FATEK®

Instruction Manual

AC SERVO MOTOR and SERVO AMPLIFIER
SD3 Series

FATEK AUTOMATION CORP.

Thank you for your purchase of this products.

This Instruction Manual includes precautions for the product use.

- ■ Please study this manual first and use the product properly and safely.
- ■ Before using the product, be sure to carefully read the Safety Instructions.
- ■ After reading this manual, please keep it for future reference.
- ■ Product specifications are subject to change without notice in the course of product improvement.

Apr. 2019

Overview of the SD3 Series Instruction Manual

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MEMO

1 Introduction

1. Important Safety Instructions

1. Safety Precautions

This manual uses the signs below to indicate serious but avoidable problems caused by misuse of the product. One is for death or serious bodily harm. The other is for bodily injury or product or equipment damage.

⚠ DANGER	Identifies information about imminent hazards that will result in death or serious injury.
⚠ CAUTION	Identifies information about hazards that could result in injury or equipment damage.

Throughout this document, the safety precautions that users must follow are marked as follows.

🚫	Safety Precaution - **Prohibited** Action
❗	Safety Precaution - **Mandatory** Action

The possible hazardous events are marked as follows.

	**Cautions and Dangers** Causes unexpected, unstable, or uncontrolled motions. Compromises the performance or reliability of the product. Shortens the service life of the product.
	**Electric shock hazard**
	**Burn hazard**
	**Fire hazard**
	**Injury hazard**
	**Failure and damage hazard**

1. Important Safety Instructions

⚠ DANGER

Sign	Precautionary Measures	If Not Observed
Installation and Wiring		
🚫	Never connect the motor directly to a commercial power supply.	🔥 ⚠
	Do not place any flammable items near the motor or amplifier.	🔥
❗	Protect the amplifier with a protective case and ensure the clearance between the amplifier, the case and other devices as specified in this manual.	⚡ 🔥 ⚠
	Install the product in a place with little dust and free from water or oil splash.	⚡ 🔥 ⚠
	Mount the motors and amplifiers on metallic or other noncombustible materials.	🔥
	All wiring work must be performed by certified electricians.	⚡
	Ground the FG terminals of mother and amplifiers.	⚡
	Turn off the upstream circuit breaker before wiring. Wiring must be performed correctly.	⚡ ✋ ⚠
	Be sure with secure cable connections. The current-carrying components must be insulated.	⚡ 🔥 ⚠
Operations		
🚫	Never touch the inside of the amplifier.	♨ ⚡
	Be careful not to damage the cables. Do not apply excessive force to them or place heavy objects on top of them. Do not let any part of cables become pinched or twisted.	⚡ ⚠
	Never touch the rotating component of the motor during operation.	✋
	Do not use the product where it may be subjected to water, corrosive atmosphere, flammable gas, or combustible materials.	🔥
	Do not use the product where excessive vibration or impact load is present.	⚡ ✋ 🔥
	Do not use cables soaked in water or oil.	⚡ ⚠
	Do not handle wiring nor operate the motor with wet hands.	⚡ ✋ 🔥
	Do not touch the keyway if you are using a motor with a shaft-end keyway.	✋
	Do not touch the motor or amplifier heat sink. It becomes very hot.	🔥 ⚠
	Do not use external power to run the motor.	🔥

1. Important Safety Instructions

⚠ DANGER

Sign	Precautionary Measures	If Not Observed
Additional Precautions		
❗	Be sure to confirm the safe condition of the equipment after each earthquake.	⚡ ✋ 🔥
	To prevent a fire or personal injury during an earthquake, carry out installation work securely and properly.	⚡ ✋ 🔥 ⚠
	Install external emergency stop circuitry so that the operation can be stopped and the power supply can be shut down immediately in case of emergency.	⚡ ✋ 🔥 ⚠
Maintenance and Inspection		
🚫	Never attempt to disassemble the product.	⚡ ✋ 🔥
❗	There are hazardous voltage sections in the amplifier. Before performing any wiring or inspection, be sure to allow more than 5 minutes after the power shuts off for the internal voltage to completely discharge.	⚡

1. Important Safety Instructions

⚠ CAUTION

Sign	Precautionary Measures	If Not Observed
Installation and Wiring		
🚫	Do not directly touch the terminal portion of any connectors.	⚡ 🔥
	Do not block the air vents. Do not allow ingress of any foreign objects to the product.	⚡ 🔥
❗	Keep the motor-amplifier pairing as specified.	🔥 💥
	Before a test run, confirm that the motor is fixed in place, check the motions while the motor is isolated from the machinery first, then install the motor in the machinery.	✋
	Observe the mounting method and orientation as specified.	✋ 💥
	Install the product in an appropriate way suitable for its main body mass and the rated output of the product.	✋ 💥
Operations		
🚫	Do not step on the product or place any heavy object on it.	⚡ ✋ 💥
	Never make drastic changes during tuning, which if not observed, will result in unstable motions.	💥
	Do not come close to the machinery right after power restoration following a power outage. The machinery may restart unexpectedly at any moment. Take appropriate measures to ensure safety against an unexpected restart.	✋
	Do not use the product where it may be exposed to direct sunlight.	💥
	Do not apply impact load.	💥
	Never use the electromagnetic contactor installed on the main power supply-side to operate or stop the motor.	💥
	Do not use the built-in brake of the motor for regular braking purposes. It is a holding brake.	✋ 💥
	Do not use faulty, damaged motors or amplifies.	✋ ⚡ 🔥
❗	Confirm that the power specifications are normal.	💥
	The holding brake is not a stopping device to secure the safety of the machine. The machine requires a separate stopping device to secure safety.	✋
	Upon occurrence of an alarm, remove the cause and ensure the safe condition of the equipment before resetting the alarm and restarting the machine.	✋
	Connect the brake control relay and the emergency stop relay in series.	✋ 💥

1. Important Safety Instructions

⚠ CAUTION

Sign	Precautionary Measures	If Not Observed
Transportation and Storage		
🚫	Do not store the product at a location subject to water or moisture, or where toxic gases or liquids are present.	⚠
	Do not hold the cables or motor shafts during transportation.	⚠ ⚠
	When transporting the amplifier and monitor, do not drop them or let them fall.	⚠ ⚠
❗	When the product has been stored for an extended time, contact our customer service center.	⚠
	Store the product in suitable storage environments as specified in the instruction manual.	⚠
Additional Precautions		
❗	Prior to disposal of the batteries, insulate them with tape or other material. Dispose of them following the local laws and regulations.	
	When disposing of this product, treat it as industrial waste.	
Maintenance and Inspection		
🚫	Never attempt to overhaul the product.	⚠
	Do not power cycle too frequently.	⚠
	The motor, heat sink of the amplifier, and regenerative resistor may become dangerously hot. Do not touch any of them with hands when power is on or for a while after power shutdown.	⚠ ⚠
❗	If the amplifier or motor fails, shut down both the control power supply and the main circuit power supply.	⚠
	When not using the product for an extended period, be sure to turn the power off.	⚠

1. Important Safety Instructions

2. Other Considerations and Precautions

Export of this product or its applications

If the end user or applications of the product is involved in military activities or weapons, its export may be subject to "Foreign Exchange and Foreign Trade Law (Japan)" (or equivalent in your country).
Have adequate legal reviews and follow any required export procedures.
Follow the laws and regulations of the destination.

Use of the product – Not in human life related field

This product is designed and manufactured to be used for general industrial products.
Medical applications are not allowed.

Applications for special environments or purposes such as nuclear power, aerospace and transportation

Please contact us in advance of use.

Application that could cause serious accidents or damage due to product failure

Be sure to have safety device or protection device installed before using your equipment.

Applying voltage beyond the rated power range of this product

Doing so could become a fire or smoke hazard to the amplifier. Be sure to check and confirm proper wiring before turning the power on. Be particularly careful in a location such as a clean room.

Operations with the motor shaft not electrically grounded

Depending on the device or installation environment, bearing noise might be increased by galvanic corrosion of the motor bearings. Perform careful check on grounding.

Operations in environment under significant influence of external noise and static electricity

This product has been designed and manufactured to pass extensive noise tests. However, there is a possibility of unexpected behavior depending on user's environment.
Practice a fail-safe design and take adequate measures to ensure safety within the range of machine motion.

Use of the product in a manner not rated by the manufacture

Such use shall void the manufacture warranty. Be mindful before you attempt to do so.

3. Safety Standards

Not Applicable

Rating		Motor	Amplifier
EU/EC Directives	Low Voltage Directive (*1)	EN60034-1 EN60034-5	EN61800-5-1
	EMC Directive (*2)	-	EN61000-6-2 EN55011 Class A, Group1
	Machinery Directive	(N/A)	
China Compulsory Product Certification System (CCC)		(N/A)	

*1) Install the product in the environment that meets the following requirements:

- Overvoltage Category II
- Class I
- Pollution Degree 2 (Circuitry)

*2) The test conditions for the machinery and equipment with this product installed may be different from our test conditions. Such machinery or equipment must meet the safety standards for their final configurations.

4. Maintenance and Inspection

🚫	Never overhaul the product.
❗	For safe use of the product, be sure to perform regular maintenance and inspection on the amplifier and motor.
	Ensure the electrical and mechanical safety before each inspection.

This product assumes the following operating conditions.

Ambient Temperature	Average annual temperature of 30℃ (not exceeding the rated temperature range)
Load Factor	80% max
Operating Hours	20 hours a day

Maintenance

For safe use of the product, perform daily and periodic inspections.

Daily Inspection: Check the following before each operation:

- Ambient temperature, humidity and atmosphere
- No foreign objects or dust; especially ensure that nothing is blocking the vent holes
- No excessive bending or damage of the wires
- Power supply voltage is within the specifications
- No foreign objects in mobile components of the device and the range of motion.
- No unusual noise or smell right after the machinery starts.

Periodic Inspection: Check the following at least once a year:

- No loose clamp screw problems in the amplifier and motor.
- No deformation or discoloration in the amplifier, motor, cables, and terminal blocks due to overheating.
- No looseness in wiring fixings and terminal block screws.

1. Important Safety Instructions

5. Warranty

Terms of Warranty

The term of warranty for this product is twelve (12) months after the date of product manufacture.

However, brake-equipped motors whose number of axis accelerations and decelerations exceeded the rated maximum shall not be covered by the warranty.

Conditions of Warranty

Should any failure develop during the warranty period under normal operations in accordance to this instruction manual, our company agrees to make repairs at free of charge. However, even during the warranty period, our company will make only fee-based repair if the failure is due to the following reasons:

- Misuse, improper repair, or alteration of the product
- Product is dropped after purchase or damaged during transportation
- Use of this product is not within the product specifications
- Fire, earthquake, lightning, storm and flood damage, salt damage, abnormal voltage, or any other acts of God or natural disasters
- Ingress of foreign matter such as water, oil or metal chips.

This warranty does not apply to any parts or accessories that have been used longer than their rated service life.
The warranty applies to delivered products only. FATEK shall not be liable for any indirect, incidental or consequential damage caused by the product failure or damage.

2. Overview

Misuse or mishandling of the product will not only result in its suboptimal performance, but also failure or shorter service life.
For safety and proper use of the product, please read the instruction manuals carefully.

About This Product and This Instruction Manual

■ Product features and parts are subject to change without prior notice due to potential future product improvement initiatives.

■ Please contact us in advance if you are to acquire safety standards certification etc. for equipment with this product installed.

■ We have prepared the contents of this manual with extreme care. Please do not hesitate to contact us if you have any questions.

■ Include the following precautions in the User Guide of your SD3 Series application product:
  - This is a high-voltage product which can be hazardous.
  - Residual voltage exists at the terminals and inside the equipment (even after power shutoff), which is hazardous.
  - The product contains high temperature components.
  - It is prohibited to disassemble the product.

■ For optimal service life of this product, use of the product under proper conditions is essential. Follow the safety precautions and instructions described in this manual.

■ We always strive to include up-to-date information in the instruction manual; therefore, it is subject to change without prior notice.

■ For a copy of the latest version of the instruction manual, please contact us.

■ Reproducing or copying this document, in whole or in part, without prior approval of FATEK, is strictly prohibited.

Check Items Upon Unpacking

■ Please compare the actual items received with your product purchase order.

■ Inspect all items received for evidence of damage during transit.

■ Should you have any problems, please contact our sales department.

2. Overview

1. Product Label

Motor Label (50 W to 750 W)

Label 1

Motor Model

Specifications

AC SERVO MOTOR
M3B040CSNNC01
INPUT 3ΦAC150V 2.7A
RATED OUTPUT 400W
RATED REV. 3000rpm
FATEK®

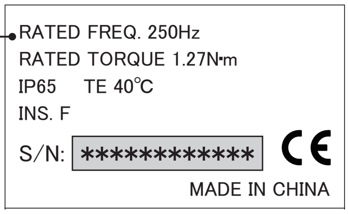
Label 2

Specifications

Product Number
(Produced year and month + Control No. + Serial No.)

A product number is indicated by 12 digits.

S/N: * * ****** ****
Year(*)
Month(*)
Serial No.
Control No.



RATED FREQ. 250Hz
RATED TORQUE 1.27N•m
IP65 TE 40℃
INS. F
S/N: ************
CE
MADE IN CHINA

※ The product label is separated in two parts which are located shown in this picture.

Motor Label (1 kW to 2 kW)

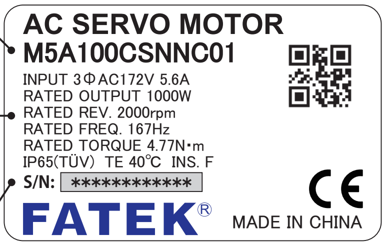
Motor Model

Specifications

Product Number
(Produced year and month + Control No. + Serial No.)

A product number is indicated by 12 digits.

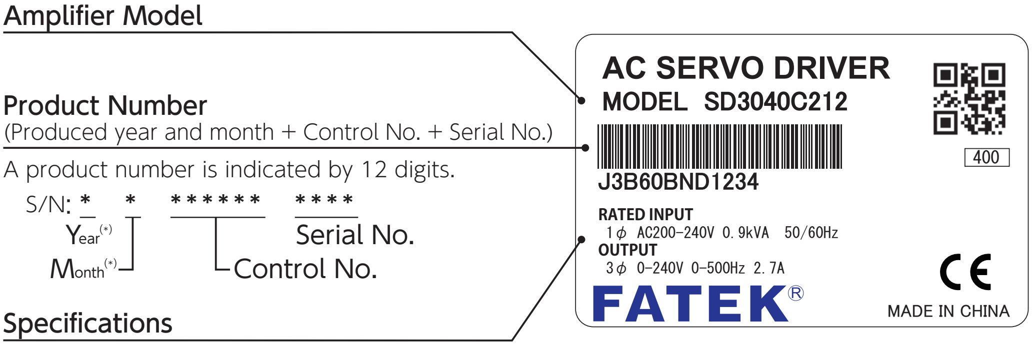
S/N: * * ****** ****
Year(*)
Month(*)
Serial No.
Control No.



AC SERVO MOTOR
M5A100CSNNC01
INPUT 3ΦAC172V 5.6A
RATED OUTPUT 1000W
RATED REV. 2000rpm
RATED FREQ. 167Hz
RATED TORQUE 4.77N•m
IP65(TÜV) TE 40℃ INS. F
S/N: ************
FATEK®
CE
MADE IN CHINA

Amplifier Label

The product label is located in the side cover of the amplifier.



Amplifier Model

Product Number
(Produced year and month + Control No. + Serial No.)

A product number is indicated by 12 digits.

S/N: * * ****** ****
Year(*)
Month(*)
Serial No.
Control No.

Specifications

AC SERVO DRIVER
MODEL SD3040C212
J3B60BND1234
400
RATED INPUT
1ϕ AC200-240V 0.9kVA 50/60Hz
OUTPUT
3ϕ 0-240V 0-500Hz 2.7A
FATEK®
MADE IN CHINA

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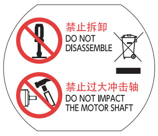
*) About indication of "the year".
" I " = 2018., " J " = 2019., …

About indication of "the month".
"1" = Jan., … "9" = Sep., "X" = Oct., "Y" = Nov., and "Z" = Dec.

2. Danger Signs

NO IMPACT/NO DISASSEMBLY LABEL



Do not remove the encoder cover. Never overhaul the encoder.
Beating the encoder cover will cause encoder failure.
Do not apply strong impact to the motor and its shaft

HOT SURFACE WARNING

Do not touch the product during operation or for a while afterward, or you may get burned from the heat.

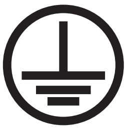
ELECTRIC SHOCK WARNING

Do not touch the amplifier during operation and within 5 minutes after operation, or you may get injured.

DANGER・CAUTION

Incorrect use of the amplifier may cause injury or damage. Avoid misuse or improper handling of the amplifier, or injury will result.

FG (FRAME GROUND/PROTECTIVE GROUNDING) SYMBOL



Be sure to perform grounding with the screw located at this sign.

2

Specifications

1. Motor

1. Models

M 5 G 005 C S N N C * *

Control Number

Encoder	
Code	Specifications
C	17 bit (Incremental)
A	17 bit (Absolute)

Oil Seal	
Code	Oil Seal
N	Without
S	With

Brake	
Code	Holding Brake
N	Without
B	With

Shaft	
Code	Shaft
S	Straight
K	Key

Rated Output	
Code	Rated Output
005	50 W
010	100 W
020	200 W
040	400 W
075	750 W
100	1 kW
150	1.5 kW
200	2 kW

Inertia	
Code	Specifications
3	Low Inertia
5	Middle Inertia
7	High Inertia

Inertia

L	Low Inertia
M	Middle Inertia
H	High Inertia

Flange Size

40 SQUARE	40 mm x 40 mm
60 SQUARE	60 mm x 60 mm
80 SQUARE	80 mm x 80 mm
130 SQUARE	130 mm x 130 mm

Rotational Speed

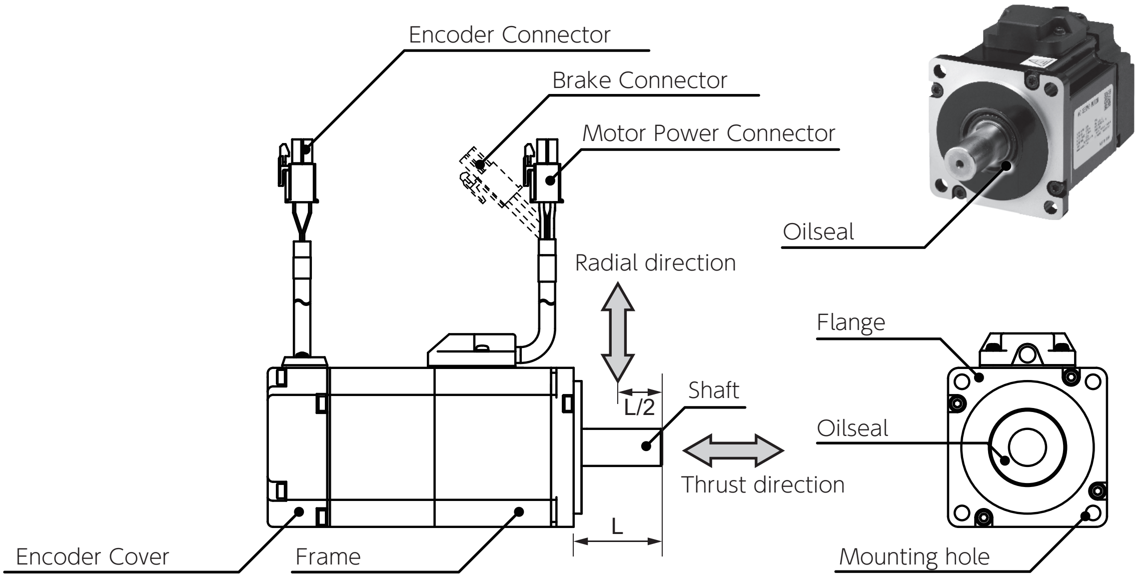
	Rated Motor Speed / Max. r/min
30 20	2,000 / 3,000 r/min
60 30	3,000 / 6,000 r/min

IP Code

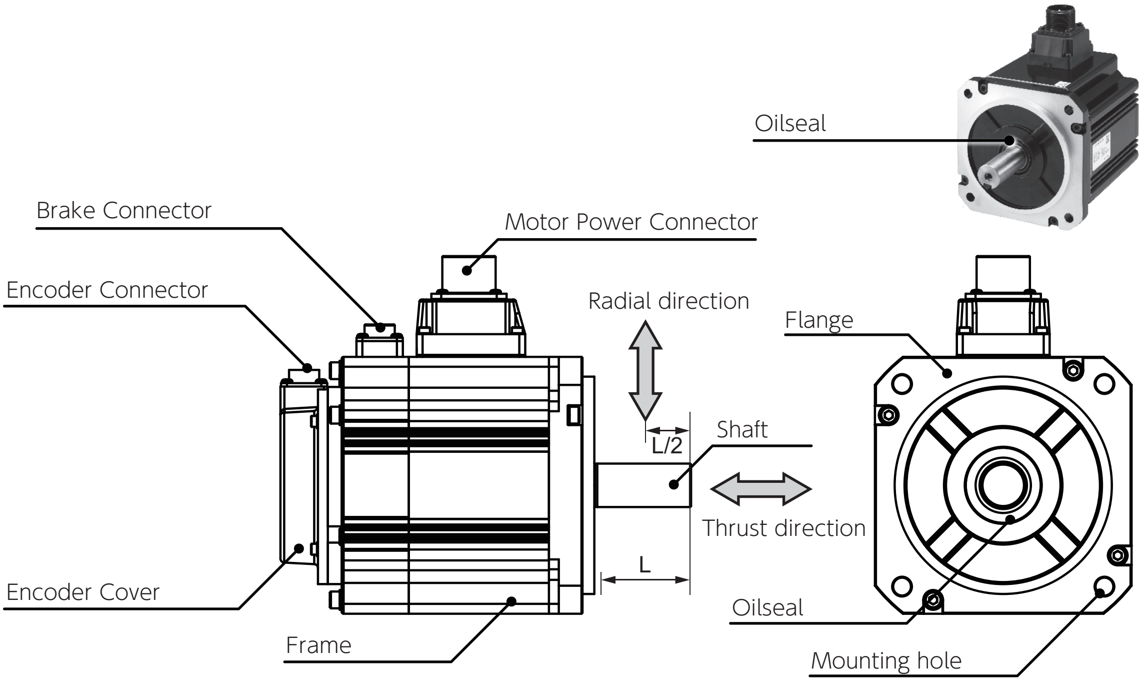
IP 65	IP65
IP 67	IP67

2. Names of parts

Motor: 50W 100W 200W 400W 750W 1kW 1.5kW 2kW



Motor: 50W 100W 200W 400W 750W 1kW 1.5kW 2kW



3. Specifications

Item	Specifications
Ambient temperature for operation	0 to 40℃
Ambient humidity for operation	20 to 85% RH (no condensation)
Ambient temperature for storage	− 20 to 65℃ (no condensation) (not subjected to direct sunlight) 80℃ for 72 hours
Ambient humidity for storage	20 to 85% RH (no condensation)
Atmosphere for operation / storage	Indoors (not subject to direct sunlight), Free from corrosive gases, flammable gases, oil mist, dust, flammables, grinding fluid
Insulation resistance	≧ 5 MΩ (at 1,000 VDC)
Dielectric strength	AC 1500 V for one minute across the primary and FG
Operating altitude	≦ 1,000 m
Vibration class	V15 (JEC2121)
Vibration resistance	49 m/s^2 (5 G)
Impact resistance	98 m/s^2 (10 G)
Protective structure	IP65 : 50 W to 750 W IP67 : 1 kW to 2 kW
Electric shock protection	Class I (Mandatory grounding)
Overvoltage category	Ⅱ
Installation environment	Pollution degree 2

The brake has polarity.

Lead wire color: Connection
Yellow (BRK+): +24 V
Blue (BRK−): GND

Incorrect wiring may result in motor failure or suboptimal performance of the motor.

50 W

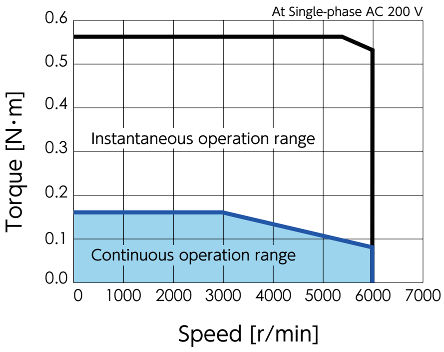
Motor Model： M5B005 C □ □ □ □ * *

Item		Unit	Specifications
Rotor inertia		–	Middle
Fitting flange size		mm	40 sq.
Approximate mass	Without brake	kg	0.4
	With brake		0.6
Compatible amplifier model		–	SD3005CY12
Voltage		V	AC200 V to 240 V
Rated output		W	50
Rated torque		N·m	0.16
Instantaneous maximum torque		N·m	0.56
Rated current (stall current)		A	0.68
Instantaneous maximum current		A	2.4
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.25
Induced voltage constant per phase		mV/(r/min)	8.8
Rated power rate	Without brake	kW/s	6.5
	With brake		5.4
Mechanical time constant	Without brake	ms	1.92
	With brake		2.31
Electrical time constant		ms	0.74
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.039
	With brake		0.047

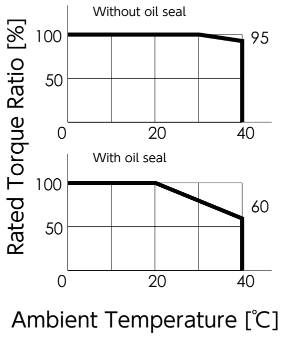
Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24 V ± 10%
Rated current	A	0.25
Static friction torque	N·m	≧ 0.16
Suction time	ms	≦ 35
Release time	ms	≦ 20
Release voltage	V	≧ DC 1 V

Item	Unit	Specifications
Radial	N	68
Thrust	N	58

Rotational Speed vs. Torque

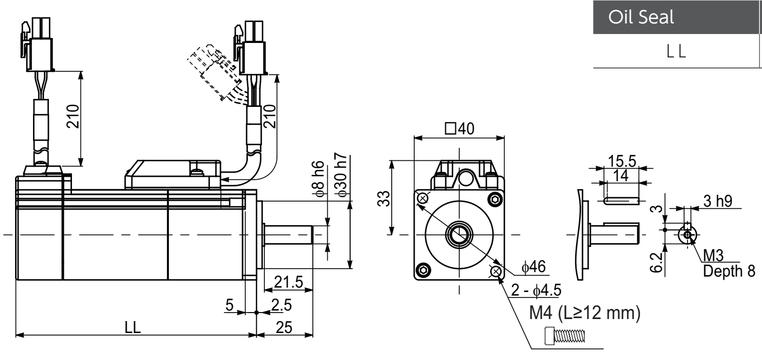


Derating Curve



(mm)

Brake	Without		With	
Oil Seal	Without	With	Without	With
L L	66.4	72.0	106.8	112.4



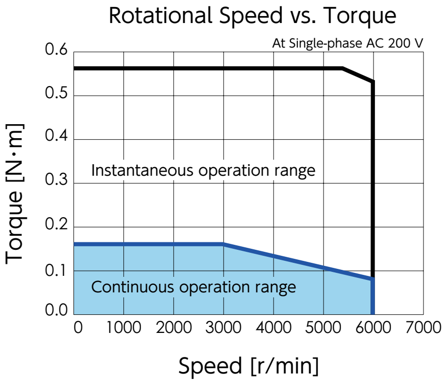
1. Motor

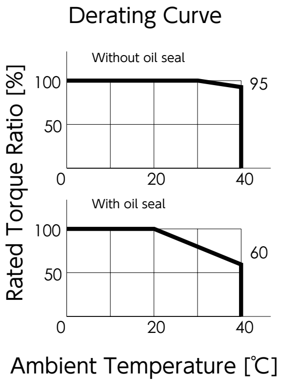
Motor Model : M5G005 C □ □ □ □✻✻

Item		Unit	Specifications
Rotor inertia		–	Middle
Fitting flange size		mm	40 sq.
Approximate mass	Without brake	kg	0.4
	With brake		0.6
Compatible amplifier model		–	SD3005CY12
Voltage		V	AC200 V to 240 V
Rated output		W	50
Rated torque		N·m	0.16
Instantaneous maximum torque		N·m	0.56
Rated current(stall current)		A	0.68
Instantaneous maximum current		A	2.4
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.25
Induced voltage constant per phase		mV/(r/min)	8.8
Rated power rate	Without brake	kW/s	6.6
	With brake		5.4
Mechanical time constant	Without brake	ms	2.02
	With brake		2.45
Electrical time constant		ms	0.65
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.039
	With brake		0.047

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24 V ± 10%
Rated current	A	0.25
Static friction torque	N·m	≧ 0.16
Suction time	ms	≦ 35
Release time	ms	≦ 20
Release voltage	V	≧ DC 1 V

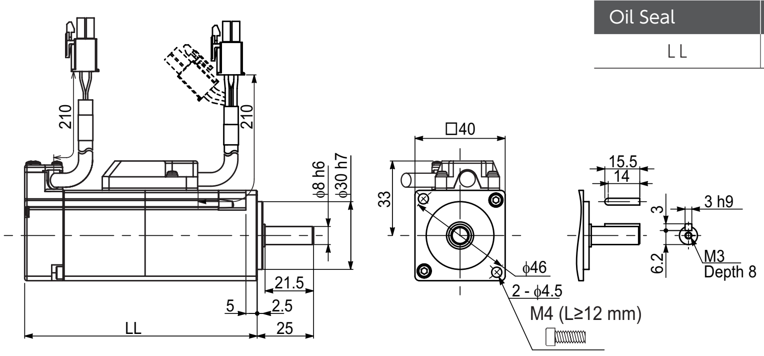
Item	Unit	Specifications
Radial	N	68
Thrust	N	58


Rotational Speed vs. Torque


Derating Curve

(mm)

Brake	Without		With	
Oil Seal	Without	With	Without	With
L L	57.1	64.7	89.5	97.1



1. Motor

100 W

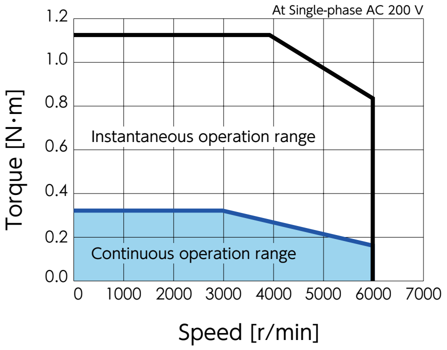
Motor Model : M5B010 C □ □ □ □ * *

Item		Unit	Specifications
Rotor inertia		–	Middle
Fitting flange size		mm	40 sq.
Approximate mass	Without brake	kg	0.5
	With brake		0.8
Compatible amplifier model		–	SD3010CZ12
Voltage		V	AC200 V to 240 V
Rated output		W	100
Rated torque		N·m	0.32
Instantaneous maximum torque		N·m	1.12
Rated current(stall current)		A	0.97
Instantaneous maximum current		A	3.3
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.35
Induced voltage constant per phase		mV/(r/min)	12.3
Rated power rate	Without brake	kW/s	16.5
	With brake		14.6
Mechanical time constant	Without brake	ms	1.17
	With brake		1.32
Electrical time constant		ms	0.89
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.061
	With brake		0.069

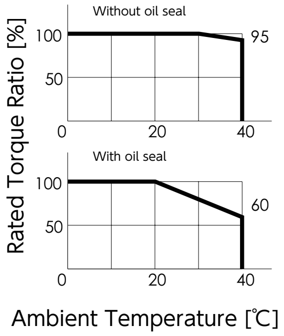
Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24 V ± 10%
Rated current	A	0.25
Static friction torque	N·m	≧ 0.32
Suction time	ms	≦ 35
Release time	ms	≦ 20
Release voltage	V	≧ DC 1 V

Item	Unit	Specifications
Radial	N	68
Thrust	N	58

Rotational Speed vs. Torque

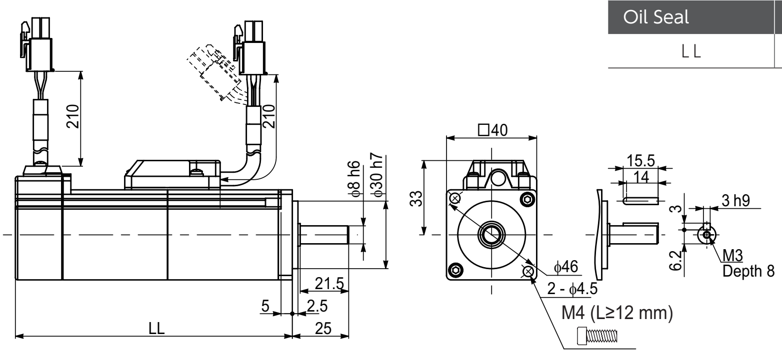


Derating Curve



(mm)

Brake	Without		With	
Oil Seal	Without	With	Without	With
L L	82.4	88.0	122.8	128.4



2. Specifications

1. Motor

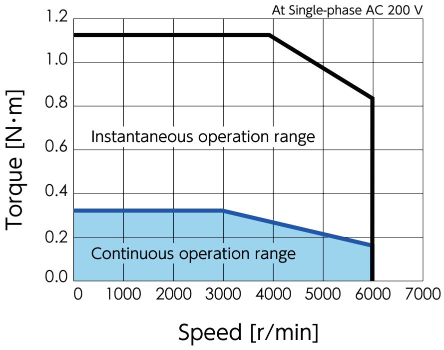
Motor Model : M5G010 C □ □ □ □＊＊

Item		Unit	Specifications
Rotor inertia		–	Middle
Fitting flange size		mm	40 sq.
Approximate mass	Without brake	kg	0.5
	With brake		0.7
Compatible amplifier model		–	SD3010CZ12
Voltage		V	AC200 V to 240 V
Rated output		W	100
Rated torque		N·m	0.32
Instantaneous maximum torque		N·m	1.12
Rated current(stall current)		A	0.93
Instantaneous maximum current		A	3.3
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.35
Induced voltage constant per phase		mV/(r/min)	12.3
Rated power rate	Without brake	kW/s	15.8
	With brake		14.1
Mechanical time constant	Without brake	ms	1.32
	With brake		1.49
Electrical time constant		ms	0.78
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.064
	With brake		0.072

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24 V ± 10%
Rated current	A	0.25
Static friction torque	N·m	≧ 0.32
Suction time	ms	≦ 35
Release time	ms	≦ 20
Release voltage	V	≧ DC 1 V

Item	Unit	Specifications
Radial	N	68
Thrust	N	58

Rotational Speed vs. Torque



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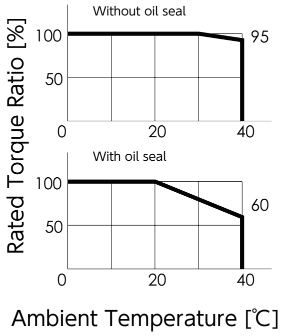
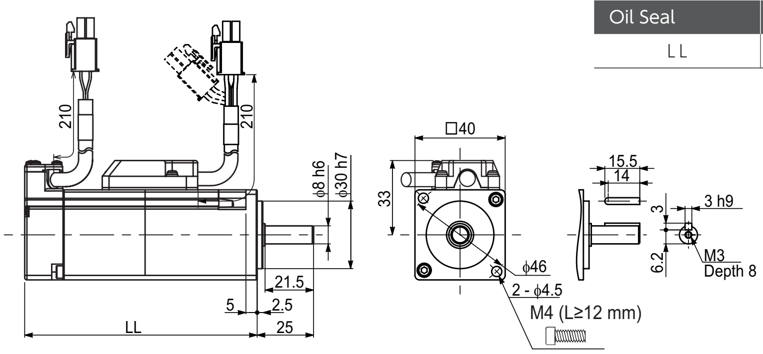


(mm)

Brake	Without		With	
Oil Seal	Without	With	Without	With
L L	70.7	78.3	103.1	110.7



200 W

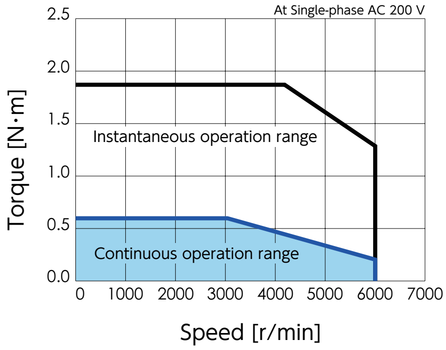
Motor Model : M3B020 C □ □ □ □ * *

Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	0.8
	With brake		1.3
Compatible amplifier model		–	SD3020C112
Voltage		V	AC200 V to 240 V
Rated output		W	200
Rated torque		N·m	0.64
Instantaneous maximum torque		N·m	1.91
Rated current(stall current)		A	1.7
Instantaneous maximum current		A	5.2
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.41
Induced voltage constant per phase		mV/(r/min)	14.3
Rated power rate	Without brake	kW/s	28.2
	With brake		23.5
Mechanical time constant	Without brake	ms	0.72
	With brake		0.87
Electrical time constant		ms	2.53
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.14
	With brake		0.17

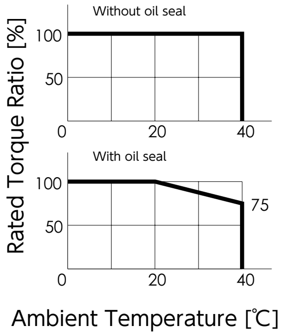
Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24V ± 10%
Rated current	A	0.3
Static friction torque	N·m	≧ 1.27
Suction time	ms	≦ 50
Release time	ms	≦ 15
Release voltage	V	≧ DC 1 V

Item	Unit	Specifications
Radial	N	245
Thrust	N	98

Rotational Speed vs. Torque

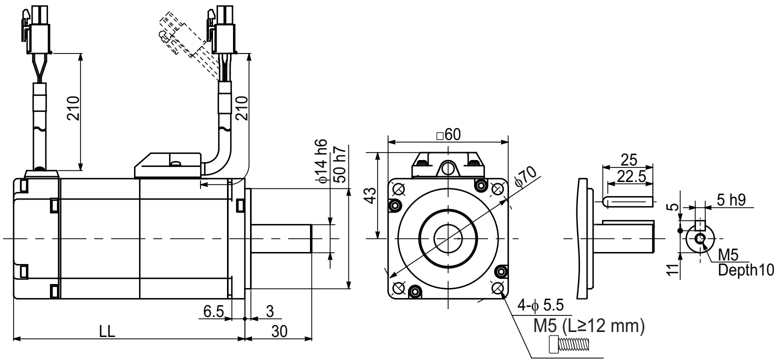


Derating Curve



(mm)

Brake	Without	With
LL	76.5	113.0



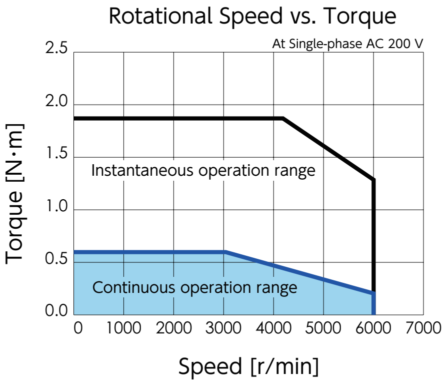
1. Motor

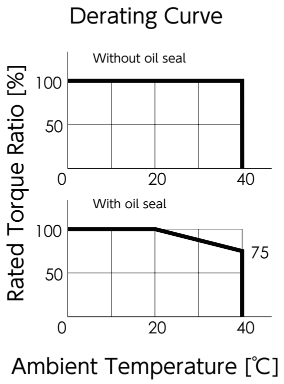
Motor Model : M7B020 C □ □ □ □＊＊

Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	1.0
	With brake		1.5
Compatible amplifier model		–	SD3020C112
Voltage		V	AC200 V to 240 V
Rated output		W	200
Rated torque		N·m	0.64
Instantaneous maximum torque		N·m	1.91
Rated current(stall current)		A	1.7
Instantaneous maximum current		A	5.2
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.41
Induced voltage constant per phase		mV/(r/min)	14.3
Rated power rate	Without brake	kW/s	9.1
	With brake		8.6
Mechanical time constant	Without brake	ms	2.23
	With brake		2.38
Electrical time constant		ms	2.53
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.44
	With brake		0.47

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24 V ± 10%
Rated current	A	0.3
Static friction torque	N·m	≧ 1.27
Suction time	ms	≦ 50
Release time	ms	≦ 15
Release voltage	V	≧ DC 1 V

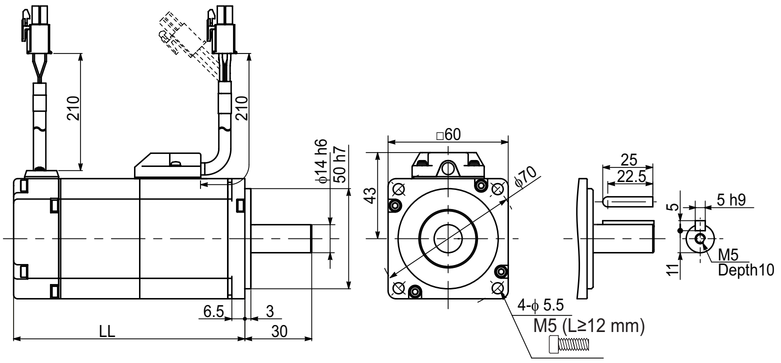
Item	Unit	Specifications
Radial	N	245
Thrust	N	98





(mm)

Brake	Without	With
LL	93.5	130.0



400 W

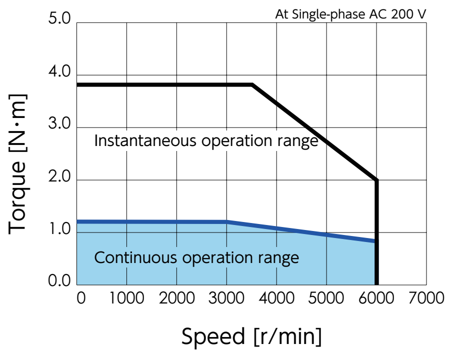
Motor Model : M3B040 C □ □ □ □＊＊

Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	1.3
	With brake		1.8
Compatible amplifier model		–	SD3040C212
Voltage		V	AC200 V to 240 V
Rated output		W	400
Rated torque		N·m	1.27
Instantaneous maximum torque		N·m	3.82
Rated current(stall current)		A	2.7
Instantaneous maximum current		A	8.5
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.49
Induced voltage constant per phase		mV/(r/min)	17.1
Rated power rate	Without brake	kW/s	69.4
	With brake		61.8
Mechanical time constant	Without brake	ms	0.47
	With brake		0.53
Electrical time constant		ms	2.92
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	0.23
	With brake		0.26

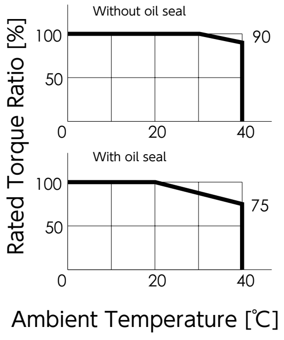
Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24 V ± 10%
Rated current	A	0.3
Static friction torque	N·m	≧ 1.27
Suction time	ms	≦ 50
Release time	ms	≦ 15
Release voltage	V	≧ DC 1 V

Item	Unit	Specifications
Radial	N	245
Thrust	N	98

Rotational Speed vs. Torque

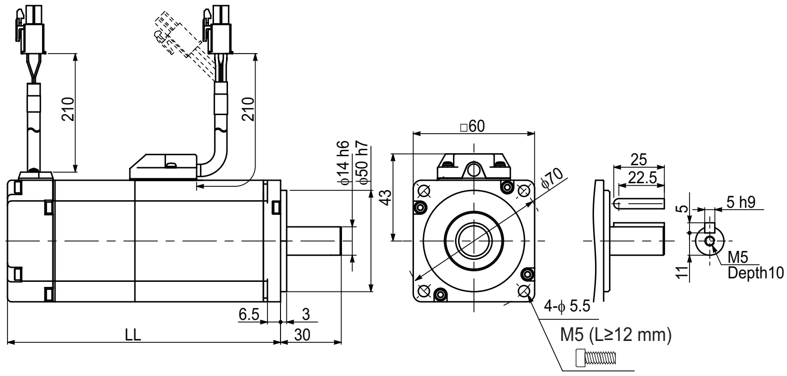


Derating Curve



(mm)

Brake	Without	With
LL	93.5	130.0



1. Motor

400W 60 SQUARE H 60 30 IP 65

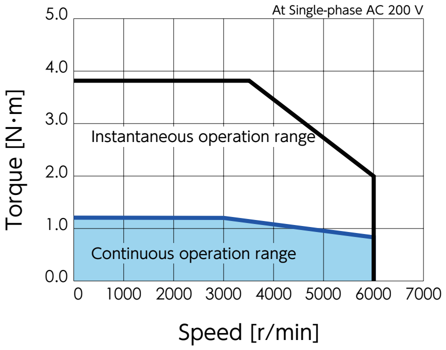
Motor Model : M7B040 C □□□□✻✻

Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	1.5
	With brake		2.0
Compatible amplifier model		–	SD3040C212
Voltage		V	AC200 V to 240 V
Rated output		W	400
Rated torque		N·m	1.27
Instantaneous maximum torque		N·m	3.82
Rated current(stall current)		A	2.7
Instantaneous maximum current		A	8.5
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.49
Induced voltage constant per phase		mV/(r/min)	17.1
Rated power rate	Without brake	kW/s	23.0
	With brake		22.1
Mechanical time constant	Without brake	ms	1.42
	With brake		1.47
Electrical time constant		ms	2.92
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	0.71
	With brake		0.73

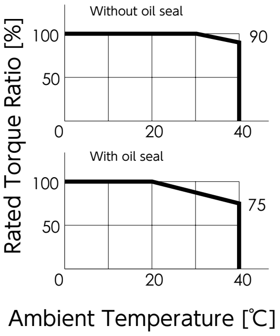
Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24 V ± 10%
Rated current	A	0.3
Static friction torque	N·m	≧ 1.27
Suction time	ms	≦ 50
Release time	ms	≦ 15
Release voltage	V	≧ DC 1 V

Item	Unit	Specifications
Radial	N	245
Thrust	N	98

Rotational Speed vs. Torque

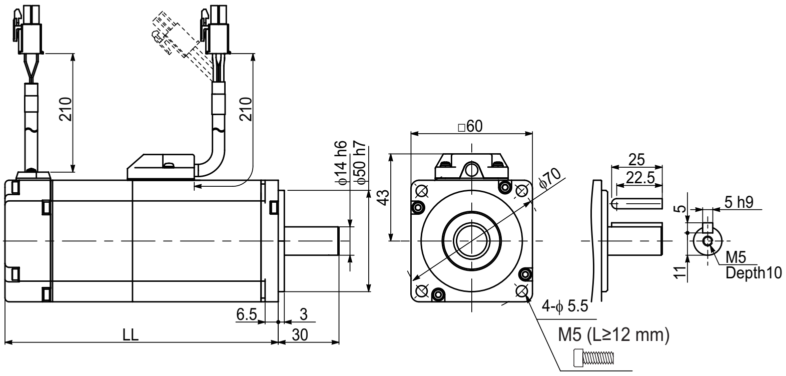


Derating Curve



(mm)

Brake	Without	With
LL	110.5	147.0



1. Motor

750 W

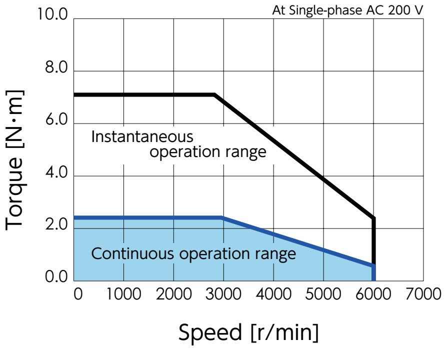
Motor Model : M3B075 C □□□□＊＊

Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	80 sq.
Approximate mass	Without brake	kg	2.2
	With brake		3.0
Compatible amplifier model		–	SD3080C312
Voltage		V	AC200 V to 240 V
Rated output		W	750
Rated torque		N·m	2.39
Instantaneous maximum torque		N·m	7.1
Rated current(stall current)		A	4.2
Instantaneous maximum current		A	12.2
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.63
Induced voltage constant per phase		mV/(r/min)	21.9
Rated power rate	Without brake	kW/s	76.6
	With brake		60.7
Mechanical time constant	Without brake	ms	0.40
	With brake		0.50
Electrical time constant		ms	4.60
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	0.74
	With brake		0.94

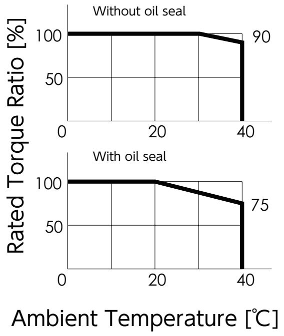
Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24 V ± 10%
Rated current	A	0.4
Static friction torque	N·m	≧ 2.39
Suction time	ms	≦ 70
Release time	ms	≦ 20
Release voltage	V	≧ DC 1 V

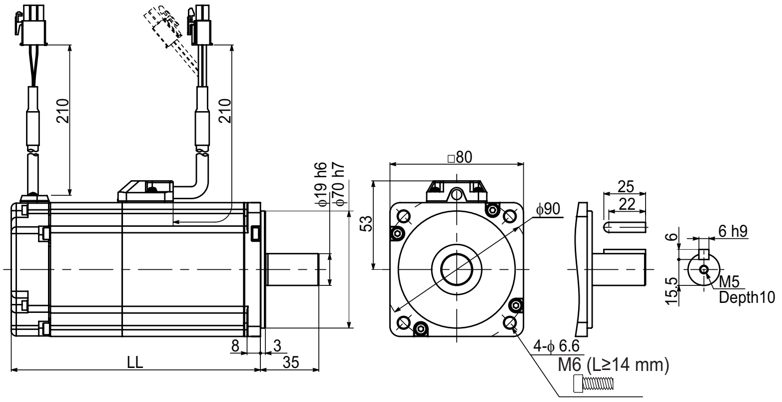
Item	Unit	Specifications
Radial	N	392
Thrust	N	147

Rotational Speed vs. Torque



Derating Curve





(mm)

Brake	Without	With
LL	107.3	144.3

1. Motor

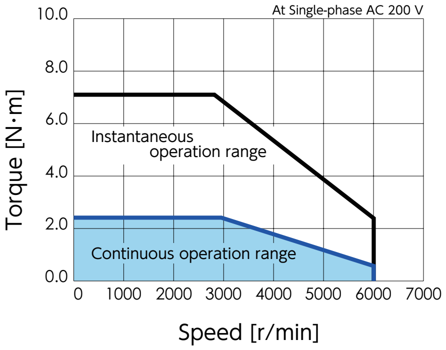
Motor Model : M7B075 C □ □ □ □＊＊

Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	80 sq.
Approximate mass	Without brake	kg	2.5
	With brake		3.3
Compatible amplifier model		–	SD3080C312
Voltage		V	AC200 V to 240 V
Rated output		W	750
Rated torque		N·m	2.39
Instantaneous maximum torque		N·m	7.1
Rated current(stall current)		A	4.2
Instantaneous maximum current		A	12.2
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.63
Induced voltage constant per phase		mV/(r/min)	21.9
Rated power rate	Without brake	kW/s	35.4
	With brake		31.6
Mechanical time constant	Without brake	ms	0.86
	With brake		0.96
Electrical time constant		ms	4.60
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	1.61
	With brake		1.81

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24 V ± 10%
Rated current	A	0.4
Static friction torque	N·m	≧ 2.39
Suction time	ms	≦ 70
Release time	ms	≦ 20
Release voltage	V	≧ DC 1 V

Item	Unit	Specifications
Radial	N	392
Thrust	N	147

Rotational Speed vs. Torque



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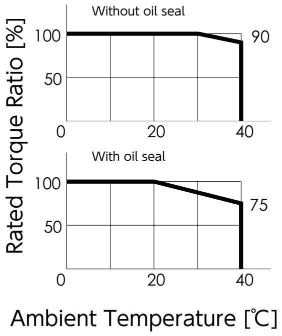
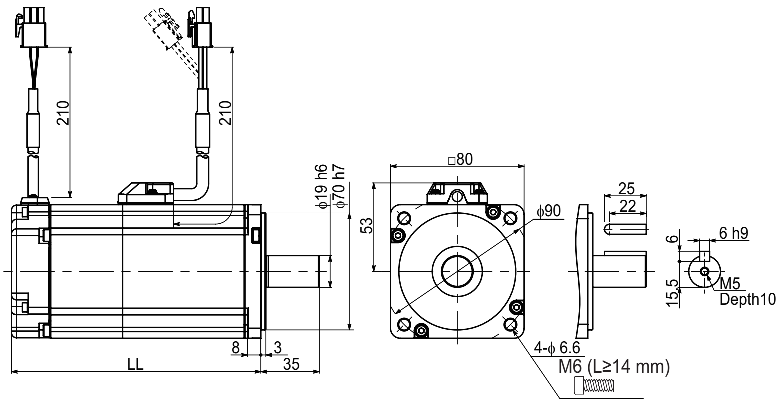




(mm)

Brake	Without	With
L L	122.3	159.3

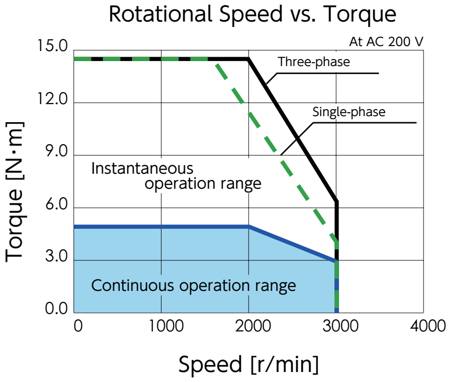
1. Motor

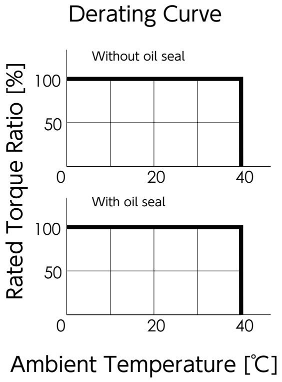
Motor Model : M5A100 C □ □ □ □**

Item		Unit	Specifications
Rotor inertia		–	Middle
Fitting flange size		mm	130 sq.
Approximate mass	Without brake	kg	5.6
	With brake		7.0
Compatible amplifier model		–	SD3100C412
Voltage		V	AC200 V to 240 V
Rated output		W	1,000
Rated torque		N·m	4.77
Instantaneous maximum torque		N·m	14.3
Rated current(stall current)		A	5.6
Instantaneous maximum current		A	16.8
Rated revolving speed		r/min	2,000
Maximum revolving speed		r/min	3,000
Torque constant		N·m/A	0.88
Induced voltage constant per phase		mV/(r/min)	30.9
Rated power rate	Without brake	kW/s	50.0
	With brake		36.5
Mechanical time constant	Without brake	ms	0.76
	With brake		1.05
Electrical time constant		ms	10.1
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	4.56
	With brake		6.24

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24 V ± 10%
Rated current	A	1.0
Static friction torque	N·m	≧ 9.55
Suction time	ms	≦ 120
Release time	ms	≦ 30
Release voltage	V	≧ DC 1 V

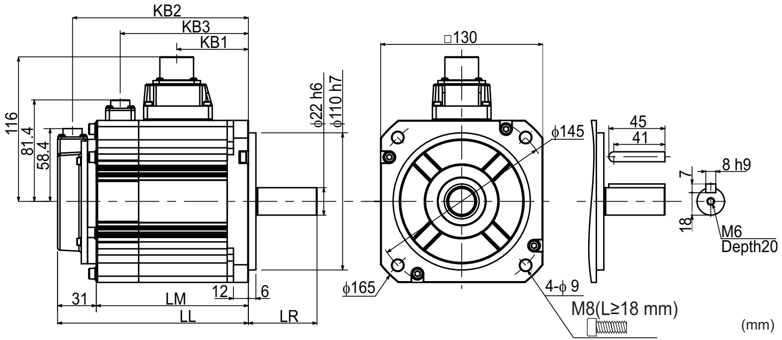
Item	Unit	Specifications
Radial	N	490
Thrust	N	196





(mm)

Brake	Without	With
LL	128.0	153.0
LM	97.0	122.0
LR	55.0	
KB1	57.5	
KB2	116.0	141.0
KB3	–	102.8



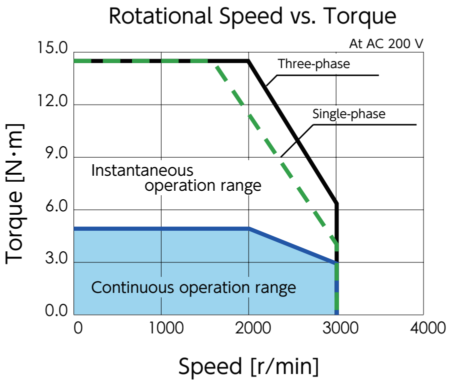
1. Motor

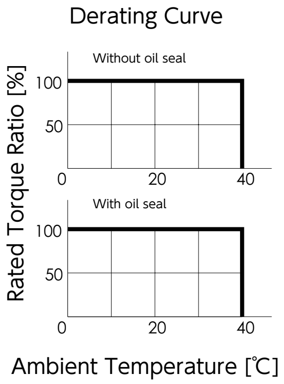
Motor Model : M7A100 C □□□□＊＊

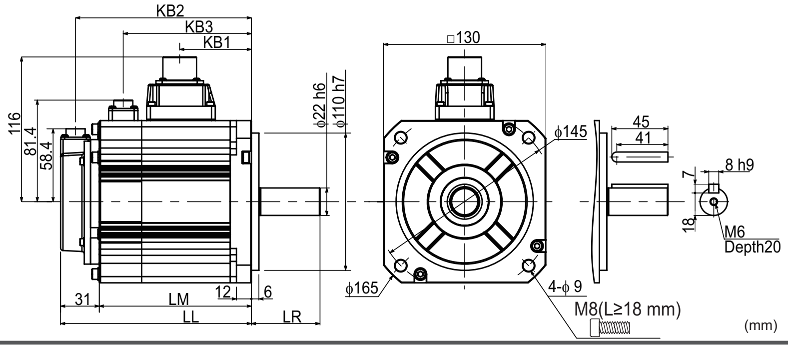
Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	130 sq.
Approximate mass	Without brake	kg	7.6
	With brake		9.0
Compatible amplifier model		–	SD3100C412
Voltage		V	AC200 V to 240 V
Rated output		W	1,000
Rated torque		N·m	4.77
Instantaneous maximum torque		N·m	14.3
Rated current(stall current)		A	5.6
Instantaneous maximum current		A	16.8
Rated revolving speed		r/min	2,000
Maximum revolving speed		r/min	3,000
Torque constant		N·m/A	0.88
Induced voltage constant per phase		mV/(r/min)	30.9
Rated power rate	Without brake	kW/s	9.2
	With brake		8.6
Mechanical time constant	Without brake	ms	4.17
	With brake		4.43
Electrical time constant		ms	10.1
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	24.9
	With brake		26.4

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24 V ± 10%
Rated current	A	1.0
Static friction torque	N·m	≧ 9.55
Suction time	ms	≦ 120
Release time	ms	≦ 30
Release voltage	V	≧ DC 1 V

Item	Unit	Specifications
Radial	N	490
Thrust	N	196







(mm)

Brake	Without	With
LL	163.0	188.0
LM	132.0	157.0
LR	70.0	
KB1	92.5	
KB2	151.0	176.0
KB3	–	137.8

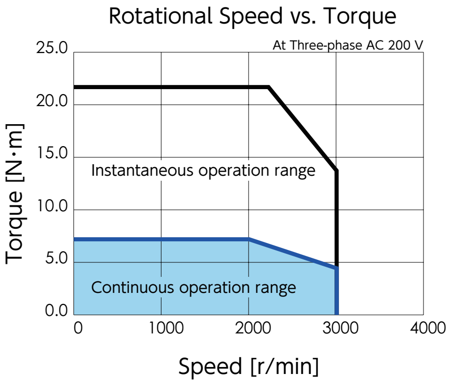
1.5 kW

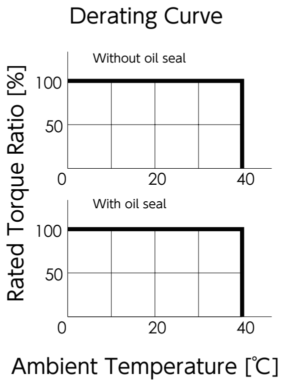
Motor Model : M5A150 C □ □ □ □＊＊

Item		Unit	Specifications
Rotor inertia		–	Middle
Fitting flange size		mm	130 sq.
Approximate mass	Without brake	kg	7.0
	With brake		8.4
Compatible amplifier model		–	SD3150C612
Voltage		V	AC200 V to 240 V
Rated output		W	1,500
Rated torque		N·m	7.16
Instantaneous maximum torque		N·m	21.5
Rated current(stall current)		A	9.0
Instantaneous maximum current		A	27
Rated revolving speed		r/min	2,000
Maximum revolving speed		r/min	3,000
Torque constant		N·m/A	0.81
Induced voltage constant per phase		mV/(r/min)	28.4
Rated power rate	Without brake	kW/s	76.9
	With brake		61.4
Mechanical time constant	Without brake	ms	0.60
	With brake		0.75
Electrical time constant		ms	12.2
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	6.67
	With brake		8.35

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24 V ± 10%
Rated current	A	1.0
Static friction torque	N·m	≧ 9.55
Suction time	ms	≦ 120
Release time	ms	≦ 30
Release voltage	V	≧ DC 1 V

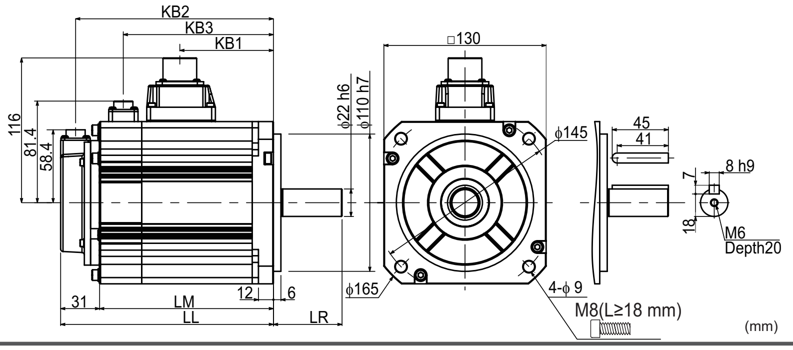
Item	Unit	Specifications
Radial	N	490
Thrust	N	196





(mm)

Brake	Without	With
LL	145.5	170.5
LM	114.5	139.5
LR	55.0	
KB1	75.0	
KB2	133.5	158.5
KB3	–	120.3



1. Motor

1.5kW 130 SQUARE H 3000 2000 IP 67

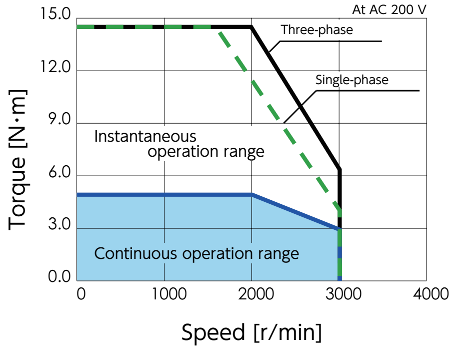
Motor Model : M7A150 C □□□□＊＊

Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	130 sq.
Approximate mass	Without brake	kg	9.0
	With brake		10.4
Compatible amplifier model		–	SD3150C612
Voltage		V	AC200 V to 240 V
Rated output		W	1,500
Rated torque		N·m	7.16
Instantaneous maximum torque		N·m	21.5
Rated current(stall current)		A	9.0
Instantaneous maximum current		A	27
Rated revolving speed		r/min	2,000
Maximum revolving speed		r/min	3,000
Torque constant		N·m/A	0.81
Induced voltage constant per phase		mV/(r/min)	28.4
Rated power rate	Without brake	kW/s	13.8
	With brake		13.3
Mechanical time constant	Without brake	ms	3.32
	With brake		3.46
Electrical time constant		ms	12.2
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	37.12
	With brake		38.65

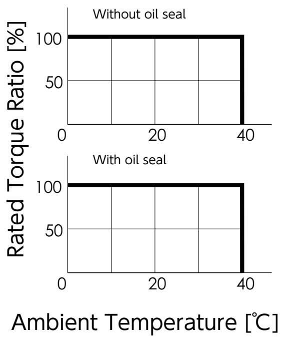
Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24 V ± 10%
Rated current	A	1.0
Static friction torque	N·m	≧ 9.55
Suction time	ms	≦ 120
Release time	ms	≦ 30
Release voltage	V	≧ DC 1 V

Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque

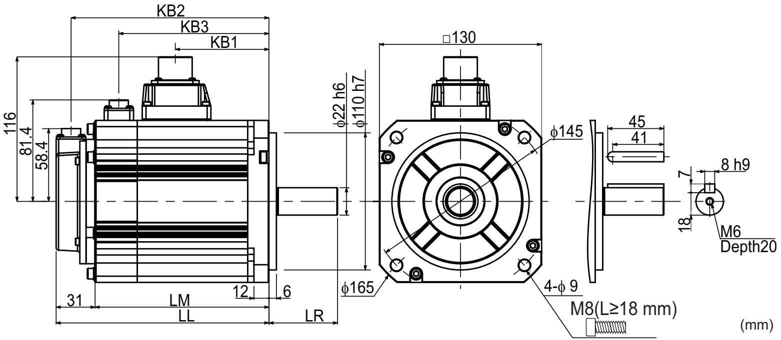


Derating Curve



(mm)

Brake	Without	With
LL	180.5	205.5
LM	149.5	174.5
LR	70.0	
KB1	110.0	
KB2	168.5	193.5
KB3	–	155.3



1. Motor

2 kW

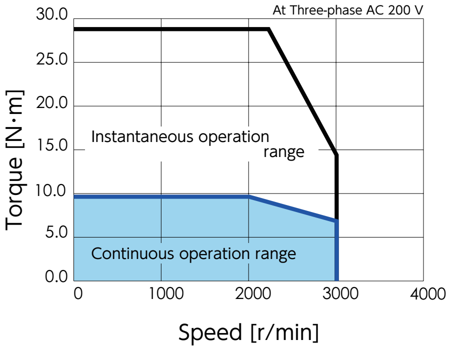
Motor Model : M5A200 C □ □ □ □＊＊

Item		Unit	Specifications
Rotor inertia		–	Middle
Fitting flange size		mm	130 sq.
Approximate mass	Without brake	kg	8.4
	With brake		9.8
Compatible amplifier model		–	SD3200C812
Voltage		V	AC200 V to 240 V
Rated output		W	2,000
Rated torque		N·m	9.55
Instantaneous maximum torque		N·m	28.6
Rated current(stall current)		A	11.9
Instantaneous maximum current		A	35.7
Rated revolving speed		r/min	2,000
Maximum revolving speed		r/min	3,000
Torque constant		N·m/A	0.85
Induced voltage constant per phase		mV/(r/min)	29.6
Rated power rate	Without brake	kW/s	104.9
	With brake		87.9
Mechanical time constant	Without brake	ms	0.58
	With brake		0.69
Electrical time constant		ms	12.2
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	8.70
	With brake		10.38

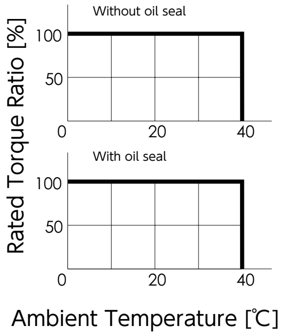
Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC 24 V ± 10%
Rated current	A	1.0
Static friction torque	N·m	≧ 9.55
Suction time	ms	≦ 120
Release time	ms	≦ 30
Release voltage	V	≧ DC 1 V

Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque

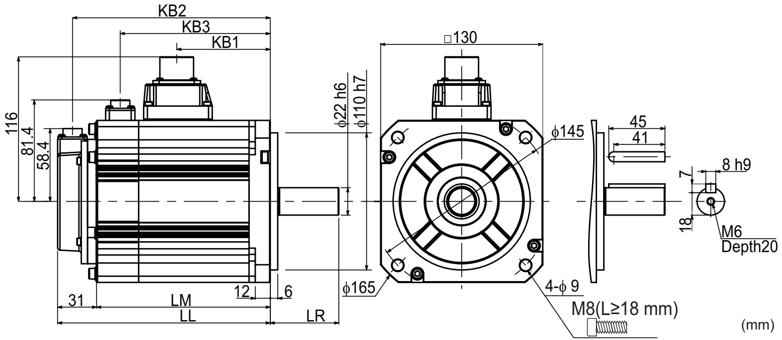


Derating Curve



(mm)

Brake	Without	With
LL	163.0	188.0
LM	132.0	157.0
LR	55.0	
KB1	92.5	
KB2	151.0	176.0
KB3	–	137.8



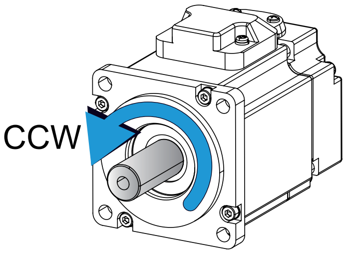
2. Encoder

1. Specifications

Item			Specifications	
Motor model			M□□□□□ C □□□ **C** **	M□□□□□ C □□□ **A** **
Resolution			Incremental 17 bit	Absolute 17 bit
Environmental requirements	Ambient operating temperature		0 to 85℃	
	External disturbance magnetic field		±2 mT (20 G) or below	
Electrical specifications	Power supply	Voltage	DC 4.5 to 5.5 V (Power supply ripple ≦ 5%)	
		Current consumption	160 mA typ.(Not including rush current)	
	External battery	Voltage	–	DC 2.4 to 4.2 V
		Current consumption	–	10 μA typ. (*1)
	Multi-turn count		–	65,536 counts
	Maximum revolving speed		6,000 r/min	
	Count-up direction		CCW (*2)	
	Input/output type		Differential transform	
Communication specification	Transmission method		Half-duplex asynchronous serial communication	
	Communication speed		2.5 Mbps	

*1) Measurement conditions:
room temperature, the motor not in motion, battery voltage of 3.6 V.

