity (IN01.02) until detecting the homing sensor. At this point, the motor decelerates and stops; it starts moving reversely with the creep velocity (IN01.03). When it hits the first marker after losing the signal input from the home sensor, the deceleration stops, and it returns to the position where it detected the active-going edge of the first marker.



Home Type 2: Return to Limit/Marker

Homing Type 2 uses the limit sensor (+) or (-) and markers.

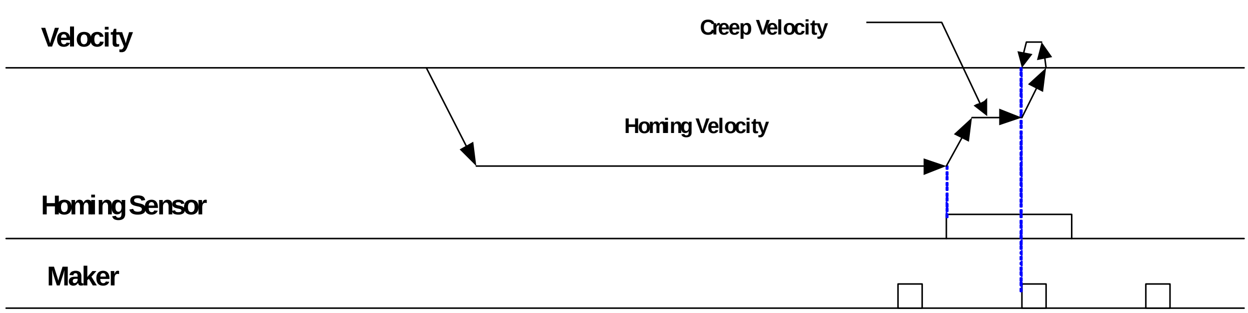
Only the limit sensor installed in the homing direction is used, and the hardware limit fault is deactivated. Operating principles are same as Homing Type 1. The only difference is that it uses the limit sensor instead of the home sensor.



Homing Type 3: Forward to Homing Sensor/Marker

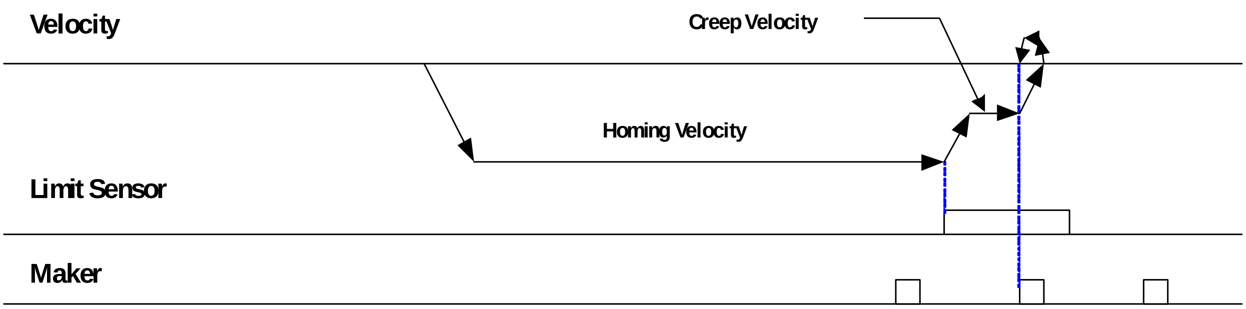
Similar to the Homing Type 1, the Homing Type 3 also uses the homing sensor and markers to define Home. However, the mechanism is different.

When the home sensor is detected, the speed decelerates to the creep velocity and maintains until the active-going edge is detected. After it decelerates again and stops, it moves reversly to the position where the active-going edge was detected.



Homing Type 4: Forward to Limit/Marker

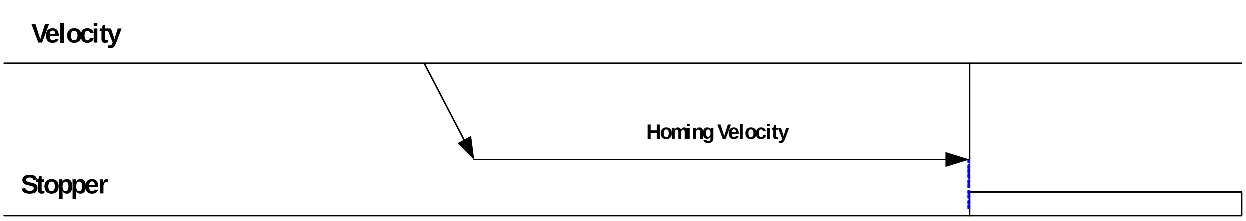
Similar to Homing Type 2, Homing Type 4 uses the limit sensor (+) or (-) and markers. Only the limit sensor in the home direction is used, and hardware Limit Fault is deactivated. Operating principles are same as Homing Type 3. The only difference is that it uses the limit sensor instead of the home sensor.



Homing Type 5: Stopper

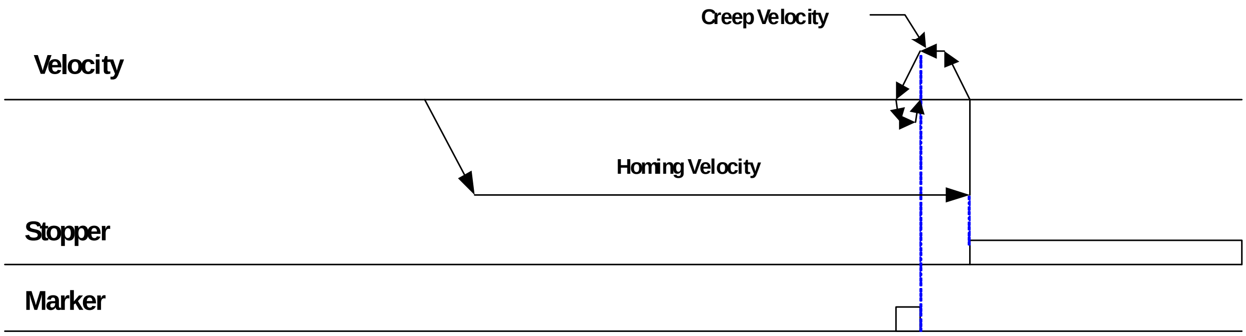
The Homing Type 5 performs a mechanical stop by using the stopper.

Once the home searching begins, it moves in the homing direction with the homing velocity (IN01.02). When the current is maintained higher than the current of the home current time, it stops; Home is defined where it stops. The home current is defined in the parameter IN01.09.



Homing Type 6: Return to Stopper and Markers

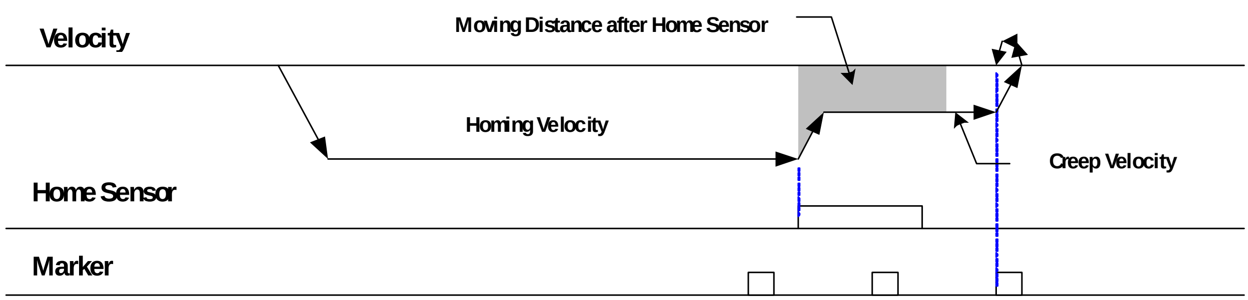
The operation is similar to that of the Homing Type 5, but in this mode, it moves reversly until it detects the falling edge of a marker when the current maintains higher than the current of the home current time. After detecting the active-going edge of a marker, it stops after decelerating. Then, it returns to the position where it detected the active-going edge of the first marker.