*2) CCW when viewed from the load side shaft end.

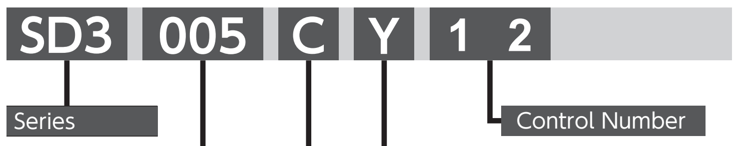


Precautions

Using the motor with rotations of 180 degrees or less will reduce the encoder's rotational accuracy.
For a motor equipped with a brake, follow the brake voltage and polarity specifications.
If the brake voltage is less than 12 V or the polarity is reversed, the encoder's rotational accuracy will be reduced.

3. Amplifier

1. Models



Compatible Motor		
Code	Model	Rated Output
Y	M5□005C□□□□**	50 W
Z	M5□010C□□□□**	100 W
1	M□B020C□□□□**	200 W
2	M□B040C□□□□**	400 W
3	M□B075C□□□□**	750 W
4	M□A100C□□□□**	1 kW
6	M□A150C□□□□**	1.5 kW
8	M5A200C□□□□**	2 kW

Input Power Supply		
Code	Main Circuit Power	Control Power
C	AC200 V to 240 V (*)	DC24 V

(*) Single- or Three-phase option depends on compatible motor.

50 W to 750 W : Single-phase
1 kW : Single-phase / Three-phase
1.5 kW, 2 kW : Three-phase

Main Circuit Power Supply	
Code	Supply
005	50 W
010	100 W
020	200 W
040	400 W
080	750 W
100	1 kW
150	1.5 kW
200	2 kW

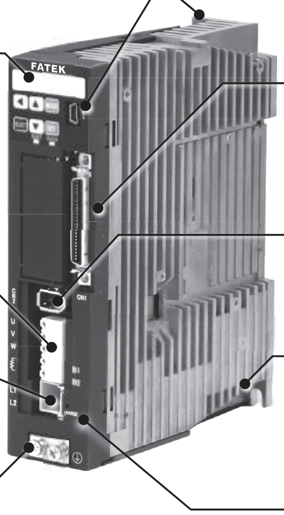
Amplifier / Motor Combinations

Amplifier	Motor		Motor Rated Output Power
SD3 005 CY12	M5B 005 C□□□□ **,	M5G 005 C□□□□ **	50 W
SD3 010 CZ12	M5B 010 C□□□□ **,	M5G 010 C□□□□ **	100 W
SD3 020 C112	M3B 020 C□□□□ **,	M7B 020 C□□□□ **	200 W
SD3 040 C212	M3B 040 C□□□□ **,	M7B 040 C□□□□ **	400 W
SD3 080 C312	M3B 075 C□□□□ **,	M7B 075 C□□□□ **	750 W
SD3 100 C412	M5A 100 C□□□□ **,	M7A 100 C□□□□ **	1 kW
SD3 150 C612	M5A 150 C□□□□ **,	M7A 150 C□□□□ **	1.5 kW
SD3 200 C812	M5A 200 C□□□□ **		2 kW

❗	Use a motor and the amplifier in a correct combination.	⚠ ⚠

2. Names of parts

Amplifier: **50W** **100W** **200W** **400W** 750W 1kW 1.5kW 2kW



Mounting holes

⌀ 5.5 (one location)
The recommended screw: M5x12 mm, with spring washer

Setting panel

Used for parameter setting, tuning, and status display

Motor power connector

UVW: Motor power output
B1 B2: Regenerative resistor connection

Main power connection

L1 L2: Single-phase AC200 V input

FG(Protective earth) terminal

Two terminals:
M4x8 mm screw with spring washer

CN3 PC communication connector

Used for parameter settings, tuning, and status display in the dedicated software "Servo Studio"

CN1 User I/O connector

Control power input, Command input, Parallel I/O, and ABZ output

CN2 Encoder connector

Encoder connection

Mounting notch

⌀ 5.5 (one location)
The recommended screw:
M5x12 mm with spring washer

Hazardous voltage display LED

This will be lit while there is residual hazardous voltage inside the amplifier

Amplifier: 50W 100W 200W 400W **750W** 1kW 1.5kW 2kW

Mounting holes

⌀ 5.5 (one location)
The recommended screw: M5 × 12 mm, with spring washer

Setting panel

Used for parameter setting, tuning, and status display

Motor power connector

UVW: Motor power output

Main power connection

B1 B2: Regenerative resistor connection
L1 L2: Single-phase AC200 V input

Hazardous voltage display LED

This will be lit while there is residual hazardous voltage inside the amplifier

FG(Protective earth) terminal

Two terminals:
M4x8 mm screw with spring washer

CN3 PC communication connector

Used for parameter settings, tuning, and status display in the dedicated software "Servo Studio"

CN1 User I/O connector

Control power input, Command input, Parallel I/O, and ABZ output

CN2 Encoder connector

Encoder connection

Mounting notch

⌀ 5.5 (one location)
The recommended screw:
M5x12 mm with spring washer

3. Amplifier

Amplifier: 50W 100W 200W 400W 750W 1kW 1.5kW 2kW

Mounting holes

⌀ 5.5 (two locations)
The recommended screw: M5x12 mm and 8 mm, with spring washer

Setting panel

Used for parameter setting, tuning, and status display

Motor power connector

UVW: Motor power output

Main power connection

B1 B2: Regenerative resistor connection
L1 L2 L3: Single-phase AC200 V input

Hazardous voltage display LED

This will be lit while there is residual hazardous voltage inside the amplifier

FG(Protective earth) terminal

Two terminals:
M4x8 mm screw with spring washer

CN3 PC communication connector

Used for parameter settings, tuning, and status display in the dedicated software "Servo Studio"

CN1 User I/O connector

Control power input, Command input, Parallel I/O, and ABZ output

CN2 Encoder connector

Encoder connection

Mounting notch

⌀ 5.5 (one location)
The recommended screw:
M5x12 mm with spring washer

3. Specifications

Basic Specifications

Item		Specifications							
Model SD3 □□□□□ 12		50 W 005CY	100 W 010CZ	200 W 020C1	400 W 040C2	750 W 080C3	1 kW 100C4	1.5 kW 150C6	2 kW 200C8
Compatible Motor		M5□005	M5□010	M□B020	M□B040	M□B075	M□A100	M□A150	M5A200
External dimensions		(See "Dimensions" beginning on page 30.)							
Weight (Kg)		0.7				0.8	1.0	1.6	
Input power	Main circuit power	Single-phase AC200 V to 240 V ± 10% 50 / 60 Hz					Three-phase AC200 V to 240 V (*1) ± 10% 50 / 60 Hz		
	Control power (*2)	DC24V ±10%							
	Input current (Arms typ)	0.8	1.3	2.4	3.6	7.2	Single-phase : 9.7 Three-phase : 5.1	6.1	9.0
	Control power Current Consumption (mA Typ.)	170			210	260	240	350	
		(Rush current apprpx.1.4 A)							
Control type		Three-phase PWM inverter sine-wave driven							
Output Rating	Rated current (A)	0.7	1.0	1.7	2.7	4.3	5.6	9.5	12.2
	Output frequencies(Hz)	0 to 500					0 to 250		
Encoder feedback		17 bit single-turn absolute (The product can function as a multi-turn absolute type when batteries are added.)							
Control signal	Input	8-point (24 VDC system, photo-coupler input insulation) inputs whose functions are switched by the control mode							
	Output	8-point (24 VDC system, open-collector output insulation) outputs whose functions are switched by the control mode							
Analog signal	Input	1-point (±10 V) input whose functions can be switched by the control mode							
Pulse signal	Input	RS-422 differential Open-collector							
	Output	Encoder feedback pulse (A−/B−/Z-phase), RS-422 differential output Z-phase pulse through open-collector as well							
Communication function		USB : connection to PC with "Servo Studio" installed RS-485 : host remote control communication (multi-drop compatible)							
Amplifier status display function		Amplifier status display function 6 digits of 7-segment display on Setup Panel Normal/Error display on STATUS LED Green light when Power ON Normal, Red light when Power ON Error, Dim when Power OFF							
Regeneration function		A regenerative resistor may be installed externally (*3)							
Dynamic brake		None (*4) ☞ 3 Preparation							
Control mode		Position Control, Velocity Control, Torque Control							

3. Amplifier

Environmental Specification

Item		Specifications
Ambient temperature	For operation	0 to 55℃ (*5, *6)
	For storage	−20 to 65℃
Ambient humidity	For operation	20 to 85% RH(no condensation)
	For storage	
Atmosphere for operation and storage		Indoors (not subject to direct sunlight), Free from corrosive gases, flammable gases, oil mist, dust, flammables, grinding fluid
Altitude		≦ 1,000 m
Vibration		≦ 5.8 m/s^2 (0.6 G) 10 to 60 Hz (no continuous operation allowed at frequency of resonance)
Dielectric strength		AC 1,500 V for one minute across the primary and FG
Electric shock protection		ClassI(mandatory grounding)
Overvoltage category		Ⅱ
Installation environment		Pollution degree 2

Functions Specifications

Position Control Mode

Item		Specifications
Pulse Input	Control input	Servo ON, alarm reset, command input not allowed, emergency stop, deviation counter clear, 2-stage torque limit, CCW/CW run not allowed, ABS data demand, homing start
	Control output	Alarm status, servo status, servo ready, under torque limit, brake release, positioning complete, motion complete, alarm, dynamic brake release, ABS data transmitting, homing complete
	Maximum command pulse frequency	RS-422 differential: 4 Mpps Open-collector: 200 kpps
	Input pulse signal form (*7)	pulse and direction (PLS + DIR), quadrature phase difference pulse (A-phase + B-phase), positive or negative pulse (CCW + CW)
	Command pulse-paired ratio	ratio A/B: 1/1,000 < A/B < 1,000 Setting range A: 1 to 65,535, Setting range B: 1 to 65,535
Internal Position	Control input	Servo ON, alarm reset, deviation counter clear, motion start point selection 16, home position sensor input, homing start
	Control output	Alarm status, servo status, servo ready, under torque limit, brake release, homing complete, motion complete
	Operation mode	Point table, communication operation
Smoothing filter		FIR Filter
Damping control		Enabled

Velocity Control Mode

Item		Specifications
Analog Velocity	Control input	Servo ON, alarm reset, command input inhibit (zero torque command), 2-stage torque limit, CCW/CW run prohibited
	Control output	Alarm status, servo status, servo ready, under torque limit, brake release
	Speed command input	Input voltage: − 10 V to +10 V (max speed is reached at ± 10 V
Internal Velocity	Control input	Servo ON, alarm reset, start 1 (CCW), start 2 (CW), 8-stage speed command 2-stage torque limit
	Control output	Alarm status, servo status, servo ready, under torque limit, brake release
Smoothing filter		IIR Filter, FIR Filter

3. Amplifier

Torque Control Mode

Item		Specifications
Analog Torque	Control input	Servo ON, alarm reset, command input not allowed (zero clamp command) 2-stage torque limit, CCW/CW run prohibited
	Control output	Alarm status, servo status, servo ready, under torque limit, brake release
	Torque command input	Input voltage, − 10 V to +10 V (max speed is reached at ± 10 V)
Smoothing filter		IIR Filter

Common Features

Item		Specifications
Speed observer		Available
Auto-tuning		Available
Encoder output Division /Multiplication		Available
Tuning & Function Setup		Available through the SD3 series setup software "Servo Studio" Tuning with the setup panel on the amplifier front side
Protective functions	By hardware	Overvoltage, low voltage, Overcurrent, Abnormal temperature, Overload, Encoder error
	By software	Overspeed, Position deviation too high, Parameter errors
Alarm Log		Can be referenced with the setup software "Servo Studio"

3. Amplifier

Notice

*1) In the Amplifier SD3100C412 (1 kW), single-phase can be used for primary circuit power source.
To use single-phase 200 to 240 VAC, connect it to the primary circuit power connectors L1 and L3.

Item		Specifications	
Amplifier Model		SD3100C412	
Compatible Motor		1kW (M5A100C □□□□ **., M7A100C □□□□ **)	
Primary Circuit Power Supply	Voltage Range	Three-phase 200 to 240 VAC ± 10% 50/60 Hz	Single-phase 200 to 240 VAC ± 10% 50/60 Hz
	Input Current	Rated at 4.5 A (200 VAC input) Rated at 3.8 A (230 VAC input) Up to approximately 13 A	Rated at 8.6 A (200 VAC input) Rated at 7.3 A (230 VAC input) Up to approximately 23 A

*2) Use SELV (Safety Extra Low Voltage/Non-Hazardous Voltage) power supply with reinforced isolation from hazardous voltage.
As a countermeasure against amplifier failure, install overcurrent protection or use power output capacity of no higher than 100 W.
The current consumption values in the table assume that no I/O signals except the Servo-On signal are connected.
Current consumption by all I/O signals in use must be added up.

If multiple amplifiers are to share control power, select power source that will support the total inrush current of all connecting amplifiers.

*3) Regenerative resistor values do not guarantee optimal performance. If the generated heat temperature becomes too high, increase the resistance value or select a resistor whose allowable power is larger enough. Whether or not a regenerative resistor installation is necessary can be checked on the Setup Panel or "Servo Studio".

☞ 3 Preparation
☞ 5 Setting Parameters

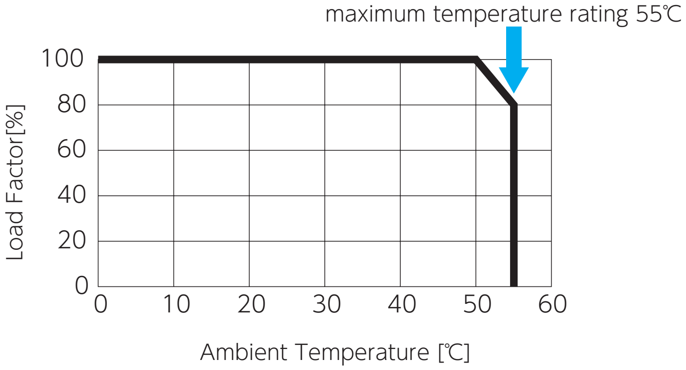
*4) SD3 series amplifiers are equipped with a software-based dynamic braking function to stop the equipment.
This dynamic braking function does not necessarily work in case of disconnection from control power such as amplifier failure and power outage.
If you are to make your own dynamic brake circuit, perform thorough testing before actual use.

☞ 3 Preparation

*5) When mounting amplifiers to an enclosure such as a protection case, install a cooling devise, or secure required clearance around it so that ambient temperature will not rise above the specification temperature.

☞ 3 Preparation

*6) For 2 kW amplifier (SD3100C412), refer to the following temperature derating curve.



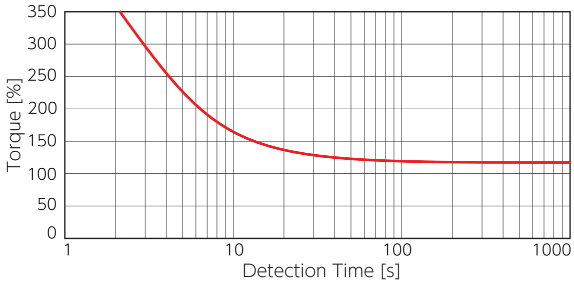
*7) The minimum time interval varies depending on input format.

☞ 4 Connections

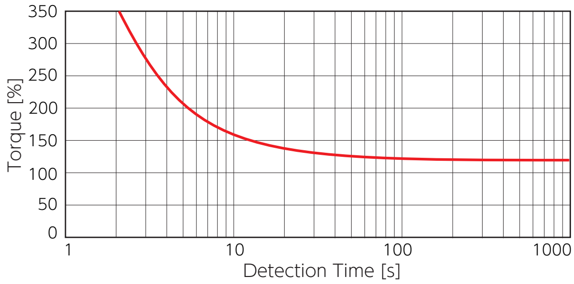
Overload Detection Feature

SD3 series amplifiers features overload protection-overload alarm output and emergency stop upon alarm output - in case of motor operation with load level above the overload detection curve shown below.

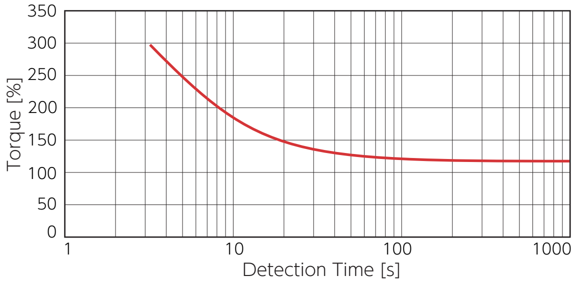
50W



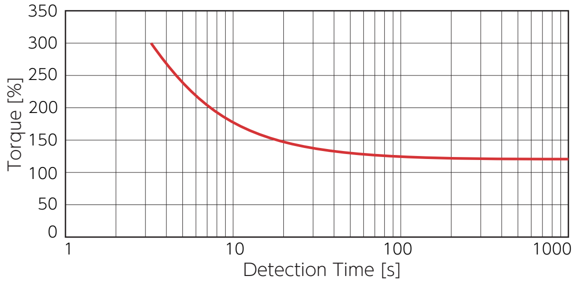
100W



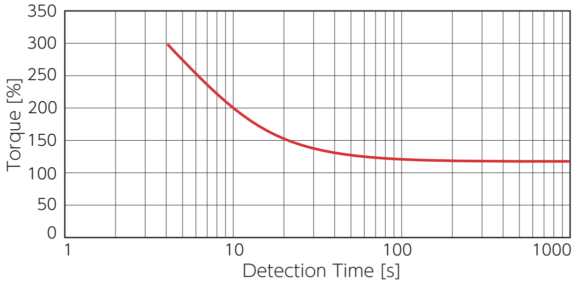
200W



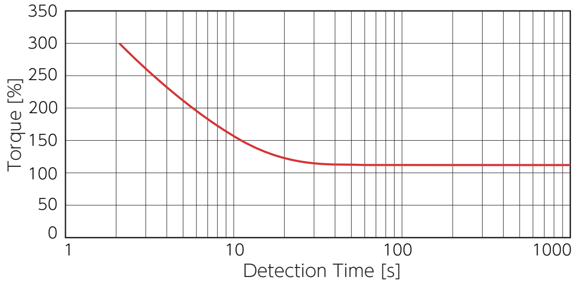
400W



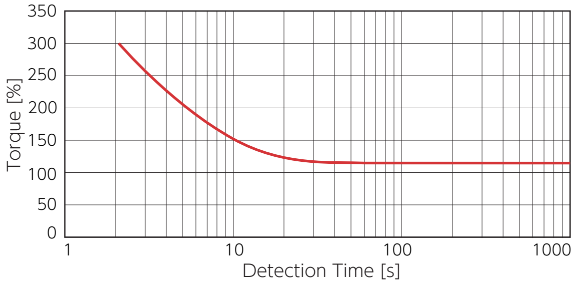
750W



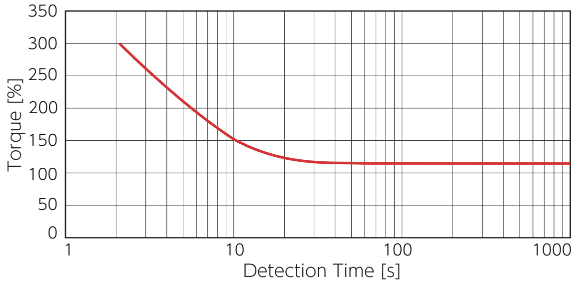
1kW



1.5kW



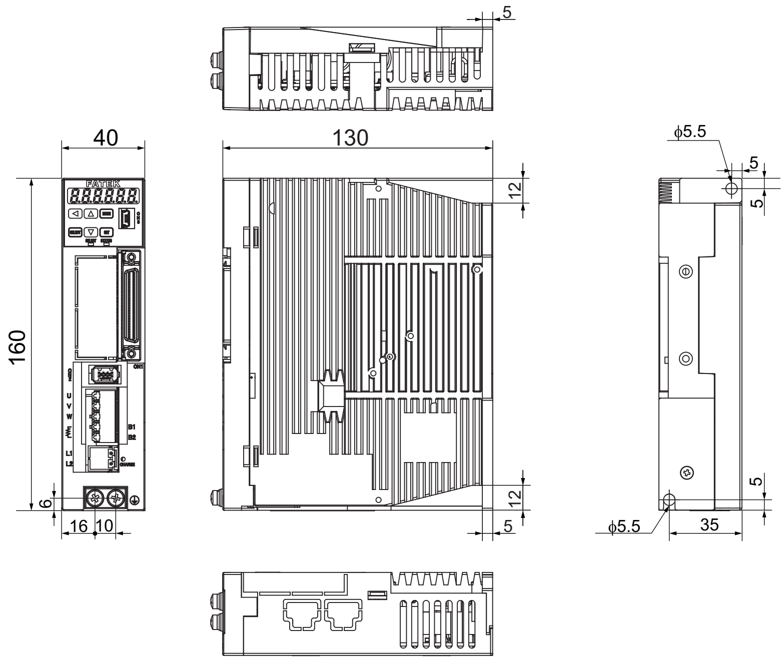
2kW

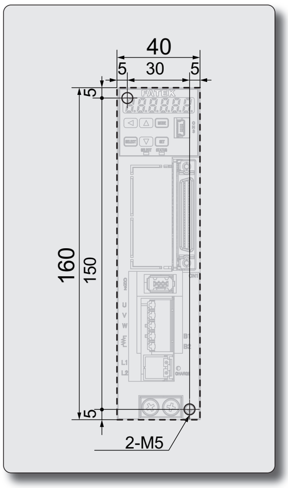


4. Dimensions

Figure 1

50W 100W 200W 400W 750W 1kW 1.5kW 2kW



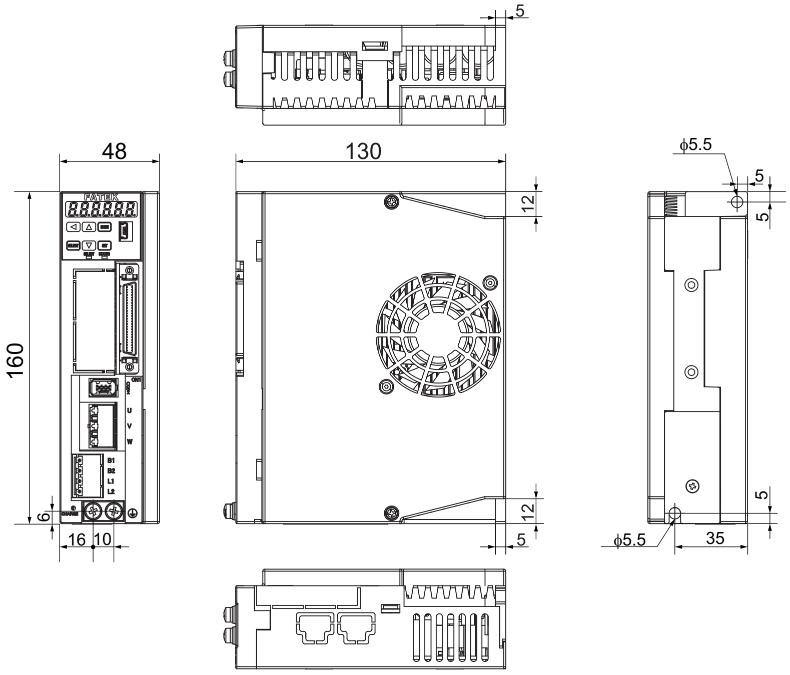


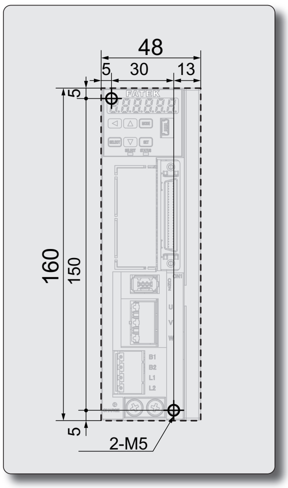
Mounting Dimension

(mm)

Figure 2

50W 100W 200W 400W 750W 1kW 1.5kW 2kW



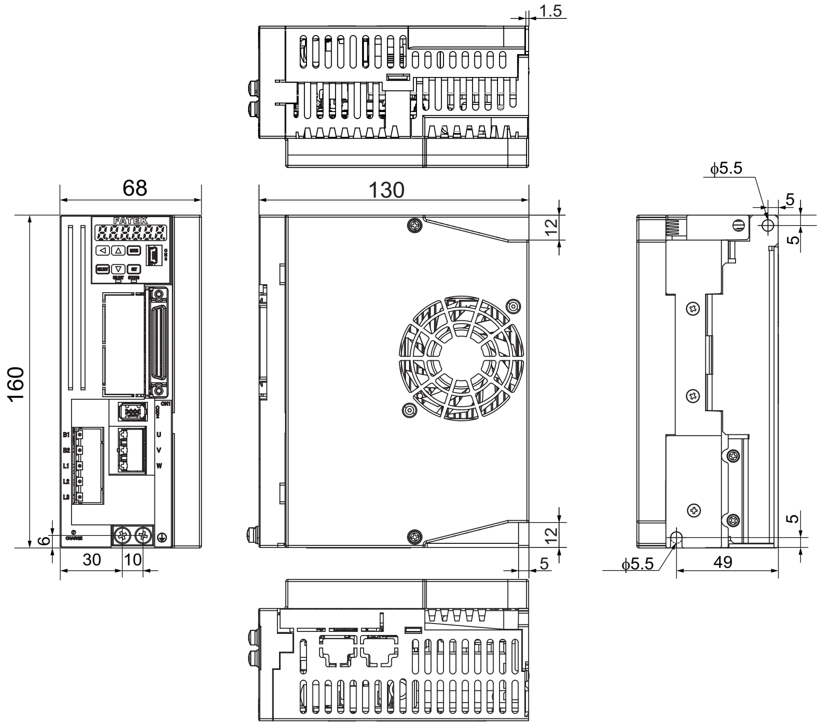


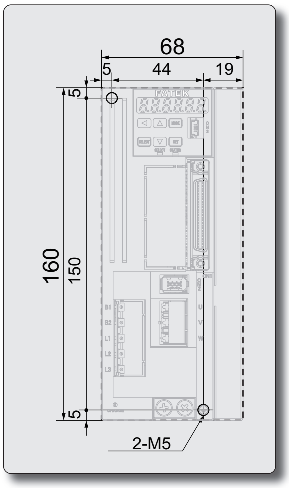
Mounting Dimension

(mm)

Figure 3

50W 100W 200W 400W 750W **1kW** 1.5kW 2kW



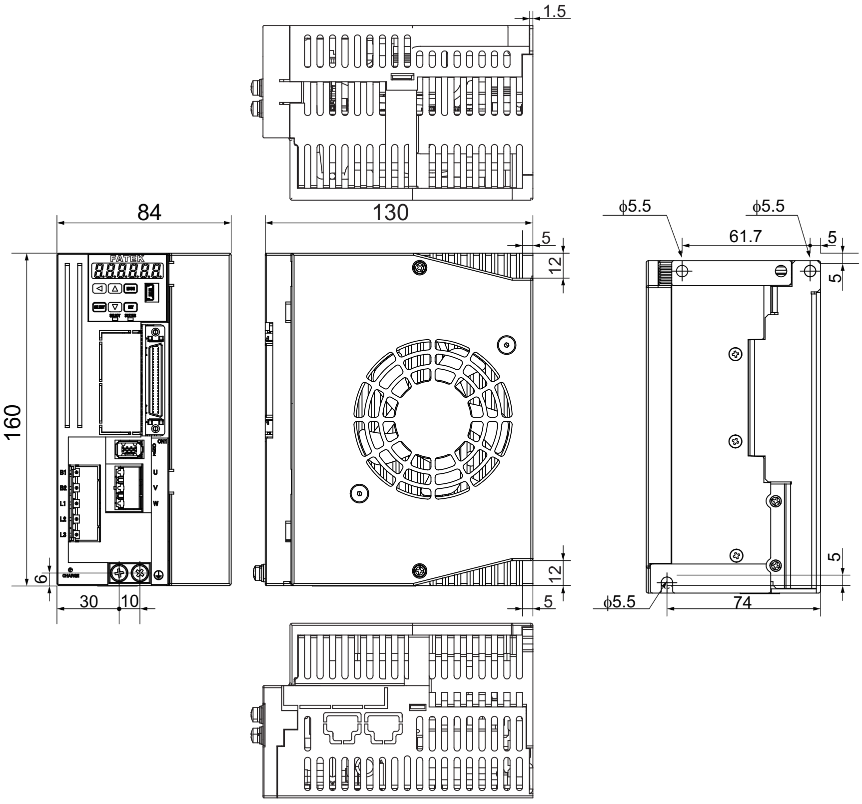


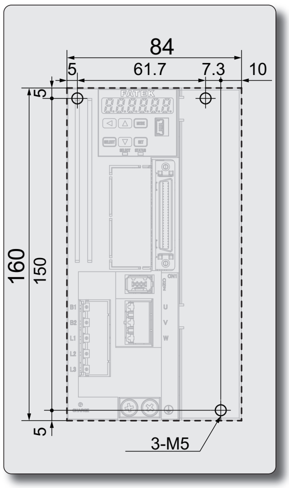
Mounting Dimension

(mm)

Figure 4

50W 100W 200W 400W 750W 1kW **1.5kW** **2kW**





Mounting Dimension

(mm)

MEMO

3 Preparation

1. Installation

Installation and Operating Environment

Ensure that the environments for installation and operation meet the requirements specified in this document.

Should you use the product in conditions different from the specifications, please contact us.

- Do not install the product where it could be directly exposed to direct sunlight.
- Be sure to install each amplifier inside a control panel.
- Install the product in an environment free from humidity and ingress of water and oil such as cutting oil and oil mist.
- Never use the product in ambient air of explosive or flammable gases, chloride, acidic or alkaline corrosive ambiance such as sulfur dioxide, chlorine, ammonia and so on.
- Use the product in an environment free from dust, iron dust, and chips.
- Do not use the product near locations exposed to high temperatures, continuous vibrations, or excessive shock.

Precautions

- The control power and the host control device must share one power supply (24 VDC).
- When performing maintenance, be sure to turn off the circuit breaker of the main power in advance.
- Be aware of the residual voltage in the amplifier remaining for 5 minutes after the main power shut off.
- Never attempt to replace a fuse.
- The amplifier of 750 W or more has a cooling fan on the right side.
  Do not touch or block the air vent of the amplifier. Do not place objects which would block the air vent.

Dust-proof and Waterproof

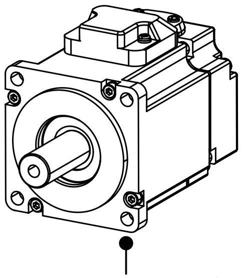
SD3 Series Amplifiers are not waterproof.

The protective enclosure rating of motors depends on the rated output.

50 W to 750 W : IP65
1 kW to 2 kW : IP67
(except for the shaft output component and the connectors)

1. Motor Installation

Do not use any other screws but those in the recommended sizes.



Recommended Motor Mounting Screws

Motor Model	Mounting Hole	Hexagon socket head bolt
50 W:	2- ø 4.5	M4 × 12 mm or more
100 W:		
200 W:	4- ø 5.5	M5 × 12 mm or more
400 W:		
750 W:	4- ø 6.6	M6 × 14 mm or more
1 kW:	4- ø 9.0	M8 × 18 mm or more
1.5 kW:		
2 kW:		

Installation Precautions

Never remove the encoder from the motor or disassemble the motor.
The motor shaft has anti-rust oil applied at the time of shipment. Before installing the motor, wipe off the oil completely
Perform precise axis alignments. Otherwise, the motor operation will cause vibration or result in shorter service life of the motor.

Shock and Impact Force

When transporting, installing or removing the motor, do not apply excessive impact force or load.
Do not hold the encoder unit, cables, or connectors when carrying the motor.
Shock resistance of the motor is 200 m/s^2 (20 G) or less.
During installation or operation, radial load or axial load applied to each motor has to be within the withstand rating.
When attaching a coupling to the motor shaft end or removing it, avoid direct impact by a tool such as hammer.
To remove the pulley, coupling, or any other parts from the shaft, use a puller.

1. Installation

Connection with Machines

Use a coupling to absorb angle and direction deviations so that the motor shaft load will be less than the rated allowable axial load.
Otherwise, the bearing life in the motor will be shorter, or the shaft may become damaged.
If you are using a rigid coupling, install it very carefully such that the axial misalignment will be minimal. (Using a flexible coupling is recommended.)

Countermeasure for Oil and Water

Do not use any cable immersed in water or oil.
Install the motor such that the cable side is facing downward.
Do not use the motor in an environment where it will be constantly subjected to oil or water splash.
In the case that a speed reducer to be connected to a motor will be located over the motor shaft, use an oil-sealed motor so that no oil from the speed reducer permeates into the motor.

Types of Mounting and OilSeal

SD3 series motors can be mounted in two different ways, horizontally and vertically. Observe the following precautions for motor installation.

Horizontal Installation

To protect the motor from oil or water, have the cable-pull side downward.

Vertical Installation

If a speed reducer is connected to a motor such that it will be located over the motor shaft, use an oil-sealed motor so that no oil from the speed reducer permeates into the motor.

Stress to the Cables

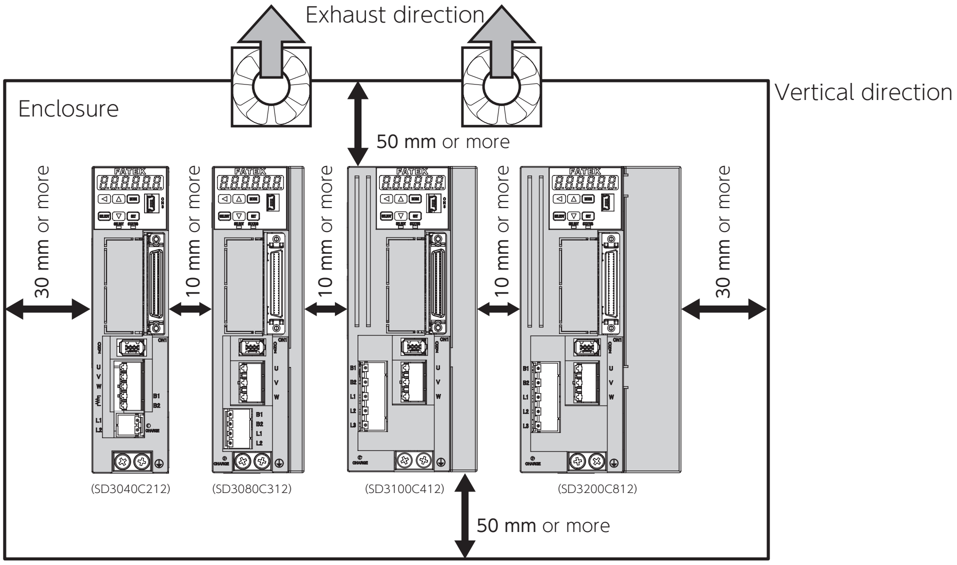
Be careful not to apply stress, such as excessive bending or motor weight, to the cable-pull part or its connecting section.
In motor movable operation, be sure to use a flexible cable.
When placing the cable in a cableveyor, minimize the bending stress to the cable.
Bending radii of the motor power cable must be more than R20 mm.

2. Amplifier Installation

🚫	Do not turn on the primary circuit power or the control power until all wiring work is completed.	⚠

Mounting Orientation and Clearance

❗	When installing amplifiers, secure required clearances for protective enclosures and control panels for heat dissipation and air flow.	⚠



- ■ Install all amplifiers vertically. Use M5 screws at two locations to mount 50 W to 750 W amplifiers and three locations to mount 1 kW to 2 kW amplifiers.

☞ 2 **Specifications:** Amplifier Dimensions

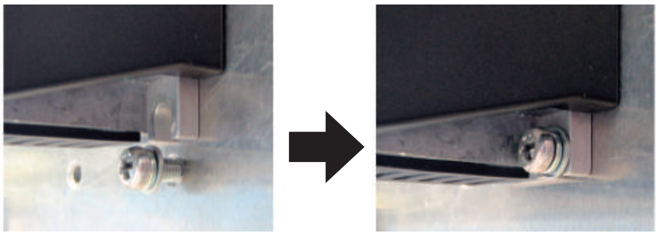
- ■ If you are mounting the amplifier into an enclosure such as protective casing, use a fan or air conditioner so that the ambient temperature inside each board will not exceed 55℃.
- ■ The temperature of the heat sink at its surface may become 30℃ (or more) higher than the ambient temperature.
- ■ Use heat resistant wiring materials and keep amplifiers away from heat-sensitive equipment and wiring.
- ■ The service life of each amplifier depends on the ambient temperatures of the internal electrolytic capacitor. Electrolytic capacitors last approximately 5 to 6 years under the conditions of 30℃ annual average temperature, 80% load factor, and 20 hours or less average daily operation.

1. Installation

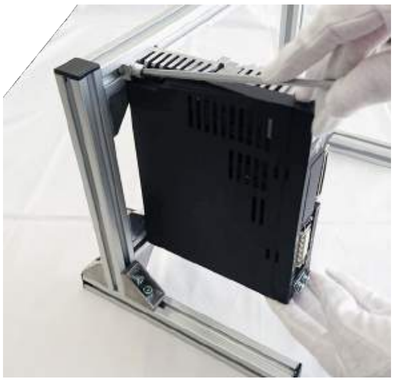
Mounting Amplifiers

Be sure to mount each amplifier on conductive surface such as aluminum brushed plate.

Hook the U-shaped installation notch of the amplifier to the bolt that has been screwed in advance.



Tighten the mounting screws on the amplifier top.



Loosely screw all amplifier to the chassis first, and then securely tighten them all together.
(Tightening torque: 1.4 N·m to 1.6 N·m)

⚠ DANGER

❗	Be mindful when wiring and handling high voltage materials	⚠ ⚠ ⚠

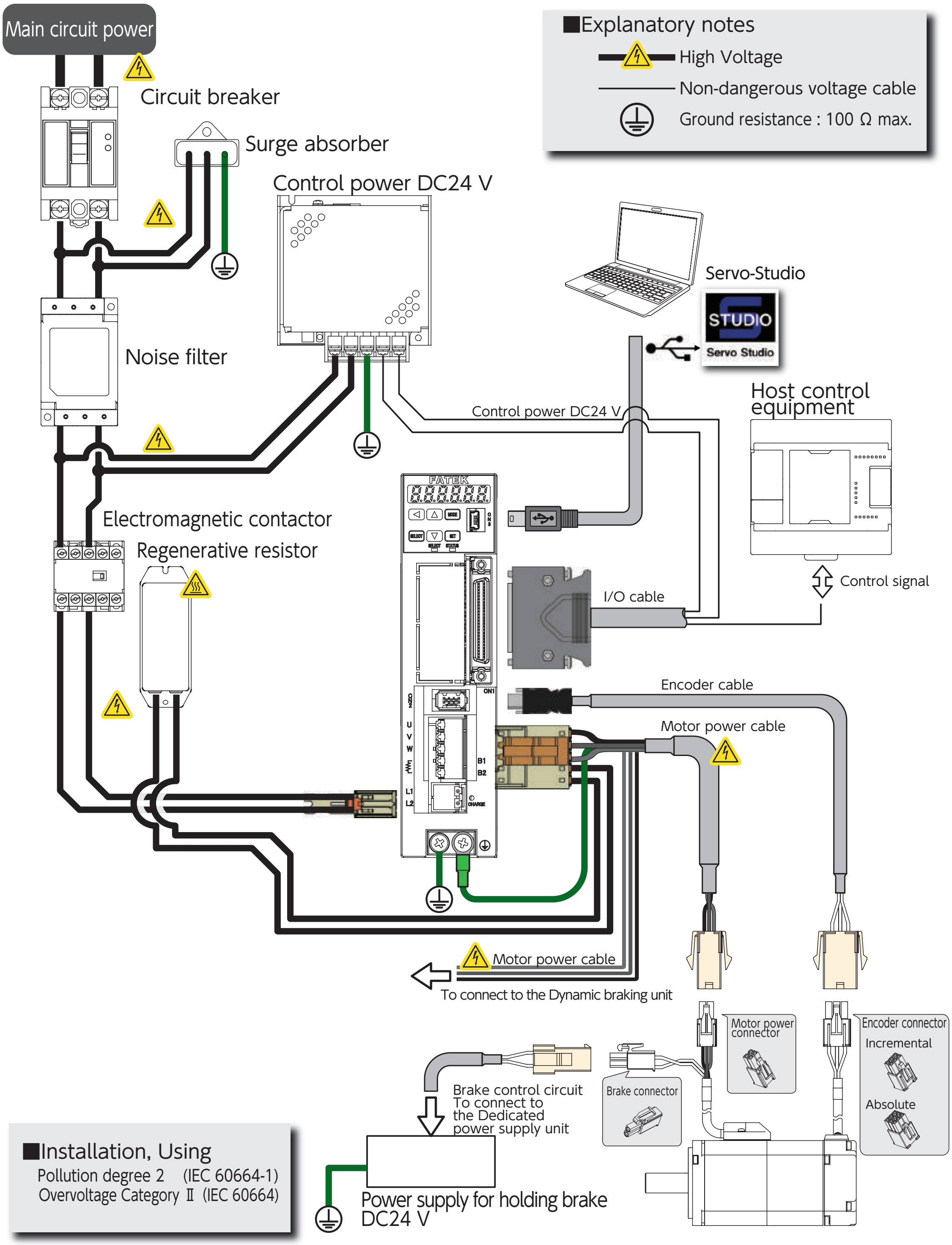
❗	To comply with the EC Directive, select appropriate devices, each of which is compliant with its applicable standards.
	FG connection is a must.
	Connect the input power of control power to the same power supply that the primary circuit power is connected to.
	Do not use the electromagnetic contactor (installed on the primary circuit power side) to run or stop the motor.
	Do not install a switch between the control power supply and the amplifier. Install the switch on the primary input side of the control power supply.
	For high-voltage cables, use wires of 600 V withstand voltage or more.
	For a CN1 connector cable, use a shielded twisted-pair cable of 2 m or less.
	The encoder cable length must be 20 meters or less.
	For stranded wire, use insulation coating, rod or ring crimp terminals.

2. System Wiring

1. System Wiring

Wiring Pattern 1

50W 100W 200W 400W 750W 1kW 1.5kW 2kW



■Explanatory notes

- High Voltage
- Non-dangerous voltage cable
- Ground resistance : 100 Ω max.

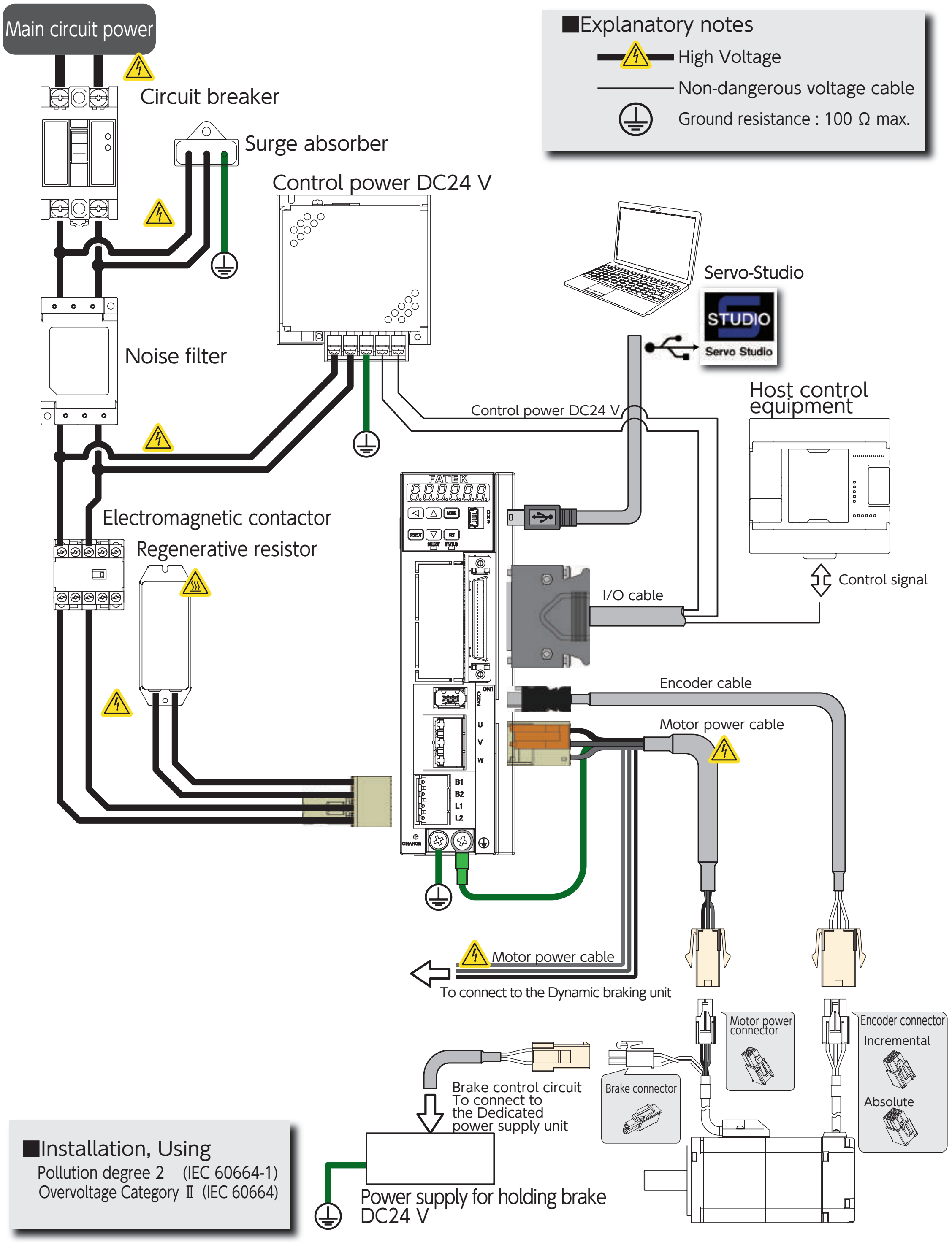
■Installation, Using

Pollution degree 2 (IEC 60664-1)
Overvoltage Category Ⅱ (IEC 60664)

2. System Wiring

Wiring Pattern 2

50W 100W 200W 400W **750W** 1kW 1.5kW 2kW



■Installation, Using

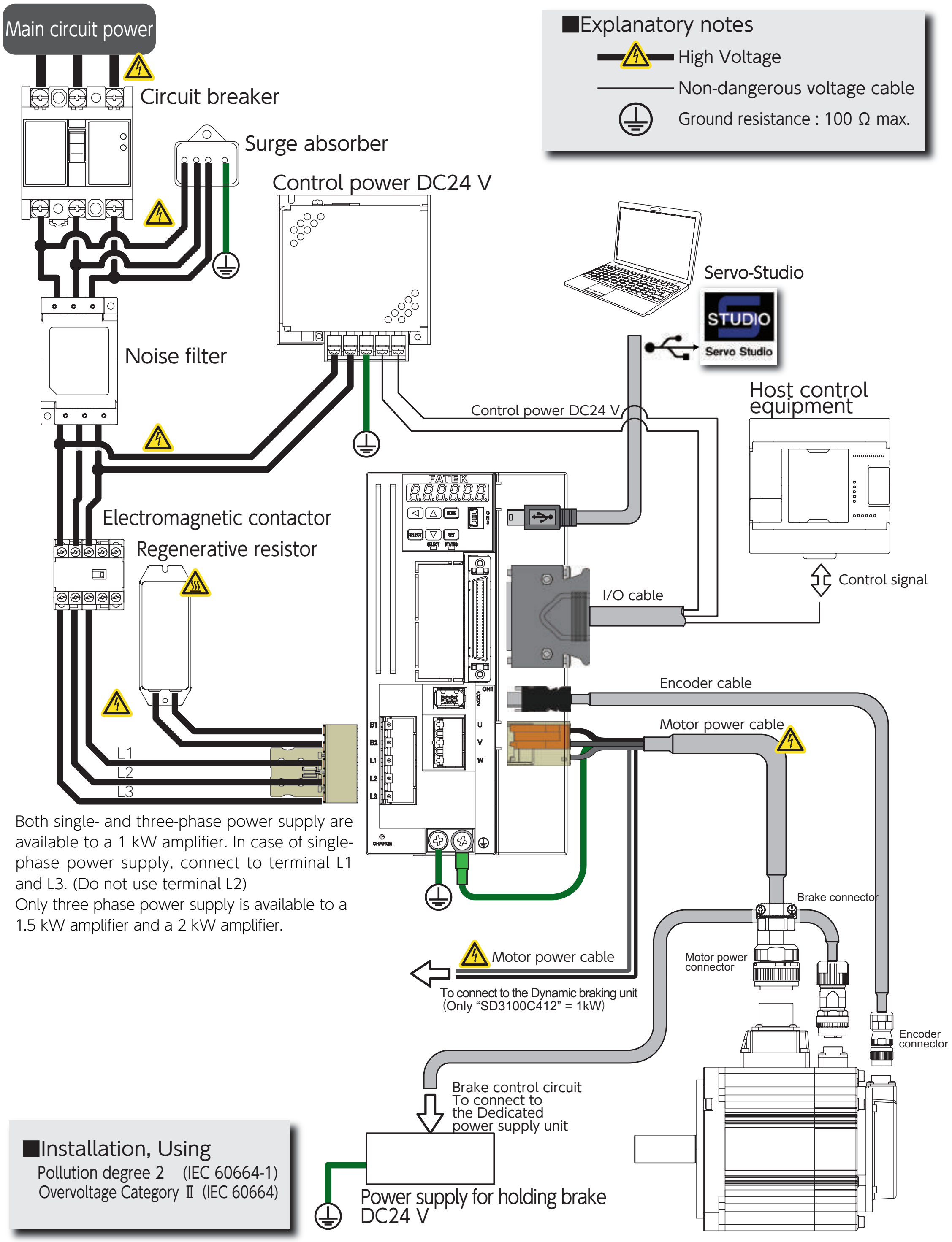
Pollution degree 2 (IEC 60664-1)

Overvoltage Category Ⅱ (IEC 60664)

2. System Wiring

Wiring Pattern 3

50W 100W 200W 400W 750W **1kW** **1.5kW** **2kW**



■Explanatory notes

⚠ High Voltage

Non-dangerous voltage cable

⏚ Ground resistance : 100 Ω max.

Both single- and three-phase power supply are available to a 1 kW amplifier. In case of single-phase power supply, connect to terminal L1 and L3. (Do not use terminal L2)
Only three phase power supply is available to a 1.5 kW amplifier and a 2 kW amplifier.

■Installation, Using

Pollution degree 2 (IEC 60664-1)
Overvoltage Category Ⅱ (IEC 60664)

2. System Wiring

2. Connecting Equipments and Recommended Peripherals

Main circuit power

Please use this product in the power supply environment of Over-Voltage Category Ⅱ defined by IEC60664-1.
This is the primary circuit power for amplifiers.
Using a overvoltage protection relay is recommended.

50 W to 750 W	:Single-phase	AC200 V to 240 V	± 10%	50/60 Hz
1 kW to 2 kW	:Three-phase	AC200 V to 240 V	± 10%	50/60 Hz

- When having single-phase power wired to a 1 kW amplifier, wire the primary circuit AC200 V between the L1 and L3 terminals of the amplifier.
- To avoid unbalance of the three-phase AC200 V wiring in your factory, we recommend that you consider balance of currencies in your three-phase wirings.
- Confirm that your contract with the electric power company is not limited to use of three-phase.

Control power

This is power supply of DC24V ± 10% for amplifier control power, I/O power and motor brake release power.
Use a SELV (Safety Extra Low Voltage) power supply with reinforced insulation against hazardous voltages.
Be sure to connect a varistor to the motor braking release power supply.

Cables

Use of UL wires and cables suitable for motor rated output are recommended.
Should you use a cable longer than the specification, please contact us in advance.

High-voltage cables and FG cables:

For 50 W to 750 W	: AWG18 / 600 V breakdown voltage or equivalent
For 1 kW to 2 kW	: AWG14 / 600 V breakdown voltage or equivalent

Motor power cables:

For 50 W to 750 W	: AWG18 / 300 V breakdown voltage or equivalent
For 1 kW to 2 kW	: AWG14 / 300 V breakdown voltage or equivalent

Encoder cables:
AWG22 and AWG24 compound / 30 V breakdown voltage or equivalent
Shielded cables with twisted pair wires
Length not exceeding 20 m

User I/O cable:
AWG26 / 300 V breakdown voltage or equivalent
Shielded cables with twisted pair wires
Length not exceeding 2 m

Circuit breaker

To protect the power supply line, circuit breakers shut the circuit down in the event of over-current.
Be sure to use an IEC standard and UL-certified circuit breaker between the power supply and the noise filter.
To ensure compliance with EMC, use an earth leakage circuit breaker that we recommend.

Recommended Product	Fuji Electric Co Ltd	Single-phase: EW32AAG-2P020B Three-phase: EW32AAG-3P020B

20 A for single-phase (three-phase) 200 V
Leakage current of 30 mA. An equivalent product is acceptable
Select the capacity and other characteristics according to your entire system configuration.

Noise filter

Noise filters prevent ingress of external noise from the power supply line.To ensure compliance with EMC, use the recommended noise filter.

Recommended Product	OKAYA Electric Industries Co Ltd	Single-phase: SUPF-EX □□ -ER-6 Three-phase: 3SUPF-BE □□ -ER-6- □

Included in SD3 series amplifier's EMC testing.
Select the capacity and other characteristics according to your entire system configuration.

Electromagnetic contactor

This is an on/off switch for the main power supply. Use a surge absorber on the input side of the primary circuit power supply.

Recommended Product	Fuji Electric Co Ltd	SK06G-E10

An equivalent product is acceptable.
Select the capacity and other characteristics according to your entire system configuration.

Surge absorber

To ensure compliance with EMC, connect the recommended surge absorber to the primary side of primary circuit power supply.

Recommended Product	OKAYA Electric Industries Co Ltd	Single-phase: LV275DI-Q4 Three-phase: LV275DI-U4

Included in SD3 series amplifier's EMC testing

Signal line noise filter/ferrite core

To ensure compliance with EMC, use the recommended signal line noise filter/ferrite core.

Recommended Product	SEIWA ELECTRIC MFG. CO., LTD. (MISUMI Corporation)	E04SR401938 (ATCK-1130)

Included in SD3 series amplifier's EMC testing

Regenerative resistor

This product is not equipped with regenerative resistor. If the smoothing capacitor inside the servo amplifier cannot absorb regenerative power, an external regenerative resistor is required. As a guideline, check the regeneration state on the settings panel, and use a regenerative resistor if the regenerative voltage warning is ON. Build an overheating prevention circuit using a resistor which has built-in thermostat. If the temperature of generated heat becomes high, you can suppress the heat by installing a cooling device, or selecting a resistor whose allowable power is 5 to 10 times larger than regenerative voltage.

Recommended Product	Chiba Techno Co., Ltd.	For 50 W to 750 W: CAN100S 47 Ω J For 1 kW., 1.5 kW : CAN400S 30 Ω J For 2 kW : CAN750S 20 Ω J

When considering a regenerative resistor other than the recommended above, use the following as a guideline.

Motor Rated output	50 W	100 W	200 W	400 W	750 W	1 kW	1.5 kW	2 kW
Regeneration Resistance	40 Ω to 50 Ω					30 Ω		20 Ω
Regeneration Allowable Wattage	20 W					40 W		60 W
Recommended Wattage	100 W to 200 W					400 W to 800 W		600 W to 1,200 W

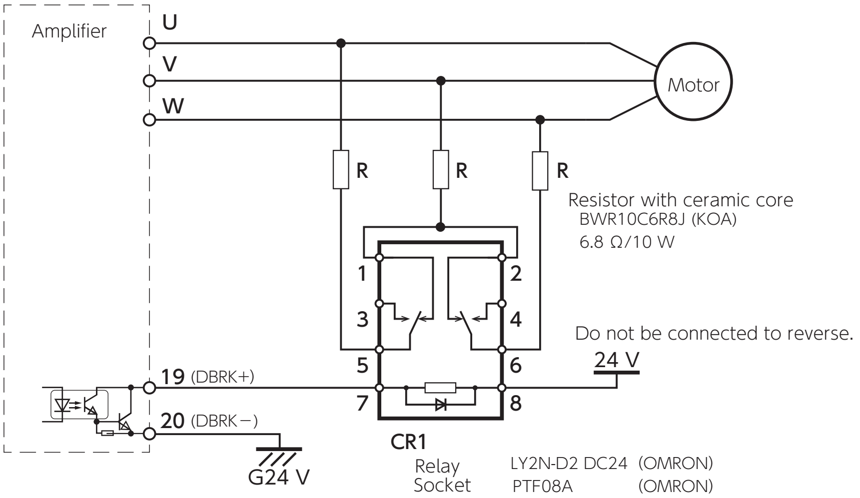
The regeneration resistance values do not guarantee the optimal performance. Regeneration allowable voltages above are minimum values as a point of reference.
The regeneration resistor may become very hot. It requires sufficient margin of regeneration allowable power.

2. System Wiring

Dynamic brake

This product is not equipped with a dynamic brake feature. Use the following circuit example when building a dynamic brake circuit.

Select a cement resistor of 6.8 Ω 10 W.
Select coil surge protection relays with diode.
For wiring with the motor power line, UL wires (AWG18 / 600 V or equivalent) are recommended.



To build a dynamic brake circuit, please use our recommended products listed below.

	Device	Manufacturer	Model Code
Recommended Product	Relay	OMRON	LY2N-D2 DC24V
	Relay socket	OMRON	PTF08A
	Resistor with ceramic core	KOA	BWR10C6R8J

Grounding

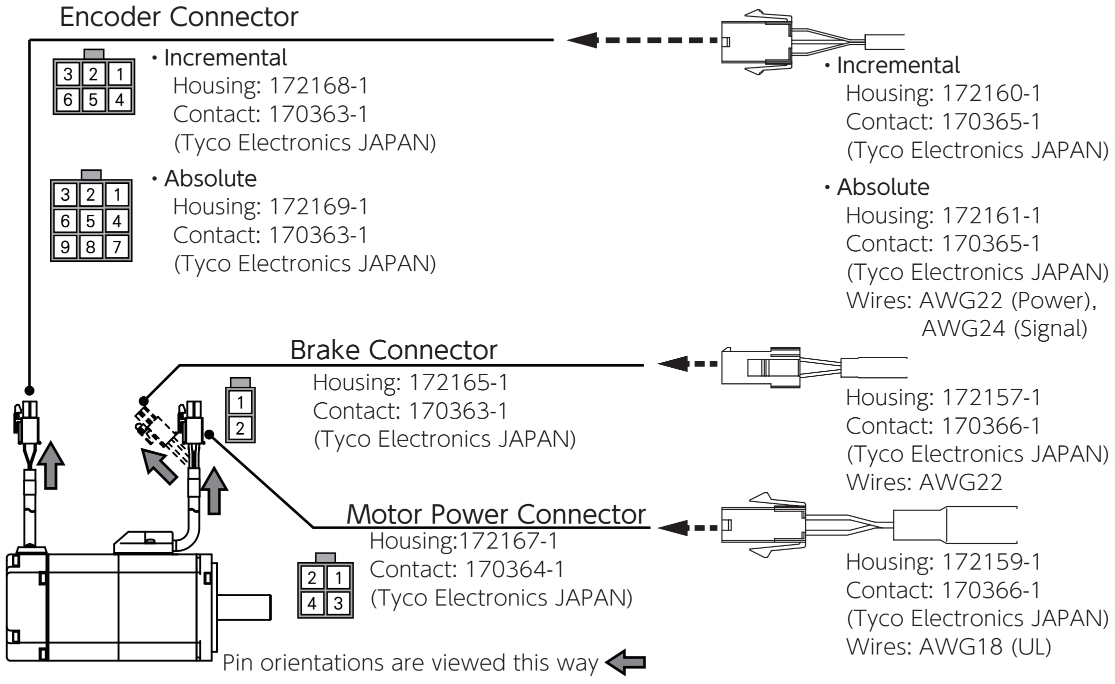
Since this product is Class I device, protective grounding is mandatory.
(Type D grounding: grounding resistance of up to 100 Ω)
Properly ground the product using protective grounding terminals through EMC-compatible casing and control panel.

2. System Wiring

3. Wiring to the Connectors

Motor Connector Pinout

Motor 50W 100W 200W 400W 750W 1kW 1.5kW 2kW



Encoder Connector

- Incremental
  Housing: 172168-1
  Contact: 170363-1
  (Tyco Electronics JAPAN)
- Absolute
  Housing: 172169-1
  Contact: 170363-1
  (Tyco Electronics JAPAN)

- Incremental
  Housing: 172160-1
  Contact: 170365-1
  (Tyco Electronics JAPAN)
- Absolute
  Housing: 172161-1
  Contact: 170365-1
  (Tyco Electronics JAPAN)
  Wires: AWG22 (Power),
  AWG24 (Signal)

Brake Connector

Housing: 172165-1
Contact: 170363-1
(Tyco Electronics JAPAN)

Housing: 172157-1
Contact: 170366-1
(Tyco Electronics JAPAN)
Wires: AWG22

Motor Power Connector

Housing:172167-1
Contact: 170364-1
(Tyco Electronics JAPAN)

Housing: 172159-1
Contact: 170366-1
(Tyco Electronics JAPAN)
Wires: AWG18 (UL)

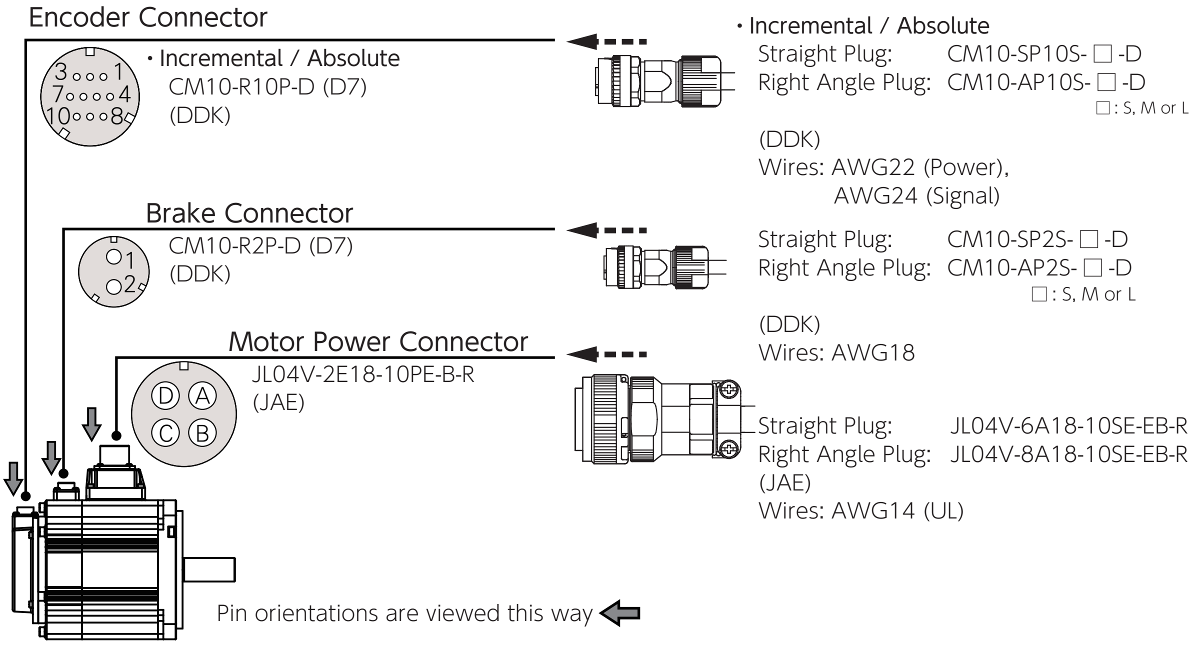
Pin orientations are viewed this way

Name	Pin No.	Signal	Description
Motor Power	1	U	Motor power U-phase
	2	V	Motor power V-phase
	3	W	Motor power W-phase
	4	FG	Motor frame ground
Brake (*1)	1	BRK+	Brake power supply DC24V
	2	BRK−	Brake power supply GND
Encoder (Incremental)	1	-	(No Connect)
	2	+D	Serial communication data: +Data
	3	−D	Serial communication data:−Data
	4	VCC	Encoder power supply: +5 V
	5	SG	Signal ground
	6	SHIELD	Shield
Encoder (Absolute)	1	BAT	External battery (*2)
	2	-	(No Connect)
	3	SHIELD	Shield
	4	+D	Serial communication data: +Data
	5	−D	Serial communication data:−Data
	6	-	(No Connect)
	7	VCC	Encoder power supply: +5 V
	8	SG	Signal ground
	9	-	(No Connect)

*1) Only for a motor equipped with a brake
*2) Connect the negative pole of the battery to SG (Signal Ground).

2. System Wiring

Motor 50W 100W 200W 400W 750W 1kW 1.5kW 2kW



Encoder Connector

- Incremental / Absolute
CM10-R10P-D (D7)
(DDK)

- Incremental / Absolute
Straight Plug: CM10-SP10S-☐-D
Right Angle Plug: CM10-AP10S-☐-D
☐: S, M or L
(DDK)
Wires: AWG22 (Power),
AWG24 (Signal)

Brake Connector
CM10-R2P-D (D7)
(DDK)

Straight Plug: CM10-SP2S-☐-D
Right Angle Plug: CM10-AP2S-☐-D
☐: S, M or L
(DDK)
Wires: AWG18

Motor Power Connector
JL04V-2E18-10PE-B-R
(JAE)

Straight Plug: JL04V-6A18-10SE-EB-R
Right Angle Plug: JL04V-8A18-10SE-EB-R
(JAE)
Wires: AWG14 (UL)

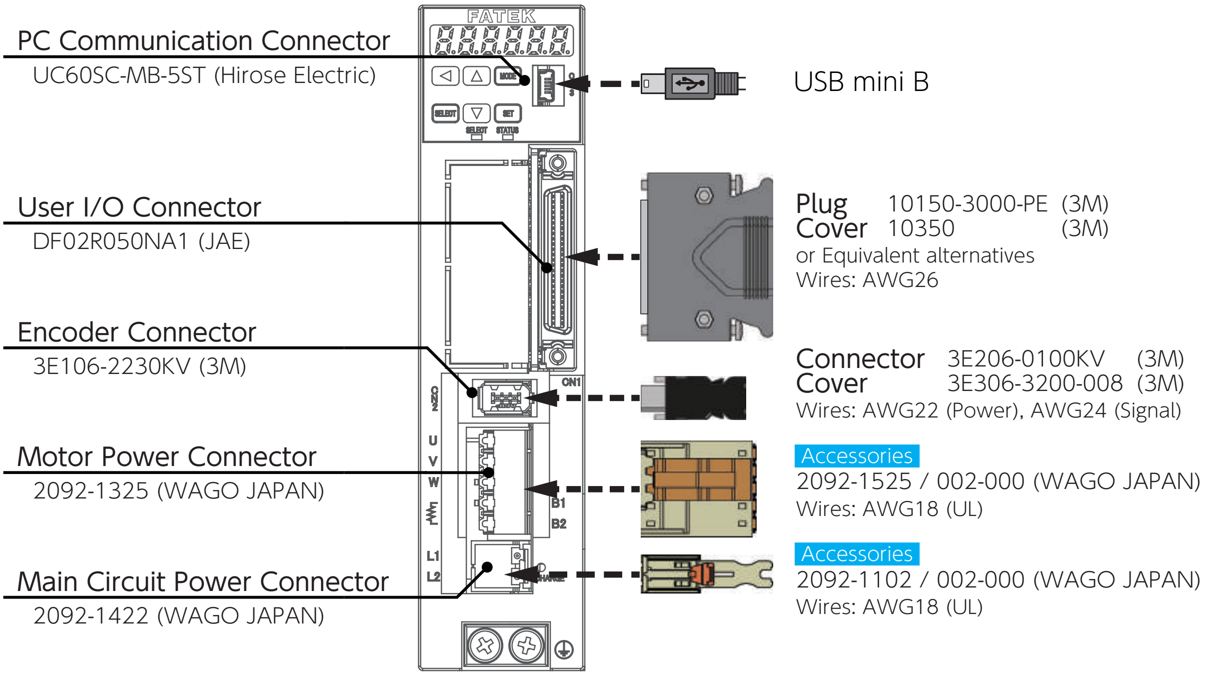
Pin orientations are viewed this way ⇦

Name	Pin No.	Signal	Description
Motor Power	A	U	Motor power U-phase
	B	V	Motor power V-phase
	C	W	Motor power W-phase
	D	FG	Motor frame ground
Brake (*1)	1	BRK+	Brake power supply DC24V
	2	BRK−	Brake power supply GND
Encoder (Incremental)	1	VCC	Encoder power supply: +5 V
	2	SG	Signal ground
	3, 4	-	(No Connect)
	5	+D	Serial communication data: +Data
	6	−D	Serial communication data: −Data
	7, 8, 9	-	(No Connect)
	10	SHIELD	Shield
Encoder (Absolute)	1	VCC	Encoder power supply: +5 V
	2	SG	Signal ground
	3	-	(No Connect)
	4	BAT	External battery (*2)
	5	+D	Serial communication data: +Data
	6	−D	Serial communication data: −Data
	7, 8	-	(No Connect)
	9	SG	Signal ground
	10	SHIELD	Shield

*1) Only for a motor equipped with a brake
*2) Connect the negative pole of the battery to SG (Signal Ground).

Amplifier Connectors and Pinouts

Amplifier 50W 100W 200W 400W 750W 1kW 1.5kW 2kW



PC Communication Connector
UC60SC-MB-5ST (Hirose Electric)

USB mini B

User I/O Connector
DF02R050NA1 (JAE)

Plug 10150-3000-PE (3M)
Cover 10350 (3M)
or Equivalent alternatives
Wires: AWG26

Encoder Connector
3E106-2230KV (3M)

Connector 3E206-0100KV (3M)
Cover 3E306-3200-008 (3M)
Wires: AWG22 (Power), AWG24 (Signal)

Motor Power Connector
2092-1325 (WAGO JAPAN)

Accessories
2092-1525 / 002-000 (WAGO JAPAN)
Wires: AWG18 (UL)

Main Circuit Power Connector
2092-1422 (WAGO JAPAN)

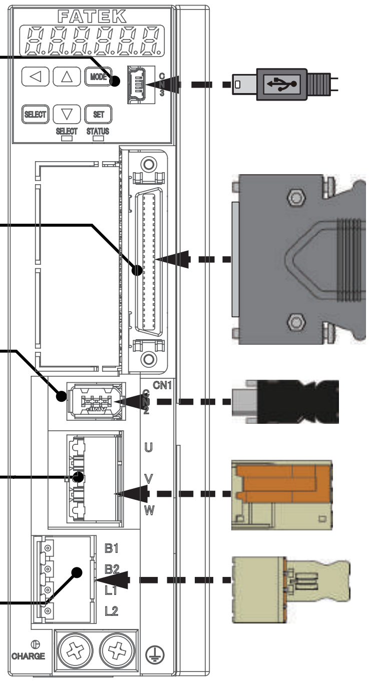
Accessories
2092-1102 / 002-000 (WAGO JAPAN)
Wires: AWG18 (UL)

Name	Code	Pin No.	Signal	Description
Main Circuit Power	L1L2	1	L1	Main power cable 1
		2	L2	Main power cable 2
Motor Power	UVW / B1B2	1	U	Motor power U-phase
		2	V	Motor power V-phase
		3	W	Motor power W-phase
		4	B1	Regenerative resistor connection (+)
		5	B2	Regenerative resistor connection (−)
Encoder	CN2	1	VCC	Encoder power supply +5 V
		2	SG	Signal ground
		3, 4	-	(No Connect)
		5	+D	Serial communication data +Data
		6	−D	Serial communication data −Data
		-	FG	SHIELD wired to the connector casing
PC Communication	CN3	1	VBUS	USB power supply +5 V
		2	D−	USB data −
		3	D+	USB data +
		4	-	(No Connect)
		5	SG	USB signal ground
User I/O	CN1	Route power and signal wiring suitable for your operation mode.		

☞ 4 Connections

2. System Wiring

Amplifier 50W 100W 200W 400W **750W** 1kW 1.5kW 2kW



PC Communication Connector
UC60SC-MB-5ST (Hirose Electric)

USB mini B

User I/O Connector
DF02R050NA1 (JAE)

Plug 10150-3000-PE (3M)
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or Equivalent alternatives
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Encoder Connector
3E106-2230KV (3M)

Connector 3E206-0100KV (3M)
Cover 3E306-3200-008 (3M)
Wires: AWG22 (Power), AWG24 (Signal)

Motor Power Connector
2092-3323 (WAGO JAPAN)

Accessories
2092-3523 / 002-000 (WAGO JAPAN)
Wires: AWG18 (UL)

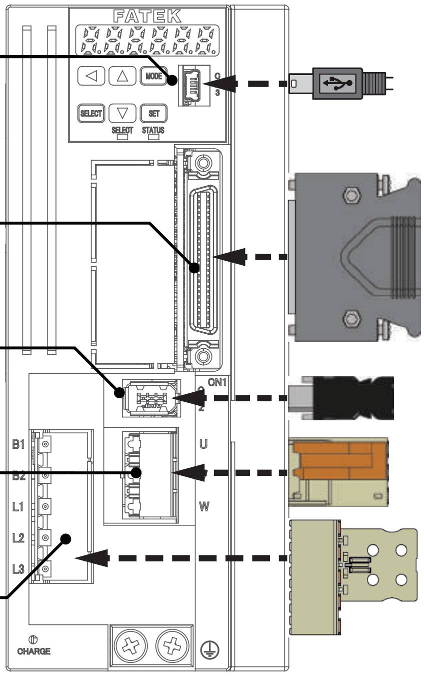
Main Circuit Power Connector
2092-1424 (WAGO JAPAN)

Accessories
2092-1104 / 002-000 (WAGO JAPAN)
Wires: AWG18 (UL)

Name	Code	Pin No.	Signal	Description
Main Circuit Power	L1L2 / B1B2	1	B1	Regenerative resistor connection (+)
		2	B2	Regenerative resistor connection (−)
		3	L1	Main power cable 1
		4	L2	Main power cable 2
Motor Power	UVW	1	U	Motor power U-phase
		2	V	Motor power V-phase
		3	W	Motor power W-phase
Encoder	CN2	1	VCC	Encoder power supply: +5 V
		2	SG	Signal ground
		3, 4	-	(No Connect)
		5	+D	Serial communication data: +Data
		6	−D	Serial communication data: −Data
		-	FG	SHIELD wired to the connector casing
PC Communication	CN3	1	VBUS	USB power supply: +5 V
		2	D−	USB data: −
		3	D+	USB data: +
		4	-	(No Connect)
		5	SG	USB signal ground
User I/O	CN1	Route power and signal wiring suitable for your operation mode. ☞ 4 Connections		

2. System Wiring

Amplifier 50W 100W 200W 400W 750W 1kW 1.5kW 2kW



PC Communication Connector
UC60SC-MB-5ST (Hirose Electric)

User I/O Connector
DF02R050NA1 (JAE)

Encoder Connector
3E106-2230KV (3M)

Motor Power Connector
2092-3323 (WAGO JAPAN)

Main Circuit Power Connector
2092-3425 (WAGO JAPAN)

USB mini B

Plug 10150-3000-PE (3M)
Cover 10350 (3M)
or Equivalent alternatives
Wires: AWG26

Connector 3E206-0100KV (3M)
Cover 3E306-3200-008 (3M)
Wires: AWG22 (Power), AWG24 (Signal)

Accessories
2092-3523 / 002-000 (WAGO JAPAN)
Wires: AWG18 (UL)

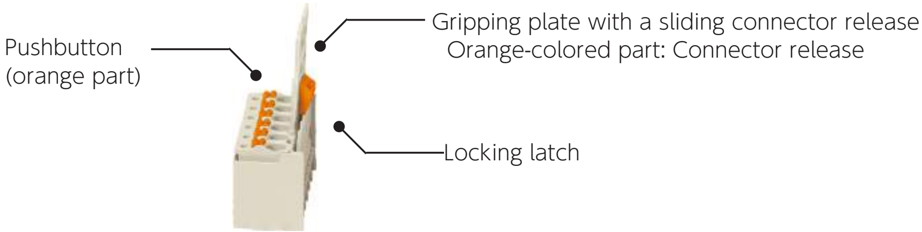
Accessories
2092-3105 / 002-000 (WAGO JAPAN)
Wires: AWG14 (UL)

Name	Code	Pin No.	Signal	Description
Main Circuit Power	L1L2L3 / B1B2	1	B1	Regenerative resistor connection (+)
		2	B2	Regenerative resistor connection (−)
		3	L1	Main power cable 1 (*1)
		4	L2	Main power cable 2 (*2)
		5	L3	Main power cable 3 (*1)
Motor Power	UVW	1	U	Motor power U-phase
		2	V	Motor power V-phase
		3	W	Motor power W-phase
Encoder	CN2	1	VCC	Encoder power supply: +5 V
		2	SG	Signal ground
		3, 4	-	(No Connect)
		5	+D	Serial communication data: +Data
		6	−D	Serial communication data: −Data
		-	FG	SHIELD wired to the connector casing
PC Communication	CN3	1	VBUS	USB power supply: +5 V
		2	D−	USB data −
		3	D+	USB data +
		4	-	(No Connect)
		5	SG	USB signal ground
User I/O	CN1	Route power and signal wiring suitable for your operation mode. ☞ 4 Connections		

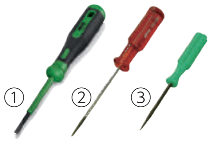
*1)When having single-phase power wired to 1kW amplifiers (SD3100C412), connect the primary circuit power to L1 and L3.
*2)**Do not connect** when using with single-phase power.

4. Accessory Connector

Connector Parts

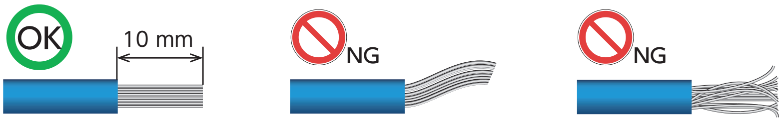


Stripping cables with recommended tools

Tools	Manufacturer	Model Code	Image
Pushbutton Tools	WAGO JAPAN	Use this tool to connect or disconnect a cable to a connector. 210-720 (standard type made in Europe) · · · ① 210-120J (standard type made in Japan) · · · ② 210-350/01 (short type) · · · ③	
Wire Stripper	WAGO JAPAN	Use this tool to make a clean cut without damaging wires. 206-124 (QUICKSTRIP 10)	

Trimming the cable wrap:

The leftmost image illustrates a good result. Other three are bad examples.

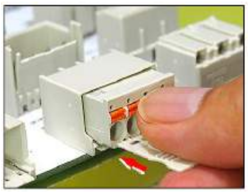
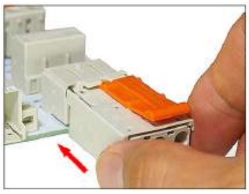


Specialized Ferrule (recommended)

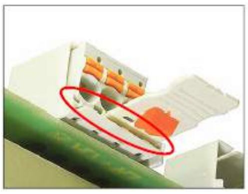
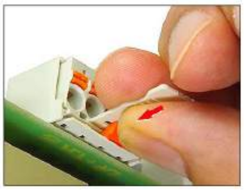
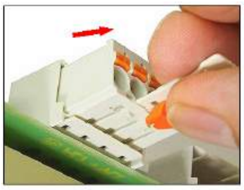
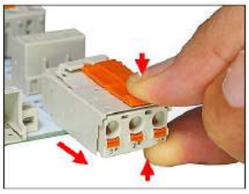
For stranded wire, a specialized ferrule helps you with wiring more safely and effectively.

Tools	Manufacturer	Model Code	Image
Ferrule	WAGO JAPAN	Insulated ferrule with sleeve 216-203, red sleeve (for AGW18) 216-206, blue sleeve (for AGW14)	
	WAGO JAPAN	Non-insulated ferrule (no sleeve) 216-143 (for AWG18) 216-106 (for AWG14)	
Ferrule crimping tool	WAGO JAPAN	206-204	

Connecting the connectors

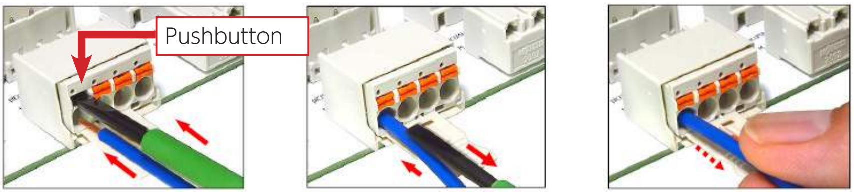
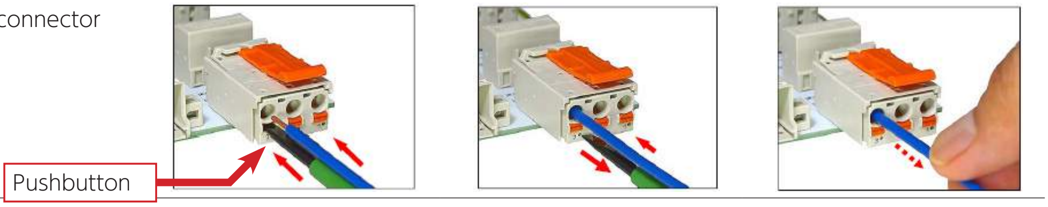
Primary circuit power connector		Hold the grip plate and keep pushing in until you hear a clicking sound.
Motor power connector		Hold the frame of the connector and keep pushing in until you hear a clicking sound.

Disconnecting the connectors

Primary circuit power connector		The connector is fixed with the locking latch.
	 	Push in the orange-colored connector release. Pull out the connector.
Motor power connector		Keep pressing the top lever to the arrow direction and pull out the connector.

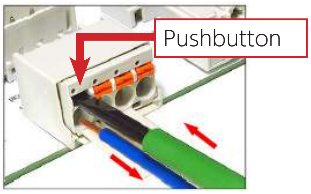
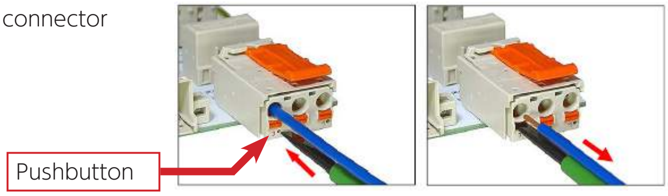
Wire connection

With the orange pushbutton pushed in with the tool, insert the wire until it hits the round insertion slot. (the image to the left). Release the pushbutton to finish. (the image in the middle)
Pull the wire slightly to verify that the wire connection is not loose. (the image to the right)

Primary circuit power connector	
Motor power connector	

Wire disconnection

While pushing in the pushbutton, pull out the cable.

Primary circuit power connector	
Motor power connector	

5. Cables

Recommended cable wires

Connection cables required for this product are sold separately.
Use our recommendations below to select cables based on your actual usage.
(Equivalent alternatives are also good)
Should you use a cable longer than the specification, please contact us in advance.

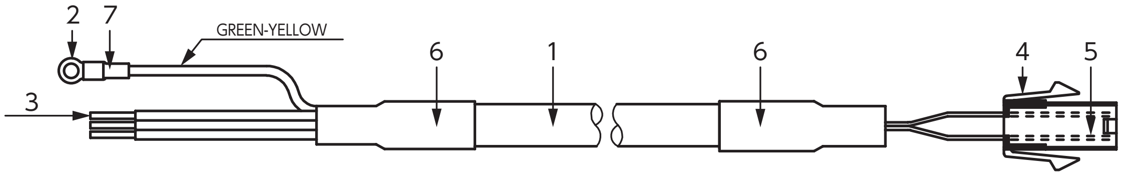
Cable Name	AWG	UL	Temperature Rating	Voltage Rating	Note
Motor power (≦ 750 W)	18	2517	105℃	300 V	
Motor power (≧ 1 kW)	14	2517	105℃	300 V	AWG16 wires can be used only for 1 kW motors
Main circuit power (≦ 750 W) (Including FG cable)	18	1015	105℃	600 V	
Main circuit power (≧ 1 kW) (Including FG cable)	14	1015	105℃	600 V	AWG16 wires can be used only for 1 kW motors.
Encoder	Power: 22 Signal: 24	20276	80℃	30 V	Shielded twisted pair cables of length no exceeding 20 m
User I/O	26	1007	80℃	300 V	Shielded twisted pair cables of length no exceeding 2 m
Regenerative resistor	18	1015	105℃	600 V	
Dynamic brake	18	1015	105℃	600 V	
Brake	18	2517	105℃	300 V	1 pair (2 cores)

Motor Power Cable

50W 100W 200W 400W 750W 1kW 1.5kW 2kW

4 HOUSING

Pin No.	Signal	Color
1	U	RED
2	V	WHITE
3	W	BLUE
4	FG	GREEN - YELLOW



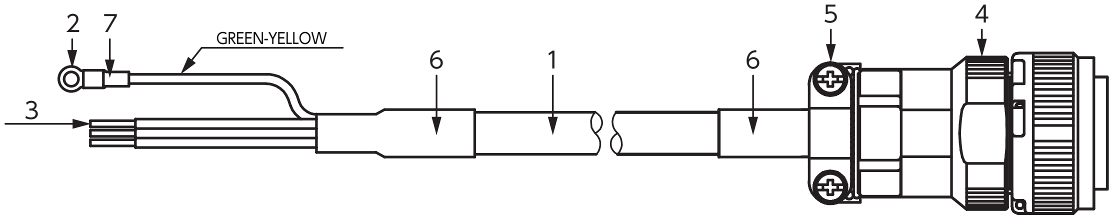
No.	Item	Model	Supplier
1	CABLE	NA3CT-18-4 (for fixed wiring) NA3CTR-18-4 (for movable wiring)	MISUMI Group Ink
2	RING TONGUE TERMINAL	R2-4	J.S.T. Mfg. Co., Ltd.
3	FERRULE	216-143	WAGO JAPAN
4	HOUSING	172159-1	Tyco Electronics JAPAN
5	TERMINAL	170366-1	Tyco Electronics JAPAN
6	SUMITUBE	F(Z) 11x0.25	Sumitomo Electric Industries
7	(MARKER TUBE)	(arbitrary)	(arbitrary)

Motor Power Cable

50W 100W 200W 400W 750W 1kW 1.5kW 2kW

4 PLUG

Pin No.	Signal	Color
1	U	RED
2	V	WHITE
3	W	BLUE
4	FG	GREEN - YELLOW

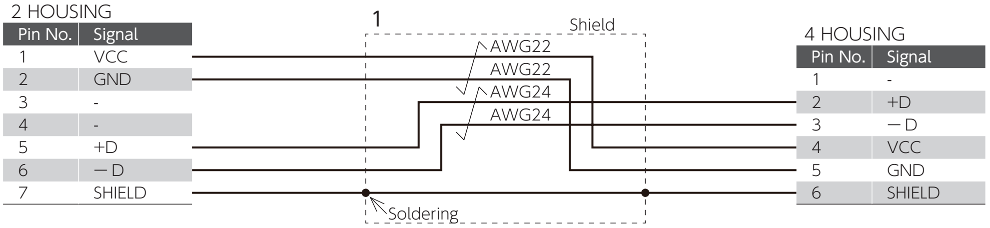


No.	Item	Model	Supplier
1	CABLE	NA6CT-14-4 (for fixed wiring) NA6CTR-14-4 (for movable wiring)	MISUMI Group Ink
2	RING TONGUE TERMINAL	R2-4	J.S.T. Mfg. Co., Ltd.
3	FERRULE	216-106	WAGO JAPAN
4	PLUG	JL04V-6A18-10SE-EB-R	JAE
5	CABLE CLAMP	JL04V-18CK13-CR-R	JAE
6	SUMITUBE	F(Z) 14x0.3	Sumitomo Electric Industries
7	(MARKER TUBE)	(arbitrary)	(arbitrary)

Encoder Cable

50W 100W 200W 400W 750W 1kW 1.5kW 2kW

(Incremental)

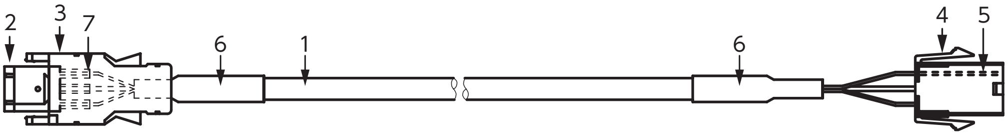


2 HOUSING

Pin No.	Signal
1	VCC
2	GND
3	-
4	-
5	+D
6	− D
7	SHIELD

4 HOUSING

Pin No.	Signal
1	-
2	+D
3	− D
4	VCC
5	GND
6	SHIELD

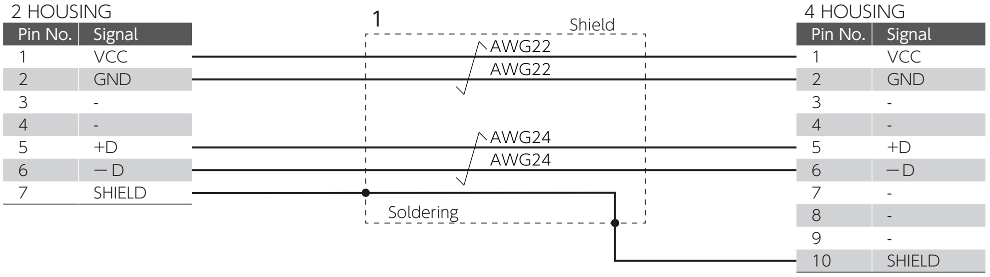


No.	Item	Model	Supplier
1	CABLE	NA20276TSB-C (for fixed wiring) NA20276RRSB-C (for movable wiring)	MISUMI Group Ink
2	HOUSING	3E206-0100KV	3M
3	COVER	3E306-3200-008	3M
4	HOUSING	172160-1	Tyco Electronics JAPAN
5	TERMINAL	170365-1	Tyco Electronics JAPAN
6	SUMITUBE	F(Z) 7x0.25	Sumitomo Electric Industries
7	SUMITUBE	F(Z) 3/64 or 1.5x0.2	Sumitomo Electric Industries

Encoder Cable

50W 100W 200W 400W 750W 1kW 1.5kW 2kW

(Incremental)

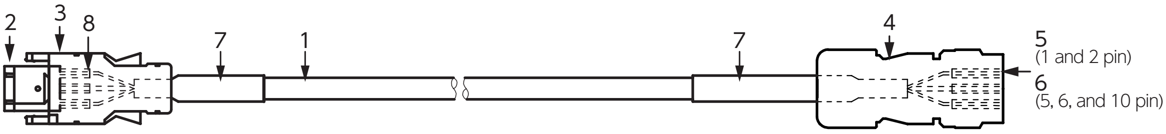


2 HOUSING

Pin No.	Signal
1	VCC
2	GND
3	-
4	-
5	+D
6	− D
7	SHIELD

4 HOUSING

Pin No.	Signal
1	VCC
2	GND
3	-
4	-
5	+D
6	− D
7	-
8	-
9	-
10	SHIELD

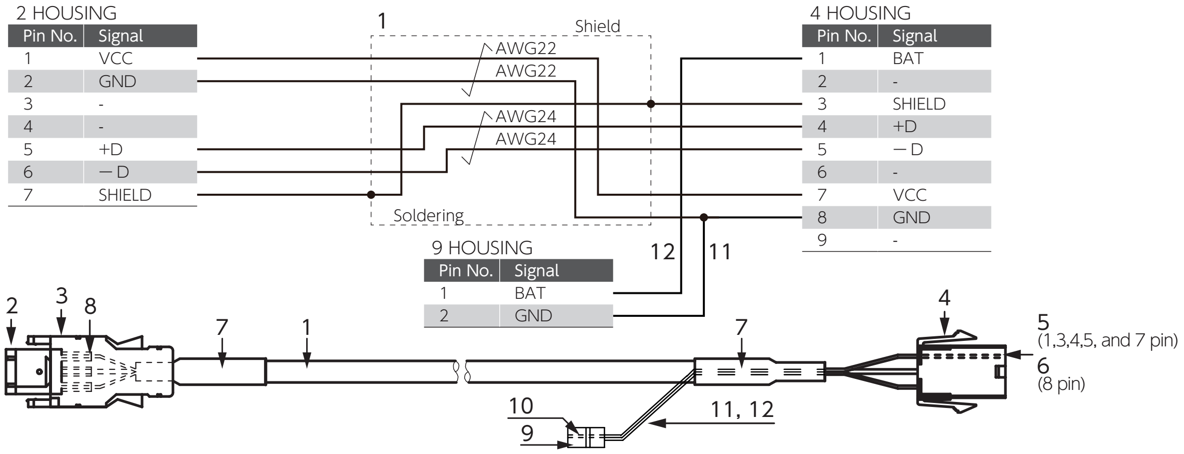


No.	Item	Model	Supplier
1	CABLE	NA20276TSB-C (for fixed wiring) NA20276RRSB-C (for movable wiring)	MISUMI Group Ink
2	HOUSING	3E206-0100KV	3M
3	COVER	3E306-3200-008	3M
4	HOUSING	CM10-SP10S-M	DDK
5	TERMINAL	CM10-#22SC(C1)(D8)	DDK
6	TERMINAL	CM10-#22SC(C2)(D8)	DDK
7	SUMITUBE	F(Z) 7x0.25	Sumitomo Electric Industries
8	SUMITUBE	F(Z) 3/64 or 1.5x0.2	Sumitomo Electric Industries

Encoder Cable

50W 100W 200W 400W 750W 1KW 1.5KW 2KW

(Absolute)



2 HOUSING

Pin No.	Signal
1	VCC
2	GND
3	-
4	-
5	+D
6	－D
7	SHIELD

4 HOUSING

Pin No.	Signal
1	BAT
2	-
3	SHIELD
4	+D
5	－D
6	-
7	VCC
8	GND
9	-

9 HOUSING

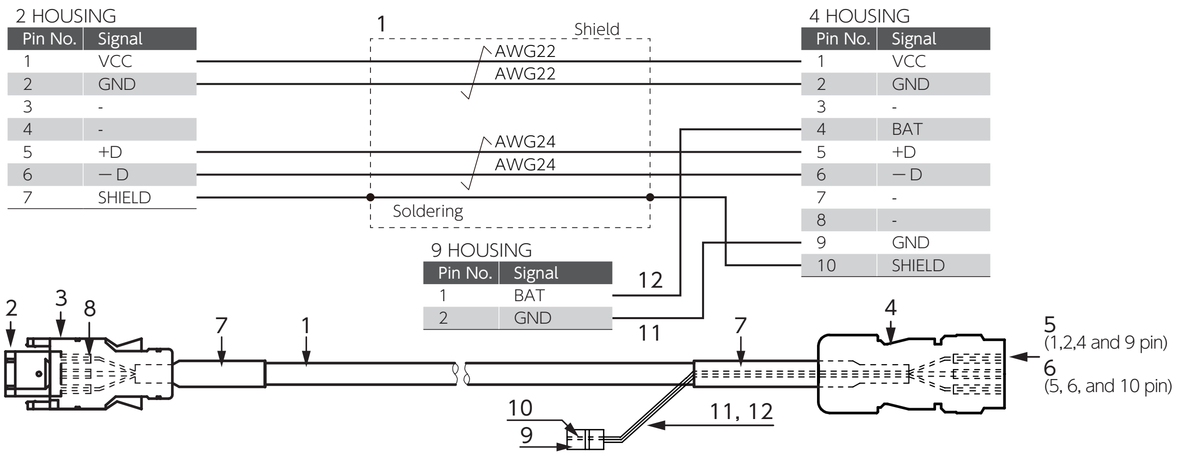
Pin No.	Signal
1	BAT
2	GND

No.	Item	Model	Supplier
1	CABLE	NA20276TSB-C (for fixed wiring) NA20276RRSB-C (for movable wiring)	MISUMI Group Ink
2	HOUSING	3E206-0100KV	3M
3	COVER	3E306-3200-008	3M
4	HOUSING	172161-1	Tyco Electronics JAPAN
5	TERMINAL	170365-1	Tyco Electronics JAPAN
6	TERMINAL	170366-1	Tyco Electronics JAPAN
7	SUMITUBE	F(Z) 7x0.25	Sumitomo Electric Industries
8	SUMITUBE	F(Z) 3/64 or 1.5x0.2	Sumitomo Electric Industries
9	HOUSING	DF3-2EP-2C	Hirose Electric
10	TERMINAL	DF3-EP2428PCFA	Hirose Electric
11	CABLE	NAUL1007-24-BK	MISUMI Group Ink
12	CABLE	NAUL1007-24-R	MISUMI Group Ink

Encoder Cable

50W 100W 200W 400W 750W 1KW 1.5KW 2KW

(Absolute)



2 HOUSING

Pin No.	Signal
1	VCC
2	GND
3	-
4	-
5	+D
6	－D
7	SHIELD

4 HOUSING

Pin No.	Signal
1	VCC
2	GND
3	-
4	BAT
5	+D
6	－D
7	-
8	-
9	GND
10	SHIELD

9 HOUSING

Pin No.	Signal
1	BAT
2	GND

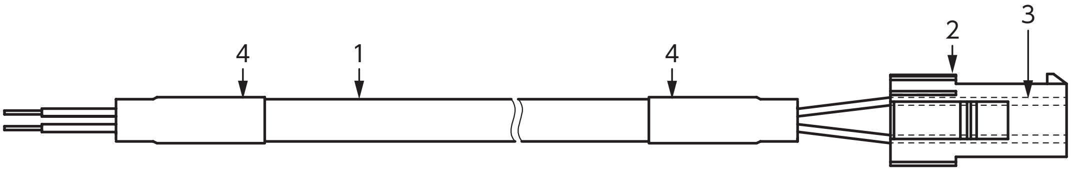
No.	Item	Model	Supplier
1	CABLE	NA20276TSB-C (for fixed wiring) NA20276RRSB-C (for movable wiring)	MISUMI Group Ink
2	HOUSING	3E206-0100KV	3M
3	COVER	3E306-3200-008	3M
4	HOUSING	CM10-SP10S-M	DDK
5	TERMINAL	CM10-#22SC(C1)(D8)	DDK
6	TERMINAL	CM10-#22SC(C2)(D8)	DDK
7	SUMITUBE	F(Z) 7x0.25	Sumitomo Electric Industries
8	SUMITUBE	F(Z) 3/64 or 1.5x0.2	Sumitomo Electric Industries
9	HOUSING	DF3-2EP-2C	Hirose Electric
10	TERMINAL	DF3-EP2428PCFA	Hirose Electric
11	CABLE	NAUL1007-24-BK	MISUMI Group Ink
12	CABLE	NAUL1007-24-R	MISUMI Group Ink

Brake Cable

50W 100W 200W 400W 750W 1KW 1.5KW 2KW

2 HOUSING

Pin No.	Signal	Color
1	BRK+	BRACK
2	BRK−	BRACK



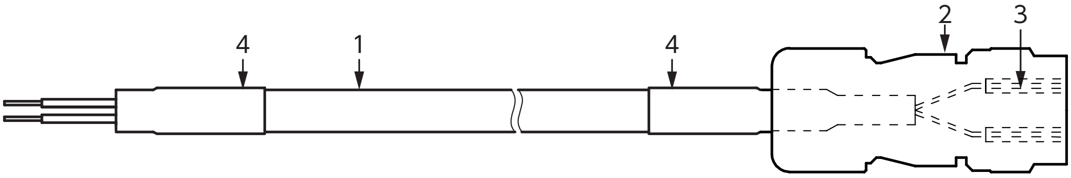
No.	Item	Model	Supplier
1	CABLE	MAST-UL2517-19-2 (for fixed wiring) NA3UCR-18-2 (for movable wiring)	MISUMI Group Ink
2	HOUSING	172157-1	Tyco Electronics JAPAN
3	TERMINAL	170366-1 or 170639-1	Tyco Electronics JAPAN
4	SUMITUBE	F(Z) 8x0.25	Sumitomo Electric Industries

Brake Cable

50W 100W 200W 400W 750W 1KW 1.5KW 2KW

2 PLUG

Pin No.	Signal	Color
1	BRK+	BRACK
2	BRK−	BRACK



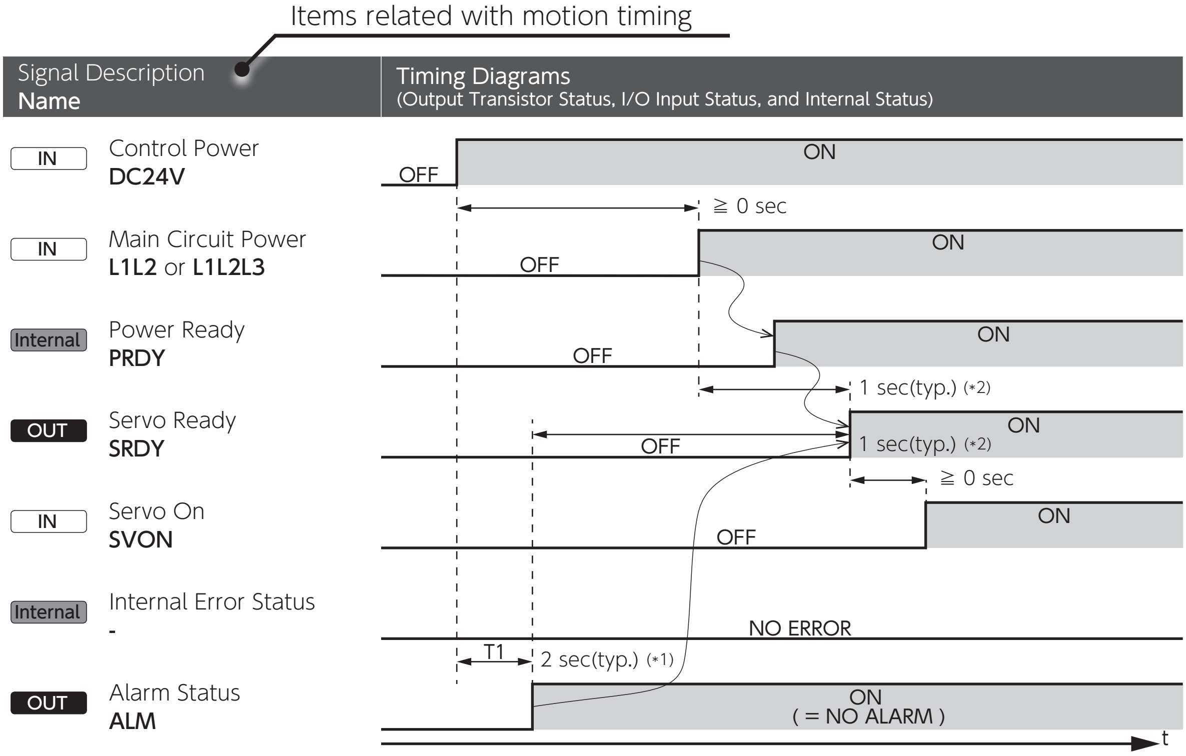
No.	Item	Model	Supplier
1	CABLE	MAST-UL2517-19-2 (for fixed wiring) NA3UCR-18-2 (for movable wiring)	MISUMI Group Ink
2	PLUG	CM10-SP2S-M-D	DDK
3	CONTACT	CM10-#22SC(S2)(D8)-100	DDK
4	SUMITUBE	F(Z) 8x0.25	Sumitomo Electric Industries

3. Timing Diagrams

List of Timing Diagrams

When designing a host controller system, consider the timing of control signal input from the controller to the amplifier, or alarm signal output from the amplifier.

Timing Diagram Overview



OUT : Output Signal

Output Transistor	I/O Output Status
OFF	Open
ON	Close (The contact paired with COM- is closed)

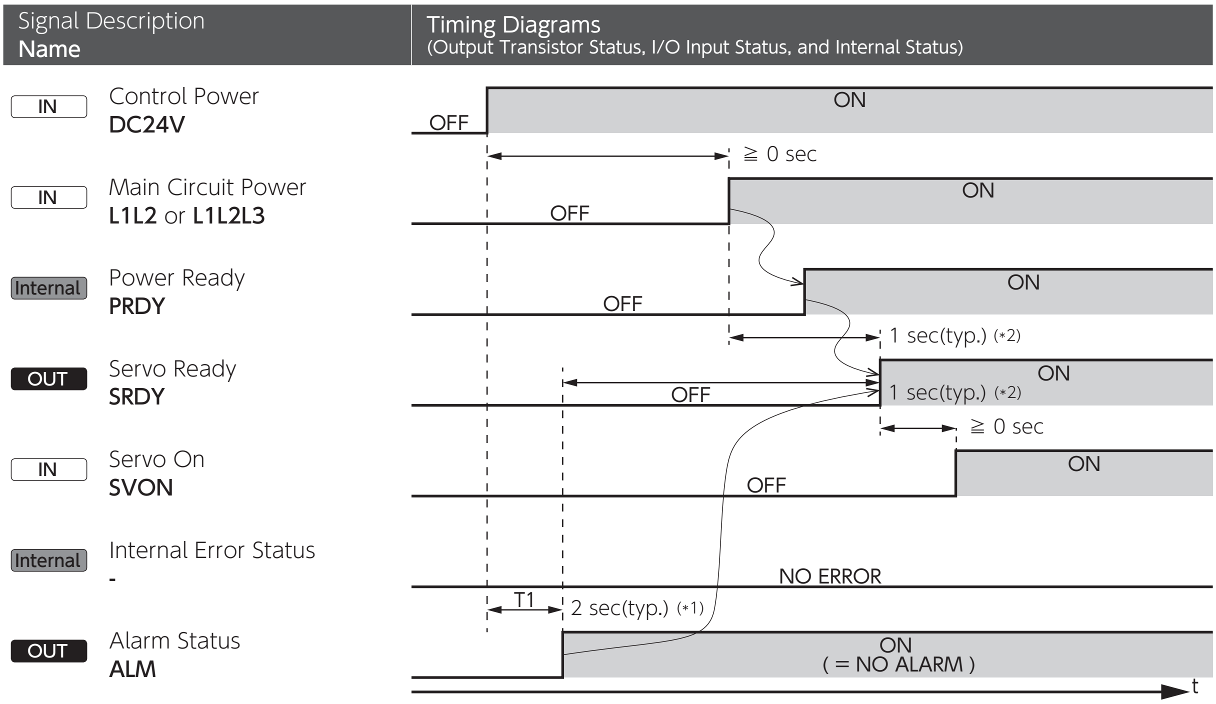
IN : Input Signal

Contacts of Input Circuit	I/O Input Status
Open	OFF
Close (Close the contact paired with GND)	ON

Internal : Internal Status of the Amplifier

3. Timing Diagrams

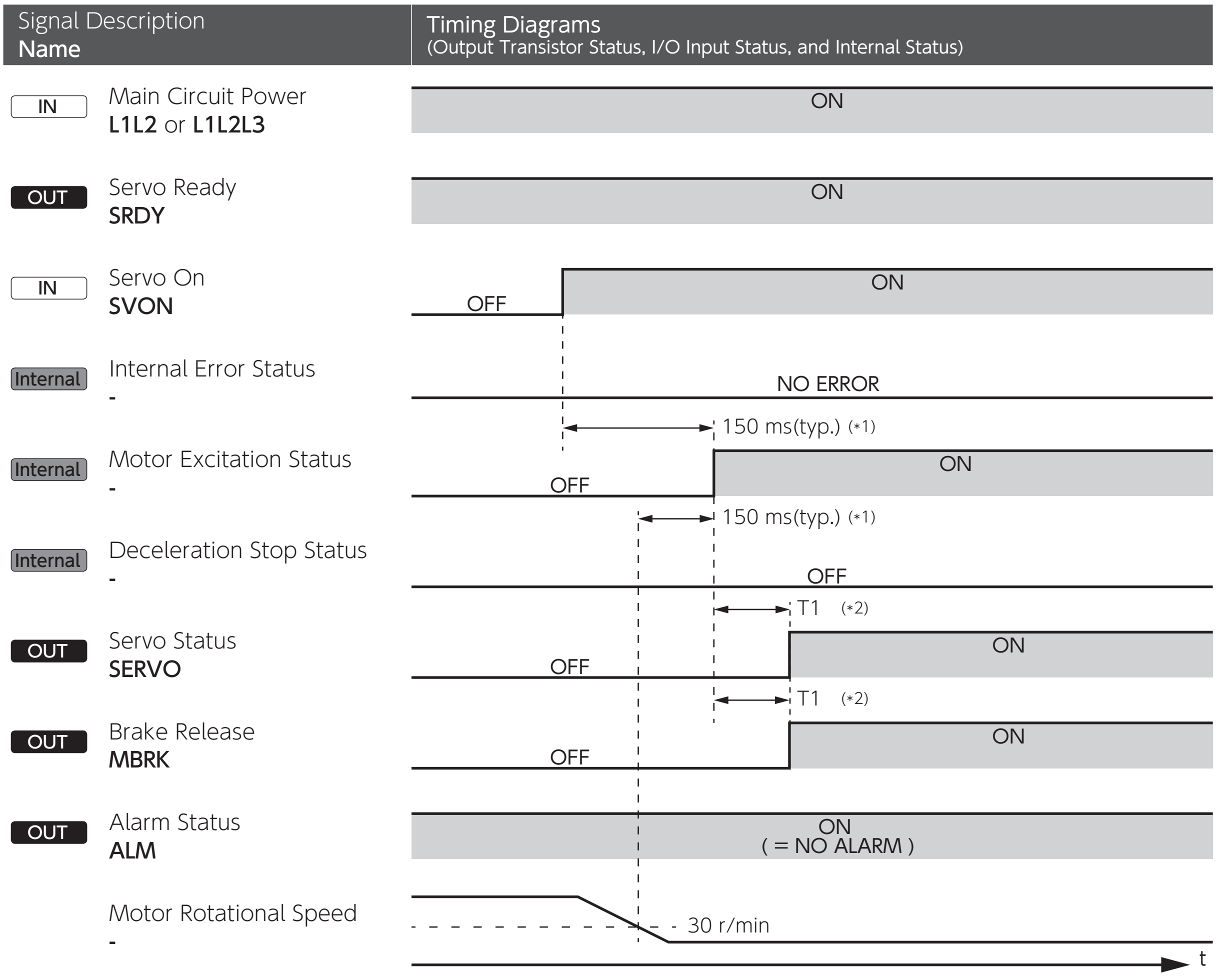
1. Turning the Power On



*1) After Clear Parameter execution, T1 needs approximately 5 seconds for parameter initialization.
*2) **SRDY** turns ON when **Primary Circuit Power** and **PRDY** turns ON consecutively while **Internal Error Status** remains No Errors.

3. Timing Diagrams

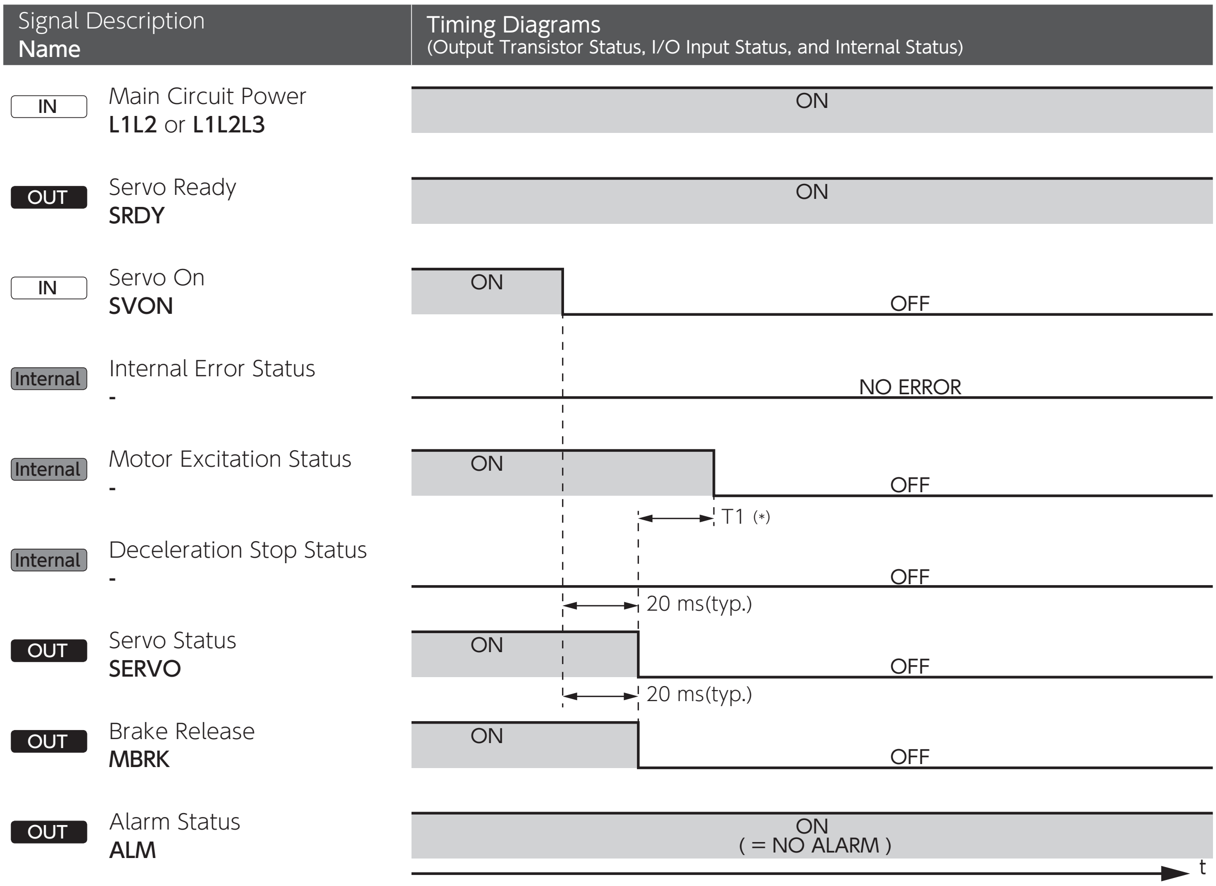
2. Servo OFF → ON



*1) **Motor Excitation Status** remains OFF until **Motor Rotational Speed** drops to 30 r/min or below.
*2) T1 is specified by Bake-Release Delay Time (No.238.0).

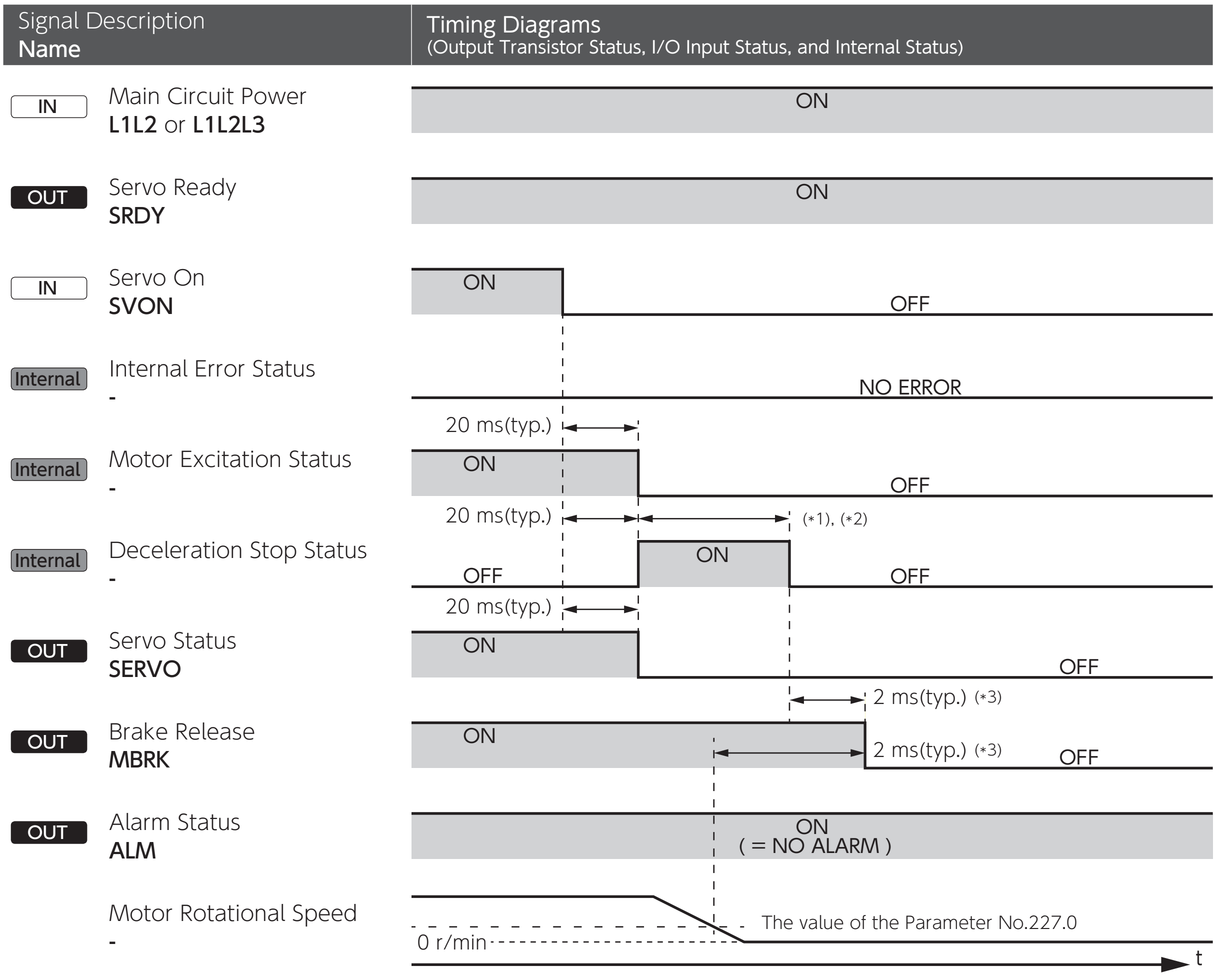
3. Timing Diagrams

3. Servo ON → OFF (Motor idling)



*) T1 is specified by Servo OFF Delay time (No.237.0).

4. Servo ON → OFF (Motor rotating)



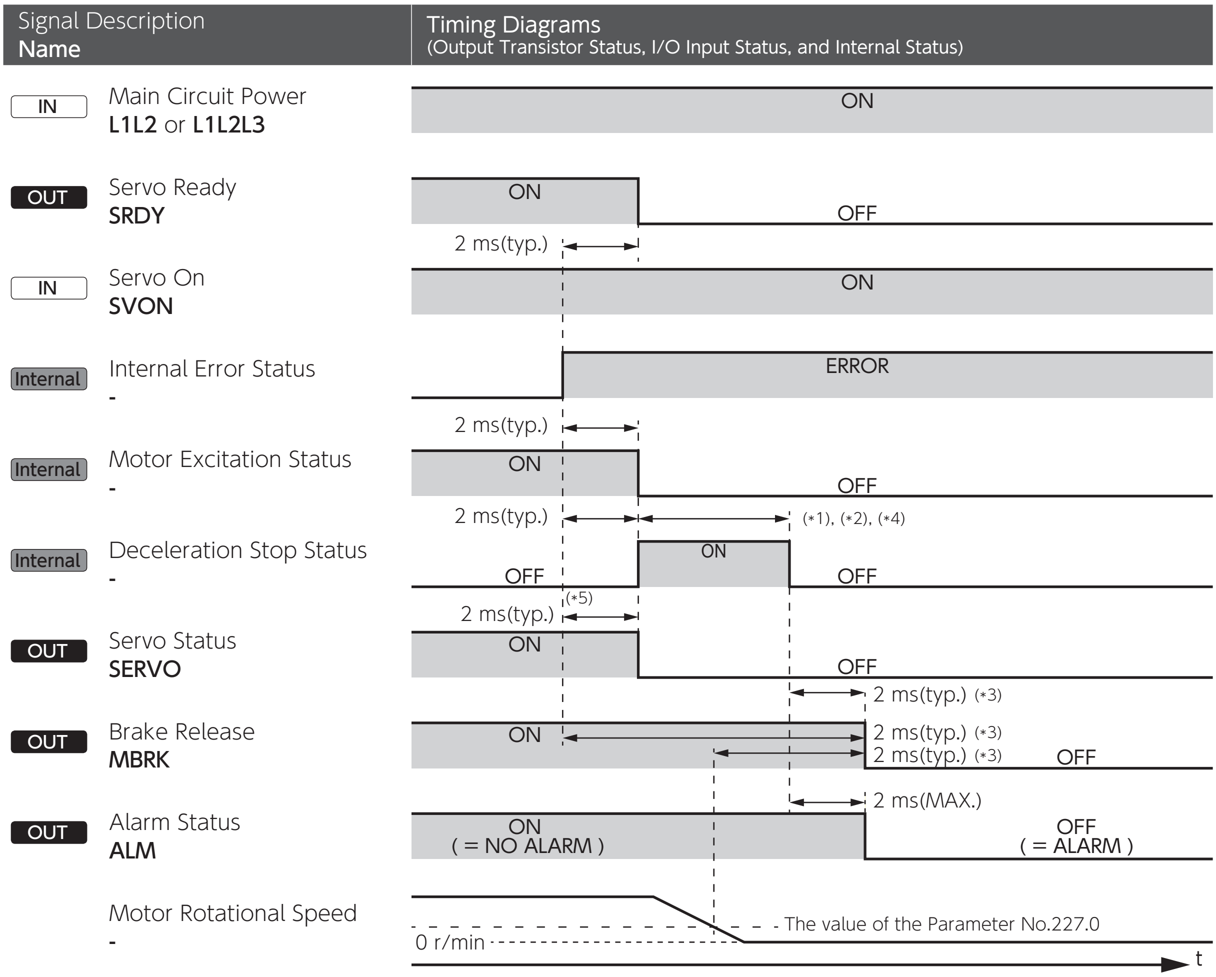
*1) The motor decelerates according to the method specified by Deceleration Stop Method (No.224.0)
*2) Quick stop or Short brake ends when deceleration stop conditions set by parameters (No.224.1, No.226.0, and No.227.0) are met.
*3) Deceleration Stop Method (No.224.0) = 2 (quick stop) or 1 (short brake)

MBRK turns OFF when one of the following conditions is met:
a) **Deceleration Stop Status** turns OFF
b) The rotational speed drops to the value specified by **Deceleration stop Rotational speed to cancel** (No.227.0) or below.

Deceleration Stop Method (No.224.0) = 0 (free run)

MBRK turns OFF when **Motor Excitation Status** becomes OFF.

5. Alarm Occurs



*1) The motor will stop per Deceleration Stop Method (No.224.0) as follows.

2 (quick stop) or 1 (short brake)	: the motor decelerates and stops by short brake.
0 (Free-run)	: no brake.

*2) **Deceleration Stop Status** ends when deceleration stop conditions set by the parameters (No.224.1, No.226.0, and No.227.0) are met.

*3) Timing of **MBRK** turning OFF

If Deceleration Stop Method (No.224.0) = 2 (quick stop) or 1 (short brake),
MBRK turns OFF when one of the following conditions is met.
1) **Deceleration Stop Status** turns OFF
2) **Motor Rotational Speed** drops to the value specified by the parameter No.227.0 or below.

If Deceleration Stop Method (No.224.0) = 0 (no brake),
MBRK turns OFF when **Motor Excitation Status** turns OFF.