Homing Type 7: Return to Home Sensor/Move/Marker

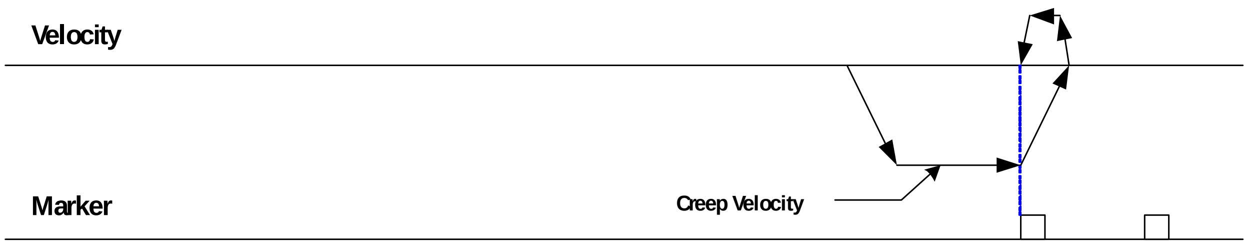
Similar to the Homing Type 3, the Homing Type 7 uses the home sensor and moving distance, after home sensoring and marking.

When the distance between the home sensor and a marker is minuscule, it might not detect the first marker. To prevent this from happening, there is one more parameter in this mode to define the minimum moving distance to detect the marker. The minimum moving distance is defined in the parameter IN01.10 as time. After detecting the home input, speed decelerates to the 2nd homing velocity and is maintained until the active-going edge of a marker is detected. The active-going edge of the marker is set as home.



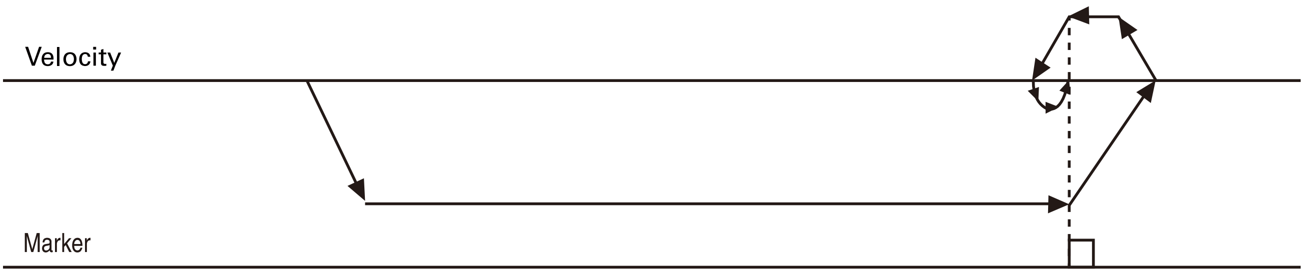
Homing Type 8: Return to Marker

The Home Type 8 uses only markers. In this mode, additional sensors such as home sensor or limit (+) or (-) are not required. Once the home searching begins, it moves in the homing direction with the creep velocity. When it detects a marker, it decelerates and stops. It moves to the position where the active-going edge of a marker was detected and sets this position as Home.



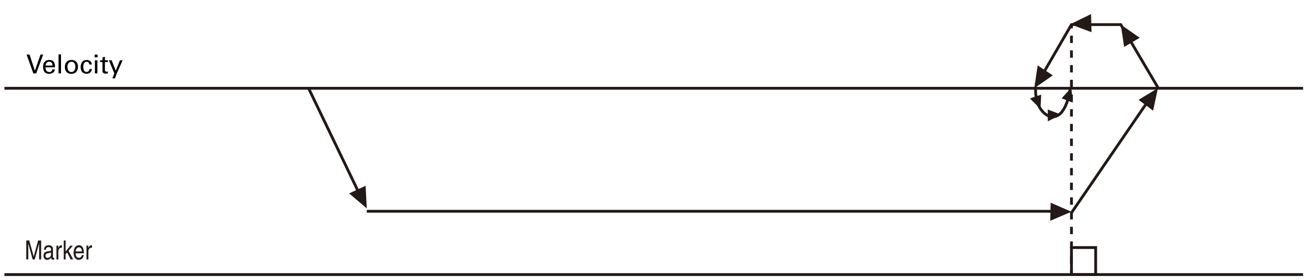
Homing Type 9: Return to Homing Sensor

Homing Type 9 defines home by using the home sensor only. When the home searching begins, the motor moves to homing direction (IN01.02) with homing velocity (IN01.02) until detecting the homing sensor. When it detects home sensor, it decelerates and stop, then it moves in the reverse direction with creep velocity (IN01.03). It returns to the position where it detected the home sensor signal.