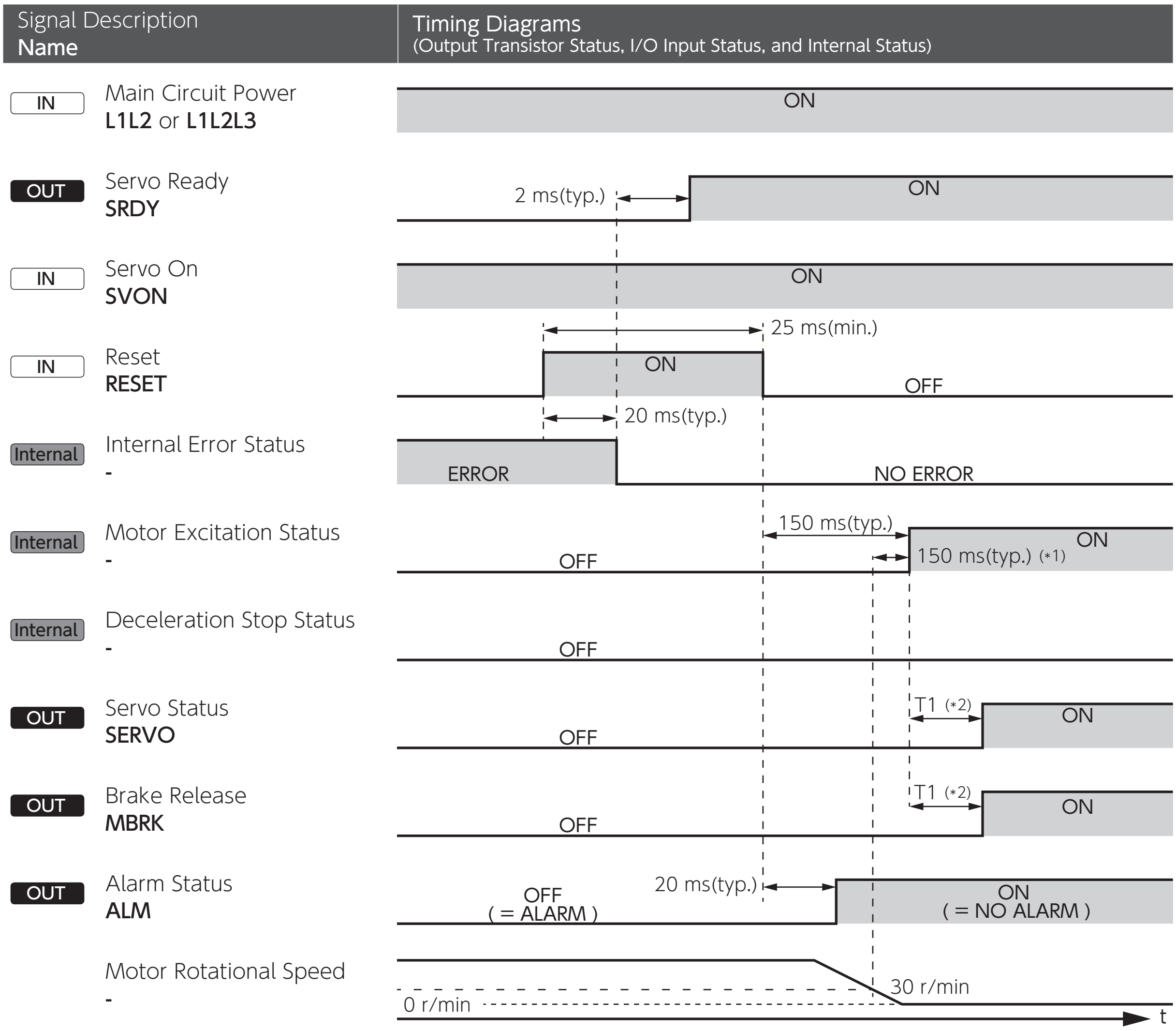
If any of the following alarms occurs,
MBRK turns OFF when the internal error status becomes **ERROR**.
a) Encoder related errors
b) Control Power voltage drop error
c) Errors related to Inverter output part
d) Overvoltage error
If any alarm except above four occurs, the motion pattern will be exactly as this timing diagram suggests.

*4) Deceleration Stop behaves as follows depending on the error type:
a) Encoder related errors: Deceleration Stop per Deceleration stop operating time (Parameter No.226.0)
b) Control Power voltage drop error: Deceleration Stop per Deceleration stop (upon control power failure) Operating time (No.228.0)
c) Errors related to Inverter output part: Free-run

*5) In case of the following alarms, **Servo Status** will remain ON until **Deceleration Stop Status** turns OFF.
a) Encoder related errors
b) Control power voltage drop error

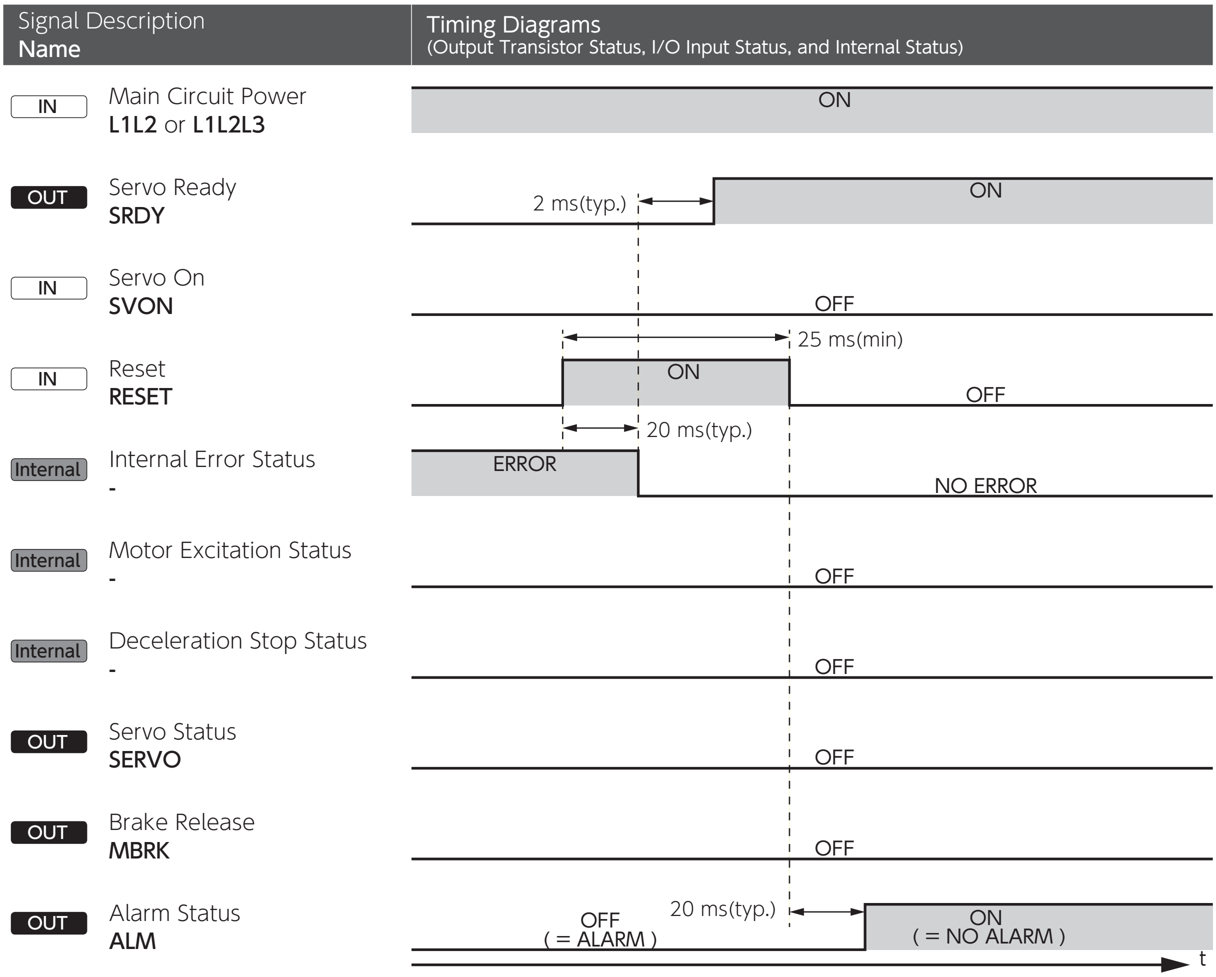
3. Timing Diagrams

6. Alarm Reset (Servo ON)



*1) **Motor Excitation Status** remains OFF until motor rotational speed drops to 30 r/min or below.
*2) T1 is specified by Bake release Delay time (No.238.0).

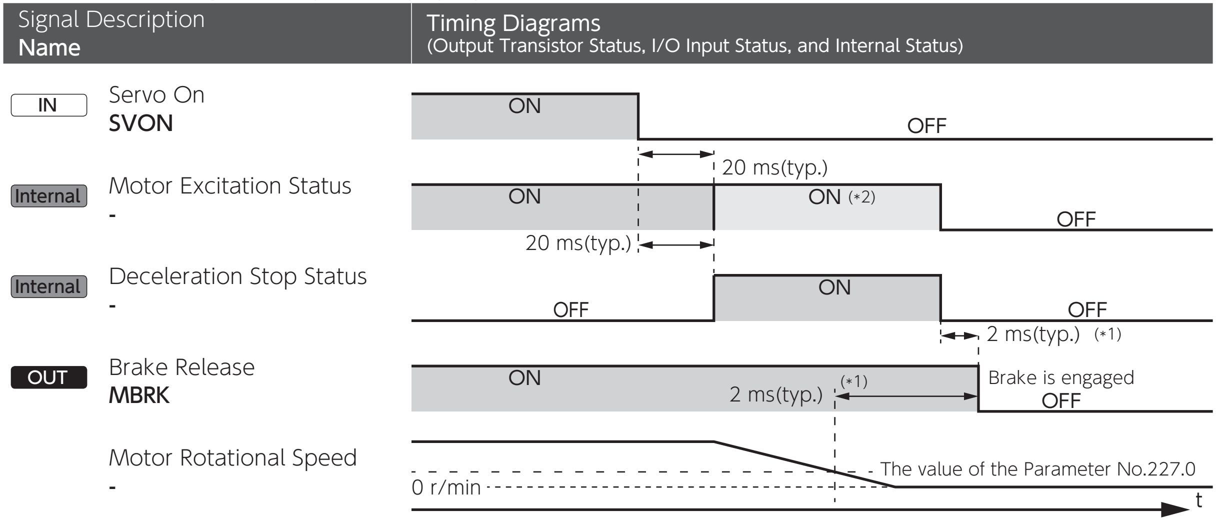
7. Alarm Reset (Servo OFF)



3. Timing Diagrams

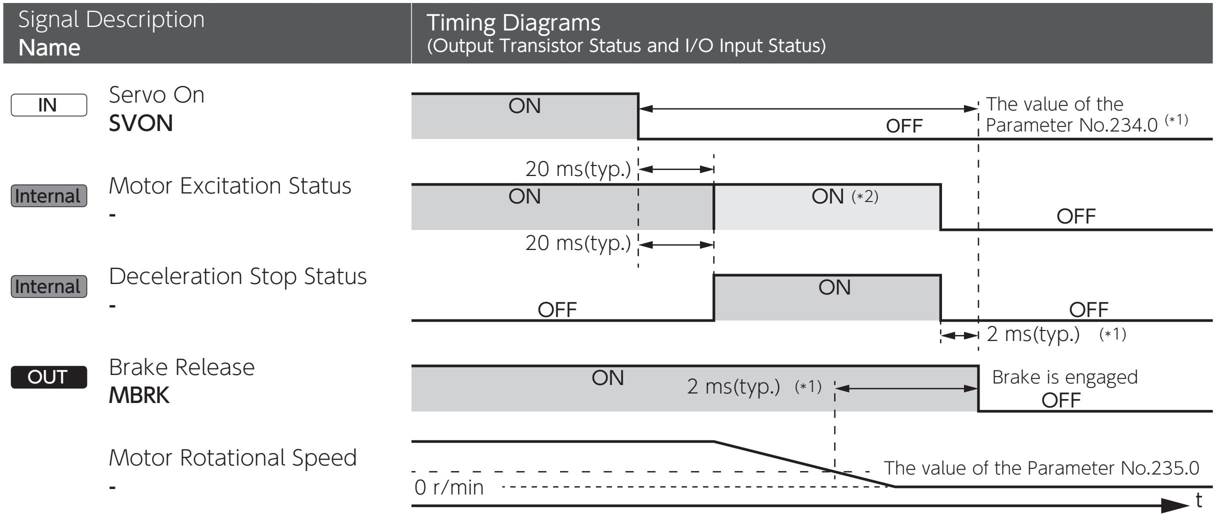
8. Brake Release

Deceleration Stop: Timing for Engaging Brake (No.232.3) = 0



*1) **MBRK** turns OFF is when one of the following becomes true, a) Deceleration Stop completes, or b) **Motor rotational speed** drops to the value of **Deceleration stop - Rotational speed to cancel** (No.227.0) or below.
*2) If the deceleration stop method is quick stop, the motor will remain excited during deceleration stop.

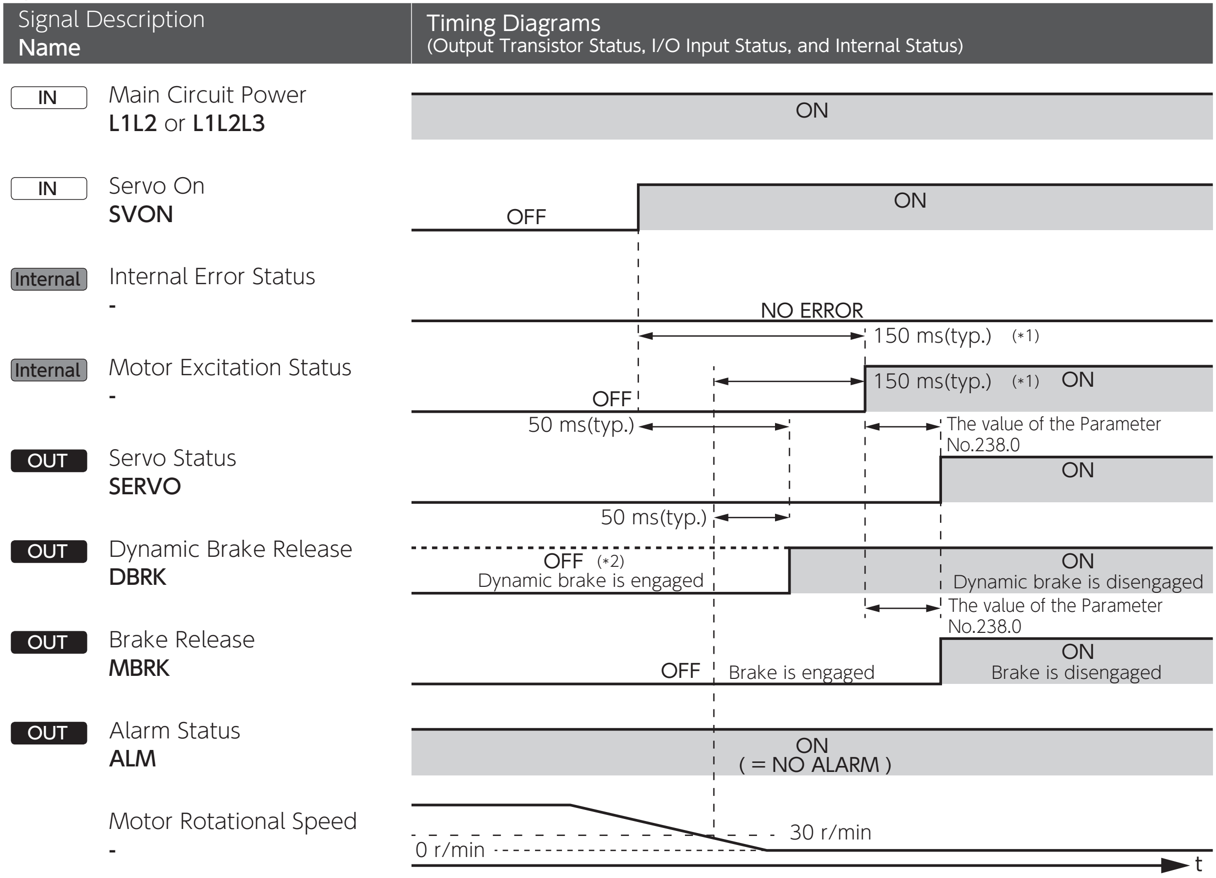
Deceleration Stop: Timing for Engaging Brake (No.232.3) = 1



*1) **MBRK** turns OFF is when one of the following becomes true, a) Deceleration Stop completes, or b) Motor rotational speed, after the time specified by Parameter No.234.0 elapses, drops to the value specified by Parameter No.235.0 or below.
*2) If the deceleration stop method is quick stop, the motor will remain excited during deceleration stop.

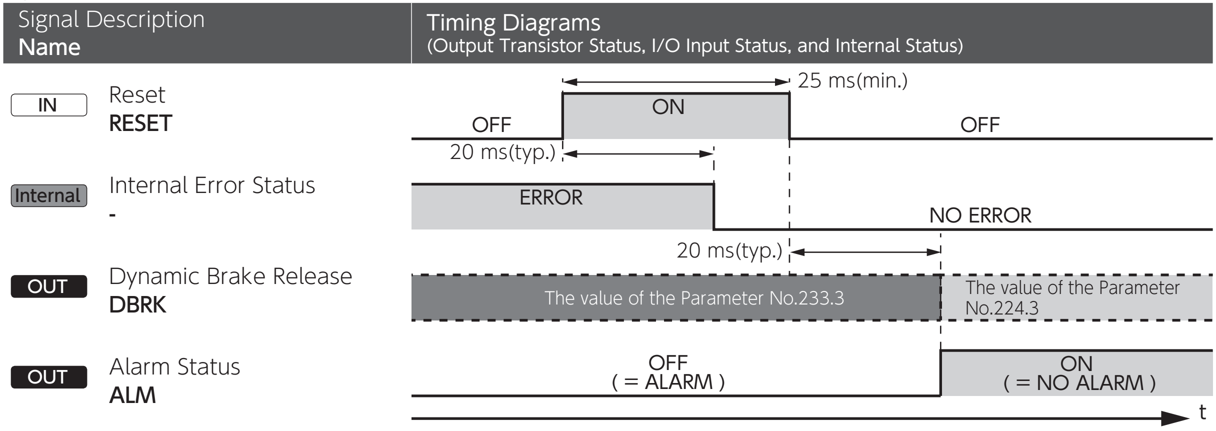
9. Dynamic Brake Release

Upon Servo ON, if Deceleration stop (when Servo is OFF) : Method (No.224.0) = 3 (dynamic brake)



*1) **SERVO** does not turn ON until **Motor Rotational Speed** drops below 30 r/min.
*2) When **DBRK** output (No.224.3) = 1 (dynamic brake) after a stop per Deceleration Stop (when Servo is OFF)

Upon Alarm Clear, if Deceleration stop (when Servo is OFF) Method (No.224.0) = 3 (dynamic brake)

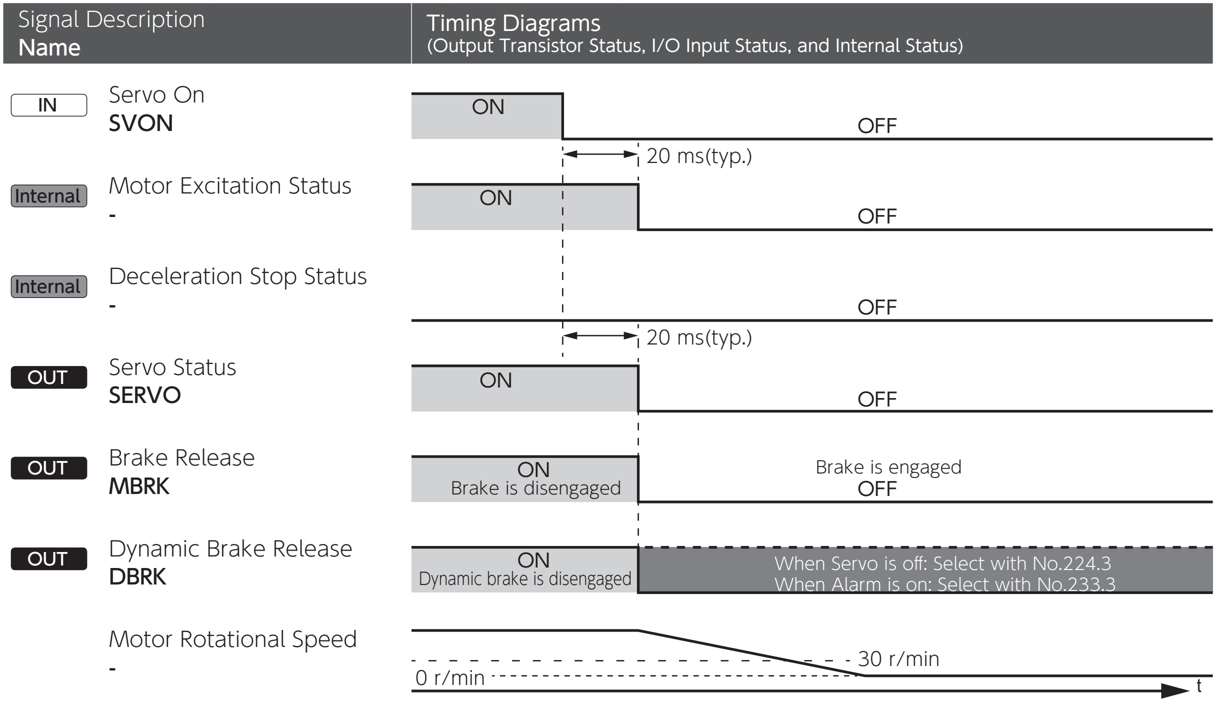


3. Timing Diagrams

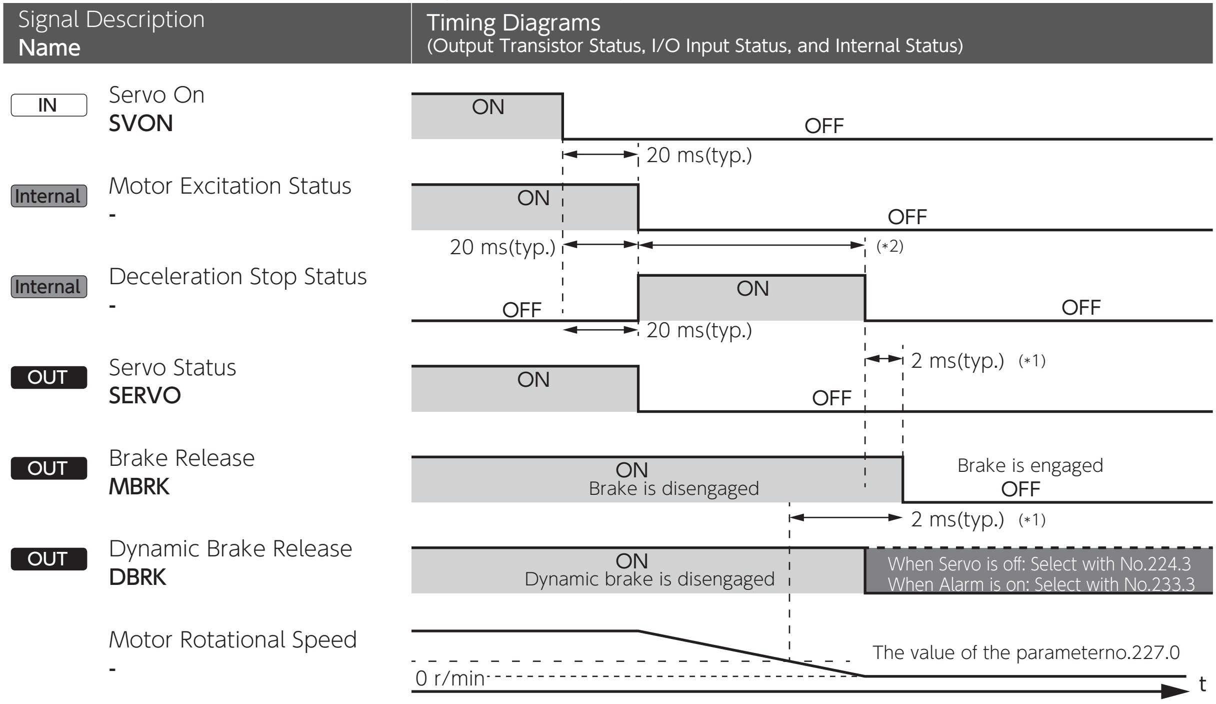
10. Deceleration Stop Status During Free Run

Deceleration Stop Status where **Deceleration Stop Method (at Servo OFF)** (No.224.0) and **Deceleration Stop Method (at Alarm ON)** (No.233.0) are set to free run.

Deceleration stop: Deceleration stop status during free-run (No.232.1) = 0 (OFF)



Deceleration stop: Deceleration stop status during free-run (No.232.1) = 1 (ON)



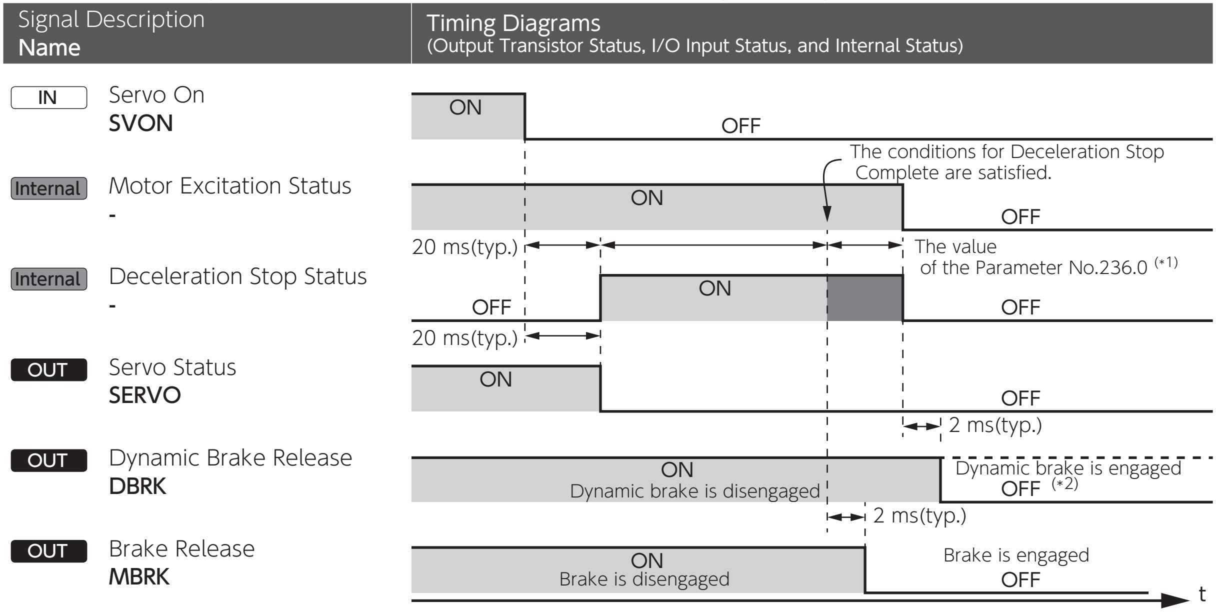
*1) **MBRK** turns OFF when one of the following conditions is met:
  a) **Deceleration Stop Status** turns OFF.
  b) **Motor Rotational Speed** drops to the value of **Deceleration stop - Rotational speed to cancel** (No.227.0) or below.
*2) **Deceleration Stop Status turns** OFF when deceleration stop conditions (No.224.1, 226.0, or 227.0) are met.

3. Timing Diagrams

11. Delay time for Quick Stop Complete

When Servo becomes OFF while motor is in motion and then the motor decelerates to stop by the quick stop method.

Deceleration stop: Method (at Servo OFF) (No.224) = 2 (quick stop)



*1) **Deceleration Stop Status** turns OFF after the deceleration stop conditions set by the Parameters (No.224.1, 226.0, and 227.0) are met and the time amount set to **Quick Brake Delay Time** (No.236.0) elapses.
*2) When **DBRK** output (No.224.3) = 1 (dynamic brake) after Deceleration Stop (at Servo OFF) ends.

MEMO

4 Connections

1. Introduction

This SD3 series feature seven operation modes for motor, which are combinations of Control Mode and Command Mode options. Work on CN1 connector wiring according to the mode that you are using.

Control Mode	Command Mode	Command Input Signal Format	Example
Position Control (*)	Pulse Train Command	Differential	Page 4
		24 V open collector	Page 10
		5 V open collector	Page 12
	Internal Command	I/O Operation	Page 14
Velocity Control	Analog Command	Analog Voltage	Page 18
	Internal Command	I/O Operation	Page 20
Torque Control	Analog Command	Analog Voltage	Page 22

*) Select one of I/O setup types: "Standard I/O configuration" or "Optional I/O configuration"
When using one of the optional I/O configurations, use "Servo Studio" to make the setting change.

Pulse Train Command

Select the pulse signal input from the following three types:

·pulse and direction	(PLS + DIR)
·quadrature phase difference pulse	(A-phase + B-phase)
·positive or negative pulse	(CCW + CW)

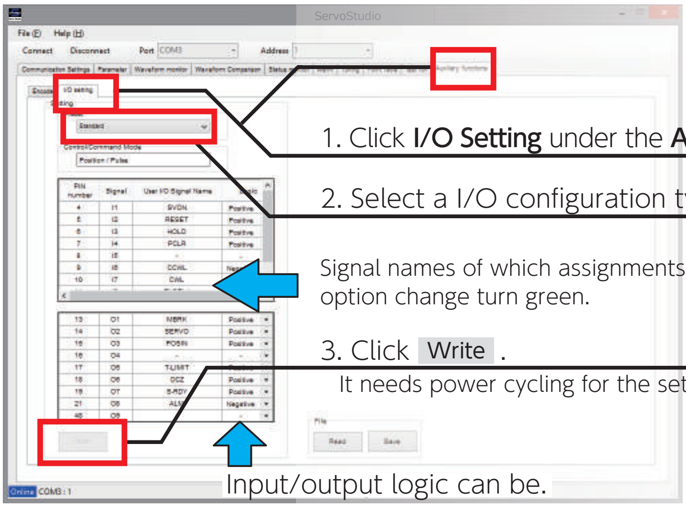
Analog Command

The motor is operated based on the voltage of external power. The range of input voltages is -10 V to +10 V.

Internal Command

The motor is operated based on the motion conditions that is preset in the amplifier. Operations are changed by combinations of command selection pins assigned to I/O.

Changing the I/O configuration by "Servo Studio"



1. Click **I/O Setting** under the **Auxiliary Functions** tab.

2. Select a I/O configuration type

Signal names of which assignments change due to your I/O preset option change turn green.

3. Click Write .

It needs power cycling for the setting changes to take effect.

Input/output logic can be.

1. Overview

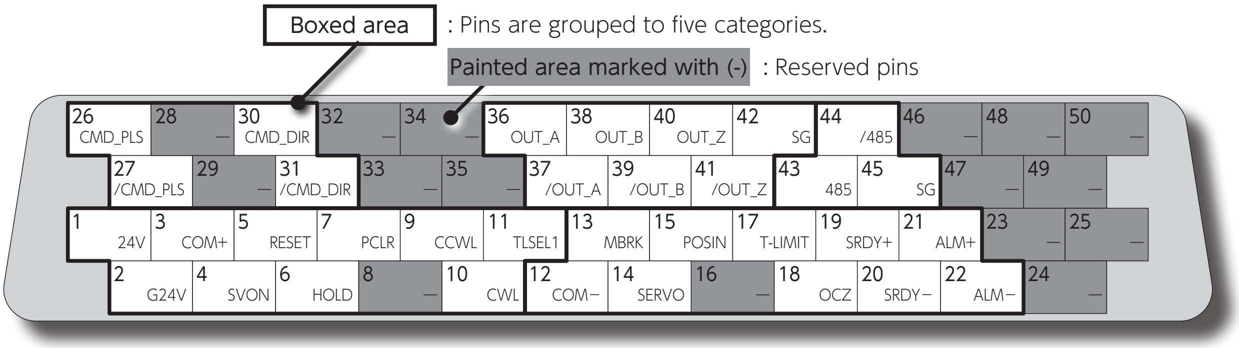
Pinout Diagram

A pinout diagram of CN1 connector pinout. The pinout depends on the control mode or motion mode that you are using. Pins are grouped to five categories.

Pins Group	Description
General-Purpose Input	The pinout depends on the control mode or motion mode that you are using. Input terminals connecting from the host controller, such as control power, I/O power, and Servo ON. You can change the input logic. (*)
General-Purpose Output	The pinout depends on the control mode or motion mode that you are using. An output terminal such as Servo Status that connects to the host controller You can change the output logic. (*)
Encoder Output	A terminal to output encoder pulse to the host controller.
Command Input	The pinout depends on the control mode or motion mode that you are using. An input terminal that receives command signal from the host controller. This terminal connects to Pulse Train Command and Analog Command.
RS-485 Communication	RS-485 interface to communicate with the host controller.

*) ☞ Page 24 Descriptions of CN1 Connector Signals

A pinout diagram illustrates the pinout on the I/O Connector soldering surface.
Do not connect anything to reserved pins.



Example: Position control mode- Pulse Train Command, Differential, Standard I/O Configuration

CN1 Connector Wiring Example

Example of CN1 Connector Wiring The pinout depends on the control mode or motion mode that you are using.
For actual wiring, check the pin numbers etched on the connector body as well.
For further details, refer to Descriptions of CN1 Connector Signals and Interface Circuit of CN1 Connector.

☞ Page 24 Descriptions of CN1 Connector Signals
☞ Page 45 I/F Circuit of CN1 Connector

2. Position Control Mode

1. Pulse Train Command

Differential, Standard I/O Setting

PLS DIF.

Pinout Diagram

Command Input

Pin No.	Signal Description
26	**CMD_PLS** Pulse, QEP A-phase or CCW
27	**/CMD_PLS** /Pulse, QEP /A-phase or /CCW
30	**CMD_DIR** Direction, QEP B-phase or CW
31	**/CMD_DIR** /Direction, QEP /B-phase or /CW

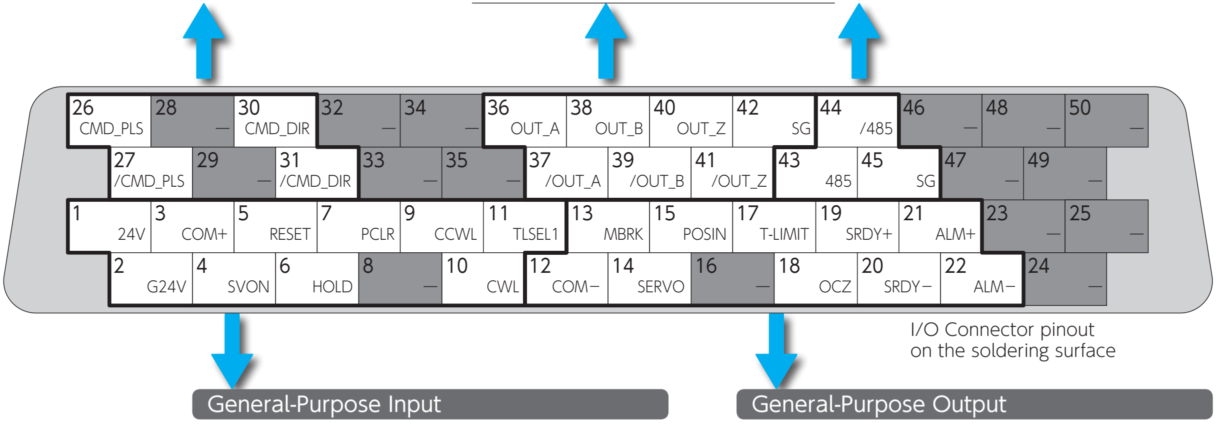
QEP: Quadrature encoder pulse

Encoder Output

Pin No.	Signal Description
36	**OUT_A** A-phase
37	**/OUT_A** /A-phase
38	**OUT_B** B-phase
39	**/OUT_B** /B-phase
40	**OUT_Z** Z-phase
41	**/OUT_Z** /Z-phase
42	**SG** Signal ground

RS-485 Communication

Pin No.	Signal Description
43	**485** Data
44	**/485** /Data
45	**SG** Signal ground



I/O Connector pinout
on the soldering surface

General-Purpose Input

Pin No.	Signal Description
1	**24V** Control power 24 V
2	**G24V** Control power GND
3	**COM+** I/O Power 24 V
4	**SVON** Servo ON
5	**RESET** Alarm reset
6	**HOLD** Command input prohibited
7	**PCLR** Deviation counter clear
9	**CCWL** CCW drive restriction
10	**CWL** CW drive restriction
11	**TLSEL1** Torque Limit

General-Purpose Output

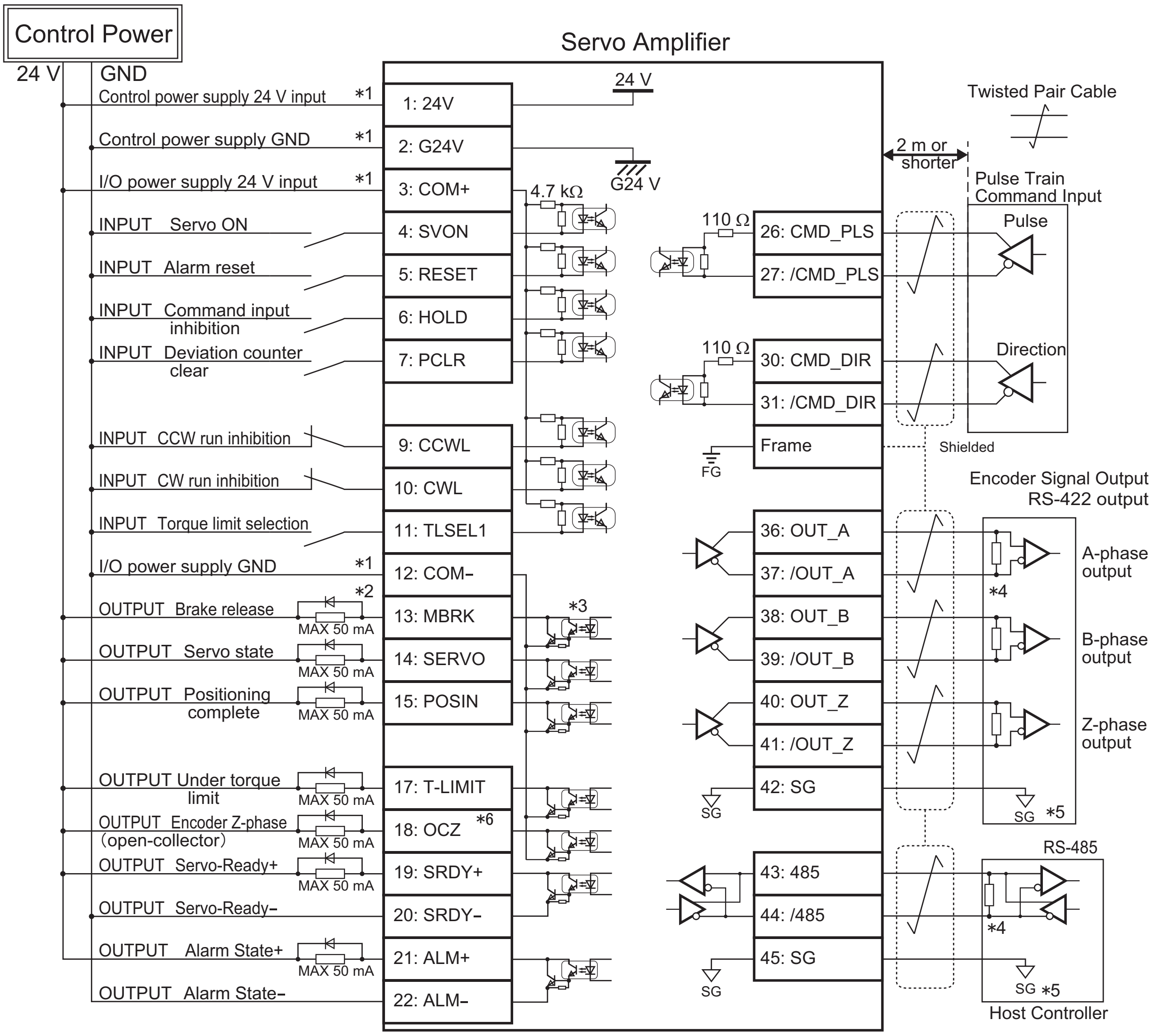
Pin No.	Signal Description
12	**COM−** I/O power GND
13	**MBRK** Brake release
14	**SERVO** Servo status
15	**POSIN** Positioning complete
17	**T-LIMIT** Torque limiting
18	**OCZ** Encoder Z-phase (open collector)
19	**SRDY+** Servo ready +
20	**SRDY−** Servo ready −
21	**ALM+** Alarm status +
22	**ALM−** Alarm status −

2. Position Control Mode

CN1 Connector Wiring Example

Pulse Train Command Differential, Standard I/O Configuration

PLS DIF.



*1) Control power (24 V, G24 V) and power for I/O (COM+, COM−) must share one common power supply.

*2) When driving a load containing inductance component such as relay, connect a protection circuit (diode).
The motor brake cannot be driven directly. Be sure to use a circuit that interfaces with a diode built-in type relay.

☞ Page 46 PO Connections to General-Purpose Output Signal

*3) The output circuit configuration is an open collector Darlington transistor output. Connects to relays and optical isolators.
Note that when the transistor is on, connector-emitter voltage V_{CE} (SAT) is approximately 1 V; a standard TTL IC does not satisfy V_{IL} and cannot be connected directly.

*4) Be sure to connect a termination resistor of approximately 220 Ω.

*5) Make the connection to the communication IC signal ground of the host controller that amplifier encoder output signals are connecting to.
Connecting signal ground SG to control power GND may result in malfunction.

*6) If Z-phase pulse width is too small to be measured accurately by the host controller, decrease pulse division rate by using pulse output ratio (parameters No.276.0 and No.278,0) or decrease rotational speed to increase the pulse width.
Pulse width [ms] = 2 / rotational speed [r/min] / (division ratio × 2^{17}) × 60 × 1,000.

2. Position Control Mode

Differential, I/O Setting Option 1

Pinout Diagram

Command Input

Pin No.	Signal Description
26	**CMD_PLS** Pulse, QEP A-phase or CCW
27	**/CMD_PLS** /Pulse, QEP /A-phase or /CCW
30	**CMD_DIR** Direction, QEP B-phase or CW
31	**/CMD_DIR** /Direction, QEP /B-phase or /CW

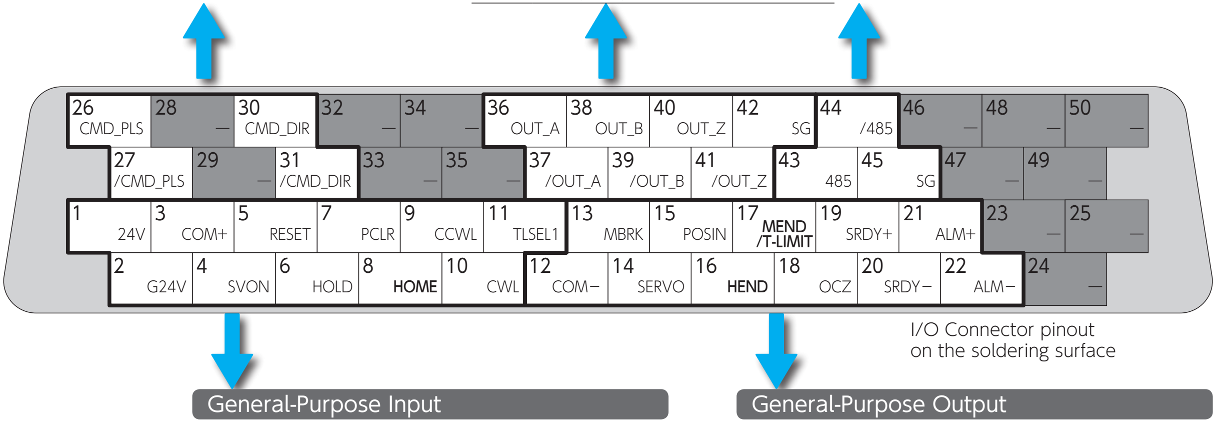
QEP: Quadrature encoder pulse

Encoder Output

Pin No.	Signal Description
36	**OUT_A** A-phase
37	**/OUT_A** /A-phase
38	**OUT_B** B-phase
39	**/OUT_B** /B-phase
40	**OUT_Z** Z-phase
41	**/OUT_Z** /Z-phase
42	**SG** Signal ground

RS-485 Communication

Pin No.	Signal Description
43	**485** Data
44	**/485** /Data
45	**SG** Signal ground



I/O Connector pinout
on the soldering surface

General-Purpose Input

Pin No.	Signal Description
1	**24V** Control power 24 V
2	**G24V** Control power GND
3	**COM+** I/O Power 24 V
4	**SVON** Servo ON
5	**RESET** Alarm reset
6	**HOLD** Command input prohibited
7	**PCLR** Deviation counter clear
8	**HOME** (*) Homing start
9	**CCWL** CCW drive restriction
10	**CWL** CW drive restriction
11	**TLSEL1** Torque Limit

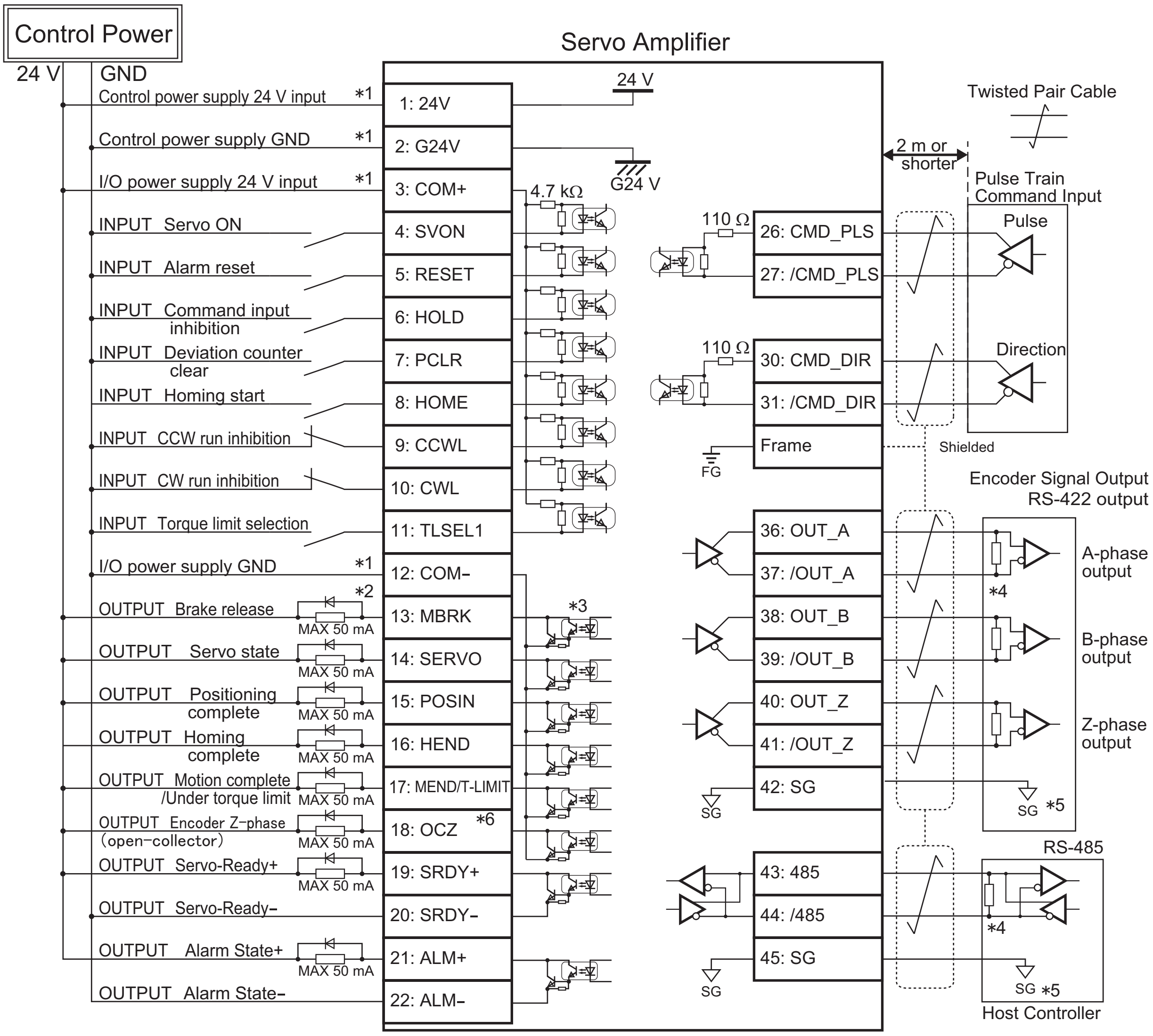
General-Purpose Output

Pin No.	Signal Description
12	**COM−** I/O power GND
13	**MBRK** Brake release
14	**SERVO** Servo status
15	**POSIN** Positioning complete
16	**HEND** (*) Homing complete
17	**MEND/T-LIMIT** (*) Motion complete/Torque limiting
18	**OCZ** Encoder Z-phase (open collector)
19	**SRDY+** Servo ready +
20	**SRDY−** Servo ready-Servo ready −
21	**ALM +** Alarm status +
22	**ALM−** Alarm status −

*) For these pins function, change I/O setting with "Servo Studio".

CN1 Connector Wiring Example

Pulse Train Command Differential, I/O Configuration Option 1



*1) Control power (24 V, G24 V) and power for I/O (COM+, COM−) must share one common power supply.

*2) When driving a load containing inductance component such as relay, connect a protection circuit (diode).
The motor brake cannot be driven directly. Be sure to use a circuit that interfaces with a diode built-in type relay.

☞ Page 46 PO Connections to General-Purpose Output Signal

*3) The output circuit configuration is an open collector Darlington transistor output. Connects to relays and optical isolators.
Note that when the transistor is on, connector-emitter voltage V_{CE} (SAT) is approximately 1 V; a standard TTL IC does not satisfy V_{IL} and cannot be connected directly.

*4) Be sure to connect a termination resistor of approximately 220 Ω .

*5) Make the connection to the communication IC signal ground of the host controller that amplifier encoder output signals are connecting to.
Connecting signal ground SG to control power GND may result in malfunction.

*6) If Z-phase pulse width is too small to be measured accurately by the host controller, decrease pulse division rate by using pulse output ratio (parameters No.276.0 and No.278,0) or decrease rotational speed to increase the pulse width.
Pulse width [ms] = 2 / rotational speed [r/min] / (division ratio × 2^{17}) × 60 × 1,000.

2. Position Control Mode

Differential, I/O Setting Option 2

Pinout Diagram

Command Input

Pin No.	Signal Description
26	**CMD_PLS** Pulse, QEP A-phase or CCW
27	**/CMD_PLS** /Pulse, QEP /A-phase or /CCW
30	**CMD_DIR** Direction, QEP B-phase or CW
31	**/CMD_DIR** /Direction, QEP /B-phase or /CW

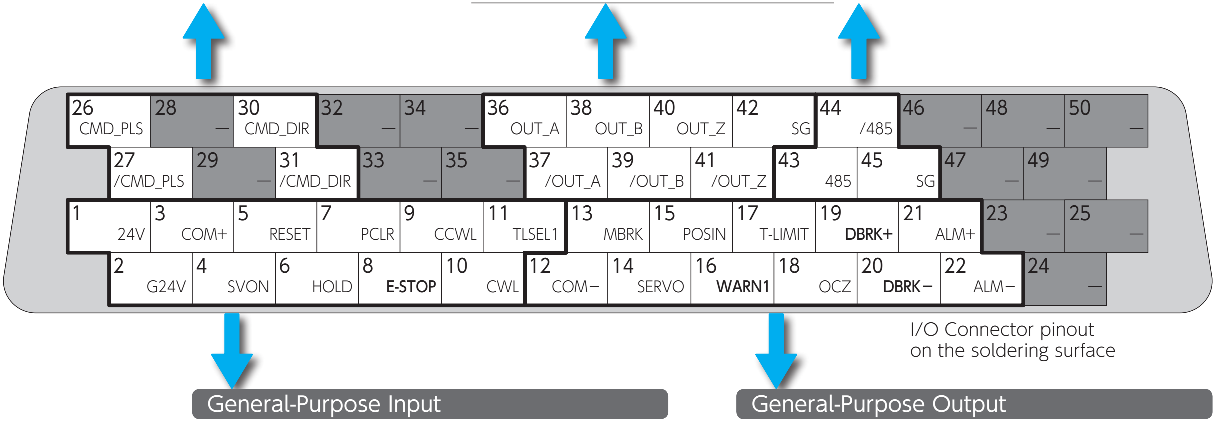
QEP: Quadrature encoder pulse

Encoder Output

Pin No.	Signal Description
36	**OUT_A** A-phase
37	**/OUT_A** /A-phase
38	**OUT_B** B-phase
39	**/OUT_B** /B-phase
40	**OUT_Z** Z-phase
41	**/OUT_Z** /Z-phase
42	**SG** Signal ground

RS-485 Communication

Pin No.	Signal Description
43	**485** Data
44	**/485** /Data
45	**SG** Signal ground



I/O Connector pinout
on the soldering surface

General-Purpose Input

Pin No.	Signal Description
1	**24V** Control power 24 V
2	**G24V** Control power GND
3	**COM+** I/O Power 24 V
4	**SVON** Servo ON
5	**RESET** Alarm reset
6	**HOLD** Command input prohibited
7	**PCLR** Deviation counter clear
8	**E-STOP** (*) Emergency stop
9	**CCWL** CCW drive restriction
10	**CWL** CW drive restriction
11	**TLSEL1** Torque Limit

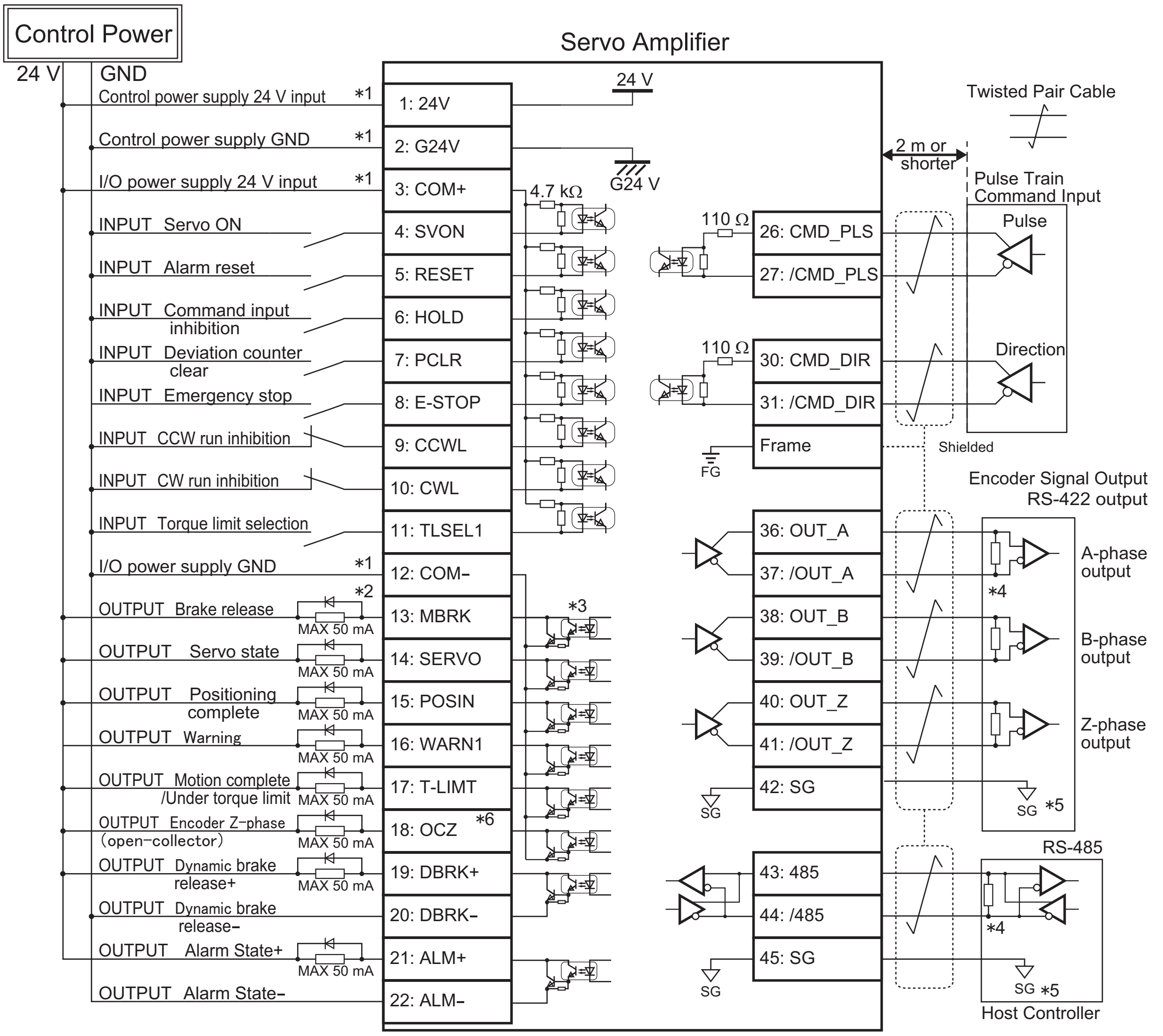
General-Purpose Output

Pin No.	Signal Description
12	**COM−** I/O power GND
13	**MBRK** Brake release
14	**SERVO** Servo status
15	**POSIN** Positioning complete
16	**WARN1** (*) Warning
17	**T-LIMIT** Torque Limit
18	**OCZ** Encoder Z-phase (open collector)
19	**DBRK+** (*) Dynamic brake release +
20	**DBRK−** (*) Dynamic brake release −
21	**ALM+** Alarm status +
22	**ALM−** Alarm status −

*) For these pins function, change I/O setting with "Servo Studio".

CN1 Connector Wiring Example

Pulse Train Command Differential, I/O configuration Option 2



*1) Control power (24 V, G24 V) and power for I/O (COM+, COM−) must share one common power supply.

*2) When driving a load containing inductance component such as relay, connect a protection circuit (diode).
The motor brake cannot be driven directly. Be sure to use a circuit that interfaces with a diode built-in type relay.

☞ Page 46 PO Connections to General-Purpose Output Signal

*3) The output circuit configuration is an open collector Darlington transistor output. Connects to relays and optical isolators.
Note that when the transistor is on, connector-emitter voltage V_{CE} (SAT) is approximately 1 V; a standard TTL IC does not satisfy V_{IL} and cannot be connected directly.

*4) Be sure to connect a termination resistor of approximately 220 Ω.

*5) Make the connection to the communication IC signal ground of the host controller that amplifier encoder output signals are connecting to.
Connecting signal ground SG to control power GND may result in malfunction.

*6) If Z-phase pulse width is too small to be measured accurately by the host controller, decrease pulse division rate by using pulse output ratio (parameters No.276.0 and No.278,0) or decrease rotational speed to increase the pulse width.
Pulse width [ms] = 2 / rotational speed [r/min] / (division ratio × 2^{17}) × 60 × 1,000.

2. Position Control Mode

24 V open collector, Standard I/O configuration

Pinout Diagram

Command Input

Pin No.	Signal Description
27	**/CMD_PLS** /Pulse, QEP /A-phase or /CCW
28	**CC-P** Open collector power 24 V-PLS
29	**CC-D** Open collector power 24 V-DIR
31	**/CMD_DIR** /Direction, QEP /B-phase or /CW

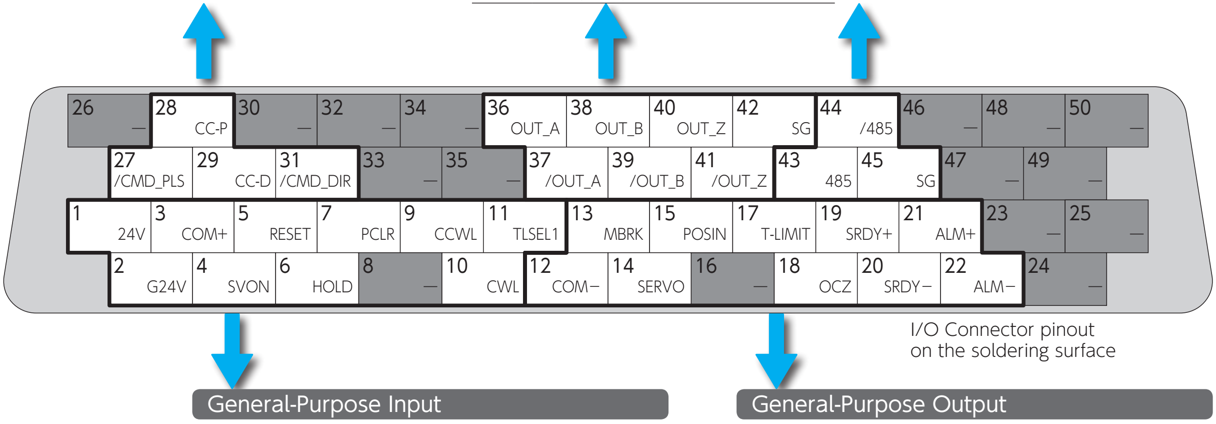
QEP: Quadrature encoder pulse

Encoder Output

Pin No.	Signal Description
36	**OUT_A** A-phase
37	**/OUT_A** /A-phase
38	**OUT_B** B-phase
39	**/OUT_B** /B-phase
40	**OUT_Z** Z-phase
41	**/OUT_Z** /Z-phase
42	**SG** Signal ground

RS-485 Communication

Pin No.	Signal Description
43	**485** Data
44	**/485** /Data
45	**SG** Signal ground



I/O Connector pinout
on the soldering surface

General-Purpose Input

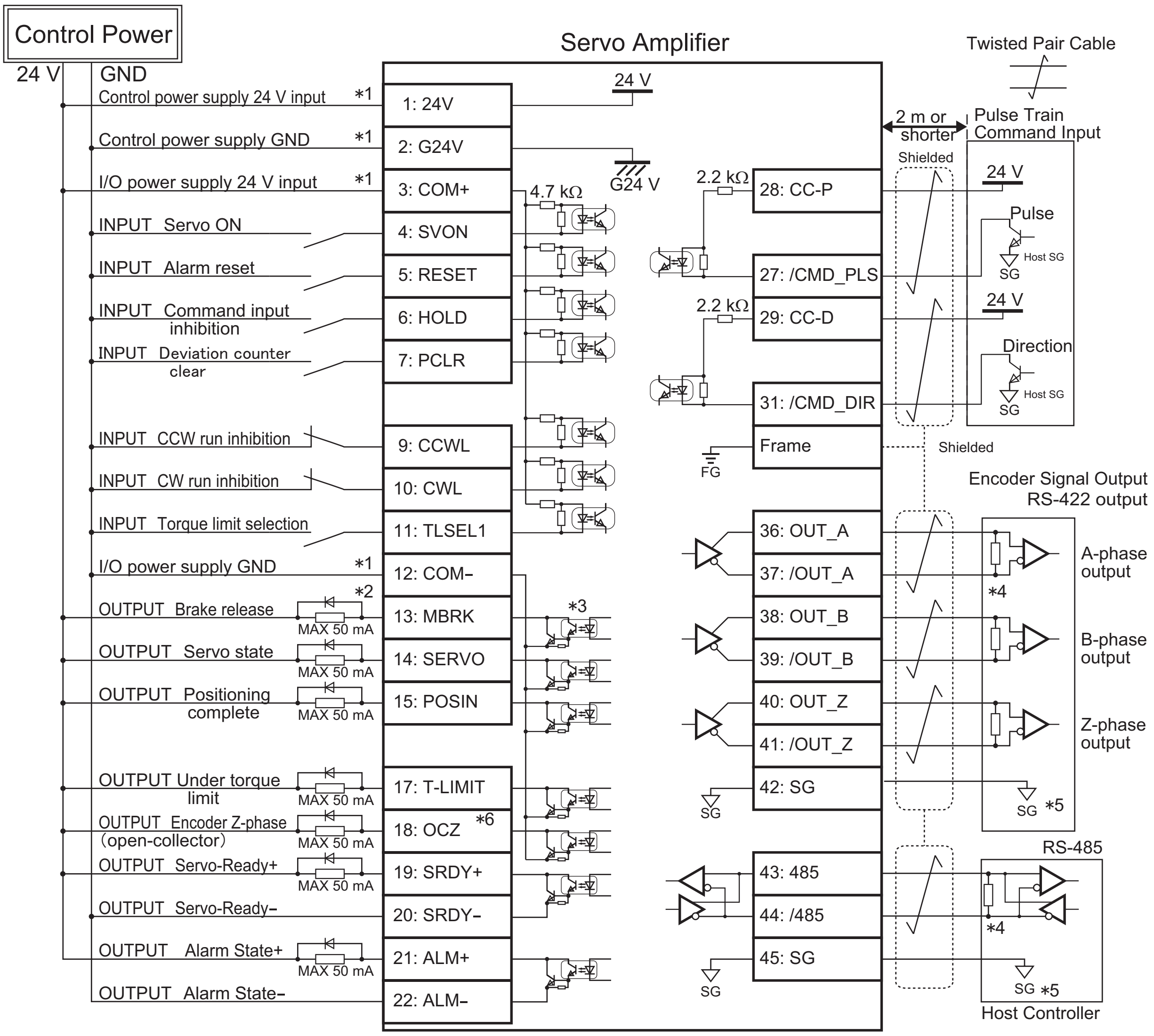
Pin No.	Signal Description
1	**24V** Control power 24 V
2	**G24V** Control power GND
3	**COM+** I/O Power 24 V
4	**SVON** Servo ON
5	**RESET** Alarm reset
6	**HOLD** Command input prohibited
7	**PCLR** Deviation counter clear
9	**CCWL** CCW drive restriction
10	**CWL** CW drive restriction
11	**TLSEL1** Torque Limit

General-Purpose Output

Pin No.	Signal Description
12	**COM−** I/O power GND
13	**MBRK** Brake release
14	**SERVO** Servo status
15	**POSIN** Positioning complete
17	**T-LIMIT** Torque limiting
18	**OCZ** Encoder Z-phase (open collector)
19	**SRDY +** Servo ready+
20	**SRDY−** Servo ready−
21	**ALM+** Alarm status+
22	**ALM−** Alarm status−

CN1 Connector Wiring Example

Pulse Train Command 24 V Open Collector, Standard I/O Configuration



*1) Control power (24 V, G24 V) and power for I/O (COM+, COM−) must share one common power supply.

*2) When driving a load containing inductance component such as relay, connect a protection circuit (diode).
The motor brake cannot be driven directly. Be sure to use a circuit that interfaces with a diode built-in type relay.

Page 46 **PO** Connections to General-Purpose Output Signal

*3) The output circuit configuration is an open collector Darlington transistor output. Connects to relays and optical isolators.
Note that when the transistor is on, connector-emitter voltage V_{CE} (SAT) is approximately 1 V; a standard TTL IC does not satisfy V_{IL} and cannot be connected directly.

*4) Be sure to connect a termination resistor of approximately 220 Ω.

*5) Make the connection to the communication IC signal ground of the host controller that amplifier encoder output signals are connecting to.
Connecting signal ground SG to control power GND may result in malfunction.

*6) If Z-phase pulse width is too small to be measured accurately by the host controller, decrease pulse division rate by using pulse output ratio (parameters No.276.0 and No.278,0) or decrease rotational speed to increase the pulse width.
Pulse width [ms] = 2 / rotational speed [r/min] / (division ratio × 2^{17}) × 60 × 1,000.

5 V open collector, Standard I/O configuration

Pinout Diagram

Command Input

Pin No.	Signal	Description
49	**CC_P-5V**	Open collector power 5 V-PLS
27	**/CMD_PLS**	/Pulse, QEP /A-phase or /CCW
50	**CC_D-5V**	Open collector power 5 V-DIR
31	**/CMD_DIR**	/Direction, QEP /B-phase or /CW

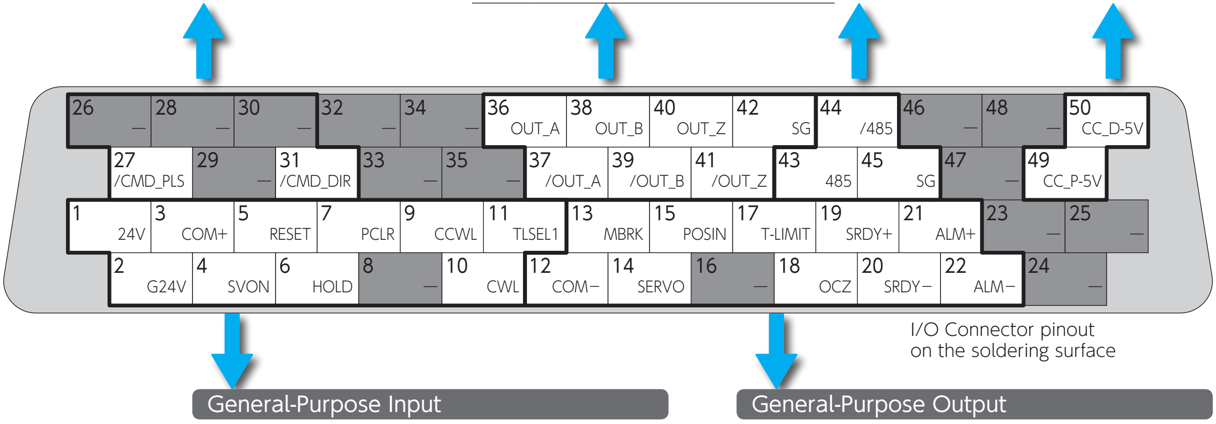
QEP: Quadrature encoder pulse

Encoder Output

Pin No.	Signal	Description
36	**OUT_A**	A-phase
37	**/OUT_A**	/A-phase
38	**OUT_B**	B-phase
39	**/OUT_B**	/B-phase
40	**OUT_Z**	Z-phase
41	**/OUT_Z**	/Z-phase
42	**SG**	Signal ground

RS-485 Communication

Pin No.	Signal	Description
43	**485**	Data
44	**/485**	/Data
45	**SG**	Signal ground



I/O Connector pinout
on the soldering surface

General-Purpose Input

Pin No.	Signal	Description
1	**24V**	Control power 24 V
2	**G24V**	Control power GND
3	**COM+**	I/O Power 24 V
4	**SVON**	Servo ON
5	**RESET**	Alarm reset
6	**HOLD**	Command input prohibited
7	**PCLR**	Deviation counter clear
9	**CCWL**	CCW drive restriction
10	**CWL**	CW drive restriction
11	**TLSEL1**	Torque Limit

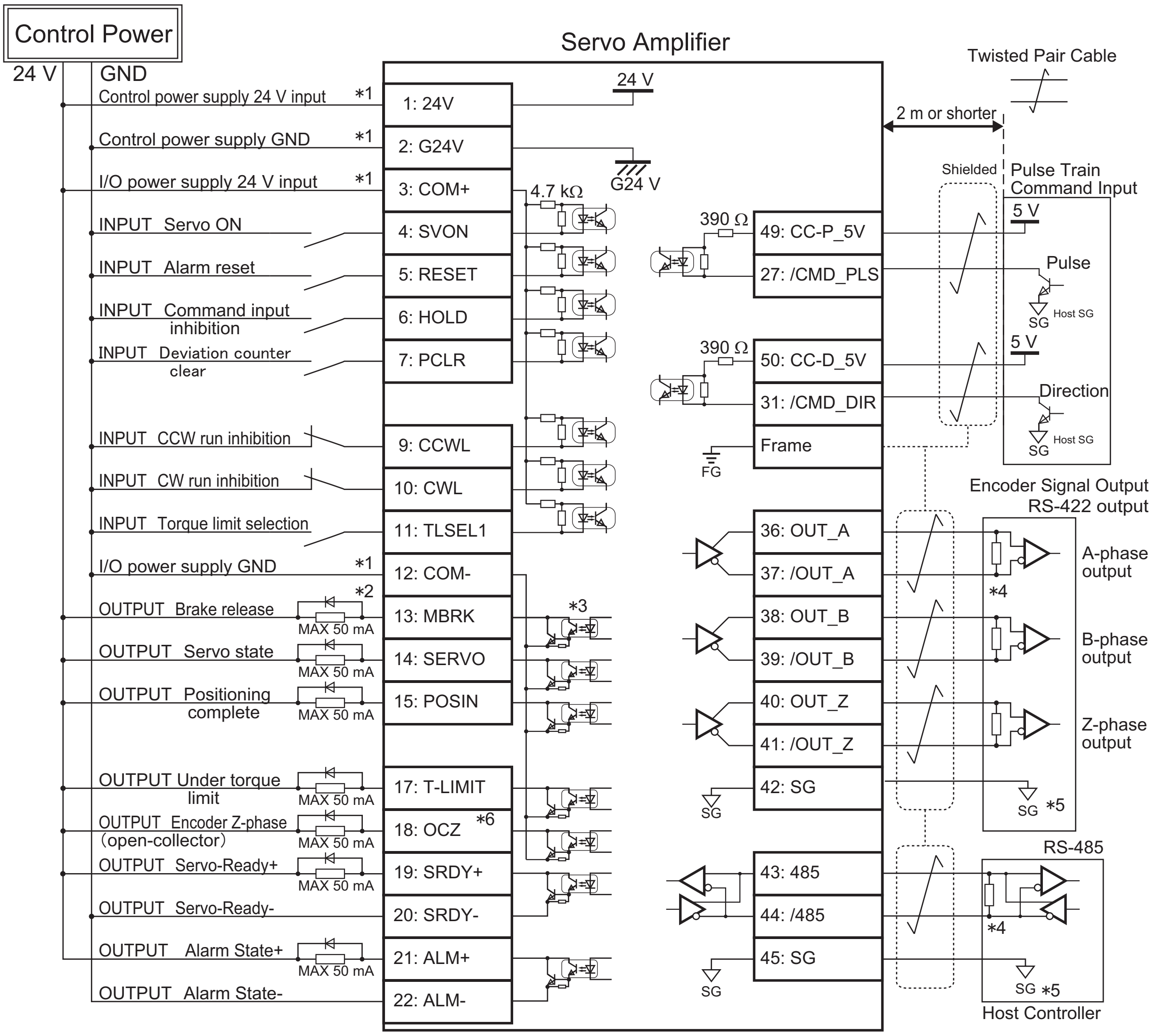
General-Purpose Output

Pin No.	Signal	Description
12	**COM−**	I/O power GND
13	**MBRK**	Brake release
14	**SERVO**	Servo status
15	**POSIN**	Positioning complete
17	**T-LIMIT**	Torque limiting
18	**OCZ**	Encoder Z-phase (open collector)
19	**SRDY+**	Servo ready+
20	**SRDY−**	Servo ready−
21	**ALM+**	Alarm status+
22	**ALM−**	Alarm status−

2. Position Control Mode

CN1 Connector Wiring Example

Pulse Train Command 5 V Open Collector, Standard I/O Configuration



*1) Control power (24 V, G24 V) and power for I/O (COM+, COM−) must share one common power supply.

*2) When driving a load containing inductance component such as relay, connect a protection circuit (diode).
The motor brake cannot be driven directly. Be sure to use a circuit that interfaces with a diode built-in type relay.

☞ Page 46 **PO** Connections to General-Purpose Output Signal

*3) The output circuit configuration is an open collector Darlington transistor output. Connects to relays and optical isolators.
Note that when the transistor is on, connector-emitter voltage V_{CE} (SAT) is approximately 1 V; a standard TTL IC does not satisfy V_{IL} and cannot be connected directly.

*4) Be sure to connect a termination resistor of approximately 220 Ω.

*5) Make the connection to the communication IC signal ground of the host controller that amplifier encoder output signals are connecting to.
Connecting signal ground SG to control power GND may result in malfunction.

*6) If Z-phase pulse width is too small to be measured accurately by the host controller, decrease pulse division rate by using pulse output ratio (parameters No.276.0 and No.278,0) or decrease rotational speed to increase the pulse width.
Pulse width [ms] = 2 / rotational speed [r/min] / (division ratio × 2^{17}) × 60 × 1,000.

2. Position Control Mode

2. Internal Position Command

Standard I/O Configuration

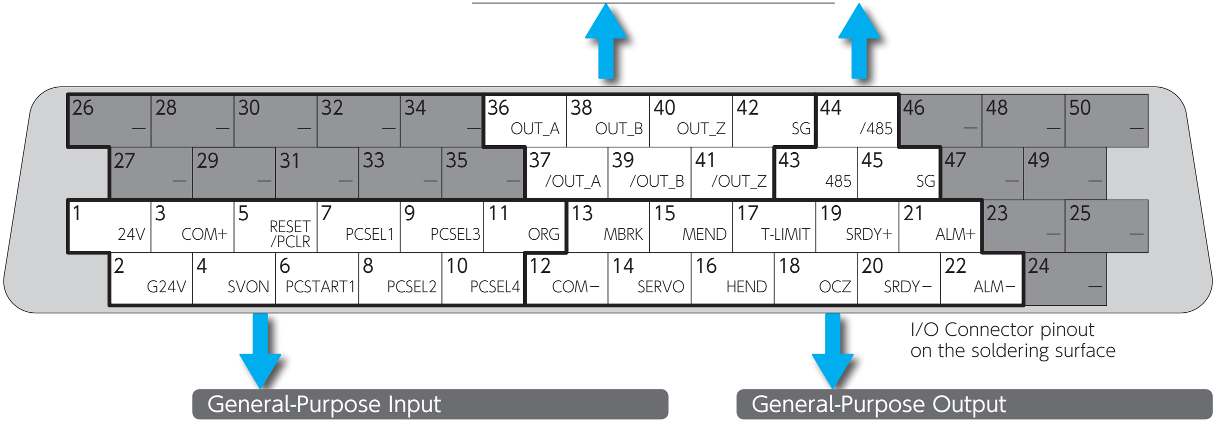
Pinout Diagram

Encoder Output

Pin No.	Signal Description
36	**OUT_A** A-phase
37	**/OUT_A** /A-phase
38	**OUT_B** B-phase
39	**/OUT_B** /B-phase
40	**OUT_Z** Z-phase
41	**/OUT_Z** /Z-phase
42	**SG** Signal ground

RS-485 Communication

Pin No.	Signal Description
43	**485** Data
44	**/485** /Data
45	**SG** Signal ground



I/O Connector pinout
on the soldering surface

General-Purpose Input

Pin No.	Signal Description
1	**24V** Control power 24 V
2	**G24V** Control power GND
3	**COM+** I/O Power 24 V
4	**SVON** Servo ON
5	**RESET/PCLR** Alarm Reset/Deviation Counter Clear
6	**PCSTART1** Start Forward Rotation
7	**PCSEL1** Point No. Select 1
8	**PCSEL2** Point No. Select 2
9	**PCSEL3** Point No. Select 3
10	**PCSEL4** Point No. Select 4
11	**ORG** Home position sensor

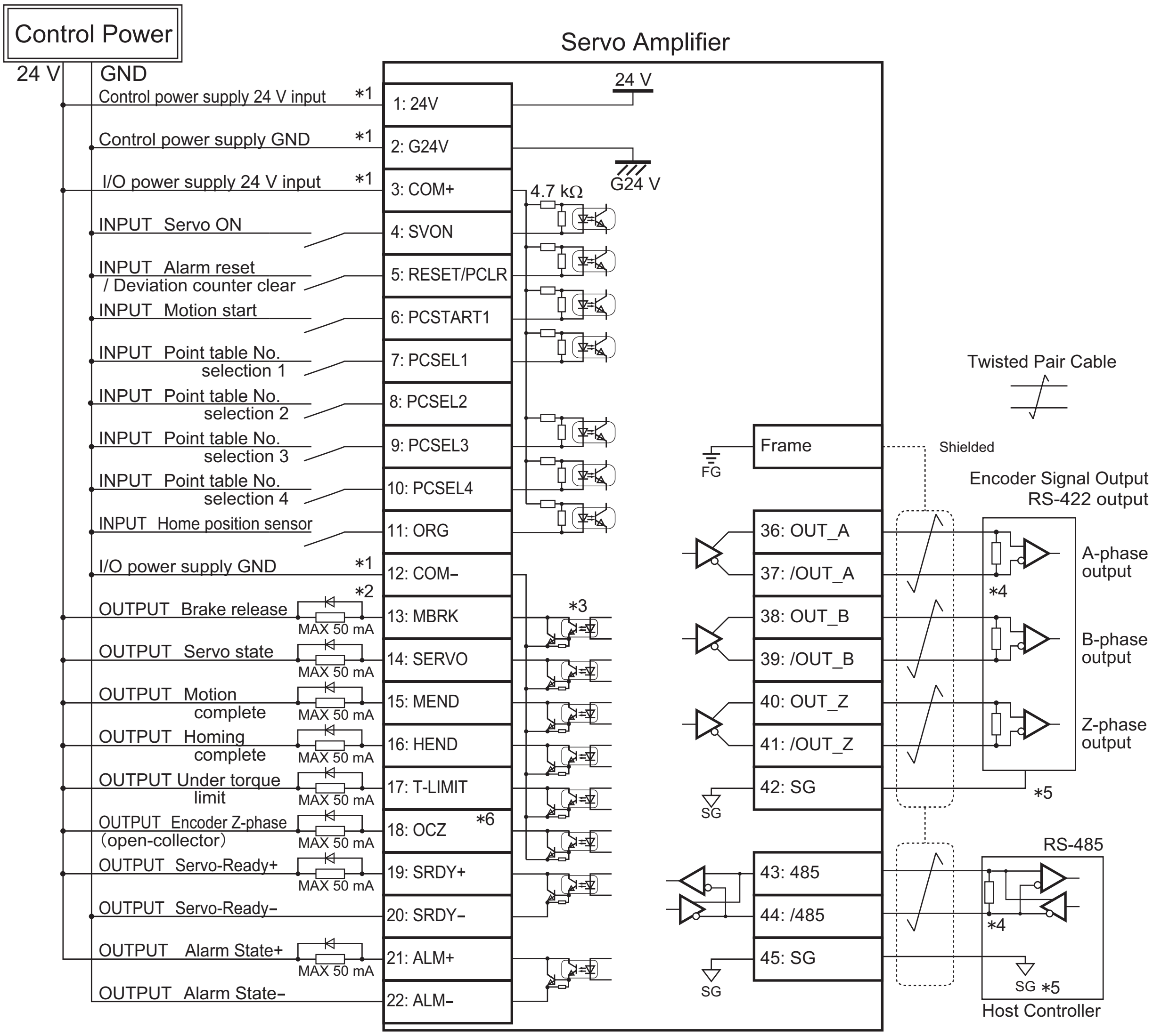
General-Purpose Output

Pin No.	Signal Description
12	**COM−** I/O power GND
13	**MBRK** Brake release
14	**SERVO** Servo status
15	**MEND** Motion complete
16	**HEND** Homing complete
17	**T-LIMIT** Torque limiting
18	**OCZ** Encoder Z-phase (open collector)
19	**SRDY+** Servo ready +
20	**SRDY−** Servo ready −
21	**ALM+** Alarm status +
22	**ALM−** Alarm status −

2. Position Control Mode

CN1 Connector Wiring Example

Internal Position Command Standard I/O Configuration



*1) Control power (24 V, G24 V) and power for I/O (COM+, COM−) must share one common power supply.

*2) When driving a load containing inductance component such as relay, connect a protection circuit (diode).
<u>The motor brake cannot be driven directly. Be sure to use a circuit that interfaces with a diode built-in type relay.</u>

☞ Page 46 PO Connections to General-Purpose Output Signal

*3) The output circuit configuration is an open collector Darlington transistor output. Connects to relays and optical isolators.
Note that when the transistor is on, connector-emitter voltage V_{CE} (SAT) is approximately 1 V; a standard TTL IC does not satisfy V_{IL} and cannot be connected directly.

*4) Be sure to connect a termination resistor of approximately 220 Ω.

*5) Make the connection to the communication IC signal ground of the host controller that amplifier encoder output signals are connecting to.
Connecting signal ground SG to control power GND may result in malfunction.

*6) If Z-phase pulse width is too small to be measured accurately by the host controller, decrease pulse division rate by using pulse output ratio (parameters No.276.0 and No.278,0) or decrease rotational speed to increase the pulse width.

Pulse width [ms] = 2 / rotational speed [r/min] / (division ratio × 2^{17}) × 60 × 1,000.

2. Position Control Mode

Optional I/O Configuration

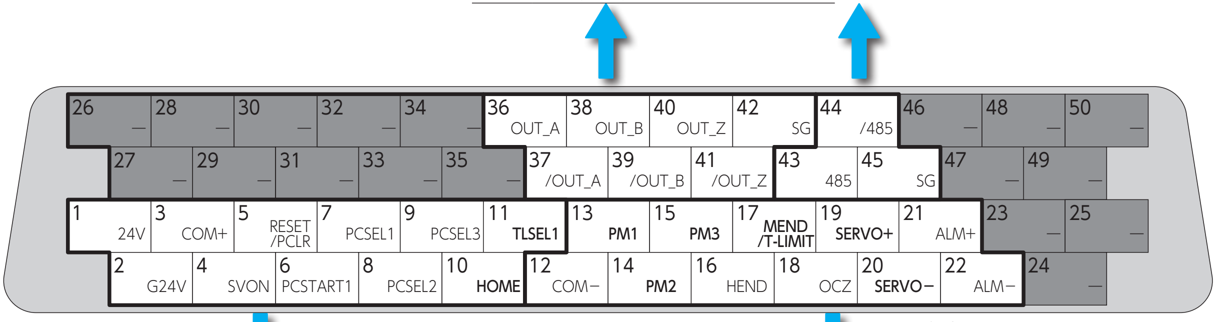
Pinout Diagram

Encoder Output

Pin No.	Signal Description
36	**OUT_A** A-phase
37	**/OUT_A** /A-phase
38	**OUT_B** B-phase
39	**/OUT_B** /B-phase
40	**OUT_Z** Z-phase
41	**/OUT_Z** /Z-phase
42	**SG** Signal ground

RS-485 Communication

Pin No.	Signal Description
43	**485** Data
44	**/485** /Data
45	**SG** Signal ground



I/O Connector pinout
on the soldering surface

General-Purpose Input

Pin No.	Signal Description
1	**24V** Control power 24 V
2	**G24V** Control power GND
3	**COM+** I/O Power 24 V
4	**SVON** Servo ON
5	**RESET/PCLR** Alarm Reset/Deviation Counter Clear
6	**PCSTART1** Start Forward Rotation
7	**PCSEL1** Point No. Select 1
8	**PCSEL2** Point No. Select 2
9	**PCSEL3** Point No. Select 3
10	**HOME** (*) Homing start
11	**TLSEL1** (*) Torque limit

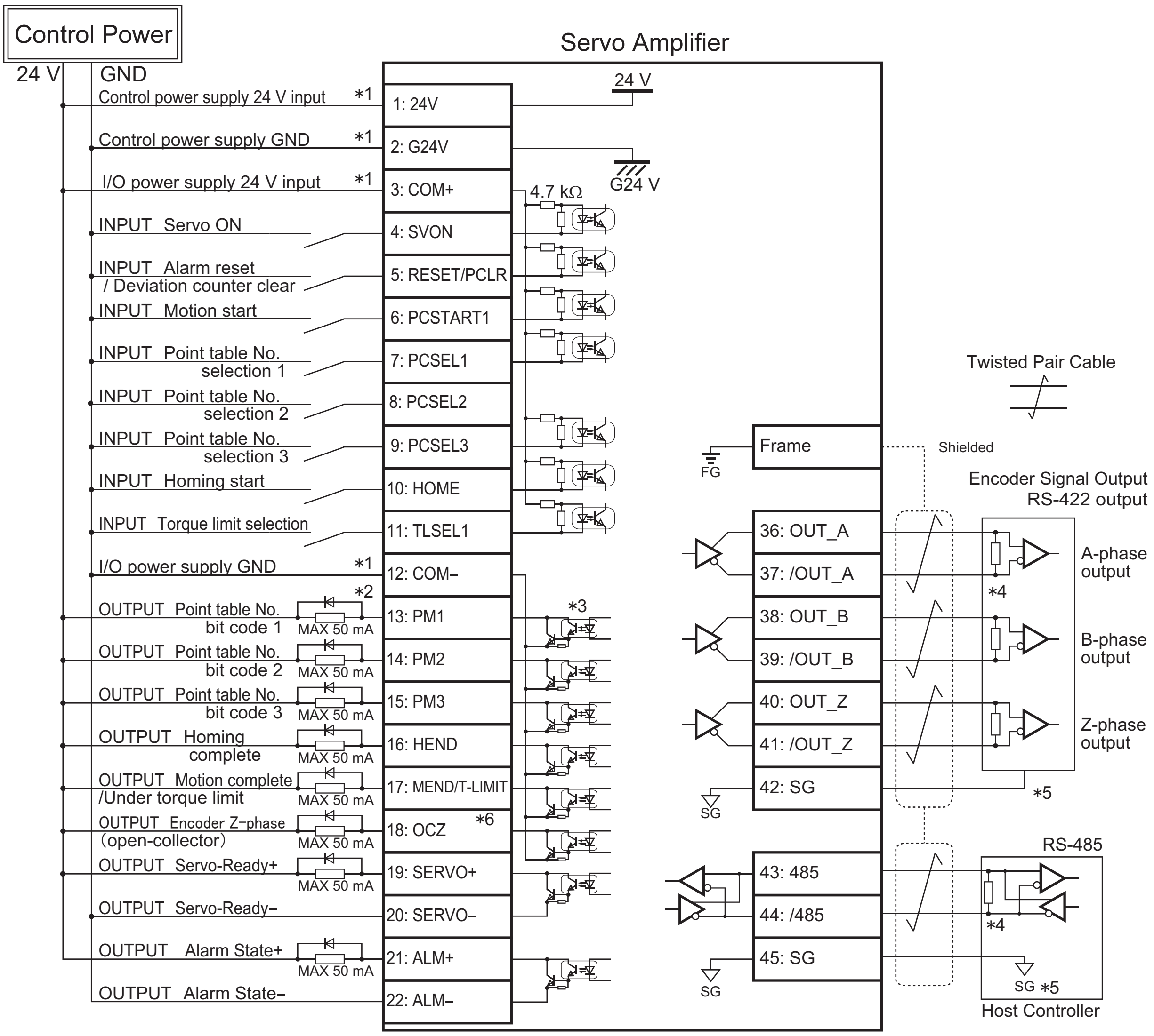
General-Purpose Output

Pin No.	Signal Description
12	**COM−** I/O power GND
13	**PM1** (*) Point No.1
14	**PM2** (*) Point No.2
15	**PM3** (*) Point No.3
16	**HEND** Homing complete
17	**MEND/T-LIMIT** (*) Motion Complete/Torque Limiting
18	**OCZ** Encoder Z-phase (open collector)
19	**SERVO+** (*) Servo Status +
20	**SERVO−** (*) Servo Status −
21	**ALM+** Alarm status +
22	**ALM−** Alarm status −

*) For these pins function, change I/O setting with "Servo Studio".

CN1 Connector Wiring Example

Internal Position Command　　Optional I/O Configuration



*1) Control power (24 V, G24 V) and power for I/O (COM+, COM−) must share one common power supply.

*2) When driving a load containing inductance component such as relay, connect a protection circuit (diode).
The motor brake cannot be driven directly. Be sure to use a circuit that interfaces with a diode built-in type relay.

☞ Page 46 PO Connections to General-Purpose Output Signal

*3) The output circuit configuration is an open collector Darlington transistor output. Connects to relays and optical isolators.
Note that when the transistor is on, connector-emitter voltage V_{CE} (SAT) is approximately 1 V; a standard TTL IC does not satisfy V_{IL} and cannot be connected directly.

*4) Be sure to connect a termination resistor of approximately 220 Ω.

*5) Make the connection to the communication IC signal ground of the host controller that amplifier encoder output signals are connecting to.
Connecting signal ground SG to control power GND may result in malfunction.

*6) If Z-phase pulse width is too small to be measured accurately by the host controller, decrease pulse division rate by using pulse output ratio (parameters No.276.0 and No.278,0) or decrease rotational speed to increase the pulse width.
Pulse width [ms] = 2 / rotational speed [r/min] / (division ratio × 2^{17}) × 60 × 1,000.

3. Velocity Control Mode

1. Analog Velocity Command

Pinout Diagram

Command Input

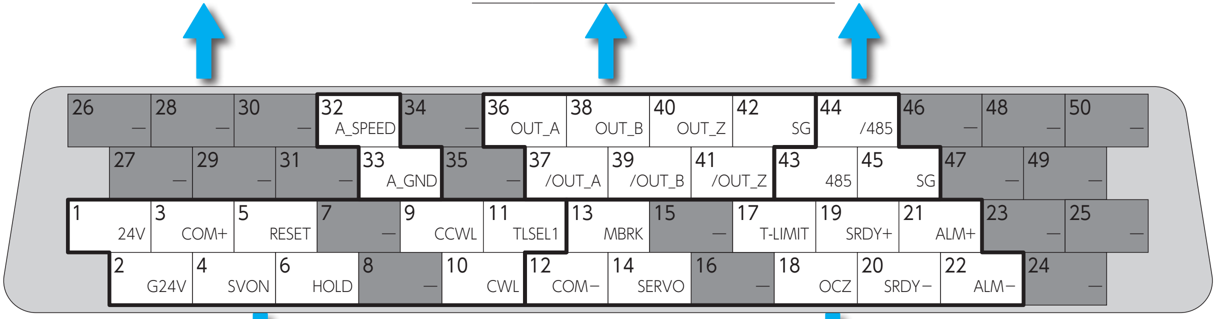
Pin No.	Signal Description
32	**A_SPEED** Analog Command
33	**A_GND** Analog Command Ground

Encoder Output

Pin No.	Signal Description
36	**OUT_A** A-phase
37	**/OUT_A** /A-phase
38	**OUT_B** B-phase
39	**/OUT_B** /B-phase
40	**OUT_Z** Z-phase
41	**/OUT_Z** /Z-phase
42	**SG** Signal ground

RS-485 Communication

Pin No.	Signal Description
43	**485** Data
44	**/485** /Data
45	**SG** Signal ground



I/O Connector pinout
on the soldering surface

General-Purpose Input

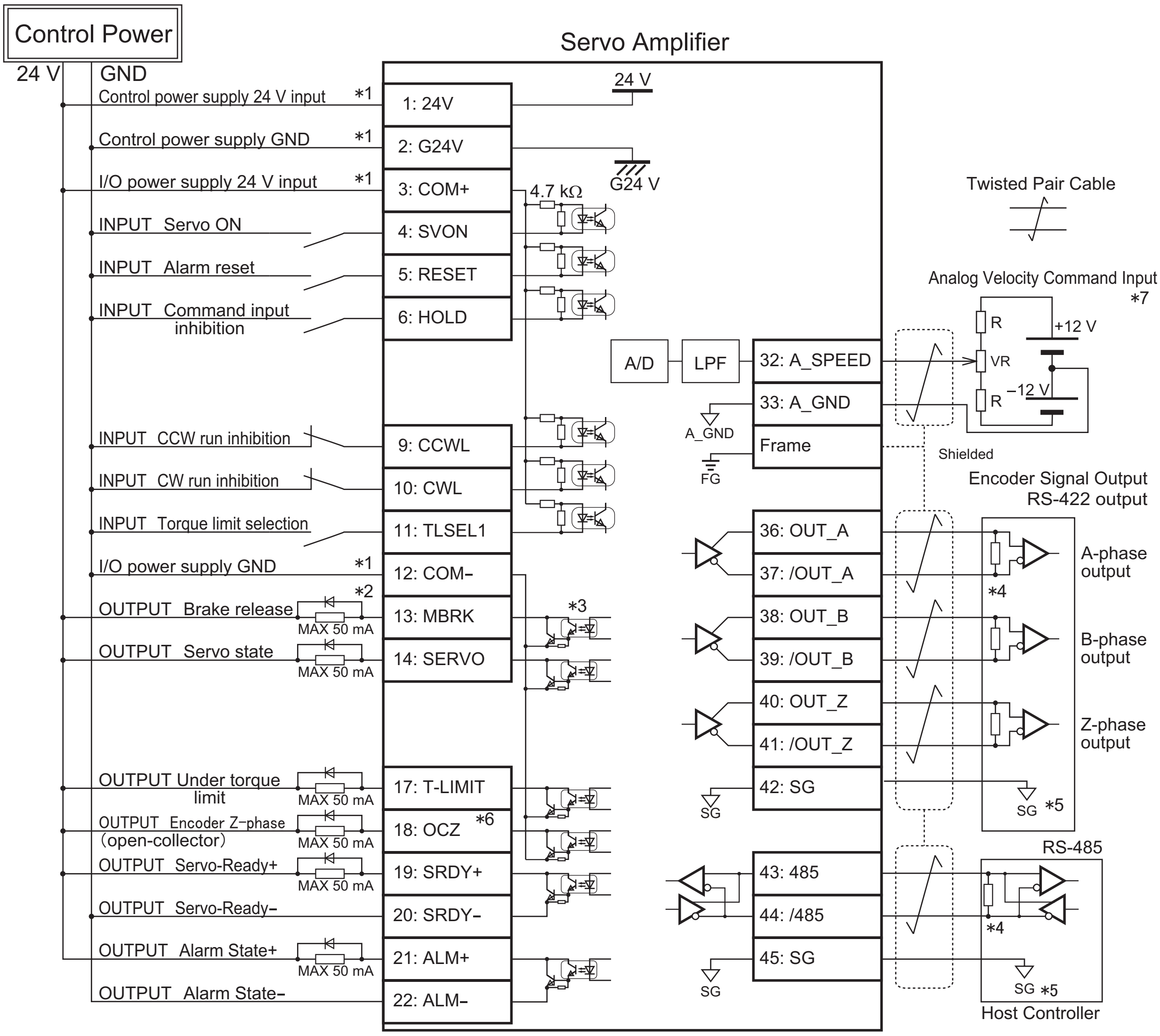
Pin No.	Signal Description
1	**24V** Control power 24 V
2	**G24V** Control power GND
3	**COM+** I/O Power 24 V
4	**SVON** Servo ON
5	**RESET** Alarm reset
6	**HOLD** Command input prohibited
9	**CCWL** CCW drive restriction
10	**CWL** CW drive restriction
11	**TLSEL1** Torque Limit

General-Purpose Output

Pin No.	Signal Description
12	**COM−** I/O power GND
13	**MBRK** Brake release
14	**SERVO** Servo status
17	**T-LIMIT** Torque limiting
18	**OCZ** Encoder Z-phase (open collector)
19	**SRDY+** Servo ready +
20	**SRDY−** Servo ready −
21	**ALM+** Alarm status +
22	**ALM−** Alarm status −

CN1 Connector Wiring Example

Analog Velocity Command



*1) Control power (24 V, G24 V) and power for I/O (COM+, COM−) must share one common power supply.

*2) When driving a load containing inductance component such as relay, connect a protection circuit (diode).
The motor brake cannot be driven directly. Be sure to use a circuit that interfaces with a diode built-in type relay.

☞ Page 46 PO Connections to General-Purpose Output Signal

*3) The output circuit configuration is an open collector Darlington transistor output. Connects to relays and optical isolators.
Note that when the transistor is on, connector-emitter voltage V_{CE} (SAT) is approximately 1 V; a standard TTL IC does not satisfy V_{IL} and cannot be connected directly.

*4) Be sure to connect a termination resistor of approximately 220 Ω.

*5) Make the connection to the communication IC signal ground of the host controller that amplifier encoder output signals are connecting to.
Connecting signal ground SG to control power GND may result in malfunction.

*6) If Z-phase pulse width is too small to be measured accurately by the host controller, decrease pulse division rate by using pulse output ratio (parameters No.276.0 and No.278,0) or decrease rotational speed to increase the pulse width.

Pulse width [ms] = 2 / rotational speed [r/min] / (division ratio × 2^{17}) × 60 × 1,000.

*7) For the command circuit configuration with a variable resistor (VR) and a resistor (R), (VR) must be 2 kΩ (1/4 W or more) and (R) must be 100 Ω to 200 Ω (1/4 W or more) , so that command input voltage range is -10 V to +10 V. If the analog voltage command circuit of the host controller is isolated from 24 V control power supply, connect A_GND to signal ground of the host controller, not to GND of control power, If the analog velocity command circuit is not isolated, connect A_GND to GND of control power.

3. Velocity Control Mode

2. Internal Velocity Command

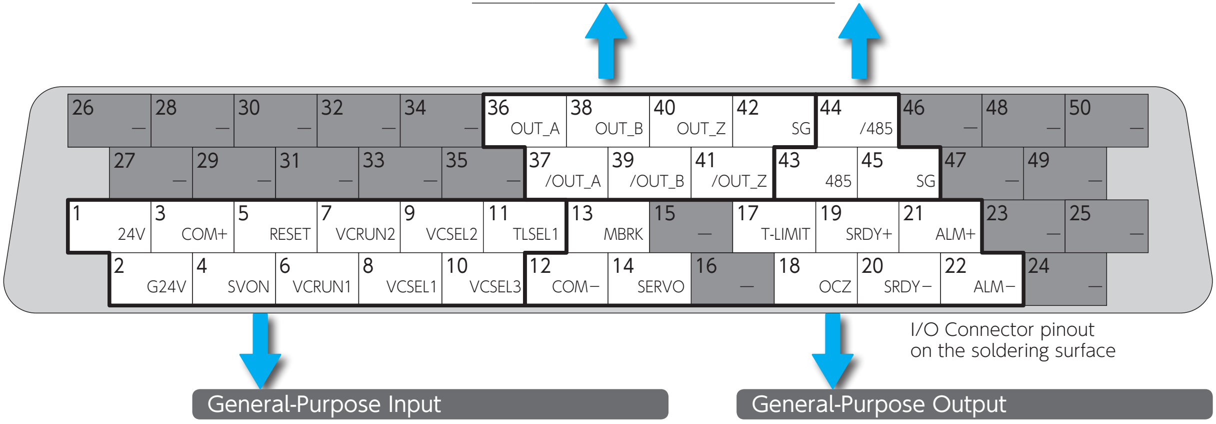
Pinout Diagram

Encoder Output

Pin No.	Signal Description
36	**OUT_A** A-phase
37	**/OUT_A** /A-phase
38	**OUT_B** B-phase
39	**/OUT_B** /B-phase
40	**OUT_Z** Z-phase
41	**/OUT_Z** /Z-phase
42	**SG** Signal ground

RS-485 Communication

Pin No.	Signal Description
43	**485** Data
44	**/485** /Data
45	**SG** Signal ground



I/O Connector pinout
on the soldering surface

General-Purpose Input

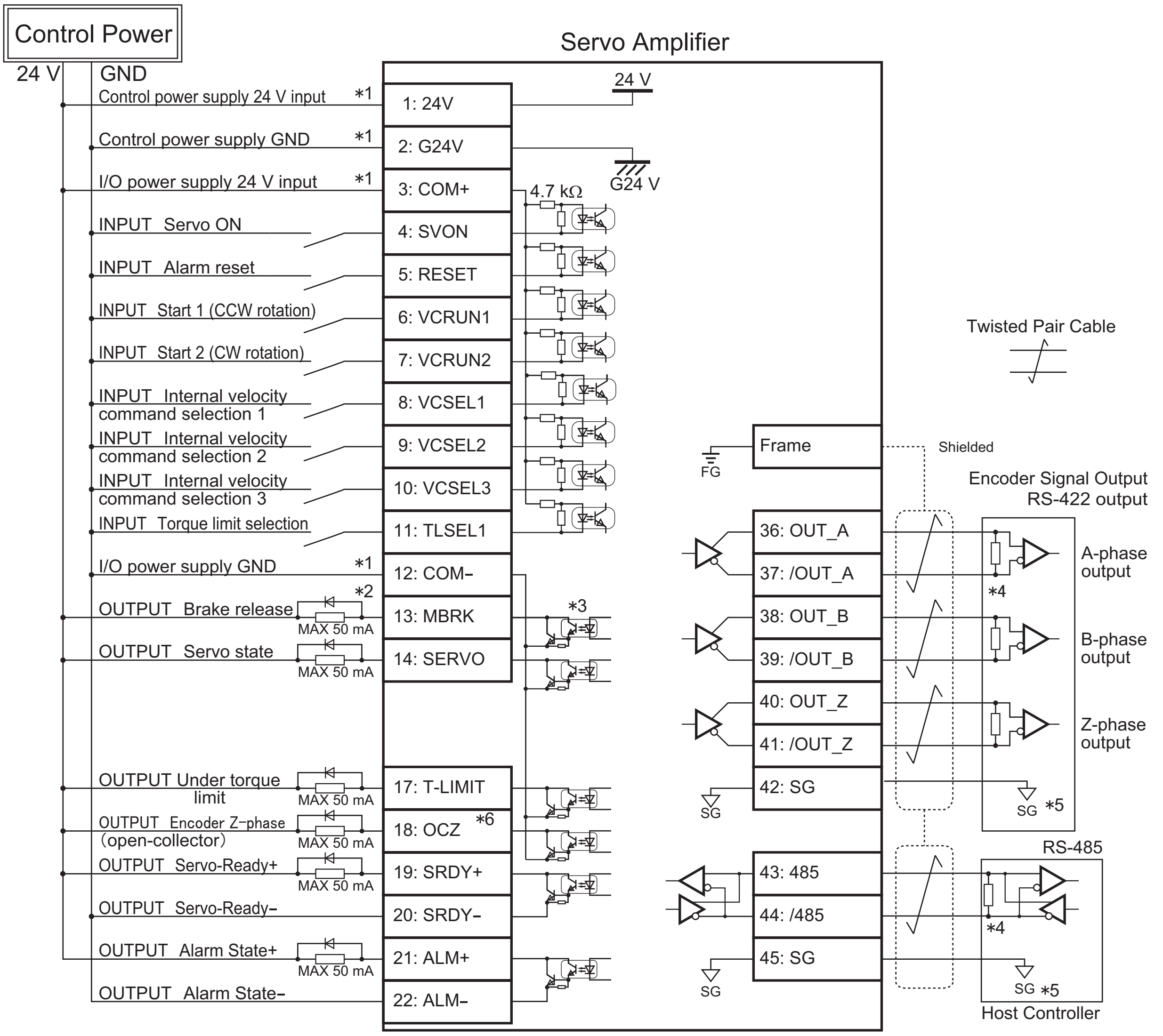
Pin No.	Signal Description
1	**24V** Control power 24 V
2	**G24V** Control power GND
3	**COM+** I/O Power 24 V
4	**SVON** Servo ON
5	**RESET** Alarm reset
6	**VCRUN1** Start 1 (CCW rotation)
7	**VCRUN2** Start 2 (CW rotation)
8	**VCSEL1** Speed Select 1
9	**VCSEL2** Speed Select 2
10	**VCSEL3** Speed Select 3
11	**TLSEL1** Torque Limit

General-Purpose Output

Pin No.	Signal Description
12	**COM−** I/O power GND
13	**MBRK** Brake release
14	**SERVO** Servo status
17	**T-LIMIT** Torque limiting
18	**OCZ** Encoder Z-phase (open collector)
19	**SRDY+** Servo ready +
20	**SRDY−** Servo ready −
21	**ALM+** Alarm status +
22	**ALM−** Alarm status −

CN1 Connector Wiring Example

Internal Velocity Command



*1) Control power (24 V, G24 V) and power for I/O (COM+, COM−) must share one common power supply.

*2) When driving a load containing inductance component such as relay, connect a protection circuit (diode).
The motor brake cannot be driven directly. Be sure to use a circuit that interfaces with a diode built-in type relay.

☞ Page 46 **PO** Connections to General-Purpose Output Signal

*3) The output circuit configuration is an open collector Darlington transistor output. Connects to relays and optical isolators.
Note that when the transistor is on, connector-emitter voltage V_{CE} (SAT) is approximately 1 V; a standard TTL IC does not satisfy V_{IL} and cannot be connected directly.

*4) Be sure to connect a termination resistor of approximately 220 Ω.

*5) Make the connection to the communication IC signal ground of the host controller that amplifier encoder output signals are connecting to.
Connecting signal ground SG to control power GND may result in malfunction.

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Pulse width [ms] = 2 / rotational speed [r/min] / (division ratio × 2^{17}) × 60 × 1,000.

4. Torque Control Mode

1. Analog Torque Command

Pinout Diagram

Command Input

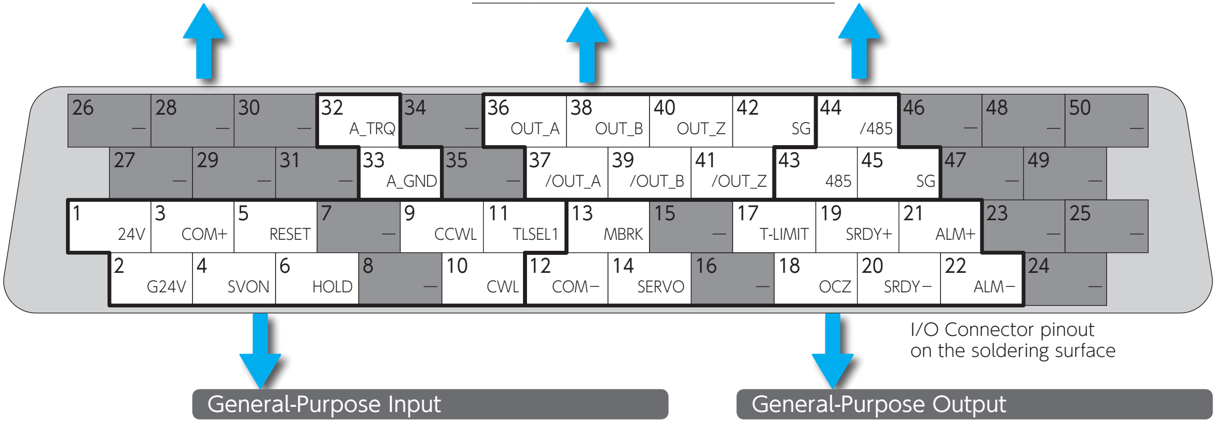
Pin No.	Signal Description
32	**A_TRQ** Analog Command
33	**A_GND** Analog Command Ground

Encoder Output

Pin No.	Signal Description
36	**OUT_A** A-phase
37	**/OUT_A** /A-phase
38	**OUT_B** B-phase
39	**/OUT_B** /B-phase
40	**OUT_Z** Z-phase
41	**/OUT_Z** /Z-phase
42	**SG** Signal ground

RS-485 Communication

Pin No.	Signal Description
43	**485** Data
44	**/485** /Data
45	**SG** Signal ground



I/O Connector pinout
on the soldering surface

General-Purpose Input

Pin No.	Signal Description
1	**24V** Control power 24 V
2	**G24V** Control power GND
3	**COM+** I/O Power 24 V
4	**SVON** Servo ON
5	**RESET** Alarm reset
6	**HOLD** Command input prohibited
9	**CCWL** CCW drive restriction
10	**CWL** CW drive restriction
11	**TLSEL1** Torque Limit

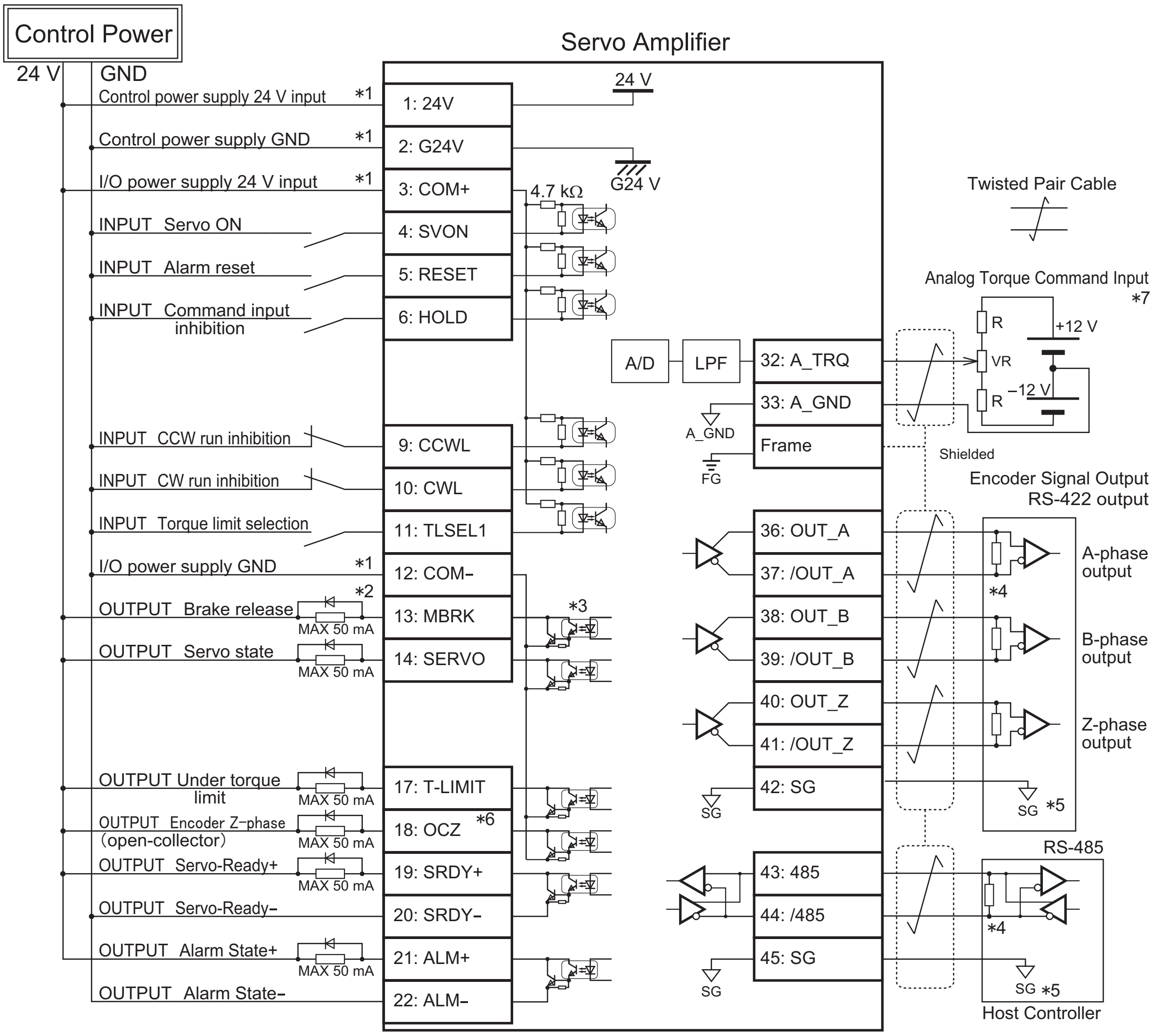
General-Purpose Output

Pin No.	Signal Description
12	**COM−** I/O power GND
13	**MBRK** Brake release
14	**SERVO** Servo status
17	**T-LIMIT** Torque limiting
18	**OCZ** Encoder Z-phase (open collector)
19	**SRDY +** Servo ready +
20	**SRDY−** Servo ready −
21	**ALM +** Alarm status +
22	**ALM−** Alarm status −

4. Torque Control Mode

CN1 Connector Wiring Example

Analog Torque Command



*1) Control power (24 V, G24 V) and power for I/O (COM+, COM−) must share one common power supply.

*2) When driving a load containing inductance component such as relay, connect a protection circuit (diode).
The motor brake cannot be driven directly. Be sure to use a circuit that interfaces with a diode built-in type relay.

☞ Page 46 PO Connections to General-Purpose Output Signal

*3) The output circuit configuration is an open collector Darlington transistor output. Connects to relays and optical isolators.
Note that when the transistor is on, connector-emitter voltage V_{CE} (SAT) is approximately 1 V; a standard TTL IC does not satisfy V_{IL} and cannot be connected directly.

*4) Be sure to connect a termination resistor of approximately 220 Ω.

*5) Make the connection to the communication IC signal ground of the host controller that amplifier encoder output signals are connecting to.
Connecting signal ground SG to control power GND may result in malfunction.

*6) If Z-phase pulse width is too small to be measured accurately by the host controller, decrease pulse division rate by using pulse output ratio (parameters No.276.0 and No.278,0) or decrease rotational speed to increase the pulse width.

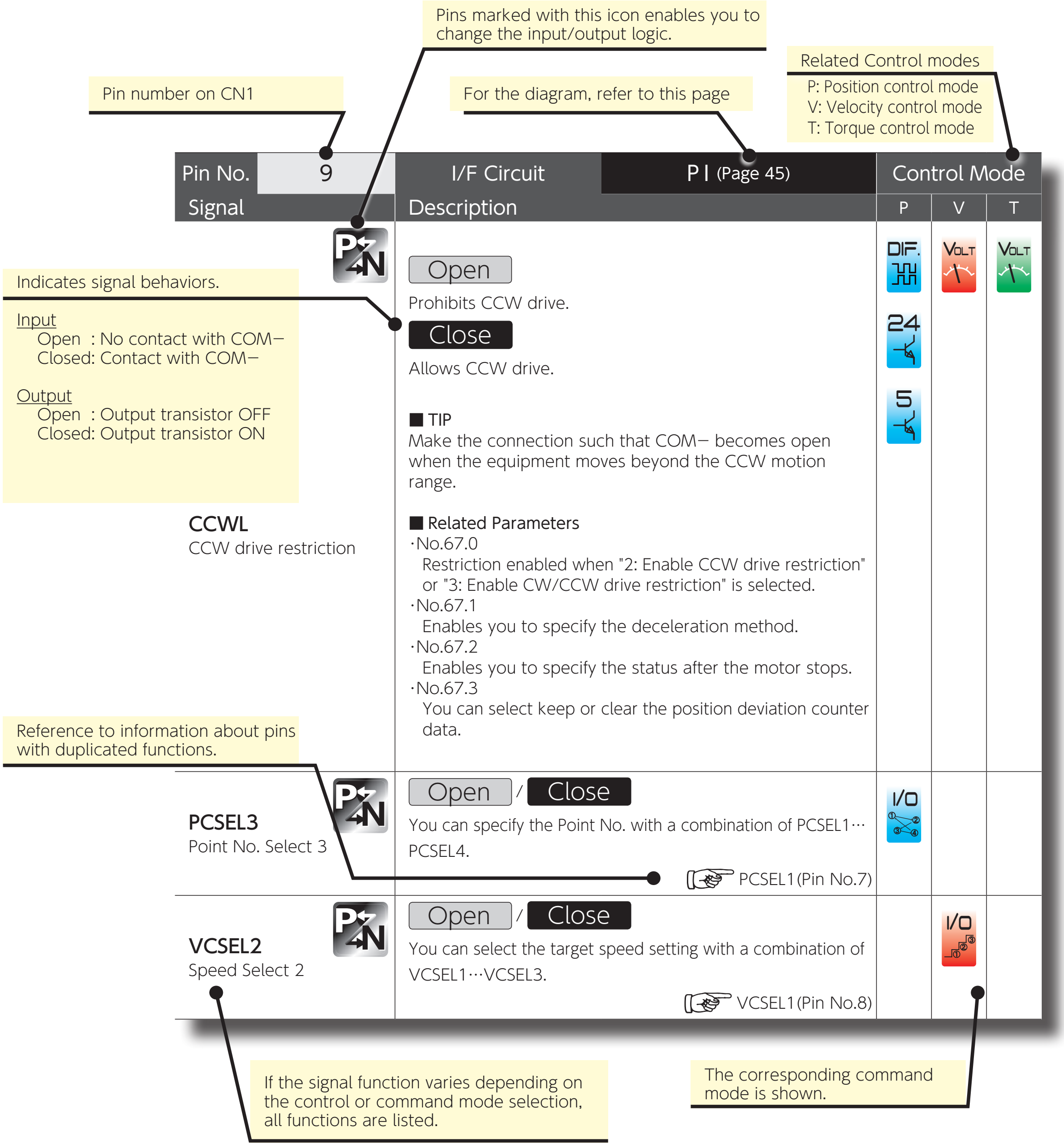
Pulse width [ms] = 2 / rotational speed [r/min] / (division ratio × 2^{17}) × 60 × 1,000.

*7) For the command circuit configuration with a variable resistor (VR) and a resistor (R), (VR) must be 2 kΩ (1/4 W or more) and (R) must be 100 Ω to 200 Ω (1/4 W or more) , so that command input voltage range is -10 V to +10 V. If the analog voltage command circuit of the host controller is isolated from 24 V control power supply, connect A_GND to signal ground of the host controller, not to GND of control power, If the analog velocity command circuit is not isolated, connect A_GND to GND of control power.

5. Descriptions of CN1 Connector Signals

1. Descriptions of CN1 Connector Signals

Each pin assignment of CN1 connector varies depending on the Control Mode/Command Mode.
Review the functions of each pin before using the product.



Pins marked with this icon enables you to change the input/output logic.

Pin number on CN1

For the diagram, refer to this page

Related Control modes
P: Position control mode
V: Velocity control mode
T: Torque control mode

Indicates signal behaviors.

Input
Open : No contact with COM−
Closed: Contact with COM−

Output
Open : Output transistor OFF
Closed: Output transistor ON

Reference to information about pins with duplicated functions.

Pin No. 9 Signal	I/F Circuit PI (Page 45) Description	Control Mode P	V	T
P⇄N **CCWL** CCW drive restriction	Open Prohibits CCW drive. Close Allows CCW drive. ■ TIP Make the connection such that COM− becomes open when the equipment moves beyond the CCW motion range. ■ Related Parameters ·No.67.0 Restriction enabled when "2: Enable CCW drive restriction" or "3: Enable CW/CCW drive restriction" is selected. ·No.67.1 Enables you to specify the deceleration method. ·No.67.2 Enables you to specify the status after the motor stops. ·No.67.3 You can select keep or clear the position deviation counter data.	DIF. 24 5	VOLT	VOLT
P⇄N **PCSEL3** Point No. Select 3	Open / Close You can specify the Point No. with a combination of PCSEL1··· PCSEL4. ☞ PCSEL1 (Pin No.7)	I/O		
P⇄N **VCSEL2** Speed Select 2	Open / Close You can select the target speed setting with a combination of VCSEL1···VCSEL3. ☞ VCSEL1 (Pin No.8)		I/O	

If the signal function varies depending on the control or command mode selection, all functions are listed.

The corresponding command mode is shown.

Icon	Control Mode Command	Icon	Control Mode Command
DIF.	Position Control Mode Differential	VOLT	Velocity Control Mode Analog Velocity Command
24	Position Control Mode 24 V open collector	I/O	Velocity Control Mode Internal Velocity Command
5	Position Control Mode 5 V open collector	VOLT	Torque Control Mode Analog Torque Command
I/O	Position Control Mode Internal Position Command		

5. Descriptions of CN1 Connector Signals

General-Purpose Input

Pin No.	1, 3	I/F Circuit	PS (Page 45)	Control Mode		
Signal		Description		P	V	T
24V (Pin No.1) Control power 24 V **COM+** (Pin No.3) I/O Power 24 V		Connect to the positive pole of the external DC power supply. Power voltage: DC24 V ± 10% Use SELV power supply with reinforced insulation that is isolated from hazardous voltages. COM+ and G24 V amplifier control power must share one common power supply. **24V:** Amplifier control power. **COM+:** A common power supply for optical isolators of general-purpose input circuit.		DIF. 24 5 I/O	VOLT I/O	VOLT

Pin No.	2	I/F Circuit	PS (Page 45)	Control Mode		
Signal		Description		P	V	T
G24V Control power GND		Amplifier control power. Connect to the negative pole of the external DC power supply. Power voltage: DC24 V ± 10% Use SELV power supply with reinforced insulation that is isolated from hazardous voltages. **G24V:** Amplifier control power.		DIF. 24 5 I/O	VOLT I/O	VOLT

DIF. Differential	24 24 V open collector	5 5 V open collector	I/O Internal Position	VOLT Analog Velocity	I/O Internal Velocity	VOLT Analog Torque

Pin No.	4	I/F Circuit	PI (Page 45)	Control Mode		
Signal		Description		P	V	T
P⇄N **SVON** Servo ON		Open Turns the servo OFF. Close Turns the servo ON.		DIF. 24 5 I/O	VOLT I/O	VOLT

Pin No.	5	I/F Circuit	PI (Page 45)	Control Mode		
Signal		Description		P	V	T
P⇄N **RESET** Alarm Reset		Close Resets an alarm. ■ TIP •Be sure to turn off this signal after alarm reset execution. •Encoder-, product code-, and system- alarms are not reset by this signal. •You must cycle control power of the amplifier. ☞ 8 **Troubleshooting** Alarms and Remedies		DIF. 24 5	VOLT I/O	VOLT
P⇄N **RESET/PCLR** Alarm Clear /Deviation Counter Clear		Close Clears Alarm and Deviation counter. ☞ 8 **Troubleshooting** Alarms and Remedies		I/O		

DIF.	Differential	24	24 V open collector	5	5 V open collector	I/O	Internal Position	VOLT	Analog Velocity	I/O	Internal Velocity	VOLT	Analog Torque

<table>
<tr><th>Pin No.</th><th>6</th><th>I/F Circuit</th><th>PI (Page 45)</th><th colspan="3">Control Mode</th></tr>
<tr><th colspan="2">Signal</th><th colspan="2">Description</th><th>P</th><th>V</th><th>T</th></tr>
<tr><td colspan="2">P⇄N
HOLD
Command input prohibit
(Position Control mode)
Zero command clamp
(Velocity Control mode, Torque Control mode)</td><td colspan="2">Open
Allows command input.
Close
Prohibits command input. Until command input becomes allowed, the motor does not move regardless command input.
■ Related Parameter
·No.67.3
In Position Control mode, you can select whether the pulse counter data to be kept while command input is prohibited.</td><td>DIF.
24
5</td><td>VOLT</td><td>VOLT</td></tr>
<tr><td colspan="2">P⇄N
PCSTART1
Start Forward Rotation</td><td colspan="2">Close
Starts motor operation.
Executes Motion or Homing per Point No. specified with PCSEL1···4.
■ TIP
Be sure to turn off this signal after the motion is completed.</td><td>I/O</td><td></td><td></td></tr>
<tr><td colspan="2">P⇄N
VCRUN1
Internal velocity Start 1</td><td colspan="2">Close
Motor rotates in CCW direction
<table><tr><th>Motor Rotational Direction (Pin No.)</th><th>VCRUN1 (No.6)</th><th>VCRUN2 (No.7)</th></tr><tr><td>CCW</td><td>Close</td><td>Open</td></tr><tr><td>CW</td><td>Open</td><td>Close</td></tr><tr><td>Motor Stop</td><td>Open</td><td>Open</td></tr><tr><td>Motor Stop</td><td>Close</td><td>Close</td></tr></table>Close : Contact with COM−
Open : No contact with COM−
■ Related Parameters
·No.390.0, No.391.0
These are used to set acceleration/deceleration time for Homing.
·No.392.0···No.399.0
These parameters are used to set 8 speeds. You can switch between the target speeds with combinations of signals, VCSEL1, VCSEL2 , and VCSEL3</td><td></td><td>I/O</td><td></td></tr>
</table>

5. Descriptions of CN1 Connector Signals

Pin No.	7	I/F Circuit	PI (Page 45)	Control Mode		
Signal		Description		P	V	T
PCLR Deviation Counter Clear		Close Deviation Counter Clear is executed. ■ TIP Be sure to turn off this signal after deviation counter execution.		DIF. 24 5		
PCSEL1 Point No. Select 1		Open / Close You can specify the Point No. with a combination of PCSEL1···PCSEL4.		I/O		
VCRUN2 Internal Velocity Start 2		Close Motor rotates in CW direction ☞ VCRUN1 (Pin No.6)			I/O	

PCSEL1 — Point No. Select 1:

Point No. (Pin No.)	PCSEL1 (No.7)	PCSEL2 (No.8)	PCSEL3 (No.9)	PCSEL4 (No.10)
0 Homing	Open	Open	Open	Open
1	Close	Open	Open	Open
2	Open	Close	Open	Open
3	Close	Close	Open	Open
4	Open	Open	Close	Open
5	Close	Open	Close	Open
6	Open	Close	Close	Open
7	Close	Close	Close	Close
8	Open	Open	Open	Close
9	Close	Open	Open	Close
10	Open	Close	Open	Close
11	Close	Close	Open	Close
12	Open	Open	Close	Close
13	Close	Open	Close	Close
14	Open	Close	Close	Close
15	Close	Close	Close	Close

Close : Contact with COM−

Open : No contact with COM−

■ Related Parameters

·No.646.3

This parameter enables you to select motion per Point No.0 from either Homing or Point Table Motion.

5. Descriptions of CN1 Connector Signals

<table>
<tr><th>Pin No.</th><th>8</th><th>I/F Circuit</th><th>PI (Page 45)</th><th colspan="3">Control Mode</th></tr>
<tr><th colspan="2">Signal</th><th colspan="2">Description</th><th>P</th><th>V</th><th>T</th></tr>
<tr><td colspan="2">PCSEL2
Point No. Select 2</td><td colspan="2">Open / Close
You can specify the Point No. with a combination of PCSEL1⋯PCSEL4.
☞ PCSEL1(Pin No.7)</td><td>I/O</td><td></td><td></td></tr>
<tr><td colspan="2">VCSEL1
Speed Select 1</td><td colspan="2">Open / Close
You can select the target speed pin number with a combination of VCSEL1⋯VCSEL3.
<table>
<tr><th>Target speed (Pin No.)</th><th>PCSEL1 (No.8)</th><th>PCSEL2 (No.9)</th><th>PCSEL3 (No.10)</th></tr>
<tr><td>0</td><td>Open</td><td>Open</td><td>Open</td></tr>
<tr><td>1</td><td>Close</td><td>Open</td><td>Open</td></tr>
<tr><td>2</td><td>Open</td><td>Close</td><td>Open</td></tr>
<tr><td>3</td><td>Close</td><td>Close</td><td>Open</td></tr>
<tr><td>4</td><td>Open</td><td>Open</td><td>Close</td></tr>
<tr><td>5</td><td>Close</td><td>Open</td><td>Close</td></tr>
<tr><td>6</td><td>Open</td><td>Close</td><td>Close</td></tr>
<tr><td>7</td><td>Close</td><td>Close</td><td>Close</td></tr>
</table>
Close : Contact with COM−
Open : No contact with COM−
☞ VCRUN1(Pin No.6)</td><td></td><td>I/O</td><td></td></tr>
<tr><td colspan="2">HOME
Start Homing</td><td colspan="2">Close
Homing starts.
■ TIP
Be sure to this terminal Open after homing is completed.</td><td>DIF.
(*1)</td><td></td><td></td></tr>
<tr><td colspan="2">E-STOP
Emergency Stop</td><td colspan="2">Open
The motor makes an emergency stop. Deceleration stop starts upon Servo OFF and the motor stops its motion. No alarm occurs. A warning is output by parameter setting.
☞ 9 Appendices Functions</td><td>DIF.
(*2)</td><td></td><td></td></tr>
</table>

*1) In I/O configuration Option 1
*2) In I/O configuration Option 2

Pin No. 9	I/F Circuit PI (Page 45)	Control Mode		
Signal	Description	P	V	T
P⇄N **CCWL** CCW drive restriction	Open Prohibits CCW drive. Close Allows CCW drive. ■ TIP Make the connection such that COM− becomes open when the equipment moves beyond the CCW motion range. ■ Related Parameters ·No.67.0 Restriction enabled when "2: Enable CCW drive restriction" or "3: Enable CW/CCW drive restriction" is selected. ·No.67.1 Enables you to specify the deceleration method. ·No.67.2 Enables you to specify the status after the motor stops. ·No.67.3 You can select keep or clear the position deviation counter data.	DIF. 24 5	VOLT	VOLT
P⇄N **PCSEL3** Point No. Select 3	Open / Close You can specify the Point No. with a combination of PCSEL1··· PCSEL4. ☞ PCSEL1 (Pin No.7)	I/O		
P⇄N **VCSEL2** Speed Select 2	Open / Close You can select the target speed setting with a combination of VCSEL1···VCSEL3. ☞ VCSEL1 (Pin No.8)		I/O	

DIF.	Differential	24	24 V open collector	5	5 V open collector	I/O	Internal Position	VOLT	Analog Velocity	I/O	Internal Velocity	VOLT	Analog Torque

5. Descriptions of CN1 Connector Signals

Pin No. 10	I/F Circuit PI (Page 45)	Control Mode		
Signal	Description	P	V	T
PN **CWL** CW Drive Restriction	Open Prohibits CW drive. Close Allows CW drive. ☞ CCWL(Pin No.9)	DIF. 24 5	VOLT	VOLT
PN **PCSEL4** Point No. Select 4	Open / Close You can specify the Point No. with a combination of PCSEL1··· PCSEL4. ☞ PCSEL1(Pin No.7)	I/O (*1)		
PN **HOME** Start Homing	Close Homing starts. ■ TIP Be sure to turn off this signal after homing is completed.	I/O (*2)		
PN **VCSEL3** Speed Select 3	Open / Close You can select the target speed setting with a combination of VCSEL1···VCSEL3. ☞ VCRUN1(Pin No.6)		I/O	

*1) In Standard I/O configuration
*2) In Optional I/O configuration.