Homing Type 10: Return to Limit Sensor

Homing Type 9 defines home by using the limit sensor only. When the home searching begins, the motor moves to homing direction (IN01.02) with homing velocity (IN01.02) until detecting the limit sensor. When it detects home sensor, it decelerates and stop, then it moves in the reverse direction with creep velocity (IN01.03). It returns to the position where it detected the limit sensor signal.



Homing Velocity

Homing Velocity means the speed used for homing. The sign indicates the moving direction while homing.

Homing Velocity is set in IN01.02. The Input Range is -6000~6000, the default is at 100, and the unit is rpm. The setting can be changed in the Servo-Off mode.

Automatic Homing when activated

A user can select a homing method among Start Homing (SHOME) or / SV-ON or Drive activation.

When the Start Homing (SHOME) option is selected, homing starts when there is an input for the signal. However, Start Homing (SHOME) is inhibited while indexing or homing. Even when Axis Homing (HOMC) is activated after a homing, homing restarts whenever there is an input for the Start Homing (SHOME) signal.

When the automatic homing start is selected when the drive is activated, homing starts only when Axis Homing (HOMC) is deactivated. When Axis Homing (HOMC) is activated, homing does not start.

... Automatic Homing when activated (IN01.01)

Value	Description
0	Active
1	Avtive only after resetting
2	Inavtive

Homing Offset

User can set a different home from the one defined at a homing operation by using this option.

When a homing offset exists, the final home is some distance (as much as homing offset) away from the original home. Homing Offset can not be applied to 17-bit absolute motors.

Homing Offset is set in IN01.05. The range is -2,147,483,647~2,147,483,647.

Moving Distance After Home Sensoring

When the Homing Type 7 is selected, all the markers that appear between the active-going edge of the home sensor and the moving distance after home sensoring are inhibited. The first marker that appears after moving distance and home sensoring is used for defining Home.

The moving distance after home sensoring is set in IN01.08. The range is 0 ~ 2,147,483,647.

Home Current and Home Current Time

When the Homing Type 5 or 6 are used for homing, the system decides whether it actually reaches the stopper when the current higher than the home current is maintained.

Home current is set at 1~250% of the rated current in IN01.09.

The home current time is set in IN01.10. The possible range is 0~1000 msec. The default is 0.

S/W Limit

User can set limit (+) and (-) in random position. The operating principles of S/W are same as that of H/W limit. When the system moves passing the S/W limit, the alarm goes off and the motor stops according to the overtravel stop method.

S/W limit operates when IN00.04 is '1'. When IN00.04 is '0', S/W limit does not work. S/W limit does not work while homing.

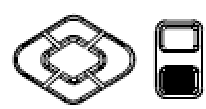
... S/W Limit (+): IN00.05
... S/W Limit (-): IN00.06
... Overtravel Stop Method: Ft-0.02 7-segment digit 1

Dwell Time

Dwell time is the time the drive stays in the target position after the motor reaches the position.

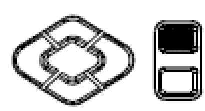
After it uses up the dwell time, the drive waits for the next command or runs the next designated index. Dwell time function works in all indexes. (all index types and all 'Action When Complete' options).

Dwell time can be set in IN-07.00~63. The input range is 0~65,535 with the default at 0.



Press ENTER for the Configuration Window.

Use the direction key to input a value between 0~65,535.



Press MODE/SET key to save the setting.

RUN

Servo Drive supports total 8 Run function(run-00~12)s. It does not support run-02,run-05~07, and run-09. In addition, run-00~01, run-03~04, run-08, and run-10~12 provide the same existing functions..

The information for each Run function is as below.

Operation Mode	Description
run-00	Jog Operation
run-01	Off-Line Auto Tuning
run-03	Auto Adjustment of Speed Command Offset
run-04	Auto Adjustment of CurrentCommand Offset
run-08	Alarm Reset
run-10	Absolute Encoder Reset
run-11	2-Group Gain Storing
run-12	Parameter Initialization

Index Alarm

A new alarm for the new functions are added..

Home Searching Failed

"Home Searching Failed" alarm occurs when homing is not complete within the designated time period(Homing Time Limit).

... HFAIL

Axis not homed

"Axis not homed" alarm occurs when an axis didn't return to home before the drive can operate the absolute coordinate index.

... notHm

Index Position Overflow

"Index Position Overflow" occurs when the index position feedback exceeds the range assigned in the absolute coordinate index, which is -2,147,483,647~2,147,483,647.

... IrAnG

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