Pin No. 11	I/F Circuit PI (Page 45)	Control Mode		
Signal	Description	P	V	T
P⇄N **TLSEL1** Torque Limit	Open Torque command limit: Value 1 (No.147.0) is applied. Close Torque command limit: Value 2 (No.148.0) is applied. ■ Related Parameters ·No.144.0 Torque Limit is enabled when 1 (enable) is selected. ·No.147.0, No.148.0 Set Torque Command Limit Values 1 and 2.	DIF. 24 5 I/O (*2)	VOLT I/O	VOLT
P⇄N **ORG** Home Sensor	Open Home sensor has not been detected. Close Home sensor has been detected. ■ Related Parameters ·No.645.0 Enables you to select home-dog-front. ·No.646.1 Enables you to change the polarity of home sensor detection.	I/O (*1)		

*1) In Standard I/O configuration
*2) In Optional I/O configuration.

DIF. Differential	24 24 V open collector	5 5 V open collector	I/O Internal Position	VOLT Analog Velocity	I/O Internal Velocity	VOLT Analog Torque

General-Purpose Output

Pin No.	12	I/F Circuit	PS (Page 45)	Control Mode		
Signal		Description		P	V	T
COM− I/O power GND		A common emitter terminal of output transistors in the general-purpose output circuit. COM+ and G24V amplifier control power must share one common power supply.		DIF. 24 5 I/O	VOLT I/O	VOLT

Pin No.	13	I/F Circuit	PO (Page 46)	Control Mode		
Signal		Description		P	V	T
MBRK Brake Release	P⇄N	Open Does not release the brake. Close Releases the brake. ■ TIP The motor brake cannot be driven directly. To drive the motor brake, be sure to use a relay. Place a surge absorber to suppress surge voltage caused by relay's on/off. Note that, if you use a diode instead of a surge absorber, the time between brake release and brake clamp is longer.		DIF. 24 5 I/O (*1)	VOLT I/O	VOLT
PM1 Point No.1	P⇄N	Open / Close Outputs the started or completed Point No. with a combination of PM1··· PM3. Right after turning the power on for the amplifier or at Servo OFF or Homing, all three are Open (i.e. Point No. = 0).		I/O (*2)		

Point No. (Pin No.)	PM1 (No.7)	PM2 (No.8)	PM3 (No.9)
0, 8, etc.	Open	Open	Open
1, 9	Close	Open	Open
2, 10	Open	Close	Open
3, 11	Close	Close	Open
4, 12	Open	Open	Close
5, 13	Close	Open	Close
6, 14	Open	Close	Close
7, 15	Close	Close	Close

Close : Contact with COM−
Open : No contact with COM−

■ Related Parameters
·No.644.0
Enables you to select timing of Point No. output and its content.

*1) In Standard I/O configuration
*2) In Optional I/O configuration.

Pin No. 14	I/F Circuit **PO** (Page 46)	Control Mode		
Signal	Description	P	V	T
P⇄N **SERVO** Servo Status	Open Servo-Off Close Servo-On	DIF. 24 5 I/O (*1)	VOLT I/O	VOLT
P⇄N **PM2** Point No.2	Open / Close Outputs the started or completed Point No. with a combination of PM1··· PM3. ☞ PM1 (Pin No.13)	I/O (*2)		

*1) In Standard I/O configuration
*2) In Optional I/O configuration.

Pin No. 15	I/F Circuit **PO** (Page 46)	Control Mode		
Signal	Description	P	V	T
P⇄N **POSIN** Positioning Complete	Open Positioning is not complete. Close Positioning is complete.	DIF. 24 5		
P⇄N **MEND** Motion Complete	Open Motion motion is not complete. Close ・Ready to receive next motion directive after Point table motion and Testing motion complete. ・In Servo-Off state	I/O (*1)		
P⇄N **PM3** Point No.3	Open / Close Outputs the started or completed Point No. with a combination of PM1··· PM3. ☞ PM1 (Pin No.13)	I/O (*2)		

*1) In Standard I/O configuration
*2) In Optional I/O configuration.

5. Descriptions of CN1 Connector Signals

Pin No.	16	I/F Circuit	PO (Page 46)	Control Mode		
Signal		Description		P	V	T
HEND Homing Complete		Open · State of Home Lost · During Homing Close State of Homing Complete		DIF. (*1) 24 (*1) 5 (*1)		
WARN1 Warning		Open No warning Close Outputting a warning ☞ 8 **Troubleshooting** Warnings and Remedies		DIF. (*2) 24 (*2) 5 (*2)		

*1) In I/O configuration Option 1
*2) In I/O configuration Option 2

5. Descriptions of CN1 Connector Signals

Pin No. 17	I/F Circuit **PO** (Page 46)	Control Mode		
Signal	Description	P	V	T
P⇄N **T-LIMIT** Torque Limiting	**Close** Motor output torque is limited. ■ Related Parameters ･No.144.1 Enables you to select conditions for torque limit.	DIF. 24 5 I/O (*1)	VOLT I/O	VOLT
P⇄N **MEND/T-LIMIT** Motion Complete /Torque Limiting	**Close** State of one of the following: • MEND Motion Complete • Torque Limiting ☞ MEND(Pin No.15) ■ Related Parameters ･No.144.1 Enables you to select conditions for torque limiting. ■ TIP Use this signal as T-LIMIT during press motion. Otherwise, use it as MEND. For T-LIMIT, turn TLSEL1 (Torque Limit) ON. For MEND, turn TLSEL1 (Torque Limit) OFF.	DIF. (*2) 24 (*3) 5 (*3) I/O (*3)		

*1) In Standard I/O configuration
*2) In Optional I/O configuration
*3) In I/O configuration Option 1

DIF. Differential	24 24 V open collector	5 5 V open collector	I/O Internal Position	VOLT Analog Velocity	I/O Internal Velocity	VOLT Analog Torque

<table>
<tr><th>Pin No.</th><th>18</th><th>I/F Circuit</th><th>PO (Page 46)</th><th colspan="3">Control Mode</th></tr>
<tr><th colspan="2">Signal</th><th colspan="2">Description</th><th>P</th><th>V</th><th>T</th></tr>
<tr><td colspan="2">P⇄N
OCZ
Encoder Z-Phase</td><td colspan="2">Close
Open collector output of Encoder Z-phase
■ TIP
Z-phase pulse is synchronized with A-phase pulse and is output with the same width as A-phase pulse.
Open-collector output
■ Related Parameters
·No.276.0, No.278.0
If Z-phase pulse width is too small to be measured accurately by the host controller, decrease frequency division ratio or rotational speed to increase the pulse width.
Pulse width [ms]
= 2 / rotational speed [r/min] / (division ratio × 2^{17}) × 60 × 1,000.</td><td>DIF.
24
5
I/O</td><td>VOLT
I/O</td><td>VOLT</td></tr>
</table>

5. Descriptions of CN1 Connector Signals

Pin No. 19, 20	I/F Circuit **PO** (Page 46)	Control Mode		
Signal	Description	P	V	T
P⇄N **SREDY+** (Pin No.19) **SREDY−** (Pin No.20) Servo ready	**Open** In one of the following conditions An alarm is occurring. The primary circuit power is not supplied to the amplifier. **Close** The following conditions are met at the same time. No alarm is occurring. The primary circuit power is supplied to the amplifier. ■ TIP The emitter side of the output transistor is independent of COM−. Cascade connection to multiple amplifiers is possible.	DIF. (*1) 24 5 I/O (*2)	VOLT I/O	VOLT
P⇄N **SERVO+** (Pin No.19) **SERVO−** (Pin No.20) Servo status	**Open** Servo-off status **Close** Servo-on status ■ TIP The emitter side of the output transistor is independent of COM−. Cascade connection to multiple amplifiers is possible.	I/O (*3)		
DBRK+ (Pin No.19) **DBRK−** (Pin No.20) Dynamic brake release	**Open** Engages the dynamic brake. **Close** Disengages the dynamic brake.	24 (*4) 5 (*4) I/O (*4)		

*1) In Standard I/O configuration
*2) In Standard I/O configuration
*3) In Optional I/O configuration
*4) In I/O configuration Option 2

DIF. Differential	24 24 V open collector	5 5 V open collector	I/O Internal Position	VOLT Analog Velocity	I/O Internal Velocity	VOLT Analog Torque

5. Descriptions of CN1 Connector Signals

Pin No. 21, 22	I/F Circuit PO (Page 46)	Control Mode		
Signal	Description	P	V	T
P⇄N **ALM+** (Pin No.21) **ALM−** (Pin No.22) Alarm	Open In one of the following conditions An alarm is occurring. Control power is not supplied to the amplifier. Close The following conditions are met at the same time. No alarm is occurring. Control power is supplied to the amplifier. ■ TIP The emitter side of the output transistor is independent of COM−. Cascade connection to multiple amplifiers is possible. ☞ 8 **Troubleshooting** Alarms and Remedies	DIF. 24 5 I/O	VOLT I/O	VOLT

5. Descriptions of CN1 Connector Signals

Command Input

Pin No.	26	I/F Circuit	CP (Page 47)	Control Mode

Signal	Description	P	V	T
CMD_PLS Pulse A-phase CCW	Command signal input from the host controller to the amplifier. Select command pulse train command signal to input. (No.32.0)	DIF.		

Parameter No.32.0	Command Signal Form	Input Signal
0	Pulse and Direction	Pulse
1	QEP	A-phase
2	CCW and CW	CCW

■ Related Parameters
- No.2.0
  Select Control Mode
- No.3.0
  Select Command Mode
- No.32.0
  Select the input signal form of Pulse Train Command.

Pin No.	27	I/F Circuit	CP (Page 47)	Control Mode

Signal	Description	P	V	T
/CMD_PLS /Pulse /A-phase /CCW	Command signal input from the host controller to the amplifier. Select command pulse train command signal to input. (No.32.0)	DIF. 24 5		

Parameter No.32.0	Command Signal Form	Input Signal
0	Pulse and Direction	/Pulse
1	QEP	/A-phase
2	CCW and CW	/CCW

■ Related Parameters
- No.2.0
  Select Control Mode
- No.3.0
  Select Command Mode
- No.32.0
  Select the input signal form of Pulse Train Command.

Pin No.	28, 29	I/F Circuit	CP (Page 47)	Control Mode

Signal	Description	P	V	T
CC-P (Pin No.28) **CC-D** (Pin No.29) 24 V open collector power	Command signal input from the host controller to the amplifier A power input terminal of 24 V open collector. **CC-P:** Use this in combination with /CMD_PLS. **CC-D:** Use this in combination with /CMD_DIR.	24		

DIF. Differential	24 24 V open collector	5 5 V open collector	I/O Internal Position	VOLT Analog Velocity	I/O Internal Velocity	VOLT Analog Torque

5. Descriptions of CN1 Connector Signals

<table>
<tr><th>Pin No.</th><th>30</th><th>I/F Circuit</th><th>CP (Page 47)</th><th colspan="3">Control Mode</th></tr>
<tr><th colspan="2">Signal</th><th colspan="2">Description</th><th>P</th><th>V</th><th>T</th></tr>
<tr><td colspan="2">CMD_DIR
Direction
B-phase
CW</td><td colspan="2">Command signal input from the host controller to the amplifier.
Select command pulse train command signal to input. (No.32.0)
<table>
<tr><th>Parameter No.32.0</th><th>Command Signal Form</th><th>Input Signal</th></tr>
<tr><td>0</td><td>Pulse and Direction</td><td>Direction</td></tr>
<tr><td>1</td><td>QEP</td><td>B-phase</td></tr>
<tr><td>2</td><td>CCW and CW</td><td>CW</td></tr>
</table>
■ Related Parameters
· No.2.0
Select Control Mode
· No.3.0
Select Command Mode
· No.32.0
Select the input signal form of Pulse Train Command.</td><td>DIF.</td><td></td><td></td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>31</th><th>I/F Circuit</th><th>CP (Page 47)</th><th colspan="3">Control Mode</th></tr>
<tr><th colspan="2">Signal</th><th colspan="2">Description</th><th>P</th><th>V</th><th>T</th></tr>
<tr><td colspan="2">/CMD_DIR
/Direction
/B-phase
/CW</td><td colspan="2">Command signal input from the host controller to the amplifier.
Select command pulse train command signal to input. (No.32.0)
<table>
<tr><th>Parameter No.32.0</th><th>Command Signal Form</th><th>Input Signal</th></tr>
<tr><td>0</td><td>Pulse and Direction</td><td>/Direction</td></tr>
<tr><td>1</td><td>QEP</td><td>/B-phase</td></tr>
<tr><td>2</td><td>CCW and CW</td><td>/CW</td></tr>
</table>
■ Related Parameters
· No.2.0
Select Control Mode
· No.3.0
Select Command Mode
· No.32.0
Select the input signal form of Pulse Train Command.</td><td>DIF.
24
5</td><td></td><td></td></tr>
</table>

<table>
<tr><th>Pin No.</th><th>49, 50</th><th>I/F Circuit</th><th>CP (Page 47)</th><th colspan="3">Control Mode</th></tr>
<tr><th colspan="2">Signal</th><th colspan="2">Description</th><th>P</th><th>V</th><th>T</th></tr>
<tr><td colspan="2">CC_P-5V (Pin No.49)
CC_D-5V (Pin No.50)
5 V Open collector power</td><td colspan="2">Command signal input from the host controller to the amplifier.
A power input terminal of 5 V open collector.
CC-P-5V:
Use this in combination with /CMD_PLS
CC-D-5V:
Use this in combination with /CMD_DIR.</td><td>5</td><td></td><td></td></tr>
</table>

5. Descriptions of CN1 Connector Signals

<table>
<tr><td>Pin No.</td><td>32</td><td>I/F Circuit</td><td>CA (Page 48)</td><td colspan="3">Control Mode</td></tr>
<tr><td colspan="2">Signal</td><td colspan="2">Description</td><td>P</td><td>V</td><td>T</td></tr>
<tr><td colspan="2">A_SPEED
Analog Velocity Command</td><td colspan="2">Speed command input with analog voltages (-10 V to +10 V).
A_GND (Pin No.33) is the reference point of electric potential.</td><td></td><td>VOLT</td><td></td></tr>
<tr><td colspan="2">A_TRQ
Analog Torque Command</td><td colspan="2">Torque command input with analog voltages (-10 V to +10 V).
A_GND (Pin No.33) is the reference point of electric potential.</td><td></td><td></td><td>VOLT</td></tr>
</table>

<table>
<tr><td>Pin No.</td><td>33</td><td>I/F Circuit</td><td>CA (Page 48)</td><td colspan="3">Control Mode</td></tr>
<tr><td colspan="2">Signal</td><td colspan="2">Description</td><td>P</td><td>V</td><td>T</td></tr>
<tr><td colspan="2">A_GND
Analog Command Ground</td><td colspan="2">This is the reference point of electric potential for Analog command voltage input to Pin No.32.
■ TIP
If the analog velocity command circuit of the host controller is isolated from 24 V control power supply, connect A_GND to signal ground of the host controller, not to GND of control power, If the analog velocity command circuit is not isolated, connect A_GND to GND of control power.</td><td></td><td>VOLT</td><td>VOLT</td></tr>
</table>

DIF. Differential	24 24 V open collector	5 5 V open collector	I/O Internal Position	VOLT Analog Velocity	I/O Internal Velocity	VOLT Analog Torque

Encoder Output

<table>
<tr><td>Pin No.</td><td>36, 37,···, 42</td><td>I/F Circuit</td><td>EO (Page 49)</td><td colspan="3">Control Mode</td></tr>
<tr><td colspan="2">Signal</td><td colspan="2">Description</td><td>P</td><td>V</td><td>T</td></tr>
<tr><td colspan="2">OUT_A (Pin No.36)
/OUT_A (Pin No.37)
A-phase output

OUT_B (Pin No.38)
/OUT_B (Pin No.39)
B-phase output

OUT_Z (Pin No.40)
/OUT_Z (Pin No.41)
Z-phase output

SG (Pin No.42)
Signal ground</td><td colspan="2">OUT_A, /OUT_A:
OUT_B, /OUT_B:
OUT_Z, /OUT_Z:
Differential output of encoder signal divided and multiplied (equivalent to RS-422)

SG:
Signal ground of the communication IC in the output circuit. This signal is connected to signal ground inside the amplifier. It is isolated from control power (G24 V, COM−). Make the connection to signal ground of the communication IC of the host controller.

■ Related Parameters
· No.276.0, No.278.0
If Z-phase pulse width is too small to be measured accurately by the host controller, decrease frequency division ratio or rotational speed to increase the pulse width.

Pulse width [ms]
= 2 / rotational speed [r/min] / (division ratio × 2^{17}) × 60 × 1,000.</td><td>DIF.
24
5
I/O</td><td>VOLT
I/O</td><td>VOLT</td></tr>
</table>

RS-485 Communication

Pin No. 43, 44, 45	I/F Circuit RS (Page 50)	Control Mode		
Signal	Description	P	V	T
485 (Pin No.43) 485 data **/485** (Pin No.44) /485 data **SG** (Pin No.45) Signal ground	**485, /485:** RS-485 interface with the host controller For cascade connection, be sure to connect a termination resistor of approximately 220 Ω to the end amplifier. **SG:** Signal ground of the amplifier communication IC. It is connected to signal ground inside the amplifier. Isolated from control power (G24 V, COM−). Connect signal ground of the communication IC of the host controller.	DIF. 24 5 I/O	VOLT I/O	VOLT

DIF. Differential	24 24 V open collector	5 5 V open collector	I/O Internal Position	VOLT Analog Velocity	I/O Internal Velocity	VOLT Analog Torque

5. Descriptions of CN1 Connector Signals

2. I/F Circuit of CN1 Connector

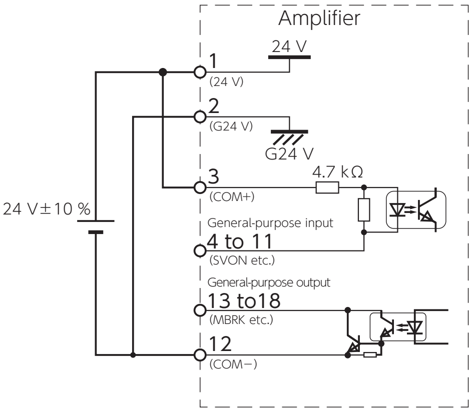
I/F Circuit

PS Connection to DC24V Power Supply

Control Mode		
P	V	T
DIF. 24 5 I/O	VOLT I/O	VOLT

Connect control power of the amplifier and I/O power.
Be careful not to reversely connect plus and minus terminals of the power supply.
Accidental reverse connection may damage the amplifier.

Control power and I/O power must share one common power supply.

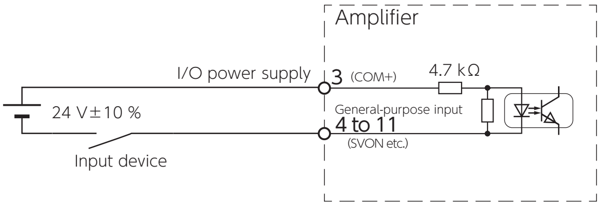


PI Connections to General-Purpose Input Signal

Control Mode		
P	V	T
DIF. 24 5 I/O	VOLT I/O	VOLT

Pin No.3
Connect to +terminal of I/O power supply. Use power supply of 24 V ± 10%.

Pin No.4 to No.11
Connect to input devices such as switch, open-collector output transistor, and relay contact.
When the input device contact is closed and the contact pair of general-purpose pin and power supply GND becomes closed, the amplifier turns on.



5. Descriptions of CN1 Connector Signals

PO Connections to General-Purpose Output Signal

Control Mode		
P	V	T
DIF. 24 5 I/O	VOLT	VOLT

The motor brake cannot be driven directly. To drive the motor brake, be sure to use a relay.

When driving a load containing inductance component such as relay, connect a protection circuit (diode). Install a diode in the direction shown in the figure below.
The output circuit configuration is an open collector Darlington transistor output. Connects to relays and optical isolators. When the transistor is on, connector-emitter voltage V_{CE} (SAT) is approximately 1 V; a standard TTL IC does not satisfy V_{IL}, and cannot be directly connected.

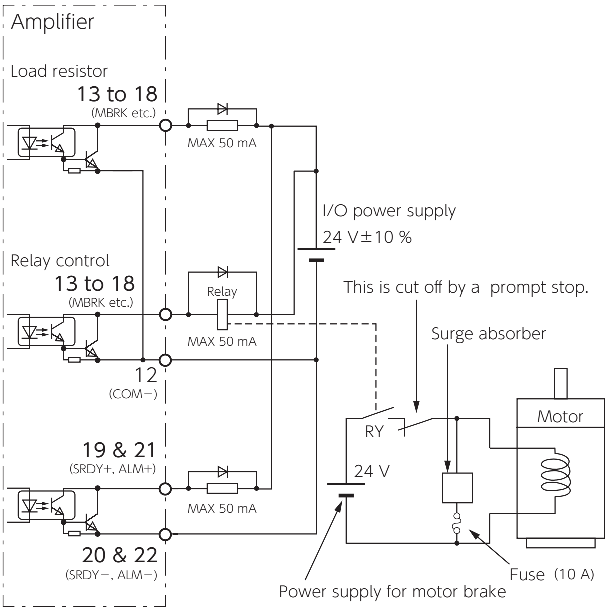
The maximum rating of output circuit is 30 V 50 mA.

Pin No.13 to 18

The emitter of output transistor is common to COM− of control power.

Pin No.19, No.21

The emitter of output resistor is Pins No.20 and No.22 and independent of COM−.



DIF. Differential	24 24 V open collector	5 5 V open collector	I/O Internal Position	VOLT Analog Velocity	I/O Internal Velocity	VOLT Analog Torque

5. Descriptions of CN1 Connector Signals

CP	Connection to Pulse Train Command Signal	Control Mode		
		P	V	T
		DIF. 24 5		

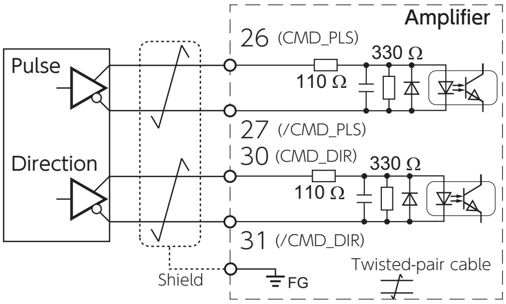
Use this for pulse train input in Position Control mode.
You can set the form of pulse signal input with **Pulse train command: Input mode** (No.32.0)

In case of positional aberration due to noise, take noise countermeasures, for example,

1) Make the signal line short between the host controller and the amplifier.
2) Be sure to use shielded twist-pair cables for the signal lines.
3) Segregate the signal lines from the primary circuit power cable and the motor power cable.
4) Adjust **Pulse train command: Input filter** (No.33.0).

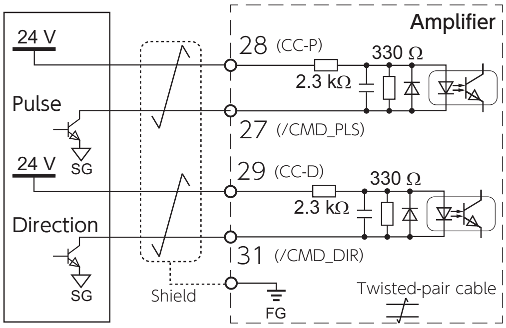
Differential

Max command pulse frequency: 4 Mpps



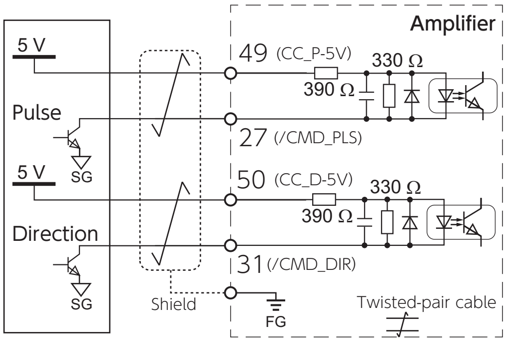
24 V open collector

Max command pulse frequency: 200 kpps
Be sure to set [Pulse train command Input filter (No.33.0)] to at least 7.



5 V open collector

Max command pulse frequency: 200 kpps
Be sure to set [Pulse train command Input filter (No.33.0)] to at least 7.



5. Descriptions of CN1 Connector Signals

CA Connection to Analog Command Signal

Control Mode		
P	V	T
	VOLT	VOLT

Input voltage tolerance range is ± 10 V. For input circuit impedance, see the figure below. For the command circuit configuration with a variable resistor (VR) and a resistor (R), (VR) must be 2 kΩ (1/4 W or more) and (R) must be 100 Ω to 200 Ω (1/4 W or more), so that command input voltage range is -10 V to +10 V.
Be sure to use shielded twisted-pair cables as a noise countermeasure.

■ TIP

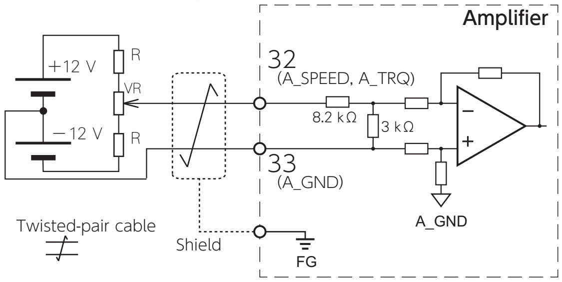
Isolation/non-isolation of the host analog command circuit and 24 V control power

If isolated

Connect A-GND with signal ground of the host controller. (Do not connect to GND of control power)

If not isolated

Connect A_GND with GND of control power.



EO Connection to Encoder Output Circuit

Control Mode		
P	V	T
DIF. 24 5 I/O	VOLT	VOLT

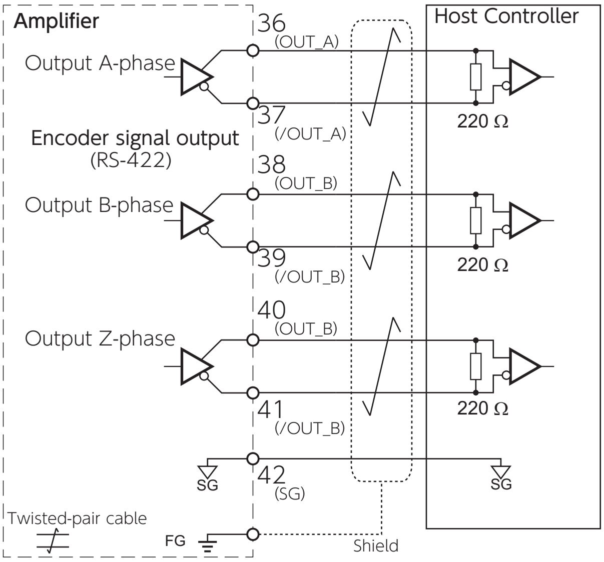
Differential output of encoder signal (A-phase, B-phase, Z-phase) which has been processed with pulse division ratio.

Be sure to connect a termination resistor to the receiver circuit of the host controller. Approximately 220 Ω (1/4W or more)

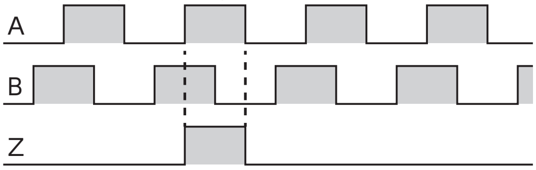
Signal ground of the communication IC in the output circuit is connected to signal ground inside the amplifier.

Connect signal ground of communications IC of the host controller to Pin No.42.

Be sure to use shielded twisted-pair cable as a noise countermeasure.



Encoder Z-phase is synchronized with A-phase and output.



5. Descriptions of CN1 Connector Signals

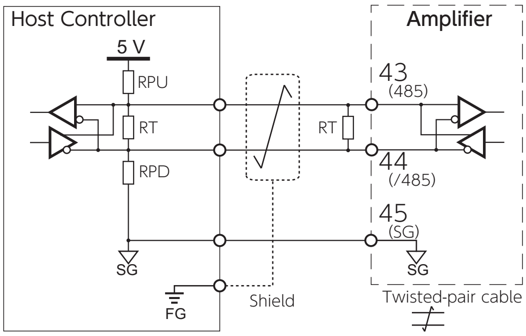
RS	Connection to RS-485 circuit	Control Mode		
		P	V	T
		DIF. 24 5 I/O	VOLT	VOLT

RS-485 communications with the host controller
When connecting multiple amplifiers, be sure to install a termination resistor of approximately 200 Ω between signal lines of the end amplifier.
Be sure to connect a pull-up resistor (RPU) and a pull-down resistor (RPD) of approximately 1.2 k Ω inside the host controller. Be sure to connect a termination resistor of approximately 220 Ω .

Make the wiring between the host controller and the amplifier less than 3 m.
Between amplifiers, make it less than 1 m.

Signal ground of communication IC of the amplifier is connected to signal ground inside the amplifier. Connect signal ground of communications IC of the host controller to Pin No.45.

Be sure to use shielded twisted-pair cable as a noise countermeasure.

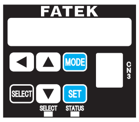


DIF. Differential	24 24 V open collector	5 5 V open collector	I/O Internal Position	VOLT Analog Velocity	I/O Internal Velocity	VOLT Analog Torque

5 Setting Parameters

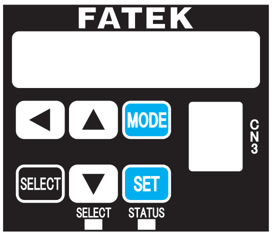
1. Overview

This section explains a variety of parameters that are required for servo-motor functions and features. Read this section carefully to become familiar with the setup methods, functions, and usages of the parameters, then adjust the parameters such that those will best suit your operating conditions.

Parameter Tuning Method	
	Tuning with the Setup Panel at front the amplifier.
STUDIO Servo Studio	Tuning with the setup software "Servo Studio". Install it on the user-supplied PC.

2. Setup Panel

1. Setup Panel Features



Setup Panel

<table>
<tr><th>Items</th><th>Descriptions</th></tr>
<tr><td>Display Panel</td><td>Displays a status or a setting value (with six digits at a time) on 7-segment display.</td></tr>
<tr><td>MODE
MODE Button</td><td>Use this button to switch between the six modes in the main menu or return to the main menu.</td></tr>
<tr><td>SET
SET Button</td><td>Use this button to select items and set values.</td></tr>
<tr><td>STATUS
STATUS LED</td><td><table>
<tr><th>Control power</th><th>LED</th><th>Status</th></tr>
<tr><td>ON</td><td>Green ON</td><td>Normal</td></tr>
<tr><td></td><td>Red ON</td><td>Alarm occurring</td></tr>
<tr><td>OFF</td><td>OFF</td><td>Normal</td></tr>
</table></td></tr>
<tr><td>▲
UP Button
▼
DOWN Button</td><td>In each mode, use these buttons to change the display item, change data, select the parameter, execute operation and so forth.
Use ▲ to increase or ▼ to decrease a numeric value</td></tr>
<tr><td>◀
LEFT Button</td><td>Use this button to move to higher order digits when changing the data.</td></tr>
</table>

Do not press more than one button simultaneously on the Setup Panel.

Otherwise, the information displayed on the DISPLAY LED will be incomplete.

Displaying A Number with 6 or More Digits

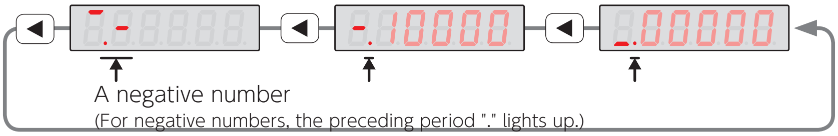
You can display a 6 to 10-digit number on the display panel with 3 separate portions, 5 digits at a time. The leftmost letter indicates which segment of the number is currently displayed: sign ¯⊢ , first 5-digit - , or last 5-digit _ segment. The last 5-digit segment is displayed first.

ex. 1: Positive number

+1,234,567,890

ex. 2: Negative number

-1,000,000,000



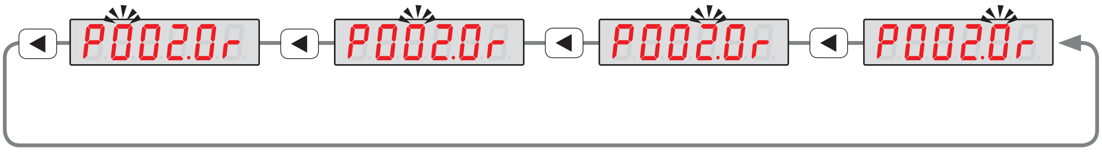
ex. 3: Model Code and Serial Number

0002020400

Selecting the digit to edit

Use ◀ button to move the blinking position to the digit place that you want to edit.

Use ▲ ▼ button to change the value of the blinking digit.



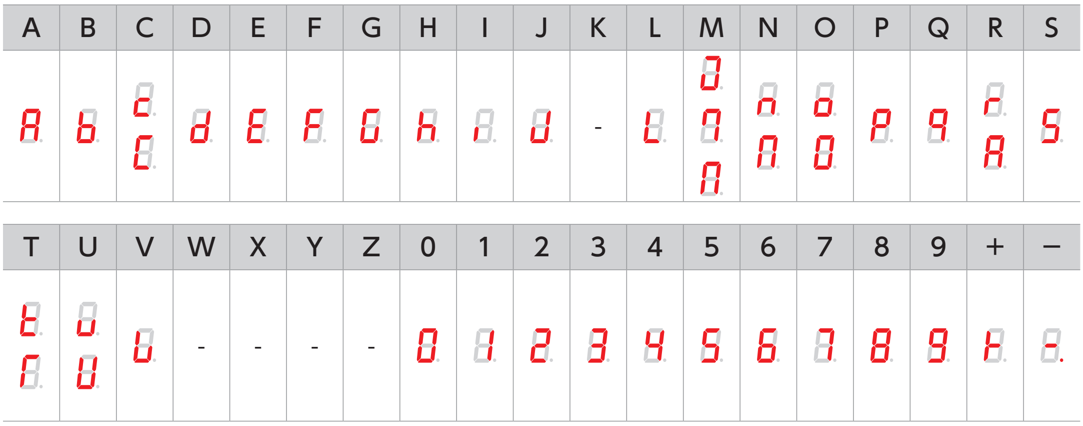
2. Setup Panel

2. Using the Setup Panel

The Setup Panel shows seven modes, each of which represents a group of functions.

Display Mode	Overview
 Status Display Mode	Motor and amplifier statuses can be verified. Not displayed when an alarm is occurring
 Alarm Status Display Mode	You can check the present alarm in this mode.
 Parameter Setting Mode	Use this mode to set up each parameter.
 Quick Tuning Mode	This mode is used for tuning to automatically estimate inertia ratio change the control gain set. (Position Control Mode only)
 Auto Tuning Mode	This mode is used to set up the parameters required for auto tuning. Not available in Torque Control Mode.
 Parameter Saving Mode	This mode enables you to save the parameters set up in Parameter Setting Mode or Auto Tuning Mode to EEPROM.
 Auxiliary Function Mode	You can perform: - JOG Operation to execute testing with no command input from the host. - Clear Parameter to reset all parameters to the factory default. - Clear Encoder to initialize multi-turn data of absolute encoder.

Character table for 7-segement LED display

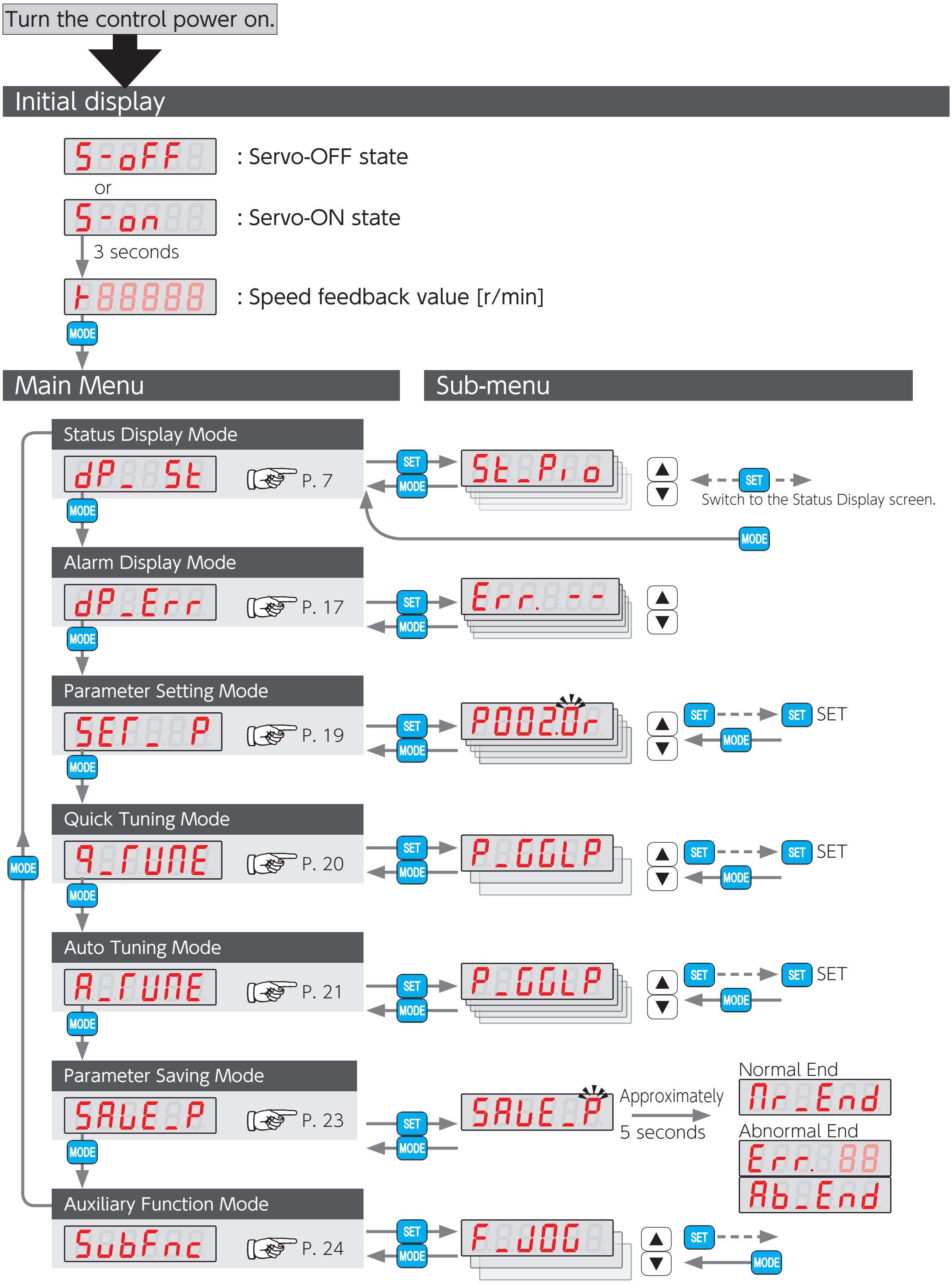


A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
										-								

T	U	V	W	X	Y	Z	0	1	2	3	4	5	6	7	8	9	+	–
			-	-	-	-												

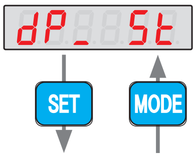
3. Using the Setup Panel

Turn on the control power of the amplifier and then press MODE twice to bring up the main menu. On the main menu, select the mode you are to setting up, then press SET to see the sub-menu.



3. Using the Setup Panel

1. Status Display Mode



On the sub-menu that you just selected, press SET to display a value or proceed to the next setup screen.

☞ Following pages for each sub-menu
☞ 9 **Appendices** List of Status Variables

Sub-menu

No.	Display	Item	Page
1	St_Pio	I/O Status	(☞ P. 8)
2	St_tMP	Control Component Temperature (reference value)	(P. 9)
3	St_PCP	Pulse Train Command Input (Position)	(P. 9)
4	St_PCS	Pulse Train Command Input (Speed)	(P. 9)
5	St_ASC	Analog Velocity Command	(P. 9)
6	St_PPS	Positioning Status	(P. 10)
7	St_PCA	ABS Position Command	(P. 10)
8	St_PFA	ABS Position Feedback	(P. 10)
9	St_PdC	Command Position Deviation	(P. 10)
10	St_PdA	ABS Position Deviation	(P. 11)
11	St_PCo	Position Command Value	(P. 11)
12	St_PFb	Position Feedback	(P. 11)
13	St_Pdu	Position Deviation	(P. 11)
14	St_SCo	Speed Command Setting	(P. 12)
15	St_SFb	Speed Feedback	(P. 12)
16	St_Sdu	Speed Deviation	(P. 12)
17	St_trq	Torque Command Value	(P. 12)
18	St_LoF	Load Factor	(P. 13)
19	St_inr	Estimated Inertia Ratio	(P. 13)
20	St_ESt	Encoder Rotor Mechanical Angle (single-turn)	(P. 13)
21	St_EAb	Encoder Rotor Mechanical Angle (multiple-turns)	(P. 13)
22	St_EtP	Encoder Temperature (reference value)	(P. 14)
23	St_Ebu	Encoder Battery Voltage	(P. 14)
24	St_EAC	Encoder Communication: No. of Retries	(P. 14)
25	St_EEC	Encoder Data Error Count	(P. 14)
26	St_AEG	Regeneration Status	(P. 15)
27	St_Pnu	Primary Circuit Power Voltage (reference value)	(P. 16)
28	Pt_drv	Amplifier Model Code	(P. 16)
	Pt_Mot	Motor Model Code	
	Pt_Enc	Encoder Model Code	
29	PS_drv	Amplifier Serial Number	(P. 16)
	PS_Mot	Motor Serial Number	
	PS_Enc	Encoder Serial Number	
1	St_Pio	I/O Status	(P. 8)

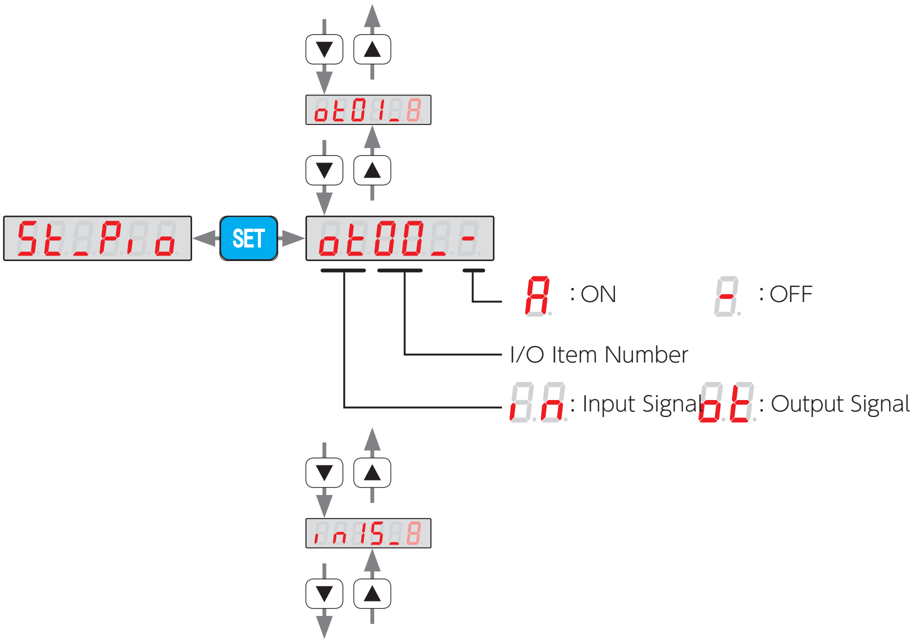
⋮

Press ▲ for the direction of the flow(↓). Press ▼ for the reverse direction.

1 I/O Status Status No.16

The flow chart below illustrates the I/O status of the CN1 connector.
The assignments of I/O pins depend on each control mode. Check each corresponding pin.

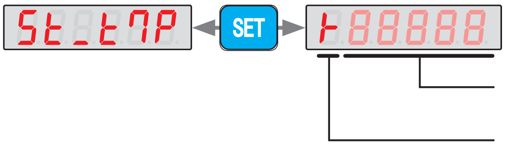
☞ **4 Connections**



Output Signal	Pin No.	Input Signal	Pin No.
ot00_8	13	in00_8	4
ot01_8	14	in01_8	5
ot02_8	15	in02_8	6
ot03_8	16	in03_8	7
ot04_8	17	in04_8	8
ot05_- (*)	18	in05_8	9
ot06_8	19	in06_8	10
ot07_8	21	in07_8	11
ot08_8 ⋮ ot15_8	Reserved	in08_8 ⋮ in15_8	Reserved

*) NOTE: The display of ot05_- is fixed at - (OFF).

2 Control Component Temperature Status No.24

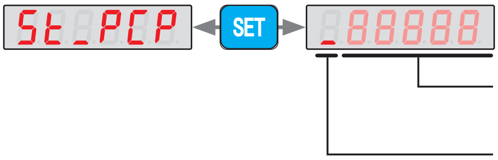


[℃]

Temperature of Amplifier Control Component (reference value)

+ : positive - : negative

3 Pulse Train Command Input (Position) Status No.33



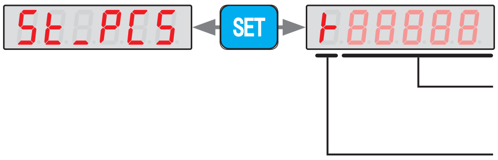
[command pulse]

Pulse count output from the host controller

Current display signs
(Press ◀ to change the display.)

‾+ : +/−sign - : first 5 digits _ : last 5 digits

4 Pulse Train Command Input (Speed) Status No.35

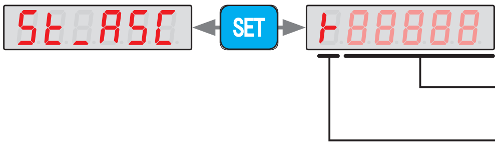


[pulse/160 µs]: 50 W to 750 W
[pulse/200 µs]: 1 kW to 2 kW

Speed derived from Pulse Train Command Input (Position)

+ : positive - : negative

5 Analog Velocity Command Status No.49



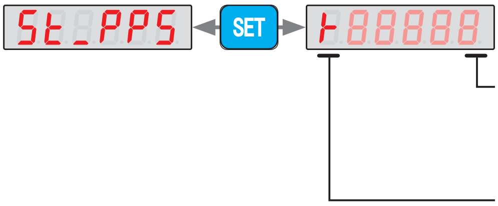
[r/min]

Analog Velocity Command input from the host controller

+ : positive - : negative

3. Using the Setup Panel

6 Positioning Status Status No.64



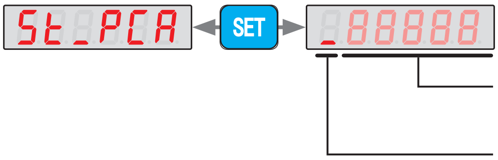
[-]

Positioning Status in Position Control Mode

0 : Executing Positioning 1 : Positioning Complete

+ : Fixed to positive

7 ABS Position Command Status No.74



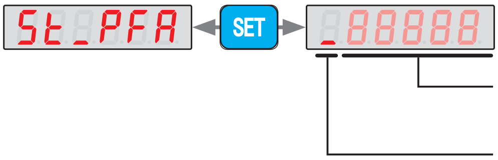
[command pulse]

Indicates a Position command value based on Home position offset

Current display signs
(Press ◀ to change the display.)

: +/− sign : first 5 digits : last 5 digits

8 ABS Position Feedback Status No.76



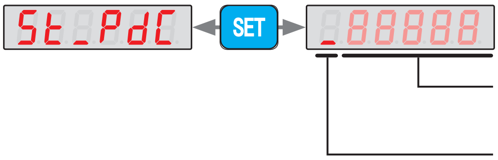
[command pulse]

Indicates the motor angular position returned from the encoder.

Current display signs
(Press ◀ to change the display.)

: +/− sign : first 5 digits : last 5 digits

9 Command Position Deviation Status No.78



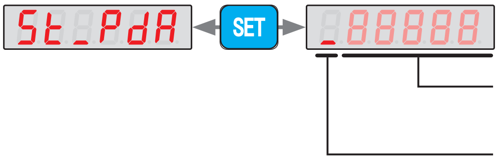
[command pulse]

Indicates the difference between the position command value and position feedback value.

Current display signs
(Press ◀ to change the display.)

: +/− sign : first 5 digits : last 5 digits

10 ABS Position Deviation State Status No.80



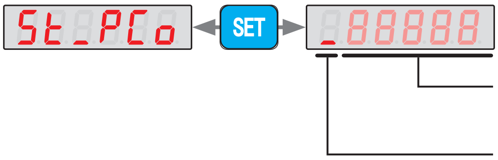
[command pulse]

Indicates the difference between ABS Position Command (Status No.74) and ABS Position Feedback (Status No.76)

Current display signs
(Press ◀ to change the display.)

: +/− sign : first 5 digits : last 5 digits

11 Positioning Command Value Status No.65



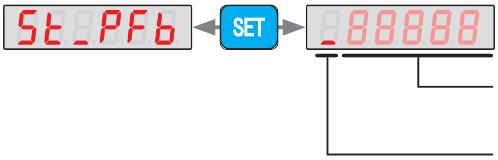
[encoder pulse]

Indicates the position command value input to the position loop

Current display signs
(Press ◀ to change the display.)

: +/− sign : first 5 digits : last 5 digits

12 Position Feedback Status No.67



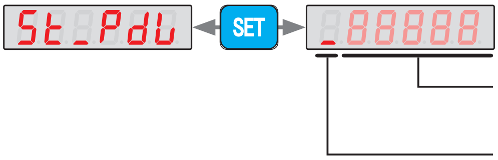
[encoder pulse]

Indicates the motor angular position detected by encoder

Current display signs
(Press ◀ to change the display.)

: +/− sign : first 5 digits : last 5 digits

13 Position Deviation Status No.69



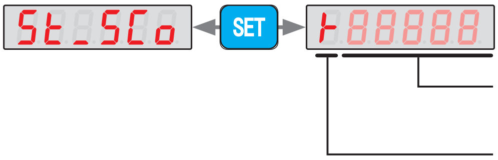
[encoder pulse]

Indicates the difference between the position control value and the position feedback value

Current display signs
(Press ◀ to change the display.)

: +/− sign : first 5 digits : last 5 digits

14 Speed Command Setting Status No.97

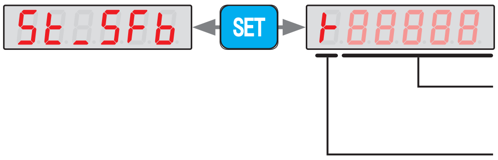


[r/min]

Indicates the value of speed command input to the speed loop

+ : positive - : negative

15 Speed Feedback Status No.98

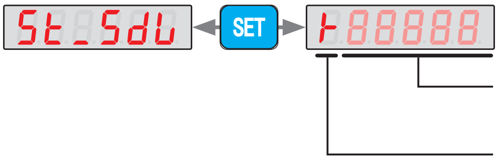


[r/min]

Indicates the motor rotational speed detected by the encoder

+ : positive - : negative

16 Speed Deviation Status No.99

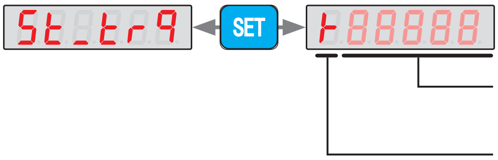


[r/min]

Indicates the difference between the speed command value and the speed feedback value

+ : positive - : negative

17 Torque Command Value Status No.113

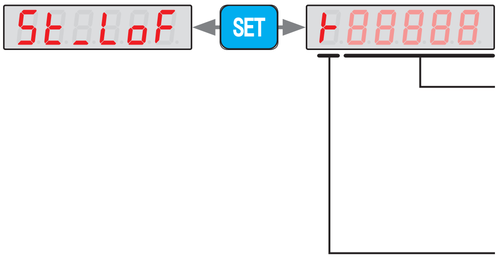


[0.1%]

Indicates the value of motor output torque

+ : positive - : negative

18 Load Factor Status No.131



[digit]

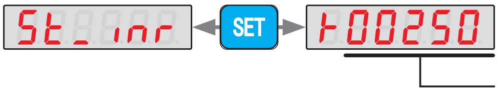
Indicates the load factor threshold to detect overload

To compare the displayed value to 100% rated torque, use the following conversion formula:

$$\sqrt{\text{Load Factor digit} \times 10}\ [\%]$$

+ : positive   - : negative

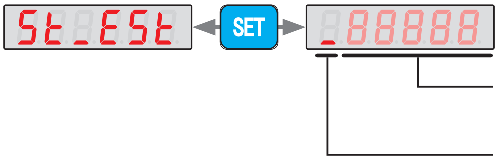
19 Estimated Inertia Ratio Status No.371



[%]

Indicates the estimated inertia ratio
(Indicates 250% in this example.)

20 Encoder Rotor Mechanical Angle (Single Turn) Status No.194



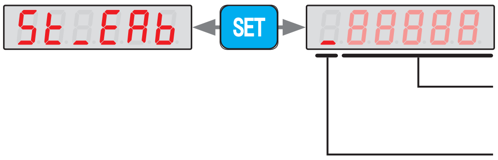
[encoder pulse]

Indicates the single-turn absolute value of the motor

Current display signs
(Press ◀ to change the display.)

: +/−sign   : first 5 digits   : last 5 digits

21 Encoder Rotor Mechanical Angle (Multiple-turns) Status No.195



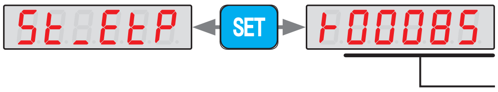
[encoder pulse]

Indicates the cumulative value of the motor's multiple-turns

Current display signs
(Press ◀ to change the display.)

: +/−sign   : first 5 digits   : last 5 digits

22 Encoder Temperature Status No.205

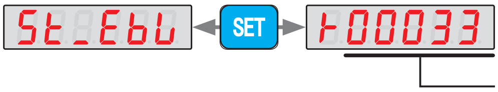


[℃]

Encoder Temperature
(Indicates 85℃ in this example.)

23 Encoder Battery Voltage Status No.206

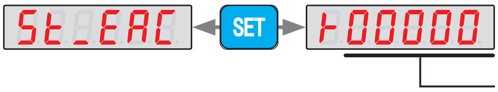
(Absolute encoder only)



[0.1 V]

Encoder battery voltage
(Indicates 3.3 V in this example.)

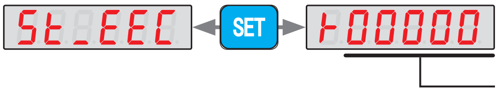
24 Encoder Communication Retry Count Status No.216



[count]

Indicates how many times encoder communication has been retried
(Indicates zero times in this example.)

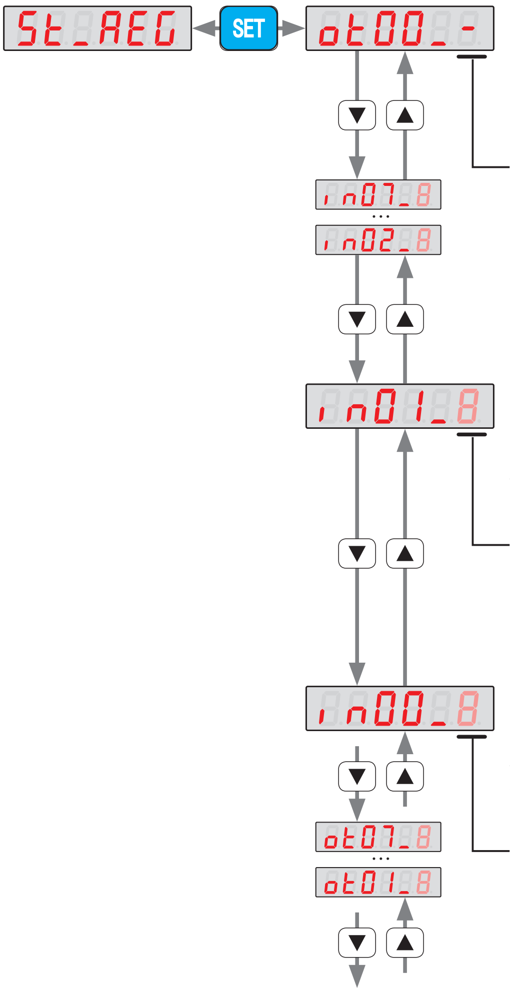
25 Encoder Data Error Counter Status No.218



[count]

Encoder Data Error Count
(Indicates zero times in this example.)

26 Regeneration Status Status No.228



Regeneration control output

Indicates the operation status of the regenerative power processing circuit.
ON: Handle with the regenerative resistor

A : ON   - : OFF

Regeneration voltage threshold

Indicates the primary circuit power voltage has reached the threshold. A power error, `Err. 15`, will occur if the regenerative resistor is not connected.

A : Reached the threshold.   - : Below the threshold

Regeneration voltage warning

Indicates the primary circuit power voltage has reached the warning level.
You need to connect a regenerative resistor to the amplifier.

A : Reached the warning threshold.   - : Below the warning threshold

How to determine whether or not a regenerative resistor is needed

1. Display `in00_8` as instructed above.
2. Observe if the display on the Setup Panel while gradually increasing the speed of the equipment from a low speed (approximately 20% of the max speed) to the actual operating speed.

`in00_-` : you do not need install a regenerative resistor.

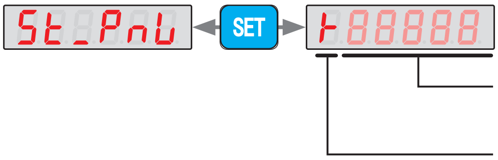
`in00_A` : install a regenerative resistor.

☞ **3 Preparation** Regenerative Resistor

CAUTION

If `Err. 15` appears while the motor is decelerating, you may need a regenerative resistor. Determine if a regenerative resistor is necessary or not as described above.

27 Primary Circuit Power Voltage Status No.232

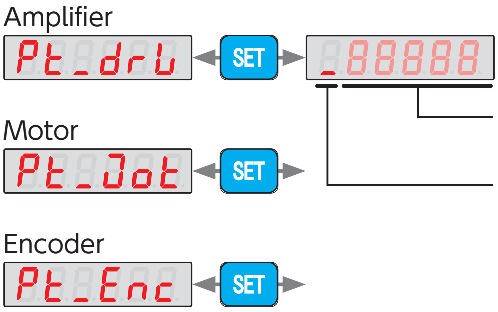


[0.1 V]

Primary Circuit Power Voltage (reference value)

: positive : negative

28 Model Code(Amplifier, Motor, Encoder)



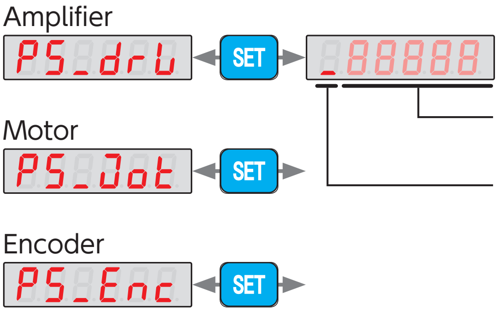
[encoder pulse]

Indicates the single-turn absolute value of the motor.

Current display signs
(Press ◀ to change the display.)

: +/- sign : first 5 digits : last 5 digits

29 Serial Number(Amplifier, Motor, Encoder)



[encoder pulse]

Indicates the single-turn absolute value of the motor.

Current display signs
(Press ◀ to change the display.)

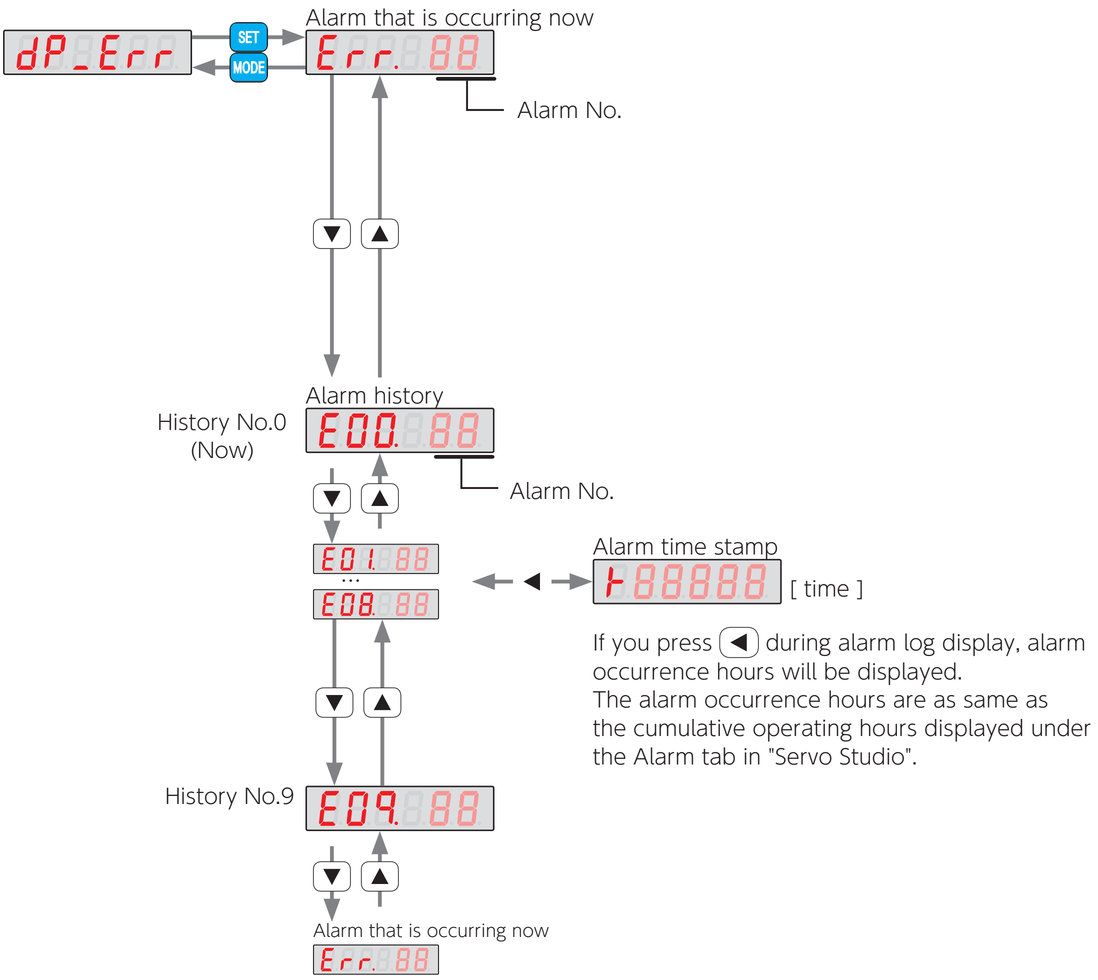
: +/- sign : first 5 digits : last 5 digits

3. Using the Setup Panel

2. Alarm Display Mode

When an alarm occurs, the Setup Panel will automatically switch to the Alarm Display Mode.
Note that this does not happen in the following modes: Parameter Setting Mode, Quick Tuning Mode, Auto Tuning Mode, Parameter Saving Mode, and Auxiliary Function Mode.
To switch to Alarm Display Mode from one of these modes, press MODE .
Status Display Mode is disabled while an alarm is occurring.
Up to 10 previous alarms can be displayed.

☞ 8 Troubleshooting



If you press ◀ during alarm log display, alarm occurrence hours will be displayed.
The alarm occurrence hours are as same as the cumulative operating hours displayed under the Alarm tab in "Servo Studio".

List of Alarms

Display	Alarm	Display	Alarm
Err. --	No alarm	Err. 16	Encoder error (Received data)
Err. 00	System error	Err. 17	Encoder error (no response)
Err. 01	EEPROM data error	Err. 18	Encoder error (circuitry)
Err. 02	Product code error	Err. 19	Encoder error (communication)
Err. 04	Overspeed error	Err. 20	Encoder error (multi-turn data)
Err. 05	Speed deviation error	Err. 21	Encoder error (voltage drop)
Err. 06	Position deviation error	Err. 22	Voltage error (control power)
Err. 07	Overload error	Err. 23	Switch circuitry error
Err. 08	Command overspeed error	Err. 24	Overcurrent error
Err. 09	Encoder pulse Output frequency error	Err. 25	Inverter error 1
Err. 10	Internal Position Command overflow error Homing failure	Err. 26	Inverter error 2
Err. 11	Encoder error (multi-turn counter overflow)	Err. 27	Current sensor error
Err. 12	Overheat error	Err. 28	Encoder error (overheat)
Err. 14	Overvoltage error	Err. 29	Voltage drop (inside the amplifier)
Err. 15	Power supply error (primary circuit power)		

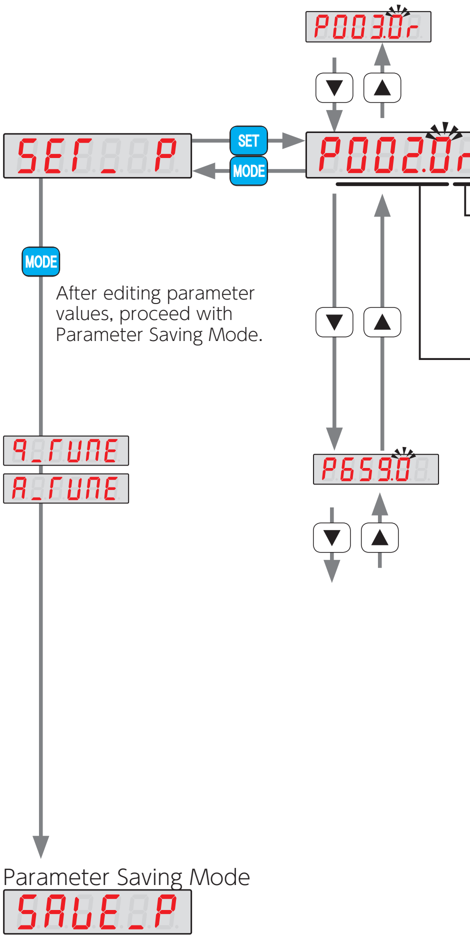
List of Warnings

Display	Warning	Display	Warning
Err.900	Encoder overheat detection	Err.903	Encoder communication warning
Err.901	Encoder battery voltage drop error detection	Err.904	Excessive position deviation
Err.902	Emergency stop		

3. Parameter Setting Mode

In Parameter Setting Mode, amplifier parameters can be checked and set up. For details of each parameter, see the Parameters.

☞ Page 28



After editing parameter values, proceed with Parameter Saving Mode.

Control power cycle

r : Necessary   8 : Unnecessary

Save the parameter settings in Parameter Saving mode to the amplifier. If you shut down the control power without saving, the setting changes will not take effect.

Parameter No.

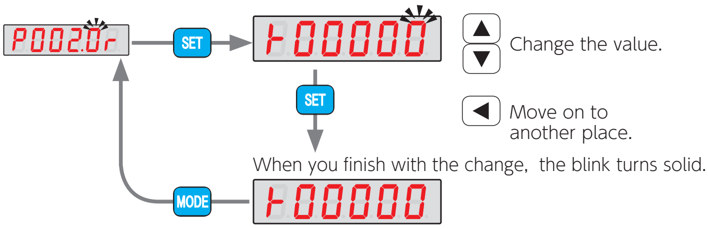
Only the configurable parameters will be displayed.

To switch to another parameter, Use ◀ button to start with the first digit of the parameter number.

Change the parameter value.

Use SET to change the number of the parameter.

While you are editing the value, the position that you selected blinks.



▲ ▼ Change the value.

◀ Move on to another place.

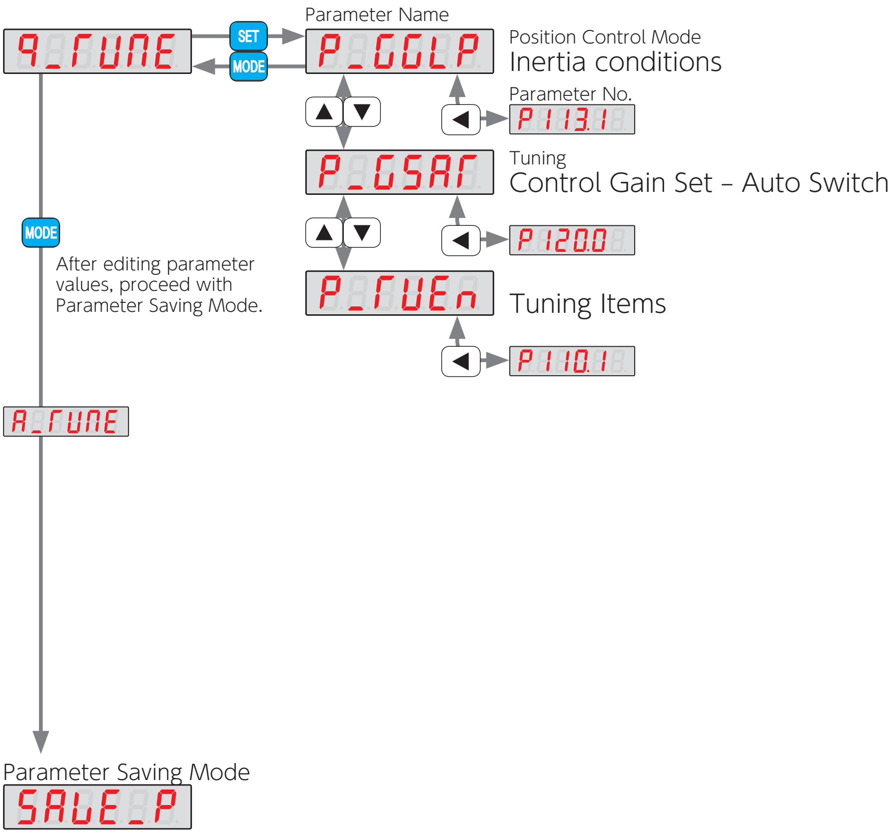
When you finish with the change, the blink turns solid.

Save the parameter settings in Parameter Saving mode to the amplifier. If you shut down the amplifier without saving them, the changes will not take effect.

4. Quick Tuning Mode(Position Control Mode Only)

For Tuning Procedures, see 7 **Tuning**.

☞ 7 **Tuning** Tuning Procedure

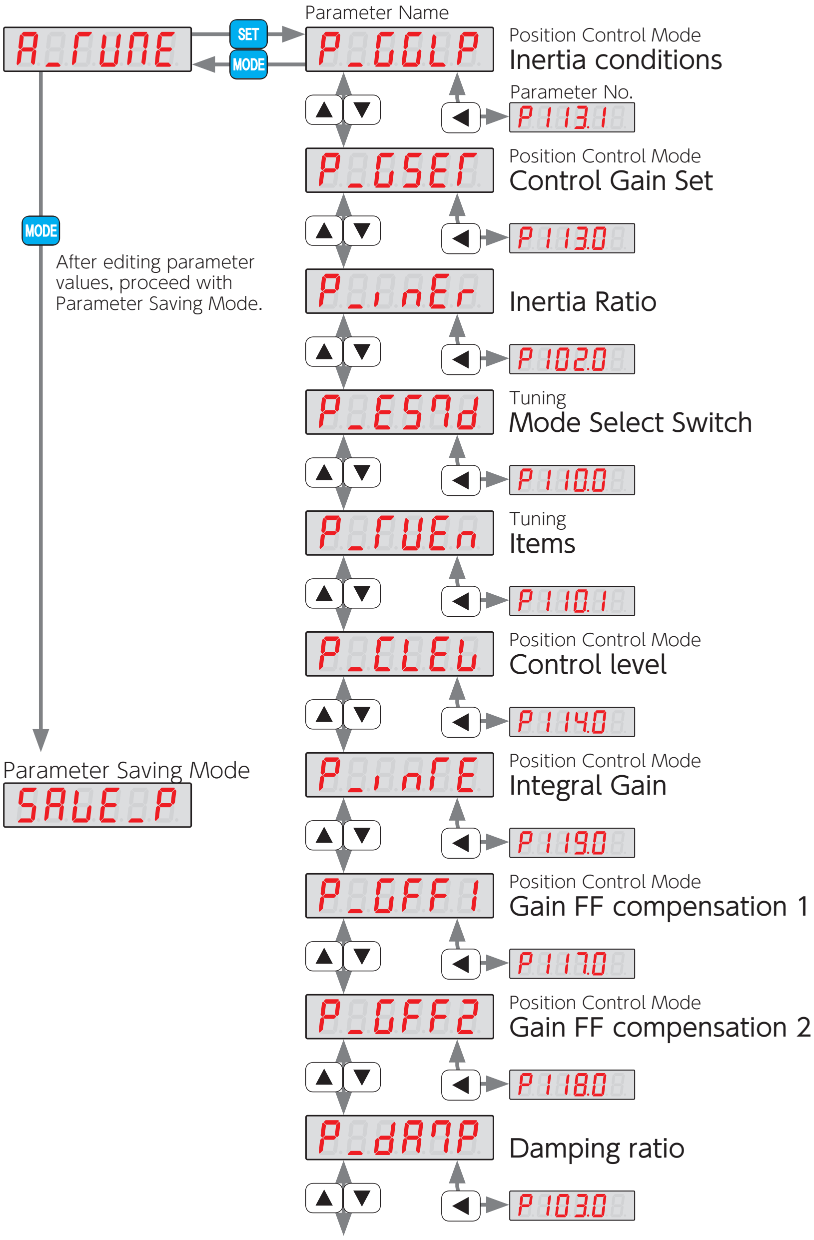


Save the parameter settings in Parameter Saving mode to the amplifier. If you shut down the amplifier without saving them, the changes will not take effect.

5. Auto Tuning Mode(Position Control Mode)

For Tuning Procedures, see 7 Tuning.

☞ 7 **Tuning** Tuning Procedure

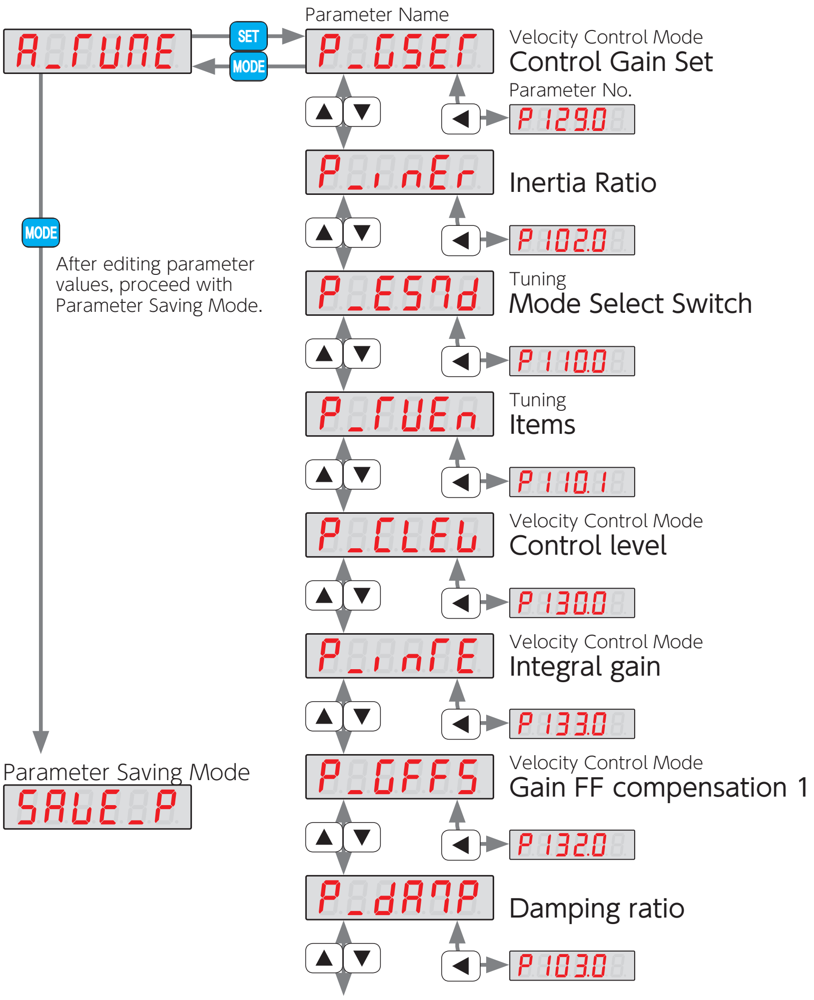


!	Save the parameter settings in Parameter Saving mode to the amplifier. If you shut down the amplifier without saving them, the changes will not take effect.

6. Auto Tuning Mode(Velocity Control Mode)

For Tuning Procedures, see **7** Tuning.

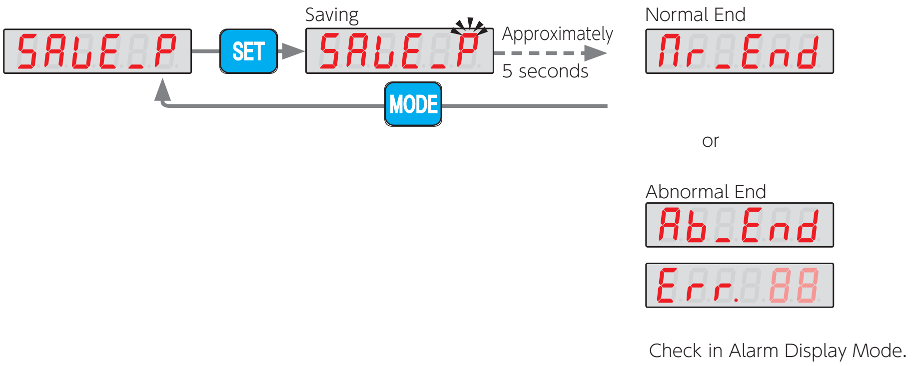
☞ **7** **Tuning** Tuning Procedure



!	Save the parameter settings in Parameter Saving mode to the amplifier. If you shut down the amplifier without saving them, the changes will not take effect.

7. Parameter Saving Mode

This mode allows you to save the parameter settings changed in Parameter Setting Mode or Auto Tuning Mode.



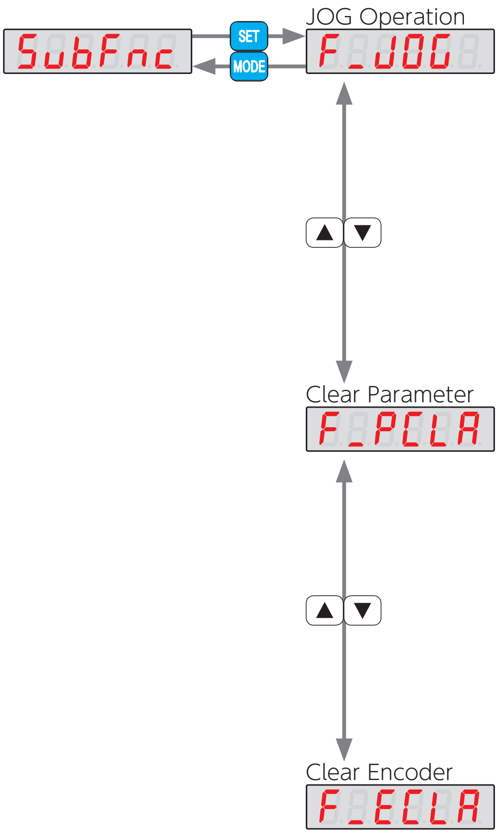
Save the parameter settings in Parameter Saving mode to the amplifier. If you shut down the amplifier without saving them, the changes will not take effect.

If you changed parameters for which control-power cycle is needed, cycle power after the new parameter settings are saved.

3. Using the Setup Panel

8. Auxiliary Function Mode

Auxiliary Function Mode allows you to perform the operations such as 1) JOG operation, 2) Clear Parameter, and 3) Clear Encoder.



☞ P. 25

- This function is used to perform a test run with no command input from the host controller.
- If tuning is your purpose, use Test Operation.
- The motor rotates only while ▲▼ is being pressed.

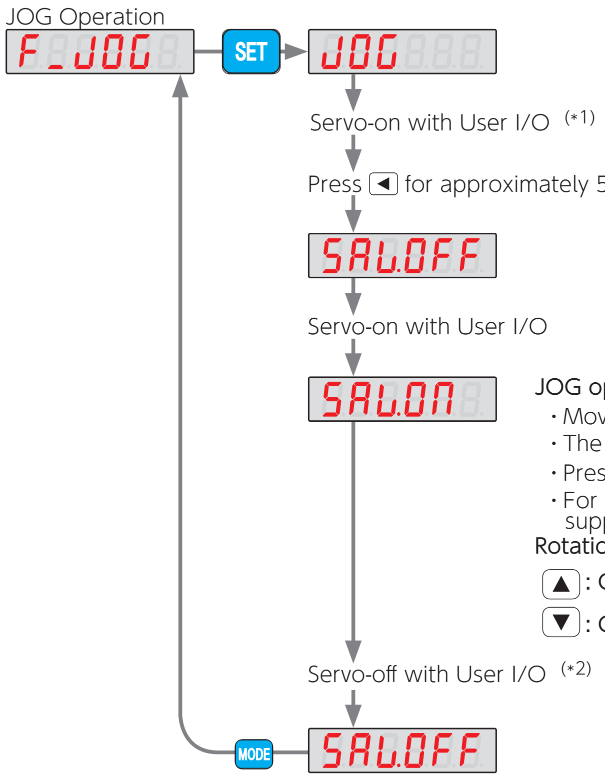
☞ P. 26

- The Parameter Clear function is used to reset all parameter settings to the factory default values.
- Control-power cycle is required.
- Perform this operation in a Servo-OFF state. If operated in a Servo-ON state, an alarm will occur.
- It is recommended to back up the current parameter settings before executing Parameter Clear.

☞ P. 26

- This function initializes the multi-turn data of absolute encoder.
- Control-power cycle is required.
- Perform this operation in a Servo-OFF state. If operated in a Servo-ON state, an alarm will occur.

JOG Operation



*1) Pressing ◀ without turning the servo off will result in Error .
Press MODE to be back to F_JOG .

JOG operation starts.

- Move the motor using ▲ or ▼ button.
- The motor moves only when either button is pressed.
- Press ▲▼ at the same time to stop the motor.
- For an emergency stop, shut off the primary circuit power supply or turn the servo off.

Rotational direction

▲: CCW rotation

▼: CW rotation

*2) Press MODE without turning the servo off, Error will be displayed first and then SAL.ON in approximately 3 seconds.

Modes and conditions that allows JOG Operation

Control Mode	Command Mode	JOG Operation
Position Control	Pulse Train Command	Yes
	Internal Position Command	No
Velocity Control	Analog Velocity Command	Yes
	Internal Velocity Command	Yes (*)
Torque Control	Analog Torque Command	No

*) Speed selection by I/O input is disabled. (VCRUN1, VCRUN2, VCSEL1, VCSEL2, VCSEL3)

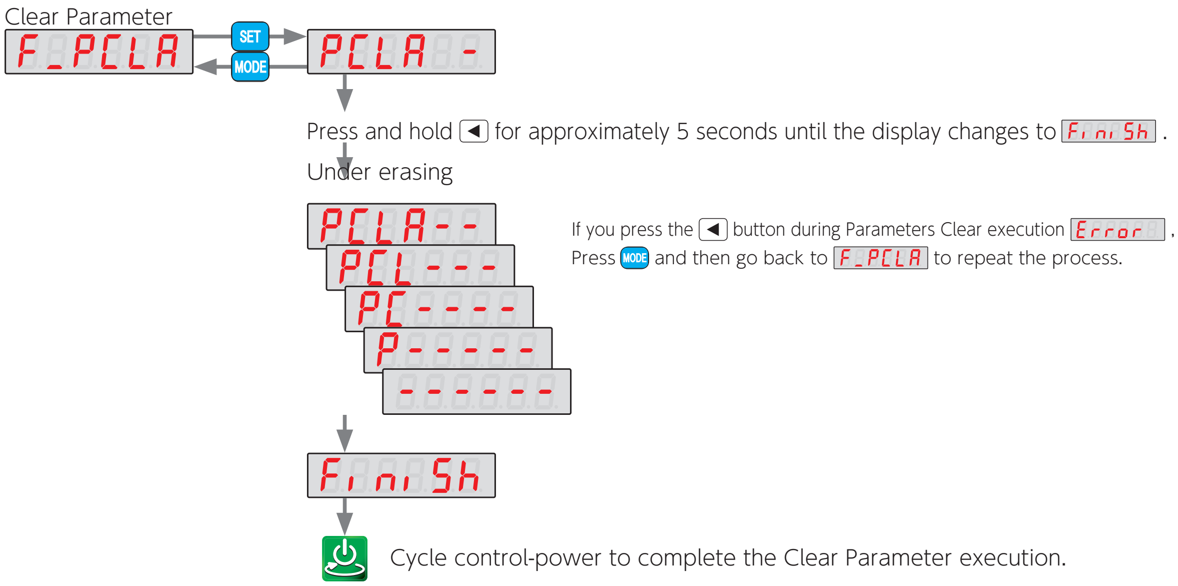
JOG Operation related parameters

Parameter No.	Parameter	Default	Range
385.0	Acceleration Time	1,000 ms	0 to 60,000
386.0 (*)	Deceleration Time	1,000 ms	0 to 60,000
387.0	Target Speed	300 r/min	0 to Maximum rotational speed of motor

*) The larger the setting, is the longer it takes for the motor to stop after releasing any of the ▲▼ buttons.

3. Using the Setup Panel

Clear Parameter



Press and hold ◀ for approximately 5 seconds until the display changes to FiniSh.

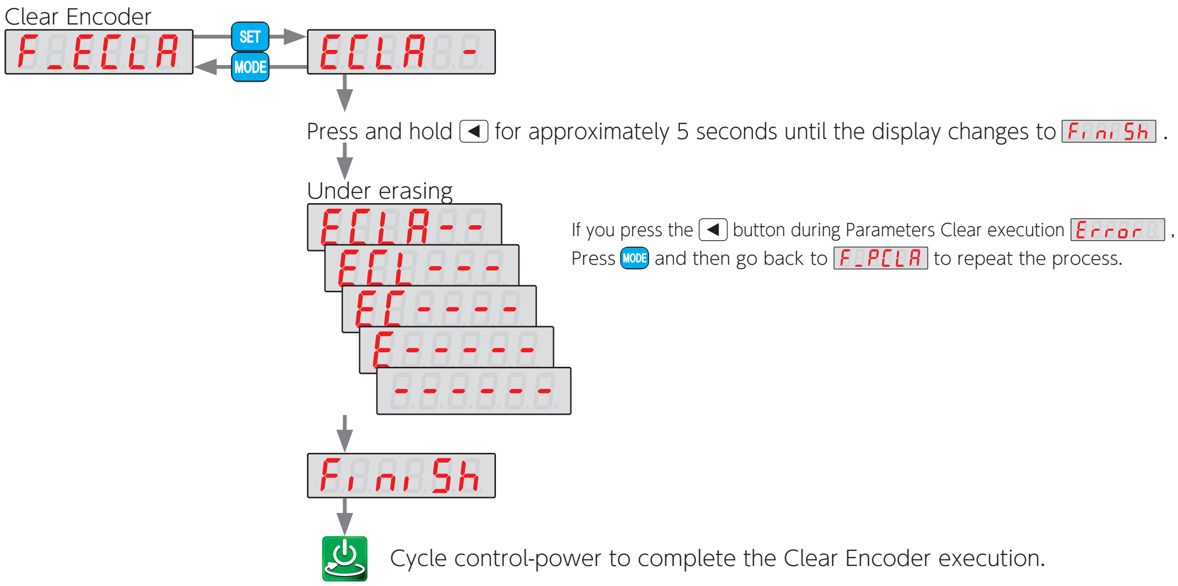
If you press the ◀ button during Parameters Clear execution Error,
Press MODE and then go back to F_PCLA to repeat the process.

Cycle control-power to complete the Clear Parameter execution.

Use this in a Servo-OFF state.

If used in a Servo-ON state, an alarm will occur.

Clear Encoder (This feature is used in absolute systems)



Press and hold ◀ for approximately 5 seconds until the display changes to FiniSh.

If you press the ◀ button during Parameters Clear execution Error,
Press MODE and then go back to F_PCLA to repeat the process.

Cycle control-power to complete the Clear Encoder execution.

Use this in a Servo-OFF state.

If used in a Servo-ON state, an alarm will occur.

4. Overview of "Servo Studio" (Setup Software)

Product Overview

"Servo Studio" is a dedicated setup software to be installed on a user-supplied PC connecting to a SD3 Series servo amplifier with a USB cable.
It enables you to perform the following operations easily.

Features:
- setting, saving, and writing amplifier parameters
- measuring, saving, and comparing data, by using a graphical waveform monitor
- monitoring the state of amplifier, alarm, and input/output
- gain tuning and setting filters
- point-table operation, test operation and homing

System Requirements for "Servo Studio"

PC	OS	Windows® XP SP3 (32-bit) Windows® 8 (64-bit) Windows® 7 (32-bit., 64-bit) Windows® 10 (64-bit)
	Language	Japanese, Chinese (Simplified), Chinese (Traditional), Korean, and English
	CPU	Pentium® III 512 MHz or higher
	RAM	256 MB or more (512 MB is recommended)
	Hard Disk	Free space of 512 MB or more
	Serial Communications	USB port
	Monitor	1024 × 768 Pixel or more Resolution 24-bit color (True Color) or higher
Cable	USB A - USB mini B	For certain noise environment, a signal noise filter cable is recommended.

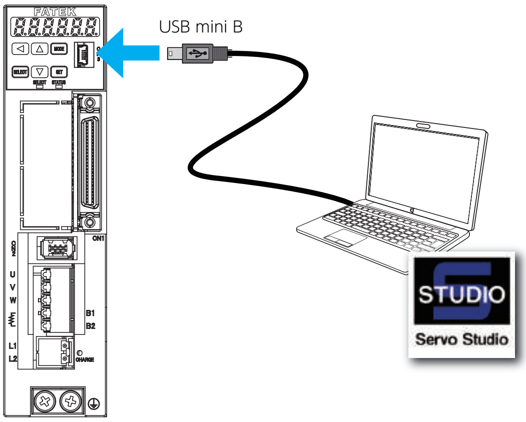
Microsoft., Windows is registered trademark of Microsoft Corporation in the United States and other countries.
Other company's names, product's names and so on are each company's registered marks.

When "Servo Studio" is used with other programs at the same time, "Servo Studio" operation may become unstable.
Use "Servo Studio" alone.

Connecting Amplifier and PC

Install "Servo Studio" on your PC.
Connect a USB cable to CN3 at the front of the amplifier.

☞ **"Servo Studio" Instruction Manual**



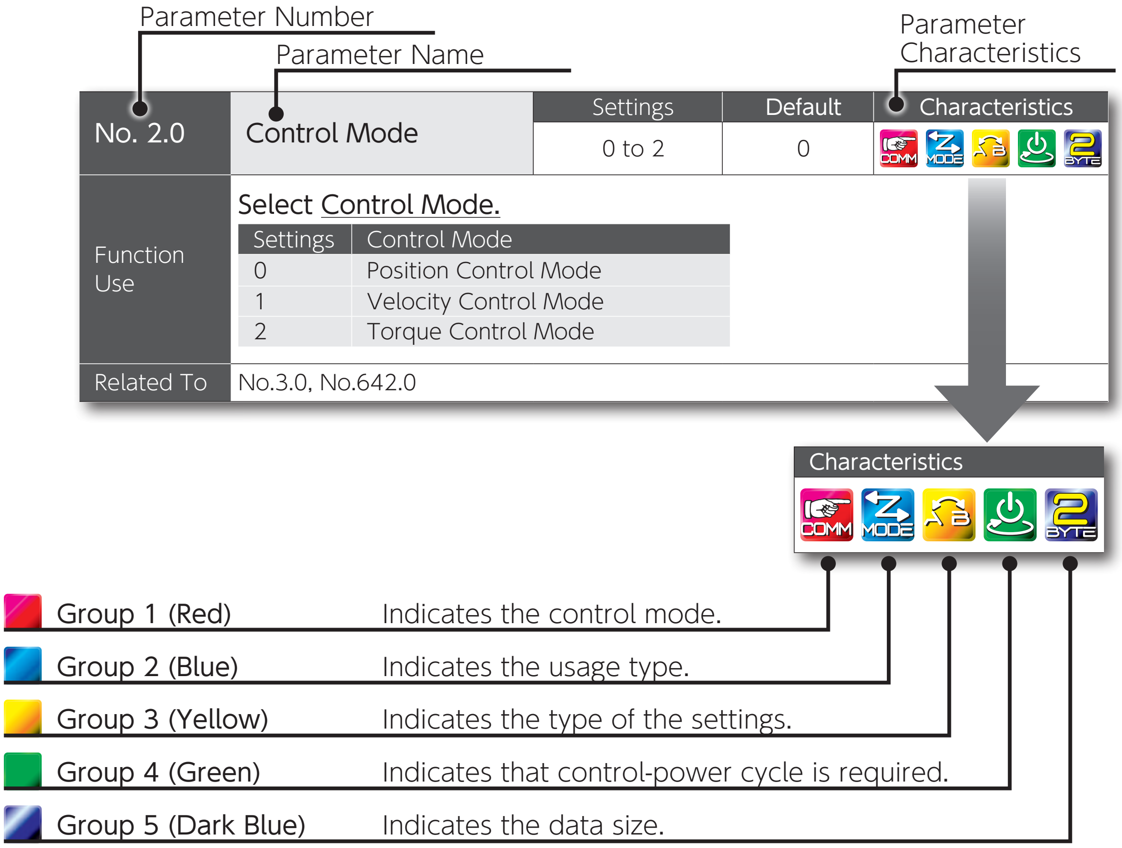
5. Parameters

Remark

Some of the tuning parameters are dependent on the settings of other parameters, which makes the values of dependent parameters invalid even if they are within the specification range.

Control Mode	Name	No.
Position Control Mode	Control gain 1	115.0
	Control gain 2	116.0
	Gain FF compensation 1	117.0
	Gain FF compensation 2	118.0
	Integral gain	119.0
Velocity Control Mode	Control gain 1	131.0
	Gain FF Compensation 1	132.0
	Integral gain	133.0

Overview of the parameter list



No. 2.0	Control Mode	Settings	Default	Characteristics
		0 to 2	0	COMM MODE A B BYTE
Function Use	Select Control Mode.			
Related To	No.3.0, No.642.0			

Settings	Control Mode
0	Position Control Mode
1	Velocity Control Mode
2	Torque Control Mode

🟥	Group 1 (Red)	Indicates the control mode.
🟦	Group 2 (Blue)	Indicates the usage type.
🟨	Group 3 (Yellow)	Indicates the type of the settings.
🟩	Group 4 (Green)	Indicates that control-power cycle is required.
🟦	Group 5 (Dark Blue)	Indicates the data size.

5. Parameters

Characteristics of Parameters

The parameters are categorized into five groups according to their functions, uses, and features. The following icons are used to represent their characteristics.

Group	Icon		Meaning
1 (Red)	COMM	Common	Used for all Control Modes
	PLS	Position Control Pulse Train Command	Used for Pulse Train Command in Position Control Mode
	IN POS	Position Control Internal Command	Used for Internal Position Command in Position Control Mode
	VEL	Velocity Control Analog Command	Used for Analog Command in Velocity Control Mode
	IN VEL	Velocity Control Internal Command	Used for Internal Velocity Command in Velocity Control Mode
	TRQ	Torque Control Analog Command	Used for Analog Command in Torque Control Mode
2 (Blue)	COM	Communication	Setup parameters for RS-485 Communication
	MODE	Operation Mode	Used for selecting Control Mode, Command Mode, Operation Mode, Pulse Form and so forth.
	CTRL	Operation Control	Used to configure Pulse Ratio and Filters
	ALM	Alarm Detection	Used for configuring Alarm Detection and Timing of Alarm Detection
	TUNE	Tuning	Gain parameters that require Tuning
	HOME	Homing	Used for positioning operation in Position Control Mode
	LIMIT	Torque Limit	Used for configuring Torque limit used in all Control Modes
	STOP	Deceleration Stop/ Emergency Stop/Quick Stop	Used for configuring Stop processes in case of emergency or drive restriction
	SUPP	Vibration Control	Parameters related to Vibration Control
3 (Yellow)	ON OFF	Switch	Parameters to enable or disable functions
	A B	Selection	Used for selecting conditions from multiple items based on your operational purposes
	0 100	Numeric Value	Numeric values are set for these parameters, for example, pulse paired ratio or filter setup parameters.
4 (Green)	⏻	Control Power Cycle	Those parameters need power cycling for their setting changes to take effect.
5 (Dark Blue)	2 BYTE	2-Byte Data	2-byte data ☞ **Communications Manual: RS-485 Communications**
	4 BYTE	4-Byte Data	4-byte data ☞ **Communications Manual: RS-485 Communications**

5. Parameters

1. Parameters

Common

Common

COMM MODE CTRL LIMIT

Name			No.	☞
Control mode			2.0	34
Command mode			3.0	34
Operation mode			9.0	35
Warning latch time			12.0	36
Alarm output timing			13.0	36
Torque command limit	Switch		144.0	62
	Value 1		147.0	63
	Value 2		148.0	63
Torque limit output			144.1	63
Servo OFF: Delay time			237.0	75
Bake release: Delay time			238.0	75
Absolute system			257.0	76
Encoder pulse output	Rotational direction		272.1	77
	Command pulse ratio	Numerator	276.0	78
		Denominator	278.0	78

JOG Operation

COMM CTRL

Name	No.	☞
Acceleration time	385.0	85
Deceleration time	386.0	85
Target speed	387.0	85

Warning/Error Detection

COMM PLS ALM

Name		No.	☞
Position deviation Error detection	Switch	65.0	41
	Value	87.0	51
	Delay time	89.0	51
Position deviation Warning detection	Value	363.0	85
	Delay time	365.0	85
Speed deviation Error detection	Switch	65.1	41
	Value	90.0	51
	Delay time	91.0	51
Encoder pulse output Error detection	Frequency upper bound	285.0	79
	Delay time	286.0	79
Encoder Overheat detection	Switch	259.0	76
	Value	267.0	77
Encoder Battery Voltage drop detection	Switch	259.1	76
	Value	268.0	77
Voltage Sag Detection	Delay time	305.0	83

RS-485 Communications

COMM COM

Name	No.	☞
Switch	8.0	35
Address	4.0	34
Communication speed	6.0	34
Stop bit	6.1	35
Parity	6.2	35
Minimum response time	11.0	35

Drive Restriction Input

COMM PLS CTRL

Name	No.	☞
Setup	67.0	43
Deceleration method	67.1	43
Idling status	67.2	43
Retaining position deviation counter	67.3	43

5. Parameters

Emergency Stop

COMM STOP

Name		No.	☞
Warning output	Switch	225.0	69
	Timing	225.1	69

Deceleration Stop

COMM STOP

Name		No.	☞
Upon Servo Off	Method	224.0	68
	DBRK output after stopping	224.3	69
When alarm is on	Method	233.0	73
	DBRK output after stopping	233.3	74
Release conditions		224.1	68
Operating time		226.0	70
Cancellation speed		227.0	70
Upon control power failure	Switch	224.2	69
	Operating time	228.0	70
Torque command limit		151.0	64
Status during free-run		232.1	71
Short brake operation after a stop		232.2	72
Brake engagement	Timing	232.3	72
	Delay time	234.0	74
	Rotational speed	235.0	74

Quick Stop

COMM STOP

Name		No.	☞
Smoothing filter	Switch	225.2	69
	Moving average counter	229.0	71
Extension Time		236.0	75
Deceleration time		239.0	75

Position Command Filter

IN-POS PLS SUPP

Name		No.	☞
Filter 1	Selection	66.0	42
	Smoothing 1 Moving average counter	80.0	48
	Notch frequency	74.0	46
	Notch width	75.0	46
	High frequency gain	76.0	46
	Notch depth	79.0	47
Filter 2	Selection	82.0	49
	Notch frequency	83.0	49
	Notch width	84.0	50
	High frequency gain	85.0	50
	Notch depth	86.0	50
Filter 3	Selection	82.1	49
	Notch frequency	357.0	84
	Notch width	358.0	84
	High frequency gain	359.0	84
	Notch depth	360.0	84
Filter 4	Selection	66.1	42
	Smoothing 2 Moving average counter	81.0	48

Torque Command Filter

COMM SUPP

Name		No.	☞
Low-pass filter	Switch	160.0	64
	Auto setting	160.2	65
	Time constant	162.0	65
Notch filter	Switch	160.1	64
	Frequency	168.0	66
	Width	169.0	66
	Depth	170.0	66
Notch filter 2	Switch	160.3	65
	Frequency	171.0	67
	Width	172.0	67
	Depth	173.0	67

5. Parameters

Position Control Mode

Pulse Train Command

PLS MODE CTRL

Name		No.	☞
Input pulse form		32.0	36
Rotational direction		32.1	37
Input logic		32.3	37
Pulse ratio	Interpolation	32.2	37
	Numerator	34.0	38
	Denominator	36.0	38
Input filter		33.0	37
Feed forward delay compensation		66.3	42

Positioning Complete

PLS CTRL

Name		No.	☞
Determination method		64.0	41
Detection criteria	Range	68.0	44
	Speed	69.0	44
	Command Input	70.0	45
Detection delay time		71.0	45

Homing

PLS POS HOME

Name		No.	☞
Re-detection of home position dog		645.3	90
Direction		646.0	91
Sensor dog polarity		646.1	92
Timeout	Switch	646.2	92
	Time	659.0	95
Torque command limit	Switch	647.0	93
	Value	656.0	95
Time to detect press stopper		655.0	95
Creep speed switch		647.1	93
Rapid speed		648.0	94
Creep speed		649.0	94
Acceleration/Deceleration time		650.0	94
Amount of home position shift		651.0	94
Home position data		653.0	95
Z-phase disabled distance		657.0	95
Home reference signal selection		645.0	89
Encoder Z-phase selection		645.1	89

Internal Position

POS MODE CTRL

Name		No.	☞
Pulse ratio	Interpolation	32.2	37
	Numerator	34.0	38
	Denominator	36.0	38
Feed forward delay compensation		66.3	42
Operation mode		642.0	88
Overflow detection		643.0	88
Point table	Point number Output method	644.0	89
	Motion of point No.0	646.3	92
	Command method	720.0～	96
	Operation	720.1～	97
	Enable/Disable	720.3～	98
	Position	722.0～	99
	Rotational speed	724.0～	99
	Acceleration time	726.0～	99
	Deceleration time	727.0～	99
	Dwell time	728.0～	100
	Positioning completion	729.0～	101

Position Control Mode: Tuning

PLS POS TUNE

Name		No.	☞
Inertia ratio		102.0	52
Damping ratio		103.0	52
Mode switch		110.0	53
Tuning items		110.1	53
Inertia ratio upper bound		106.0	52
Control gain set	Automatic switch	120.0	59
	Upper bound	120.1	59
	Tuning constant	121.0	60
Control gain set		113.0	54
Inertia conditions		113.1	55
Control level		114.0	56
Control gain 1		115.0	57
Control gain 2		116.0	57
Gain FF compensation 1		117.0	58
Gain FF compensation 2		118.0	58
Integral gain		119.0	59
Current control gain		193.0	68

Velocity Control Mode

Analog Velocity Command

VEL CTRL SUPP

Name			No.	☞
Offset	Tuning method		62.2	40
	value		60.0	40
Rotational direction			62.0	40
Input filter	Switch		62.1	40
	Numerator		48.0	38
	Denominator		49.0	38
Input gain	Numerator		50.0	39
	Denominator		51.0	39
Speed limit	CCW	Numerator	52.0	39
		Denominator	53.0	39
	CW	Numerator	54.0	39
		Denominator	55.0	39
Smoothing filter	Switch		77.0	47
	Moving average time		78.0	47

Internal Velocity

IN VEL MODE CTRL

Name		No.	☞
Command method		388.0	86
Acceleration time		390.0	86
Deceleration time		391.0	86
Target speed 1 to 8		392.0～	87
Smoothing filter	Switch	77.0	47
	Moving average time	78.0	47

Velocity Control Mode: Tuning

VEL IN VEL TUNE

Name		No.	☞
Inertia ratio		102.0	52
Damping ratio		103.0	52
Tuning	Mode switch	110.0	53
	Items	110.1	53
Control gain set		129.0	60
Control level		130.0	61
Control gain 1		131.0	61
Gain FF compensation 1		132.0	62
Integral gain		133.0	62
Current control gain		193.0	68

Torque Control Mode

Analog Torque

TRQ CTRL

Name			No.	☞
Offset	Tuning method		302.2	83
	Value		300.0	82
Direction of rotation			302.0	82
Input filter	Switch		302.1	82
	Numerator		288.0	80
	Denominator		289.0	80
Input gain	Numerator		290.0	80
	Denominator		291.0	80
Torque limit	CCW	Numerator	292.0	81
		Denominator	293.0	81
	CW	Numerator	294.0	81
		Denominator	295.0	81
Speed Limit			152.0	64

Torque Control: Tuning

TRQ TUNE

Name	No.	☞
Inertia ratio	102.0	52
Damping ratio	103.0	52
Control level	130.0	61
Control gain 1	131.0	61
Gain FF compensation 1	132.0	62
Integral gain	133.0	62
Current control gain	193.0	68

5. Parameters

2. Details of Parameters

No. 2.0	Control mode	Settings	Default	Characteristics
		0 to 2	0	COMM MODE AB ⏻ 2BYTE

Function Use

Select Control Mode.

Settings	Control Mode
0	Position Control Mode
1	Velocity Control Mode
2	Torque Control Mode

Related To No.3.0, No.642.0

No. 3.0	Command mode	Settings	Default	Characteristics
		1 to 3	1	COMM MODE AB ⏻ 2BYTE

Function Use

Select Command Mode.

Control Mode Settings	0: Position	1: Velocity	2: Torque
1: Pulse train command input	Yes	–	–
2: Analog command	–	Yes	Yes
3: Internal command	Yes	Yes	–

Related To No.3.0, No.642.0

No. 4.0	RS-485 communication: Address	Settings	Default	Characteristics
		1 to 32	1	COMM COM AB ⏻ 2BYTE

Function Use Specify the address of the RS-485 communication.

Remark Set this parameter to a unique address for each amplifier.

Related To No.6.0, No.6.1, No.6.2, No.8.0, No.11.0

No. 6.0	RS-485 communication: Communication speed	Settings	Default	Characteristics
		0 to 5	5	COMM COM AB ⏻ 2BYTE

Function Use

Specify the communications speed for the RS-485 communication.

Settings	Communications Speed [bps]
0	2,400
1	4,800
2	9,600
3	19,200
4	38,400
5	57,600

Related To No.4.0, No.6.1, No.6.2, No.8.0, No.11.0

No. 6.1	RS-485 communication: Stop bit	Settings	Default	Characteristics
		0, 1	0	COMM COM A B ⏻ 2 BYTE

Function Use

Specify the stop bit of the RS-485 communication.

Settings	Stop bit
0	1-bit
1	2-bit

Related To	No.4.0, No.6.0, No.6.2, No.8.0, No.11.0

No. 6.2	RS-485 communication: Parity	Settings	Default	Characteristics
		0 to 2	0	COMM COM A B ⏻ 2 BYTE

Function Use

Configure the parity of RS-485 communication.

Settings	Parity
0	None
1	Even
2	Odd

Related To	No.4.0, No.6.0, No.6.2, No.8.0, No.11.0

No. 8.0	RS-485 communication: Switch	Settings	Default	Characteristics
		0, 1	0	COMM COM ON OFF ⏻ 2 BYTE

Function Use

Enable/Disable RS-485 communication.

Settings	RS-485 communication
0	Disable
1	Enable

Remark	Select 0 if you are not using RS-485 communication.
Related To	No.4.0, No.11.0

No. 9.0	Operation mode	Settings	Default	Characteristics
		0, 1	0	COMM Z MODE A B - 2 BYTE

Function Use

Select I/O (CN1 connector) or Communication ("Servo Studio") as I/O signal input source.

Use this parameter to clear an alarm by using "Servo Studio".

Input source Settings	I/O (CN1 Connector)	Communication ("Servo Studio")
0	Enable	Disable
1	Disable	Enable

Remark

This item will be back to the default when the control power turns off.
You can set this item only with "Servo Studio", not with the Setup Panel.

No. 11.0	RS-485 communication: Minimum response time	Range	Default	Characteristics
		0 to 255	3 [ms]	COMM COM 0 100 ⏻ 2 BYTE

Function Use

Use this item to adjust the response time from the amplifier to meet the communication specifications of the host control device.

Related To	No.4.0, No.8.0

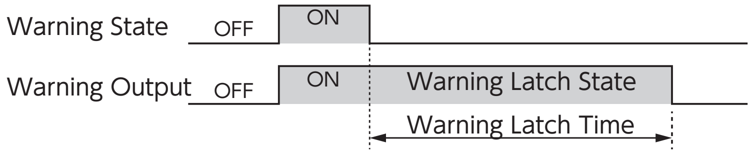
No. 12.0	Warning latch time	Range	Default	Characteristics
		0 to 200	1 [50 ms]	COMM MODE 0 100 – 2 BYTE

Function Use

Specify the length of latch time for warning output.

Setting	Description
0	No limit
1 to 200	Latching Time = Setting Value × 50 ms

Warning Output time = Waring State time + Warning Latch time



Close RESET to release the alarm latch and turn the warning off.

Related To	No.225.0, No.225.1

No. 13.0	Alarm output timing	Settings	Default	Characteristics
		0, 1	0	COMM CTRL A B – 2 BYTE

Function Use

Specify when to output an alarm.

Settings	Output timing
0	After the motor decelerates to stop
1	Immediately after an alarm occurs

Remark

If **Deceleration Stop: Method (when alarm is on)** (No.233.0) = 0 (free-run), the alarm signal will be output regardless of this parameter setting.

No. 32.0	Pulse train command: Input pulse form	Settings	Default	Characteristics
		0 to 2	0	PLS MODE A B ⏻ 2 BYTE

Function Use

Select the input signal form of Pulse Train Command.

Settings	Signal Form	
0	Pulse and Direction	(PLS + DIR)
1	Quadrature phase difference pulse	(A-Phase + B-Phase)
2	Positive pulse and Negative pulse	(CCW + CW)

Prerequisite	Position Control Mode
Related To	No.2.0, No.3.0, No.32.1, No.32.3, No.33.0, No.642.0

5. Parameters

No. 32.1

Pulse train command:
Rotational direction

Settings	Default	Characteristics
0, 1	1	PLS, CTRL, A B, ⏻, 2 BYTE

Function Use

Specify the rotational direction of pulse train command.

Settings	Direction of Rotation
0	CCW rotation if <u>negative</u> direction command
1	CCW rotation if <u>positive</u> direction command

Related To: No.2.0, No.3.0, No.32.1, No.32.3, No.33.0, No.642.0

No. 32.2

Pulse train command:
Interpolation with pulse ratio

Settings	Default	Characteristics
0, 1	1	PLS, CTRL, ON OFF, ⏻, 2 BYTE

Function Use

Enable/Disable the interpolation to smooth a command where Command Pulse Ratio is set.

Settings	Interpolation with pulse ratio
0	Disable
1	Enable

Related To: No.32.0, No.34.0, No.36.0

No. 32.3

Pulse train command:
Input logic

Settings	Default	Characteristics
0, 1	1	PLS, CTRL, A B, ⏻, 2 BYTE

Function Use

Select a logic of how to input Pulse Train Command.

Settings	Logic
0	Positive logic: Count at the time of rising edge (low to high)
1	Negative logic: Count at the time of falling edge (high to low)

Remark: For pulse and direction, change the setting of this parameter will reverse the direction signal (DIR) logic.

Related To: No.32.0, No.32.1

No. 33.0

Pulse train command:
Input filter

Range	Default	Characteristics
0 to 15	4	PLS, CTRL, 0 100, ⏻, 2 BYTE

Function Use

It helps to reduce possibility of malfunctions caused by noise.
This parameter has to be set when Pulse train command input is open collector.

Select a value according to pass-through pulse width (max frequency) of pulse train input. If a value selected did not eliminate the malfunction, select a higher value.

( ) recommended when Input

Settings	Pass-Through Pulse Width [ns]	Settings	Pass-Through Pulse Width [ns]
0	No filter	8	600 (500 kHz)
1	25	9	800
2	50 (4 MHz)	10	1,000
3	100	11	1,200
4	150 (2 MHz)	12	1,600 (250 kHz)
5	200	13	2,000
6	300 (1 MHz)	14	2,300
7	400	15	3,100

Related To: No.3.0, No.32.0

☞ 9 Appendices

		Range	Default	Characteristics
No. 34.0	Pulse train command: Ratio (Numerator)	1 to 65,535	1,000 [-]	PLS CTRL 0 100 ⏻ 4 BYTE
No. 36.0	Pulse train command: Ratio (Denominator)	1 to 65,535		

Function Use

Use these two parameters to set the multiplier and divider for the position command pulse.

When the pulse count per rotation of host command is not equal to its counterpart of motor, select one of the following for (Numerator)/(Denominator).

(Numerator)=(motor pulse count per rotation)/4=32,768
(Denominator)=(host command pulse count per rotation)/4

$$\frac{\boxed{34.0}}{\boxed{36.0}} = \frac{\text{motor pulse count per rotation}}{\text{host command pulse count per rotation}} = \frac{\text{motor pulse count per rotation / 4}}{\text{host command pulse count per rotation / 4}}$$

■ Setting Example

unit: [pulse/rev]

A Host Command Pulse count per rotation	B No. 34.0	C (= A × 1/4) No. 36.0
16,384	32,768 =131,072 (*) ÷ 4	4,096
10,000		2,500
4,096		1,024
4,000		1,000

*) 131,072 is the pulse count per rotation of the motor.
The default setting values are assumed 131,072 pulses of the host command pulse number per a rotation.

Remark

Range of Pulse Ratio (Numerator/Denominator)
- Pulse train command: x0.001 to x1,000
- Internal Position Command: x1 to x1,000

Related To No.276.0, No.278.0

		Range	Default	Characteristics
No. 48.0	Analog velocity: Input filter (Numerator)	0 to 65,535	16,000 [-]	VEL CTRL 0 100 ⏻ 2 BYTE
No. 49.0	Analog velocity: Input filter (Denominator)	1 to 65,535	65,535 [-]	

Function Use

These two parameters are used to configure a low-pass filter, which suppresses the noise component of analog velocity command input.

Setting	Noise Resistance	Command Response
Small	Strong	Slow
Large	Weak	Fast

Prerequisite Analog Velocity: Input filter switch (No.62.1) = 1 (Enable)

Remark

The ratio of No.288.0 (Numerator) to No.289.0 (Denominator) must not be higher than 1.
If the ratio = 1, filtering will not take effect.

Related To No. 62.1

<table>
<tr><th></th><th></th><th>Range</th><th>Default</th><th>Characteristics</th></tr>
<tr><td>No. 50.0</td><td>Analog velocity:
Input gain (Numerator)</td><td>0 to 65,535</td><td rowspan="2">Maximum Rotational Speed of Motor [-]</td><td rowspan="2">VEL CTRL 0 100 ⏻ 2 BYTE</td></tr>
<tr><td>No. 51.0</td><td>Analog velocity:
Input gain (Denominator)</td><td>1 to 65,535</td></tr>
<tr><td>Function
Use</td><td colspan="4">Analog velocity command Input Gain.
Set the value of a rotational speed corresponding to input voltage.
When (Numerator/Denominator) = 1/2, a motor rotational speed is a half of maximum command input voltage (± 10 V).
The motor rotational speed is max (± 10 V) when (Numerator/Denominator) = 1.
By using this gain, you can adjust the position proportional gain of the host controller.</td></tr>
</table>

<table>
<tr><th></th><th></th><th>Range</th><th>Default</th><th>Characteristics</th></tr>
<tr><td>No. 52.0</td><td>Analog velocity:
CCW speed limit (Numerator)</td><td>0 to 65,535</td><td rowspan="2">Maximum Rotational Speed of Motor [-]</td><td rowspan="2">VEL CTRL 0 100 ⏻ 2 BYTE</td></tr>
<tr><td>No. 53.0</td><td>Analog velocity:
CCW speed limit (Denominator)</td><td>1 to 65,535</td></tr>
<tr><td>Function
Use</td><td colspan="4">Analog velocity command: CCW speed limit.
$\text{CCW Speed Limit} = \text{Maximum rotational speed of motor} \times \frac{\boxed{52.0}}{\boxed{53.0}}$</td></tr>
</table>

<table>
<tr><th></th><th></th><th>Range</th><th>Default</th><th>Characteristics</th></tr>
<tr><td>No. 54.0</td><td>Analog velocity:
CW speed limit (Numerator)</td><td>0 to 65,535</td><td rowspan="2">Maximum Rotational Speed of Motor [-]</td><td rowspan="2">VEL CTRL 0 100 ⏻ 2 BYTE</td></tr>
<tr><td>No. 55.0</td><td>Analog velocity:
CW speed limit (Denominator)</td><td>1 to 65,535</td></tr>
<tr><td>Function
Use</td><td colspan="4">Analog velocity command: CW speed limit.
$\text{CW Speed Limit} = \text{Maximum rotational speed of motor} \times \frac{\boxed{54.0}}{\boxed{55.0}}$</td></tr>
</table>

Maximum Rotational Speed of Motor

Motor Capacity	Maximum rotational speed of motor [r/min]
50 W to 750 W	6,000
1 kW to 2 kW	3,000

5. Parameters

No. 60.0	Analog velocity: **Offset value**	Range	Default	Characteristics
		− 32,768 to +32,767	0 [-]	VEL CTRL 0 100 ⏻ 2 BYTE

Function Use

Set the offset value when Analog velocity: offset tuning method (No.62.2) = 1 (manual).

Connect power for the analog command, having the input voltage of 0 V, and adjust this parameter such that the rotational speed becomes 0 r/min.

1. For CCW rotations, set this parameter to a negative number, and for CW rotations, set to a positive number.
2. If the actual rotational speed is beyond the ± 10 r/min range, set this parameter to ± 50 and check the motor motions.

Prerequisite	Analog velocity: Offset tuning method (No.62.2) = 1 (manual)
Related To	No.62.2

No. 62.0	Analog velocity: **Rotational direction**	Settings	Default	Characteristics
		0, 1	1	VEL CTRL A B ⏻ 2 BYTE

Function Use

Select the rotational direction of analog speed pulse train input.

Settings	Negative Voltage Input	Positive Voltage Input
0	CCW Rotation	CW Rotation
1	CW Rotation	CCW Rotation

No. 62.1	Analog velocity: **Input filter switch**	Settings	Default	Characteristics
		0, 1	1	VEL CTRL ON OFF ⏻ 2 BYTE

Function Use

Enable/Disable Input filter for Analog Velocity Command.

This filter is a first-order IIR filter. Use it if there is too much noise in analog command.

Settings	Filter
0	Disable
1	Enable

No. 62.2	Analog velocity: **Offset tuning method**	Settings	Default	Characteristics
		0, 1	1	VEL CTRL A B ⏻ 2 BYTE

Function Use

Select either auto or manual method for offset tuning of Analog Velocity Command.

For manual adjustment, use the parameter **Analog velocity: offset value (No.60.0)** for tuning.

Settings	Offset tuning method
0	Auto: Select this to automatically adjust the offset value, such that the speed command becomes 0 r/min with the input voltage at the time of servo on.
1	Manual: Select this to manually adjust the offset value, such that the speed command becomes 0 r/min with 0 V input voltage.

Related To	No.60.0

		Settings	Default	Characteristics
No. 64.0	Positioning complete: Determination method	0, 1	0	PLS CTRL AB ⏻ 2BYTE

Function Use

Select one of two methods to output the Positioning Complete signal.

Settings	Signal Output Conditions			
	Position Deviation	Speed	Pulse Train command input	Parameter settings
0	○	○	-	Detection criteria - Range (No.68.0) - Speed (No.69.0)
1	○	○	○	Detection criteria - Range (No.68.0) - Speed (No.69.0) - command input (No.70.0)

Related To: No.68.0, No.69.0, No.70.0, No.71.0

		Settings	Default	Characteristics
No. 65.0	Position deviation error detection: Switch	0 to 3	1	PLS ALM AB – 2BYTE

Function Use

Specify what to output when excessive position deviation is detected.

Settings	Output selection
0	No detect (No output)
1	Alarm output
2	Warning output
3	Alarm and Warning output

When using Torque command limit, select 0 (No output) so that an alarm will not occur in a torque limit state.

Related To: No.87.0, No.89.0, No.363.0, No.365.0

		Settings	Default	Characteristics
No. 65.1	Speed deviation error detection: Switch	0, 1	1	COMM ALM ON OFF – 2BYTE

Function Use

Enable/Disable Speed Deviation Error Detection.

Settings	Speed deviation error detection
0	Disable
1	Enable

When using Torque command limit, select "Disable" so that an alarm will not occur during limiting.

Related To: No.90.0, No.91.0

No. 66.0	Position command filter 1: **Selection**	Settings	Default	Characteristics
		0 to 3	0	PLS SUPP A B ⏻ 2 BYTE

Function Use

Select no filter or one of the three filters:

Settings	Filter Type
0	No filter
1	Smoothing Filter 1
2	Notch filter
3	γ -Notch Filter

Remark	If you are to use Smoothing Filter 1, try Filter 4 (Smoothing Filter 2) first.
Related To	No.80.0, No.74.0, No.75.0, No.76.0, No.79.0

☞ 7 **Tuning**

No. 66.1	Position command filter 4: **Selection**	Settings	Default	Characteristics
		0, 1	1	PLS SUPP ON OFF ⏻ 2 BYTE

Function Use

Enable/Disable Position command Smoothing Filter 2 for Filter 4.

Settings	Filter
0	Disable
1	Enable

Remark	If you are to use Smoothing Filter 1, try Filter 4 (Smoothing Filter 2) first.
Related To	No.81.0

☞ 7 Tuning

No. 66.3	Pulse train command: **Feed forward delay compensation**	Settings	Default	Characteristics
		0, 1	1	PLS CTRL ON OFF ⏻ 2 BYTE

Function Use

Enable/Disable Feed Forward Delay Compensation in Position Control Mode.

Settings	Feed forward delay compensation
0	Disable
1	Enable

Remark	Usually, set 1 (enable) You can set this item only with "Servo Studio", not with the Setup Panel.

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

5. Parameters

No. 67.0	Drive restriction input: Setup	Settings	Default	Characteristics
		0 to 3	0	COMM CTRL AB ⏻ 2BYTE

Function Use

By installing sensors at the ends of linear motion, you can restrict the drive beyond the motion range.

When "Enable" is selected for this parameter, starting the motor will be blocked by I/O input ON.

Settings	CW Drive restriction	CCW Drive restriction
0	Disable	Disable
1	Enable	Disable
2	Disable	Enable
3	Enable	Enable

Related To No.67.1, No.67.2, No.67.3

		Settings	Default	Characteristics
No. 67.1	Drive restriction input: Deceleration method	0 to 2	1	COMM CTRL AB ⏻ 2BYTE
No. 67.2	Drive restriction input: Idling status	0, 1	0	

Function Use

Select the deceleration method upon drive restriction input and specify the idling state after the motor stopped its motion.

Use one of the following four combinations.

Possible Combinations	Deceleration method (No.67.1)	Idling status (No.67.2)
1	0: Free Run	0: Free Run
2	1: Short Brake	
3	2: Quick Stop	1: Zero Clamp
4		0: Free Run

Prerequisite Drive restriction input: Setup (No.67.0) = 1, 2 or 3 (Enable)

Related To No.67.0, No.67.3

No. 67.3	Drive restriction input: Retaining position deviation counter	Settings	Default	Characteristics
		0, 1	0	PLS CTRL AB ⏻ 2BYTE

Function Use

Motor's stopping upon drive restriction input results in position deviation from the input pulse.
Use this parameter to select either keep or clear that position deviation.

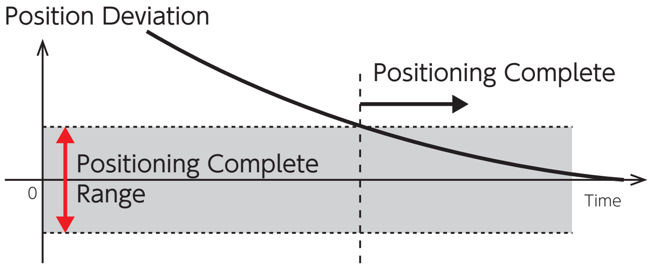
Settings	Position Deviation Counter
0	Keep
1	Clear

Related To No.67.0, No.67.1, No.67.2

		Range	Default	Characteristics
No. 68.0	Positioning complete: Detection criteria - Range	0 to 32,767	40 [encoder pulse]	PLS CTRL 0 100 ⏻ 2 BYTE

Function Use

Set the value for a pulse range (position deviation) to determine Positioning Complete.



When positioning is complete, the signal POSIN (positioning complete) will be output to the host controller.
Choose a value lower than the pulse range that the host controller uses to determine positioning complete.

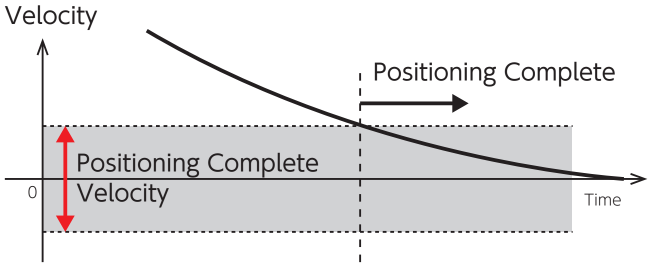
Related To No.64.0, No.69.0, No.70.0, No.71.0

		Range	Default	Characteristics
No. 69.0	Positioning complete: Detection criteria - Speed	0 to 32,767	(See below)	PLS CTRL 0 100 ⏻ 2 BYTE

Function Use

Set the upper bound for a speed to determine Positioning Complete.

Motor Capacity	Default	Units	Conversion to Rotational Speed
50 W to 750 W	2	pulse/160 µs	5.72 r/min
1 kW to 2 kW	2	pulse/200 µs	4.58 r/min



When positioning is complete, the signal POSIN (positioning complete) will be output to the host controller.
Choose a value lower than the upper bound speed that the host controller uses to determine positioning complete.

Rated To No.64.0, No.68.0, No.70.0, No.71.0

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

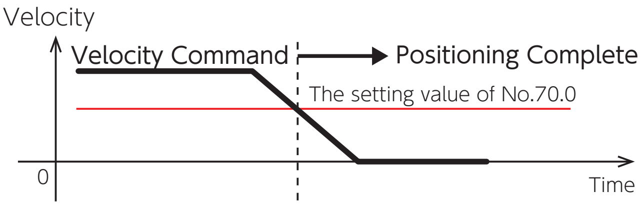
5. Parameters

No. 70.0	Positioning complete: Detection criteria - Command Input	Range	Default	Characteristics
		0 to 32,767	(See below)	PLS CTRL 0 100 ⏻ 2 BYTE

Function Use

Set the value for a pulse train command input (Speed) to determine Positioning Complete.

Motor Capacity	Default	units [encoder pulse]	Conversion to Rotational Speed
50 W to 750 W	0	pulse/160 µs	0 r/min
1 kW to 2 kW	0	pulse/200 µs	0 r/min



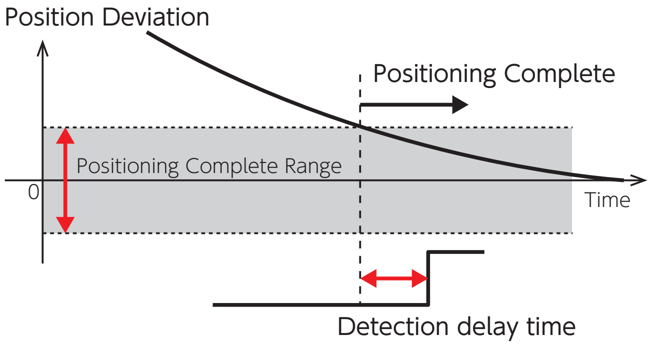
When positioning is complete, the signal POSIN (positioning complete) will be output to the host controller.
Normally, "zero" command is the criteria.

No. 71.0	Positioning complete: Detection delay time	Range	Default	Characteristics
		0 to 65,000	(See below)	PLS CTRL 0 100 ⏻ 2 BYTE

Function Use

Specify the delay time to output Positioning Complete signal (POSIN) to the host controller after Positioning Complete conditions are met.

Motor Capacity	Default	Units	Conversion to Time
50 W to 750 W	20	160 µs	3.2 ms
1 kW to 2 kW	16	200 µs	3.2 ms



Related To No.64.0, No.68.0, No.69.0, No.70.0

No. 74.0	Position command filter 1: Notch frequency	Range	Default	Characteristics
		10 to 2,000	10 [0.1 Hz]	PLS SUPP 0 100 ⏻ 2 BYTE
Function Use	Set the notch frequency for Position command filter 1.			
Prerequisite	Position command filter 1: Type (No.66.0) = 2 (Notch filter) or 3 (γ-Notch filter)			
Related To	No.66.0, No.75.0, No.76.0, No.79.0			

☞ 7 Tuning

No. 75.0	Position command filter 1: Notch width	Range	Default	Characteristics
		128 to 2,048	512 [-]	PLS SUPP 0 100 ⏻ 2 BYTE

Function Use

Set the width of notch of Position Command Filter 1.

Setting	Notch Width
Smaller	Narrower
Larger	Wider

Prerequisite	Position command filter 1: Type (No.66.0) = 2 (Notch filter)
Related To	No.66.0, No.74.0, No.79.0

☞ 7 Tuning

No. 76.0	Position command filter 1: High frequency gain	Range	Default	Characteristics
		50 to 200	100 [-]	PLS SUPP 0 100 ⏻ 2 BYTE

Function Use

Set the high frequency gain of Position Command Filter1.

Setting	Effect
50	x0.25
100	x1
200	x4

Smaller setting value gives better vibration suppression.
Larger setting value gives faster motion.

Prerequisite	Position command filter 1: Type (No.66.0) = 3 (γ-Notch filter).
Related To	No.66.0, No.74.0, No.79.0

☞ 7 Tuning

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

<table>
<tr><td rowspan="2">No. 77.0</td><td rowspan="2">Velocity command:
Smoothing filter - Switch</td><th>Settings</th><th>Default</th><th>Characteristics</th></tr>
<tr><td>0, 1</td><td>0</td><td>A VEL
SUPP
ON OFF
⏻
2 BYTE
IN VEL</td></tr>
<tr><td>Function Use</td><td colspan="4">Enable/Disable Speed Command Smoothing Filter in <u>Velocity Control Mode</u>.

This function enables to smooth the motion in high deceleration/acceleration by Speed Command. In addition, this smoothing filter can be used as a countermeasure against noise in Analog Velocity Command Mode.

<table><tr><th>Settings</th><th>Filter</th></tr><tr><td>0</td><td>Disable</td></tr><tr><td>1</td><td>Enable</td></tr></table></td></tr>
<tr><td>Related To</td><td colspan="4">No.78.0</td></tr>
</table>

<table>
<tr><td rowspan="2">No. 78.0</td><td rowspan="2">Velocity command:
Smoothing filter - Moving average time</td><th>Range</th><th>Default</th><th>Characteristics</th></tr>
<tr><td>1 to 1,000</td><td>100
[ms]</td><td>A VEL
SUPP
0 100
⏻
2 BYTE
IN VEL</td></tr>
<tr><td>Function Use</td><td colspan="4">Set the value for Speed Command Smoothing Filter-Moving Average Time in <u>Velocity Control Mode.</u>

however, this will result in delay.</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Velocity command: Smoothing filter switch (No.77.0) = 1 (Enable)</td></tr>
<tr><td>Related To</td><td colspan="4">No.77.0</td></tr>
</table>

<table>
<tr><td rowspan="2">No. 79.0</td><td rowspan="2">Position command filter 1:
Notch depth</td><th>Range</th><th>Default</th><th>Characteristics</th></tr>
<tr><td>0 to 100</td><td>0
[-]</td><td>PLS
SUPP
0 100
⏻
2 BYTE</td></tr>
<tr><td>Function Use</td><td colspan="4">Set the notch depth of Position command filter 1.

<table><tr><th>Setting</th><th>Notch Depth</th></tr><tr><td>0</td><td>Complete shutoff of notch frequency input</td></tr><tr><td>100</td><td>100% pass-through</td></tr></table>Smaller setting value gives deeper filter.
Larger setting value gives shallower filter.</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Position command filter 1: Type (No.66.0) = 2 (Notch filter) or 3 (γ -Notch filter)</td></tr>
<tr><td>Related To</td><td colspan="4">No.66.0, No.74.0, No.75.0, No.76.0</td></tr>
</table>

5. Parameters

No.	Name	Range	Default	Characteristics
No. 80.0	Position command filter 1: Smoothing 1 - Moving average counter	1 to 6,250	(See below) [-]	PLS SUPP 0 100 ⏻ 2 BYTE
No. 81.0	Position command filter 4: Smoothing 2 - Moving average counter	1 to 1,250		

Function Use

These items are used to smooth the speed changes in high deceleration/ acceleration, and can be used to suppress vibrations at settling time as well.

Use Filter 4 (Smoothing Filter 2) first.
To increase the smoothing effect further, use Filter 1 (Smoothing filter 1).

A larger value makes acceleration and deceleration smoother, but the response will become slower.
See the table below for the delay time calculation formula.
Filter 4 (Smoothing Filter 2) suppress the vibrations caused by the Gain FF compensation 2.

Motor Capacity	Delay time Calculation Formula	
50 W to 750 W:	0.16 ms	× Moving average count = Delay time
1 kW to 2 kW :	0.2 ms	

■ Setup of Vibration Suppression

Positioning will take longer as much as the delay time specified above. Set this item within the range acceptable to the equipment.

① Check the vibration interval in waveforms of position deviation and torque command at settling time.
② Calculate the moving average count as described below.
③ Using Filter 4 may reduce the resonant vibrations.
④ If suppression of the vibrations is not effective enough, recalculate the moving average count based on the vibration interval, and set it to Filter 1.

Motor Capacity	Moving average count and Vibration interval to compress	
50 W to 750 W:	6,250	× Vibration interval [s] = Moving average count
1 kW to 2 kW :	5,000	

■ Default

Motor Capacity	Filter 1 (No.80.0)	Filter 4 (No.81.0)
50 W to 750 W	25	10
1 kW to 2 kW	20	10

The default value of Position command filter 1: Type (No.66.0) is 0 (no filter).

Prerequisite

Position command filter 1: Selection (No.66.0) = 1 (Smoothing filter 1)
Position command filter 4: Selection (No.66.1) = 1 (Enable)

Remark

Before setting this parameter, wait at least 3 secs after the motor stops. In addition, configure it where the command pulse is not being input.
Setting this parameter during pulse input or presence of residual pulse could cause positioning failure.
The larger the setting is, the longer the delay time from command input becomes.

Related To

No.66.0, No.66.1

☞ 7 Tuning

No. 82.0	Position command filter 2: **Selection**	Settings	Default	Characteristics
		0 to 3	0	PLS SUPP AB ⏻ 2 BYTE

Function Use

Set the Position Command Filter 2.

Settings	Filter Type
0	No filter
1	Reserved (Do not use)
2	Notch filter
3	γ-Notch Filter

Related To No.83.0, No.84.0, No.85.0, No.86.0

☞ 7 Tuning

No. 82.1	Position command filter 3: **Selection**	Settings	Default	Characteristics
		0 to 3	0	PLS SUPP AB ⏻ 2 BYTE

Function Use

Set Position Command Filter 3.

Settings	Filter Type
0	No filter
1	Reserved (Do not use)
2	Notch filter
3	γ-Notch Filter

Related To No.357.0, No.358.0, No.359.0, No.360.0

☞ 7 Tuning

No. 83.0	Position command filter 2: **Notch frequency**	Range	Default	Characteristics
		10 to 2,000	10 [0.1Hz]	PLS SUPP 0 100 ⏻ 2 BYTE

Function Use

Set the notch frequency for Position command filter 2.

Prerequisite Position command filter 2: Select (No.82.0) = 2 (Notch filter) or 3 (γ-Notch filter)

Related To No.82.0, No.84.0, No.85.0, No.86.0

☞ 7 Tuning

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	AB	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

No. 84.0	Position command filter 2: Notch width	Range	Default	Characteristics
		128 to 2,048	512 [-]	PLS SUPP 0 100 ⏻ 2 BYTE

Function Use

Set the notch width of Position Command Filter 2.

Setting	Notch Width
Smaller	Narrower
Larger	Wider

Prerequisite Position command filter 2: Select (No.82.0) = 2 (Notch filter)

Related To No.82.0, No.83.0, No.85.0, No.86.0

No. 85.0	Position command filter 2: High frequency gain	Range	Default	Characteristics
		50 to 200	100 [-]	PLS SUPP 0 100 ⏻ 2 BYTE

Function Use

Set the high frequency gain for Position Command Filter 2.

Setting	Effect
50	x0.25
100	x1
200	x4

Smaller setting value gives better vibration suppression.
Larger setting value gives faster motion.

Prerequisite Position command filter 2: Type (No.82.0) = 3 (γ-Notch Filter)

Related To No.82.0, No.83.0, No.86.0

No. 86.0	Position command filter 2: Notch depth	Range	Default	Characteristics
		0 to 100	0 [-]	PLS SUPP 0 100 ⏻ 2 BYTE

Function Use

Specify the notch depth of Position Command Filter2.

Setting	Effect
0	Complete shutoff of notch frequency input
100	100% pass-through

Smaller setting value gives deeper filter.
Larger setting value gives shallower filter.

Prerequisite Position command filter 2: Select (No.82.0) = 2 (Notch filter) or 3 (γ-Notch filter)

Related To No.82.0, No.83.0, No.84.0, No.85.0

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

5. Parameters

No. 87.0	Position deviation error detection: Value	Range	Default	Characteristics
		0 to 2,147,483,647	196,608 [encoder pulse]	PLS ALM 0 100 - 4 BYTE
Function Use	This parameter sets a threshold value for a position deviation error detection. The higher the value, the less likely to detect position deviation error. (The initial value of 196,608 is equivalent to pulse count of rotor 1.5 rotations.)			
Prerequisite	Position deviation error detection: Switch (No.65.0) = 1 (Enable)			
Related To	No.65.0, No.89.0			

No. 89.0	Position deviation error detection: Delay time	Range	Default	Characteristics
		0 to 32,767	(See below)	PLS ALM 0 100 - 2 BYTE
Function Use	This parameter sets a delay time for a position deviation error (Alarm No.6) to be output after the position deviation exceeded the setting of [Position deviation error detection value (No.87.0)] The higher the value, the longer it takes for the error to be output. ■ Default			

Motor Capacity	Default	Converted to Time
50 W to 750 W	250 [160 µs]	40 ms
1 kW to 2 kW	200 [200 µs]	

Prerequisite	Position deviation error detection: Switch (No.65.0) = 1 (Enable)
Related To	No.65.0, No.87.0

No. 90.0	Speed deviation error detection: Value	Range	Default	Characteristics
		0 to 32,767	(See below)	COMM ALM 0 100 - 2 BYTE
Function Use	This parameter sets a threshold value for a speed deviation error detection. The higher the value, the less likely to detect a speed deviation error. ■ Default			

Motor Capacity	Default	Speed Conversion
50 W to 750 W	524 [encoder pulse/160 µs]	1,499 r/min
1 kW to 2 kW	655 [encoder pulse/200 µs]	

Prerequisite	Speed deviation error detection - Switch (No.65.1) = 1 (Enable)
Related To	No.65.1, No.91.0

No. 91.0	Speed deviation error detection: Delay time	Range	Default	Characteristics
		0 to 32,767	(See below)	COMM ALM 0 100 - 2 BYTE
Function Use	This parameter sets a delay time for a speed deviation error (Alarm No.5) to be detected after the speed deviation exceeded the setting of "Speed deviation error - Detection value"(No.90.0). The higher the value, the longer the error detection time. ■ Default			

Motor Capacity	Default	Converted to Time
50 W to 750 W	250 [160 µs]	40 ms
1 kW to 2 kW	200 [200 µs]	

Prerequisite	Speed deviation error detection - Switch (No.65.1) = 1 (Enable)
Related To	No.65.1, No.90.0

No. 102.0	Tuning: Inertia ratio	Range	Default	Characteristics
		100 to 10,000	250 [%]	COMM TUNE 0 100 – 2 BYTE
Function Use	Specify the ratio of the device load inertia to motor rotor inertia (moment of inertia). $\text{Inertia Ratio} = \dfrac{\text{Load Inertia} + \text{Rotor Inertia}}{\text{Rotor Inertia}} \times 100\%$ Inertia ratio is estimated by auto-tuning. When estimation is difficult (for example, too large an inertia ratio or too large a torque value), you can enter a calculated value of load inertia. If vibration occurs after deceleration or acceleration, increase the inertia ratio.			
Remark	The inertia ratio being too large or too small will cause noise.			

☞ 7 Tuning

No. 103.0	Tuning: Damping ratio	Range	Default	Characteristics
		100 to 5,000	100 [%]	COMM TUNE 0 100 – 2 BYTE
Function Use	This parameter can be used for tuning to improve poor settling due to viscous friction, or too large an inertia ratio. Increasing (or decreasing) this parameter value in event of overshoot (or undershoot respectively) may make the settling time shorter. The value of this parameter is estimated along with inertia ratio simultaneously if **Tuning: Items** (No.110.1) = 2 (start).			
Prerequisite	Position Control Mode, Velocity Control Mode			
Related To	No.110.1			

No. 106.0	Tuning: Inertia ratio upper bound	Range	Default	Characteristics
		100 to 10,000	3,000 [%]	COMM TUNE 0 100 – 2 BYTE
Function Use	Set the upper bound of the inertia ratio automatically adjusted in Quick Tuning.			
Prerequisite	Tuning: Control gain set - Automatic switch (No.120.0): 1 (Enable)			
Related To	No.110.1, No.120.0			

No. 110.0	Tuning: Mode switch	Settings	Default	Characteristics
		1, 2	2	COMM TUNE A B – 2 BYTE

Function Use

Select a tuning condition depending on the direction of load or the presence of unbalanced load.

Settings	Mode	Motion direction of the device connected to the motor
1	Standard	Horizontal axis force
2	Offset Load	Non-horizontal axis force

Use Offset Load Mode even for the case of axis force (horizontal motion)

Prerequisite Position Control Mode, Velocity Control Mode

☞ 7 Tuning

No. 110.1	Tuning: Items	Settings	Default	Characteristics
		0 to 2	0	COMM TUNE A B – 2 BYTE

Function Use

Select Start or Stop for tuning depending on the your willing to estimate items.

Settings (Tuning)	Estimate items	
	Inertia ratio	Damping ratio
0 (Stop)	No estimate	No estimate
1 (Start)	Estimate	
2 (Start)		Estimate

Prerequisite Position Control Mode, Velocity Control Mode

☞ 7 Tuning

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

5. Parameters

<table>
<tr><td rowspan="2">No. 113.0</td><td rowspan="2">Tuning:
Position control mode - Control gain set</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>5 to 45</td><td>15
[-]</td><td>PLS TUNE 0 100 - 2 BYTE
IN POS</td></tr>
<tr><td>Function Use</td><td colspan="4">

Select one control gain set for Position Control Mode.

Control Gain 1 (No.115.0), **Control Gain 2** (No.116.0), and **Integral Gain** (No.119.0) are set to the preset values of pairs.

■ Noise Solutions
① Use **Torque command filter: Notch filter** (such as No.160.1).
② Decrease the value of **Integral Gain** (No.119.0).
③ Decrease the value of **Control Gain 2** (No.116.0).

If the above does not work, lower Control Gain Set.

<table>
<tr><th>Setting</th><th>Command Response</th><th>Rigidity</th><th>Settling Time</th><th>Possibility of Noise</th></tr>
<tr><td>5</td><td>Slower</td><td>Lower</td><td>Longer</td><td>Lower</td></tr>
<tr><td>↕</td><td>↕</td><td>↕</td><td>↕</td><td>↕</td></tr>
<tr><td>45</td><td>Faster</td><td>Higher</td><td>Shorter</td><td>Higher</td></tr>
</table>

</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Position Control Mode</td></tr>
<tr><td>Remark</td><td colspan="4">· Too large a value of this item may cause noise.
· The default value varies depending on the setting of Position Control Mode - Inertia conditions (No.113.1).
· If Torque command filter: Low-pass filter - Auto setting (No.160.2) = 1 (auto setting ON), then Torque command filter: Low-pass filter - Time constant (No.162.0) will be included in the gain set.</td></tr>
<tr><td>Related To</td><td colspan="4">No.113.1, No.114.0, No.115.0, No.116.0, No.117.0, No.118.0, No.119.0, No.162.0</td></tr>
</table>

☞ 7 Tuning

No. 113.1	Tuning: Position control mode - Inertia conditions	Settings	Default	Characteristics
		1 to 3	2	PLS TUNE A/B - 2 BYTE IN POS

Function Use

Set the inertia conditions for Position Control Mode.

This parameter is used to determine the ratio of **Control Gain 1** (No.115.0) to **Control Gain 2** (No.116.0), which would be appropriate to equipment characteristics.

Settings	Description
1	Heavy-load equipment or equipment with substantial load fluctuation Equipment with low rigidity, robot arms, and so on
2	(medium setting) For example, general transport machines
3	Light-load equipment Equipment that demands high-speed operation or requires settling

Prerequisite	Position Control Mode
Related To	No.113.0, No.115.0, No.116.0

☞ **7 Tuning**

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A/B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

		Range	Default	Characteristics
No. 114.0	Tuning: Position control mode - Control level	5 to 45	15 [-]	PLS TUNE 0 100 - 2 BYTE IN POS

Function Use

Set the Control Level of <u>Position Control Mode</u>.

With this parameter, both **Control Gain 1** (No.115.0) and **Control Gain 2** (No.116.0) can be set to the preset values of pairs.

■ Noise Solutions

① Use **Torque command filter: Notch filter - Switch** (such as No.160.1).
② Decrease **Position control mode - Integral gain** (No.119.0).
③ Decrease **Position control mode - Control gain 2** (No.116.0).

If any of the above does not work, decrease the Control Gain Set value.

Setting	Command Response	Rigidity	Settling Time	Possibility of Noise
5	Slower	Lower	Longer	Lower
↕	↕	↕	↕	↕
45	Faster	Higher	Shorter	Higher

Prerequisite Position Control Mode

Remark

- Setting Control Level will invalidate the setting of **Control gain set** (No.113.0).
- The specified values of **Control Gain 1** (No.115.0) and **Control Gain 2** (No.116.0) vary depending on **Inertia conditions** (No.113.1).

Related To No.113.0, No.113.1, No.115.0, No.116.0

☞ 7 **Tuning**

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

5. Parameters

No. 115.0	Tuning: Position control mode - Control gain 1	Range	Default	Characteristics
		5 to 1,000	50 [rad/s]	PLS TUNE 0 100 – 2 BYTE IN POS
Function Use	Set Control Gain 1 for Position Control Mode. Increasing this parameter value reduces position deviations after the command becomes zero. Increase it when the position deviation convergence at the time of settling is not good. Set a value smaller than the value of **Control Gain 2** (No.116.0).			
Prerequisite	Position Control Mode			
Remark	· Making a change to any of the following will also change other tuning parameters (such as **Control Gain 2**) to the prearranged parameter set all at once. - **Control Gain Set** (No.113.0) - **Inertia conditions** (No.113.1) - **Control Level** (No.114.0) · To reduce the position deviation of the command being input, raise **Control Gain 2** (No.116.0).			
Related To	No.113.0, No.113.1, No.114.0, No.116.0, No.117.0			

☞ 7 Tuning

No. 116.0	Tuning: Position control mode - Control gain 2	Range	Default	Characteristics
		80 to 5,000	200 [rad/s]	PLS TUNE 0 100 – 2 BYTE IN POS
Function Use	Set Control Gain 2 for Position Control Mode. Increasing this parameter value decreases the position deviation during command input. Increasing the parameter value provides faster command response; however, too large a value may result in noise. Set a value larger than the value of **Control Gain 1** (No.115.0). ■ Noise Solutions ① Use **Torque command filter: Notch filter** (such as No.160.1) ② Lower **Integral Gain** (No.119.0) If the above does not work, decrease the **Control Gain 2**.			
Prerequisite	Position Control Mode			
Remark	· Making a change to any of the following will also change other tuning parameters (such as **Control Gain 1**) to the prearranged parameter set all at once. - **Control Gain Set** (No.113.0) - **Inertia conditions** (No.113.1) - **Control Level** (No.114.0) · To reduce position deviations after the command becomes zero, increase the value of **Control Gain 1** (No.115.0).			
Related To	No.113.0, No.113.1, No.114.0, No.115.0, No.118.0			

☞ 7 Tuning

No. 117.0	Tuning: Position control mode - Gain FF compensation 1	Range	Default	Characteristics
		0 to 15,000	10,000 [0.01%]	PLS TUNE 0 100 – 2 BYTE IN POS
Function Use	Set the Field Forward Compensation Rate (speed) with respect to Control Gain 1 (No.115.0) for Position Control Mode. Using this parameter is effective to shorten the settling time. Adjust this item after setting the following: Inertia ratio (No.102.0), Control gain set (No.113.0), Control level (No.114.0), Control gain 1 (No.115.0), Control gain 2 (No.116.0) Too high a value of this parameter will result in overshooting, and too low in undershooting. Set relatively a moderate value.			
Prerequisite	Position Control Mode			
Related To	No.113.0, No.115.0, No118.0			

☞ 7 Tuning

No. 118.0	Tuning: Position control mode - Gain FF compensation 2	Range	Default	Characteristics
		0 to 15,000	0 [0.01%]	PLS TUNE 0 100 – 2 BYTE IN POS
Function Use	Set Field Forward Compensation Rate (Torque) with respect to [Control Gain 2 (No.116.0)] for Position Control Mode. Using this item will reduce position deviations during operation. Setting this item to around 10,000 will make the position deviations during operation almost zero. Raise the value of this item only after reducing the position deviation, by using **Gain FF Compensation 1** (No.117.0) at settling. ■ Noise Solutions Adjusting **Filter 4: Smoothing 2- Moving average counter** (No.81.0) may reduce the noise.			
Prerequisite	Position Control Mode			
Related To	No.113.0, No.116.0, No.117.0			

☞ 7 Tuning

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

No. 119.0	Tuning: Position control mode - Integral gain	Range	Default	Characteristics
		45 to 5,000	160 [rad/s]	PLS TUNE 0 100 – 2 BYTE IN POS

Function Use	Set the Integral Gain for <u>Position Control mode</u>. Increasing the value of Integral Gain will improve the convergence (interfered by friction or load fluctuation) at the time of settling, and reduce position deviations. This will result in rigid and sensitive motions. ■ Noise Solutions ① Use **Torque command filter: Notch filter** (such as No.160.1). ② Decrease the value of **Integral Gain**
Prerequisite	Position Control Mode
Remark	This parameter will reset to the default if **Inertia conditions** (No.113.1) or **Control Gain Set** (No.113.0) is changed.
Related To	No.113.0

☞ 7 **Tuning**

No. 120.0	Tuning: Control gain set - Automatic switch	Settings	Default	Characteristics
		0, 1	0	PLS TUNE ON OFF – 2 BYTE IN POS

Function Use

Enable/Disable Auto Tuning for Control Gain Set

Settings	Selection
0	Disable
1	Enable

Prerequisite	Position Control Mode
Remark	Only Quick Tuning Mode with the Setup Panel. This parameter is not displayed on the "Servo Studio".
Related To	No.106.0, No.120.1

No. 120.1	Tuning: Control gain set - Upper bound	Range	Default	Characteristics
		5 to 45	15 [-]	PLS TUNE 0 100 – 2 BYTE IN POS

Function Use	Set the upper bound of Control Gain Set in Auto Tuning of Control Gain Set.
Prerequisite	Position Control Mode
Related To	No.106.0, No.120.0

No. 121.0	Tuning: Control gain set - Tuning constant	Range	Default	Characteristics
		1 to 200	24 [-]	PLS TUNE 0 100 - 2 BYTE IN POS

Function Use

This parameter is used for Quick Tuning. Usually the default value is used.

It is a constant of proportionality to calculate (**Control Gain 1** + **Control Gain 2**) based on the Inertia ratio setting value in their inverse proportionality.
Set it to a small value only if Quick Tuning has caused vibration in an extremely poor rigidity equipment.

Prerequisite

Position Control Mode
Tuning: Control gain set - Automatic switch (No.120.0): 1 (Enable)

Remark

This parameter is not displayed on the Setup Panel.

Related To

No.120.0

No. 129.0	Tuning: Velocity control mode - Control gain set	Range	Default	Characteristics
		1 to 46	15 [-]	A VEL TUNE 0 100 - 2 BYTE IN VEL

Function Use

Set the Control Gain Set for Velocity Control Mode.
With this, Control gain 1 (No.131.0) and Integral gain (No.133.0) will be set to the default together.

■ Noise Solutions
① Use **Torque command filter: Notch filter** (such as No.160.1)
② Decrease **Integral gain** (No.133.0)

If the above does not work, lower the Control Grain Set.

Setting	Command Response	Rigidity	Setting Time	Possibility of Noise
1	Slower	Lower	Longer	Lower
↕	↕	↕	↕	↕
46	Faster	Higher	Shorter	Higher

Prerequisite

Velocity Control Mode

Remark

- Too large a value may result in noise.
- If **Torque command filter: Low-pass filter constant** (No.162.0) is set to 1 (auto setting ON), **Torque command filter: Low-pass filter auto setting** (No.160.2) will be included in the gain set.

Related To

No.131.0, No.132.0, No.133.0, No.162.0

☞ 7 Tuning

No. 130.0	Tuning: Velocity control mode - Control level	Range	Default	Characteristics
		1 to 46	15 [-]	VEL TUNE 0 100 - 2 BYTE IN VEL

Function Use

Specify the Control Level for Velocity Control Mode.

Set **Control Gain 1** (No.131.0) to the preset value which was prepared every established each control level.

■ Noise Solutions

① Use **Torque command filter: Notch filter** (such as No.160.1).

② Decrease **Integral Gain** (No.133.0).

If any of the above does not work, then lower the **Control Level**.

Setting	Command Response	Rigidity	Settling Time	Possibility of Noise
1	Slower	Lower	Longer	Lower
↕	↕	↕	↕	↕
46	Faster	Higher	Shorter	Higher

Prerequisite Velocity Control Mode

Remark Setting Control Level will invalidate the setting of **Control gain set** (No.129.0).

Related To No.129.0, No.131.0, No.133.0, No.162.0

☞ 7 Tuning

No. 131.0	Tuning: Velocity control mode - Control gain 1	Range	Default	Characteristics
		100 to 6,000	399 [rad/s]	VEL TUNE 0 100 - 2 BYTE IN VEL

Function Use

Set Control Gain 1 for Velocity Control Mode.

The larger this parameter is, the smaller the speed deviation of the command being input becomes. Increasing this parameter value provides faster command response; however, too large a value may result in noise.

■ Noise Solutions

① Use **Torque command filter: Notch filter** (such as No.160.1).

② Decrease **Integral Gain** (No.133.0).

If any of the above does not work, lower the **Control Gain 1**.

Prerequisite Velocity Control Mode

Remark Making a change to any of the following will also change other tuning parameters (such as Gain FF Compensation 1) to the prearranged parameter set all at once.

- **Control gain set** (No.129.0)
- **Control level** (No.130.0)

Related To No.129.0, No.130.0, No.132.0

☞ 7 Tuning

No. 132.0	Tuning: Velocity control mode - Gain FF compensation 1	Range	Default	Characteristics
		0 to 15,000	0 [0.01%]	VEL TUNE 0 100 – 2 BYTE IN VEL

Function Use	Set Field Forward Compensation Rate with respect to Control Gain 1 for Velocity Control Mode. Increase the value of this parameter to provide faster command response. In the event of noise, decrease the setting value a little.
Prerequisite	Velocity Control Mode
Related To	No.129.0, No.130.0, No.131.0, No.133.0, No.162.0

☞ 7 Tuning

No. 133.0	Tuning: Velocity control mode - Integral gain	Range	Default	Characteristics
		45 to 5,000	300 [rad/s]	VEL TUNE 0 100 – 2 BYTE IN VEL

Function Use	Set the Integral Gain for Velocity Control Mode. Increase the value of Integral Gain to improve the convergence (interfered by friction or load fluctuation) at the time of settling, and reduce position deviations. This will result in rigid and sensitive motions. ■ Noise Solutions ① Use **Torque command filter: Notch filter** (such as No.160.1). ② Decrease the value of **Integral Gain**.
Prerequisite	Velocity Control Mode
Remark	This parameter will reset to the prearranged value if Inertia conditions or **Control Gain Set** is changed.
Related To	No.129.0, No.130.0, No.131.0, No.132.0, No.162.0

☞ 7 Tuning

No. 144.0	Torque command limit: Switch	Settings	Default	Characteristics
		0, 1	0	COMM LIMIT ON OFF – 2 BYTE

Function Use	Enable/Disable Torque Command Limit

Settings	Selection	Error Detection	
		Position deviation: No.65.0 Speed deviation : No.65.1	Error Detection Value: No.87.0, No.90.0 Delay time : No.89.0, No.91.0
0	Disable	-	-
1	Enable	0 (Disable)	-
		1 (Enable)	Select an appropriate value.

If you are to select 1 for this parameter, configure the above settings so that Position deviation error (Alarm No.6) and Speed deviation error (Alarm No.5) will be avoided.

Related To	No.65.0, No.65.1, No.87.0, No.89.0, No.90.0, No.91.0

No. 144.1	Torque command limit: **Torque limit output**	Settings	Default	Characteristics
		0 to 2	0	COMM LIMIT A B - 2 BYTE

Function Use

Select one of the condition sets to output that the motor is in a "torque limiting state".

T-LIMIT (Pin No.17) of I/O connector will output the torque limiting state, when, in each row in the table below, 1) any of the parameters marked ○ is set with a valid value, or 2) the one marked with △ is not configured.

Settings	Torque command limit: Value 1 No.147.0	Torque command limit: Value 2 No.148.0	Motor Max output Torque value	Homing Torque command limit value No.656.0	Speed Limit No.152.0
0	○	○	○	○	△
1	○	○	-	-	-
2	-	○	-	-	-

Prerequisite	Torque command limit switch (No.144.0) = 1 (Enable)
Related To	No.144.0, No.147.0, No.148.0, No.152.0, No.656.0

No.	Name	Range	Default	Characteristics
No. 147.0	Torque command limit: **Value 1**	0 to 65,535	(See below)	COMM LIMIT 0 100 - 2 BYTE
No. 148.0	Torque command limit: **Value 2**	0 to 65,535	2,000 [0.1%]	

Function Use

Set a torque command limit value as% of the rated torque (100%).

Two torque command limits can be set with Value 1 and 2.

- When TLSEL1 (Pin No.11) of the I/O connector is open, Value 1 (No.147.0) is applied. When closed, Value 2 (No.148.0) will be applied.
- The setting of 3,000 or above indicates 300% of the max rated torque.
- If the parameter is set to above 1,000, an overload error will occur in the specified time, depending on the overload characteristic.
- Under some operating conditions, overcurrent error may occur. If this happens, set the upper bound to 2,400.

■ No.147.0 Default

Each motor series have their own default values.

Motor Capacity	Default
50 W, 100 W	3,500 [0.1%]
200 W to 2 kW	3,000 [0.1%]

Prerequisite	Torque command limit switch (No.144.0) = 1 (Enable)
Related To	No.144.0, No.144.1

COMM	Common	PLS	Position Control Pulse Train Command	POS	Position Control Internal Command
VEL	Velocity Control Analog Command	VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

5. Parameters

		Range	Default	Characteristics
No. 151.0	Deceleration stop: Torque command limit	0 to 65,535	2,400 [0.1%]	COMM STOP 0 100 - 2 BYTE

Function Use

If [Deceleration stop: Method (when the servo is off) (No.224.0)] = 2 (quick stop), set the value of torque command limit at the time of a quick stop as a ratio to the rated torque (100%).

- The setting of 3,000 or above results in 300% of the max torque of each motor.
- If the parameter is set to above 1,000, an overload error will occur in the given time, depending on the overload characteristic.
- Under some operating conditions, overcurrent error may occur.
  If this happens, set the upper bound to the range with 2,400.

Prerequisite	Deceleration stop: Method (upon servo is off) (No.224.0) = 2 (Quick stop)
Related To	No.224.0

		Range	Default	Characteristics
No. 152.0	Analog torque: Speed Limit	0 to 10,000	Maximum rotational speed of motor [r/min]	TRQ CTRL 0 100 - 2 BYTE

Function Use

Set the speed limit for Analog Torque Mode.

The default value of this parameter equals to the value of Maximum rotational speed of motor in the table below.

Motor Capacity	Maximum rotational speed of motor [r/min]
50 W to 750 W	6,000
1 kW to 2 kW	3,000

Prerequisite	Torque Control Mode

		Settings	Default	Characteristics
No. 160.0	Torque command filter: Low-pass filter - Switch	0, 1	1	COMM SUPP ON OFF - 2 BYTE

Function Use

Enable/Disable Low-pass filter.

This filter is a first-order IIR filter.

Settings	First-order IIR filter
0	Disable
1	Enable

Related To	No.113.0, No.160.2, No.162.0

☞ 7 Tuning

		Settings	Default	Characteristics
No. 160.1	Torque command filter: Notch filter - Switch	0, 1	0	COMM SUPP ON OFF - 2 BYTE

Function Use

Enable/Disable Notch filter.

Settings	Notch filter
0	Disable
1	Enable

Related To	No.168.0, No.169.0, No.170.0

☞ 7 Tuning

No. 160.2	Torque command filter: Low-pass filter - Auto setting	Settings	Default	Characteristics
		0, 1	0	COMM SUPP ON OFF - 2 BYTE

Function Use

Enable/Disable the automatic configuration of [Torque command filter: Low-pass filter time constant (No.162.0)] according to the settings of the control gain sets; Position Control Mode (No.113.0) and Velocity Control Mode (No.129.0).

Settings	Auto setting
0	Auto setting OFF
1	Auto setting ON

Prerequisite Torque command filter: Low-pass filter switch (No.160.0) = 1 (Enable)

Related To No.113.0, No.129.0, No.160.0, No.162.0

☞ 7 Tuning

No. 160.3	Torque command filter: Notch filter 2 - Switch	Settings	Default	Characteristics
		0, 1	0	COMM SUPP ON OFF - 2 BYTE

Function Use

Enable/Disable Torque command Notch filter 2

Settings	Torque command- Notch filter 2
0	Disable
1	Enable

Related To No.171.0, No.172.0, No.173.0

☞ 7 Tuning

No. 162.0	Torque command filter: Low-pass filter - Time constant	Range	Default	Characteristics
		0 to 65,535	(See below) [0.01 ms]	COMM SUPP 0 100 - 2 BYTE

Function Use

Set the primary IIR filter time constant of [Torque command filter: Low-pass filter switch (No.160.0)] = 1 (Enable)

Condition for Time Constant:

$$\frac{(0.1 \text{ to } 0.2)}{\max((\omega 1+\omega 2), \omega_q)} \text{ [s] or below}$$

■ Default

Each motor series have their own default values.

Motor Capacity	Default [0.01 ms]
50 W to 750 W	0
1 kW to 2 kW	10

Prerequisite Torque command filter: Low-pass filter switch (No.160.0) = 1 (Enable)

Remark Example: Calculating in time unit and converting to frequency
20 [0.01 ms/rad] → 5,000 rad/s (equivalent to 796 Hz)

Related To No.113.0, No.160.0, No.160.2

☞ 7 Tuning

5. Parameters

<table>
<tr><td rowspan="2">No. 168.0</td><td rowspan="2">Torque command filter:
Notch filter - Frequency</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>0 to 2,500</td><td>2,500
[Hz]</td><td>COMM SUPP 0 100 – 2 BYTE</td></tr>
<tr><td>Function
Use</td><td colspan="4">Set the notch frequency for the Torque command filter - notch filter.

This item is measured with "Servo Studio".</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Torque command filter: Notch filter switch (No.160.1) = 1 (Enable)</td></tr>
<tr><td>Related To</td><td colspan="4">No.160.1, No.169.0, No.170.0</td></tr>
</table>

☞ 7 Tuning

<table>
<tr><td rowspan="2">No. 169.0</td><td rowspan="2">Torque command filter:
Notch filter - Width</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>1 to 16</td><td>8</td><td>COMM SUPP 0 100 – 2 BYTE</td></tr>
<tr><td>Function
Use</td><td colspan="4">Set the notch width of torque command notch filter.

In the default setting of this parameter, notch width=notch frequency (a factor of x1).
The larger this item is, the larger the notch width is.
In the case of multiple notch frequencies, this item increases the notch width.
<table>
<tr><th>Setting</th><th>Factor</th><th>Notch Width</th></tr>
<tr><td>16</td><td>x2</td><td>Large</td></tr>
<tr><td>12</td><td>x1.5</td><td>↕</td></tr>
<tr><td>8</td><td>x1</td><td></td></tr>
<tr><td>4</td><td>x0.5</td><td>Small</td></tr>
</table>
</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Torque command filter: Notch filter switch (No.160.1) = 1 (Enable)</td></tr>
<tr><td>Related To</td><td colspan="4">No.160.1, No.168.0, No.170.0</td></tr>
</table>

☞ 7 Tuning

<table>
<tr><td rowspan="2">No. 170.0</td><td rowspan="2">Torque command filter:
Notch filter - Depth</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>0 to 256</td><td>0
[-]</td><td>COMM SUPP 0 100 – 2 BYTE</td></tr>
<tr><td>Function
Use</td><td colspan="4">Set the depth at the notch frequency of Torque command Notch filter.
<table>
<tr><th>Setting</th><th>Notch Depth</th></tr>
<tr><td>0</td><td>Complete shutoff of notch frequency input</td></tr>
<tr><td>↕</td><td>↕</td></tr>
<tr><td>256</td><td>100% pass-through</td></tr>
</table>
· The larger this item is, the shallower the notch depth is.
· If the noise cannot be eliminated by setting a notch filter, increase the setting gradually (e.g., 50, 100, 150 and so on), which decreases the notch depth.</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Torque command filter: Notch filter switch (No.160.1) = 1 (Enable)</td></tr>
<tr><td>Related To</td><td colspan="4">No.160.1, No.168.0, No.169.0</td></tr>
</table>

☞ 7 Tuning

No. 171.0	Torque command filter: Notch filter 2 - Frequency	Range	Default	Characteristics
		0 to 2,500	2,500 [Hz]	COMM SUPP 0 100 – 2 BYTE

Function Use

Set the notch frequency of torque command notch filter 2.

Prerequisite	Torque command filter: Notch filter 2 switch (No.160.3) = 1 (Enable)
Related To	No.160.3, No.172.0, No.173.0

☞ 7 Tuning

No. 172.0	Torque command filter: Notch filter 2 - Width	Range	Default	Characteristics
		1 to 16	8	COMM SUPP 0 100 – 2 BYTE

Function Use

Set the notch width of torque command notch filter 2.

In the default setting of this parameter, notch width=notch frequency (a factor of x1).
The larger this item is, the larger the notch width is.
In the case of multiple notch frequencies, this item increases the notch width.

Setting	Factor	Notch Width
16	x2	Large
12	x1.5	↕
8	x1	
4	x0.5	Small

Prerequisite	Torque command filter: Notch filter 2 switch (No.160.3) = 1 (Enable)
Related To	No.160.3, No.171.0, No.173.0

☞ 7 Tuning

No. 173.0	Torque command filter: Notch filter 2 - Depth	Range	Default	Characteristics
		0 to 256	0 [-]	COMM SUPP 0 100 – 2 BYTE

Function Use

Set the depth at the notch frequency of Torque command Notch filter 2.

Setting	Notch Depth
0	0% pass-through
↕	↕
256	100% pass-through

- The larger this item is, the shallower the notch depth is.
- If the noise cannot be eliminated by setting a notch filter, increase the setting gradually (e.g., 50, 100, 150 and so on), which decreases the notch depth.

Prerequisite	Torque command filter: Notch filter switch (No.160.1) = 1 (Enable)
Related To	No.160.3, No.171.0, No.172.0

☞ 7 Tuning

		Settings	Default	Characteristics
No. 193.0	Tuning: Current control gain	0, 1	0	COMM TUNE AB ⏻ 2 BYTE

Function Use

This parameter is used to adjust the gain level of the current control component.

Select 1 to reduce noise generated at the time of servo-on stop.

Settings	Level	Noise	Response
0	Standard	More	Faster
1	Low	Less	Slower

Remark

- If you changed the setting, perform tuning again.
- Selecting 1 hurts response; Adjust within the acceptable range.

☞ 8 Troubleshooting

		Settings	Default	Characteristics
No. 224.0	Deceleration stop: Method (upon Servo Off)	0 to 3	1	COMM STOP AB - 2 BYTE

Function Use

Specify the deceleration stop method in case of servo off while motor is rotating.

Settings	Description
0	F RUN Free run
1	S STOP Short brake
2	P STOP Quick stop
3	D STOP Dynamic brake

Related To No.151.0, No.224.1, No.224.3, No.225.2, No.226.0, No.227.0, No.229.0, No.232.1, No.232.2, No.236.0, No.239.0

		Settings	Default	Characteristics
No. 224.1	Deceleration stop: Release conditions	0, 1	1	COMM STOP AB - 2 BYTE

Function Use

This parameter indicates conditions to cancel a deceleration stop, if an alarm occurs or the Servo ON signal turns OFF.
It is used for a motor which is slowing down as specified with Deceleration stop: Method (upon Servo Off) (No.224.0).

Settings	Deceleration stop Operating time (No.226.0)	Deceleration stop Rotational speed to cancel (No.227.0)
0	○	-
1	○	○

Prerequisite Deceleration stop Method (upon servo off) (No.224.0) = 1 (Short brake) or 2 (Quick stop)

Related To No.224.0, No.226.0, No.227.0

No. 224.2	Deceleration stop: Switch (upon control power failure)	Settings	Default	Characteristics
		0, 1	1	COMM STOP ON OFF - 2 BYTE

Function Use

Enable/Disable deceleration stop when an alarm of voltage drop error in the control power supply occurs.

Settings	Deceleration stop
0	Disable
1	Enable

Related To No.228.0

No. 224.3	Deceleration stop: DBRK output after stopping (upon Servo Off)	Settings	Default	Characteristics
		0, 1	0	COMM STOP A B - 2 BYTE

Function Use

Select Stop State when the servo is off

Settings	Description
0	F RUN Free run
1	D STOP Dynamic brake

Prerequisite No.224.0, No.232.1

No. 225.0	Emergency stop: Warning output switch	Settings	Default	Characteristics
		0, 1	0	COMM STOP A B - 2 BYTE

Function Use

Set whether a warning to be output or not in case of E-stop input.

Settings	Warning output
0	Disable
1	Enable

No. 225.1	Emergency stop: Warning output timing	Settings	Default	Characteristics
		0, 1	0	COMM STOP A B - 2 BYTE

Function Use

Specify when to output warning in case of E-stop input.

Settings	Warning output timing
0	After the motor makes a deceleration stop
1	Immediately after the warning occurs

Prerequisite Emergency stop: Warning output switch (No.225.0) = 1 (Output warning)

No. 225.2	Quick stop: Smoothing filter - Switch	Settings	Default	Characteristics
		0, 1	0	COMM STOP ON OFF - 2 BYTE

Function Use

Enable/Disable the Velocity Command smoothing filter at the time of a quick stop.

This filter suppresses vibration caused by drastic velocity change.

Settings	Velocity Command smoothing filter
0	Disable
1	Enable

Prerequisite No.229.0

No. 226.0	Deceleration stop: Operating time	Range	Default	Characteristics
		0 to 16,383	(See below)	COMM STOP 0 100 – 2 BYTE

Function Use

This parameter indicates deceleration stop operation time in case an alarm occurs or the Servo ON signal turns OFF. It is used for a motor which is slowing down as specified with the deceleration stop method (No.224.0).

■ Default

Motor Capacity	Default	Units	Converted to Time
50 W to 750 W	313	160 µs	50 ms
1 kW to 2 kW	250	200 µs	

Prerequisite	Deceleration stop Method (upon servo off) (No.224.0) = 1 (Short brake) or 2 (Quick stop)
Related To	No.224.0, No.224.1, No.227.0

No. 227.0	Deceleration stop: Cancellation speed	Range	Default	Characteristics
		0 to 32,767	(See below)	COMM STOP 0 100 – 2 BYTE

Function Use

This parameter indicates rotational speed to cancel deceleration-stop in case an alarm occurs or the Servo ON signal turns OFF.

It is used for a motor which is slowing down as specified with the deceleration stop method (No.224.0).

■ Default

Motor Capacity	Default	Units [encoder pulse]	Conversion to Rotational Speed
50 W to 750 W	17	pulse/160 µs	50 r/min
1 kW to 2 kW	22	pulse/200 µs	

Prerequisite	Deceleration stop: Method (No.224.0) = 1 (Short brake) or 2 (Quick stop) & Deceleration stop: Release conditions (No.224.1) = 1
Related To	No.224.0, No.224.1, No.226.0

No. 228.0	Deceleration stop: Operating time (upon control power error)	Range	Default	Characteristics
		0 to 16,383	(See below)	COMM STOP 0 100 – 2 BYTE

Function Use

Set Deceleration stop time in the event of the alarm output due to a control power error.

■ Default

Motor Capacity	Default	Units	Converted to Time
50 W to 750 W	62	160 µs	10 ms
1 kW to 2kW	52	200 µs	

Prerequisite	Deceleration stop: Switch (upon control power failure) (No.224.2) = 1 (Enable)
Related To	No.224.2

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

No. 229.0	Quick stop: Smoothing filter - Moving average counter	Range	Default	Characteristics
		1 to 1,000	25 [counts]	COMM STOP 0 100 – 2 BYTE

Function Use

This item indicates moving average count of speed command smoothing filter while the motor is making a quick stop.

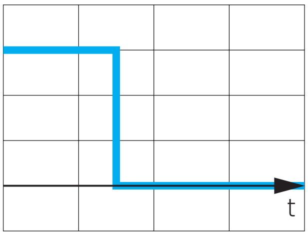
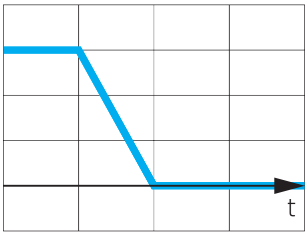
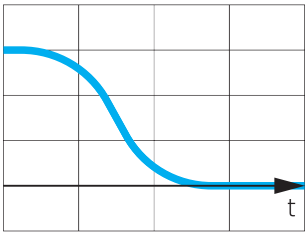
The lager the parameter value, the smoother acceleration/deceleration is and the slower the response.

Motor Capacity	Delay Time Calculation Formula	
50 W to 750 W	0.16 ms	× Moving average count = delay time
1 kW to 2 kW	0.2 ms	

The positioning will take as long as the delay time specified above, set this item within the range acceptable to the equipment.

Prerequisite	Quick stop: Smoothing filter switch (No.225.2) = 1 (Enable)
Related To	No.225.2, No.239.0

■ Waveforms for each combination of enable/disable Deceleration Stop and Smoothing Filter.

Deceleration Stop	Disable	Enable	Enable
Smoothing Filter	Disable	Disable	Enable
Command waveform			

No. 232.1	Deceleration stop: Status during free-run	Settings	Default	Characteristics
		0, 1	0	COMM STOP A B – 2 BYTE

Function Use

Select on or off for deceleration stop status during free-run.

Settings	Deceleration stop status
0	OFF (not consider as deceleration stop) As soon as the servo status becomes OFF, the brake release (MBRK) becomes open and the brake becomes engaged. With the configuration of No.224.3 (upon servo off) and No.233.3 (upon alarm on), the dynamic brake release signal (DBRK) immediately turns off and the dynamic brake becomes engaged.
1	ON (consider as deceleration stop) When the servo state becomes OFF, the deceleration stop status becomes ON. MBRK remains closed and the brake remains disengaged until the deceleration stop status becomes OFF. With the configuration of No.224.3 (upon servo off) and No.233.3 (upon alarm on), the dynamic brake release (DBRK) will remain ON and the dynamic braking will remain disengaged until the deceleration stop status becomes OFF.

☞ 3 **Preparation** Timing Diagrams

		Settings	Default	Characteristics
No. 232.2	Quick stop: Short brake operation after a stop	0, 1	0	COMM STOP A B - 2 BYTE

Function Use

Enable/Disable short braking after a quick stop.

Settings	Short braking
0	Enable
1	Disable

Prerequisite Deceleration stop: Method (when servo off) (No.224.0) = 2 (Quick stop)

		Settings	Default	Characteristics
No. 232.3	Deceleration stop: Brake engagement - Timing	0, 1	0	COMM STOP A B - 2 BYTE

Function Use

Set the timing for the brake to be engaged in a brake-equipped motor.

(That is, set the timing to open MBRK (Brake Release))

Settings	Brake engagement timing
0	When the deceleration stop status is off, or the motor rotation speed becomes lower than the setting of **Deceleration stop: Cancellation speed** (No.227.0)
1	When the deceleration stop status is off, or the motor rotation speed becomes lower than the setting of **Deceleration stop: Brake engagement - Rotation speed** (235.0), or the braking time reaches the value of **Deceleration stop: Brake engagement - Delay time** (No.234.0).

Related To No.234.0, No.235.0

☞ 3 **Preparation** Timing Diagrams

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

No. 233.0	Deceleration Stop: Method (when alarm is on)	Settings	Default	Characteristics
		0 to 7	2	COMM STOP A B - 2 BYTE

Function Use

Select a deceleration stop method in case of alarm while motor is in motion.

Each alarm group uses a different stop method. (*1)

Settings	Stop method		
	Group ①	Group ② (*2), ③ , ④	Group ⑤
0	F RUN	F RUN	F RUN
1	D STOP	D STOP	D STOP
2	F RUN	S STOP	S STOP
3	D STOP	S STOP	S STOP
4	F RUN	F RUN	P STOP
5	D STOP	D STOP	P STOP
6	F RUN	S STOP	P STOP
7	D STOP	S STOP	P STOP

*1) Alarms are categorized into five groups.
*2) When **Deceleration stop: Method** (No.224.0) = 0 (Disable), the motor will be stopped by the group ① method.
After the amount of time specified by **Deceleration stop: Operating time** (No.228.0) elapses, the motor will be stopped by the group ① method.

Alarm No.	Alarm Name and Group		Alarm No.	Alarm Name and Group	
0	System error	④	16	Encoder error (response data)	③
1	EEPROM data error	④	17	Encoder error (no response)	③
2	Product code error	④	18	Encoder error (circuitry)	③
4	Overspeed error	⑤	19	Encoder error (communication)	③
5	Speed deviation error	⑤	20	Encoder error (multi-turn data)	③
6	Position deviation error	⑤	21	Encoder error (voltage drop)	③
7	Overload error	④	22	Voltage error (control power)	②
8	Command overspeed error	⑤	23	Switch circuitry error	①
9	Encoder pulse output frequency error	④	24	Overcurrent error	①
10	Positioning command overflow error /Homing failure	⑤	25	Inverter error 1	①
11	Encoder error (multi-turn counter overflow)	⑤	26	Inverter error 2	①
12	Overheat error	⑤	27	Current sensor error	①
14	Overvoltage error	①	28	Encoder error (overheat)	⑤
15	Power supply error (primary circuit power)	⑤	29	Voltage drop (inside the amplifier)	①

F RUN Free run	P STOP Quick stop	S STOP Short brake	D STOP Dynamic brake

No. 233.3	Deceleration Stop: DBRK output after stopping (when alarm is on)	Settings	Default	Characteristics
		0, 1	0	COMM CTRL A B – 2 BYTE

Function Use

Select the type of idling in case of alarm.

Settings	Idle State
0	F RUN Free run
1	D STOP Dynamic brake

No. 234.0	Deceleration Stop: Brake engagement - Delay time	Range	Default	Characteristics
		0 to 16,383	(See below)	COMM STOP 0 100 – 2 BYTE

Function Use

Set the delay time between two events: 1) SVON (servo-on) opens while the motor is in motion or an alarm occurs, and 2) the brake becomes engaged.

Motor Capacity	Default	Units	Converted to Time
50 W to 750 W	0	160 µs	0 ms
1 kW to 2 kW	0	200 µs	

Prerequisite Timing of brake engagement (No.232.3) = 1

No. 235.0	Deceleration Stop: Brake engagement - Rotational speed	Range	Default	Characteristics
		0 to 32,767	(See below)	COMM STOP 0 100 – 2 BYTE

Function Use

Set the motor rotational speed to engage the brake when 1) SVON (servo-on) opens while the motor is in motion or 2) an alarm occurs.

■ Default

Each motor series have their own default values.

Motor Capacity	Default	Units	Converted to rotational speed
50 W to 750 W	17	pulse/160 µs	50 r/min
1 kW to 2 kW	22	pulse/200 µs	

Prerequisite Timing of brake engagement (No.232.3) = 1

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

<table>
<tr><th rowspan="2">No. 236.0</th><th rowspan="2">Quick stop:
Extension Time</th><th>Range</th><th>Default</th><th>Characteristics</th></tr>
<tr><td>0 to 3,125</td><td>(See below)</td><td>COMM STOP 0 100 – 2 BYTE</td></tr>
<tr><td>Function
Use</td><td colspan="4">This item indicates how long the quick stop to be kept after the deceleration stop complete conditions were met.
It is used to compensate the brake response time.
■ Default
It's difference in the unit depending on the motor capacity.
<table>
<tr><th>Motor Capacity</th><th>Default</th><th>Units</th><th>Converting to Time</th></tr>
<tr><td>50 W to 750 W</td><td>0</td><td>160 μs</td><td rowspan="2">0 ms</td></tr>
<tr><td>1 kW to 2 kW</td><td>0</td><td>200 μs</td></tr>
</table>
This parameter is valid only when the Deceleration Stop Method is "quick stop".
This parameter is invalid if the servo turns off while the motor idling.
Use Servo OFF: Delay time (No.237.0) to compensate the brake response time when the servo turns off during motor idling.</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Deceleration stop: Method (No.224.0) = 2 (Quick stop)</td></tr>
<tr><td>Related To</td><td colspan="4">No.224,0, No.233.0, No.237.0</td></tr>
</table>

<table>
<tr><th rowspan="2">No. 237.0</th><th rowspan="2">Servo OFF: Delay time</th><th>Range</th><th>Default</th><th>Characteristics</th></tr>
<tr><td>0 to 3,125</td><td>(See below)</td><td>COMM CTRL 0 100 – 2 BYTE</td></tr>
<tr><td>Function
Use</td><td colspan="4">This parameter indicates the delay time the motor excitation off after the servo-on signal (SVON) turns off.
By adjusting the timing to end motor excitation after the brake is engaged, brake-equipped axes such as vertical axis can be prevented from falling off.
■ Default
It's difference in the unit depending on the motor capacity.
<table>
<tr><th>Motor Capacity</th><th>Default</th><th>Units</th><th>Converting to Time</th></tr>
<tr><td>50 W to 750 W</td><td>0</td><td>160 μs</td><td rowspan="2">0 ms</td></tr>
<tr><td>1 kW to 2 kW</td><td>0</td><td>200 μs</td></tr>
</table></td></tr>
<tr><td>Related To</td><td colspan="4">No.238.0</td></tr>
</table>

<table>
<tr><th rowspan="2">No. 238.0</th><th rowspan="2">Bake release: Delay time</th><th>Range</th><th>Default</th><th>Characteristics</th></tr>
<tr><td>0 to 3,125</td><td>(See below)</td><td>COMM CTRL 0 100 – 2 BYTE</td></tr>
<tr><td>Function
Use</td><td colspan="4">This item indicates the delay time of brake release signal (MBRK) ON after the motor excitement starts.
By adjusting the timing to release the brake after the motion excitement starts, brake-equipped axes such as vertical axis can be prevented from falling off.
■ Default
Each motor series have their own default values.
<table>
<tr><th>Motor Capacity</th><th>Default</th><th>Units</th><th>Converting to Time</th></tr>
<tr><td>50 W to 750 W</td><td>25</td><td>160 μs</td><td rowspan="2">4 ms</td></tr>
<tr><td>1 kW to 2 kW</td><td>20</td><td>200 μs</td></tr>
</table></td></tr>
<tr><td>Related To</td><td colspan="4">No.237.0</td></tr>
</table>

<table>
<tr><th rowspan="2">No. 239.0</th><th rowspan="2">Quick stop:
Deceleration time</th><th>Range</th><th>Default</th><th>Characteristics</th></tr>
<tr><td>0 to 100</td><td>0
[ms]</td><td>COMM STOP 0 100 – 2 BYTE</td></tr>
<tr><td>Function
Use</td><td colspan="4">This item indicates decelerating time after a quick stop.
Set the time-length for speed command to change from 1,000 r/min to 0 r/min.</td></tr>
<tr><td>Related To</td><td colspan="4">No.224.0, No.232.2, No.236.0</td></tr>
</table>

No. 257.0	Absolute system	Settings	Default	Characteristics
		0 to 2	0	COMM MODE AB ⏻ 2BYTE

Function Use

Select either Absolute system or Incremental system.

Settings	System	Multi-rotation counter Overflow detection
0	Incremental	-
1	Absolute	Disable
2	Absolute	Enable

Using this parameter in absolute systems

- Setting "2" (this is the usual setting)
  Exceeding the encoder absolute value range of -4,294,967,296 to 4,294,967,295 (± 32,767 multi-turn data) will result in Alarm No.11 (encoder multi-turn counter overflow).
  If this happens, correct the command such that motions will be kept within the absolute value range.

- Setting "1"
  Use this setting when absolute value of single-turn is needed for continuous turns only in one direction.
  Exceeding the encoder absolute value range will result in a position that is significantly off from the position specified by next command.
  Set Pulse Paired Ratio, so that the single-turn angel can be accurately detected with sufficient resolution even outside of the range.

No. 259.0	Encoder: Overheat detection switch	Settings	Default	Characteristics
		0 to 2	0	COMM ALM AB - 2BYTE

Function Use

Select what to output when overheat of the encoder is detected.

Settings	Output
0	No output
1	Warning output
2	Alarm output

No. 259.1	Encoder: Battery voltage drop detection switch	Settings	Default	Characteristics
		0, 1	0	COMM ALM AB - 2BYTE

Function Use

Select what to output when encoder battery voltage drop is detected.

Settings	Output
0	No output
1	Warning output

No. 267.0	Encoder: Overheat detection - Value	Range	Default	Characteristics
		0 to 127	85 [℃]	COMM ALM 0 100 – 2 BYTE
Function Use	Set the value to detect overheat of the encoder. (for reference only)			
Related To	No.259.0			

No. 268.0	Encoder: Battery voltage drop detection - Value	Range	Default	Characteristics
		0 to 100	24 [0.1 V]	COMM ALM 0 100 – 2 BYTE
Function Use	Set the value to detect voltage drop of the encoder.			
Related To	No.259.0			

No. 272.1	Encoder pulse output: Rotational direction	Settings	Default	Characteristics
		0, 1	0	COMM CTRL A B ⏻ 2 BYTE
Function Use	Set the rotational direction of encoder pulse output. This indicates the direction of counting pulses in ccw rotations.			
Related To	No.276.0, No.278.0			

Settings	In CCW rotation
0	Count down
1	Count up

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

5. Parameters

		Range	Default	Characteristics
No. 276.0	Encoder pulse output: Pulse ratio (Numerator)	1 to 65,535	1,000 [-]	COMM CTRL 0 100 ⏻ 4 BYTE
No. 278.0	Encoder pulse output: Pulse ratio (Denominator)	1 to 65,535	8,000 [-]	

Function Use

Set the encoder pulse output ratio with these two parameters.

Where the pulse count per rotation of host command and the pulse count per rotation of the motor do not agree,

(Numerator) =(single-turn pulse count of host command)/4
(Denominator)=(single-turn pulse count of the motor) /4=32,768

$$\frac{\boxed{276.0}}{\boxed{278.0}} = \frac{\text{host command pulse count per rotation}}{\text{motor pulse count per rotation}} = \frac{\text{host command pulse count per rotation / 4}}{\text{motor pulse count per rotation / 4}}$$

■ Example Settings

Units: [pulse/rev]

A Host Command Pulse count per rotation	B Numerator No.276.0 (A × 1/4)	C Denominator No.278.0
16,384	4,096	32,768 (=131,072 (*) / 4)
10,000	2,500	
4,096	1,024	
4,000	1,000	

*) 131,072 is the pulse count per rotation of the motor.
The setting range of the ratio derived from these two parameters is 1/32,768 to 1.

The default setting values are assumed 16,384 pulses of the host command pulse number per a rotation.

If the Z-phase pulse width is too narrow to be measured accurately by the host controller, decrease this encoder pulse ratio or decrease the number of rotations to increase the pulse width.
PLC normally requires approximately 1 ms pulse width.

$$\text{pulse width [ms]} = 2 \times \frac{60 \times 1{,}000}{\text{number of rotations [r/min]}} \times \frac{1}{\text{the paired-pulse ratio} \times 2^{17}}$$

Remark

- Use these parameters within the max output frequency of 4 Mpps.
- Note that [Encoder output resolution] × [Numerator / Denominator] has to be a multiple of 4.

Related To No.34.0, No.36.0, No.272.1, No.276.0, No.278.0

No. 285.0	Encoder pulse output: Error detection - Frequency upper bound	Range	Default	Characteristics
		25 to 1,125	1,125 [kHz]	COMM ALM 0 100 – 2 BYTE
Function Use	Set up the upper limit of the encoder pulse output frequency. Put specification of the host controller.			
Related To	No.286.0			

No. 286.0	Encoder pulse output: Error detection - Delay time	Range	Default	Characteristics
		0 to 2,000	0 [ms]	COMM ALM 0 100 – 2 BYTE
Function Use	Set the detection delay time of encoder pulse output error.			
Related To	No.285.0			

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

5. Parameters

		Range	Default	Characteristics
No. 288.0	Analog torque: Input filter (Numerator)	0 to 65,535	16,000 [-]	TRQ CTRL 0 100 - 2 BYTE
No. 289.0	Analog torque: Input filter (Denominator)	1 to 65,535	65,535 [-]	

Function Use

Select values such that the low-pass filter constant will suppress the noise component of the Analog Torque Command input.

$$\text{low-pass filter constant} = \frac{\boxed{288.0}}{\boxed{289.0}}$$

Setting	Noise Resistance	Command Response
Smaller	Stronger	Slower
Larger	Weaker	Faster

Prerequisite	Analog torque: Input filter switch (No.302.1) = 1 (Enable)
Remark	The ratio of No.288.0 (Numerator) to No.289.0 (Denominator) must be below 1. Filtering will not take effect if the ratio is 1.
Related To	No.302.1

		Range	Default	Characteristics
No. 290.0	Analog torque: Input gain (Numerator)	0 to 65,535	(See below) [-]	TRQ CTRL 0 100 - 2 BYTE
No. 291.0	Analog torque: Input gain (Denominator)	1 to 65,535		

Function Use

Set the gain of analog torque command input.

With these two parameters, you can adjust the gain of the host controller.
The motor torque is max when (Numerator)/(Denominator)=1 and analog command voltage (± 10 V) input.

$$\text{command Input Gain} = \frac{\boxed{290.0}}{\boxed{291.0}}$$

■ Default

Each motor have their own default values.
The figures in the table below are applicable for both Numerator and Denominator.

Motor Capacity	Default	Motor Capacity	Default
50 W	3,500	750 W	2,900
100 W	3,400	1 kW	3,300
200 W	3,100	1.5 kW	3,200
400 W	3,100	2 kW	3,100

<table>
<tr><td rowspan="2">No. 292.0</td><td rowspan="2">Analog torque:
CCW torque limit (Numerator)</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>0 to 65,535</td><td rowspan="2">(See below)
[-]</td><td rowspan="2">TRQ CTRL 0 100 - 2 BYTE</td></tr>
<tr><td>No. 293.0</td><td>Analog torque:
CCW torque limit (Denominator)</td><td>1 to 65,535</td></tr>
<tr><td>Function
Use</td><td colspan="4">Set the CCW torque limit of analog torque command.
CCW torque limit = Instantaneous maximum torque × 292.0 / 293.0</td></tr>
<tr><td>Related To</td><td colspan="4">No.294.0, No.295.0</td></tr>
</table>

$$\text{CCW torque limit} = \text{Instantaneous maximum torque} \times \frac{\boxed{292.0}}{\boxed{293.0}}$$

<table>
<tr><td rowspan="2">No. 294.0</td><td rowspan="2">Analog torque:
CW torque limit (Numerator)</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>0 to 65,535</td><td rowspan="2">(See below)
[-]</td><td rowspan="2">TRQ CTRL 0 100 - 2 BYTE</td></tr>
<tr><td>No. 295.0</td><td>Analog torque:
CW torque limit (Denominator)</td><td>1 to 65,535</td></tr>
<tr><td>Function
Use</td><td colspan="4">Set the CW torque limit of analog torque command.
CW torque limit = Instantaneous maximum torque 294.0 / 295.0</td></tr>
<tr><td>Related To</td><td colspan="4">No.292.0, No.293.0</td></tr>
</table>

$$\text{CW torque limit} = \text{Instantaneous maximum torque} \frac{\boxed{294.0}}{\boxed{295.0}}$$

■ Default values of parameters No.292.0, No.293.0, No.294.0. and No.295.0

Each motor have their own default values.
The figures in the table below are applicable for both Numerator and Denominator.

Motor Capacity	Default	Motor Capacity	Default
50 W	3,500	750 W	2,900
100 W	3,400	1 kW	3,300
200 W	3,100	1.5 kW	3,200
400 W	3,100	2 kW	3,100

COMM	Common	PLS	Position Control Pulse Train Command	POS	Position Control Internal Command
VEL	Velocity Control Analog Command	VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

5. Parameters

		Range	Default	Characteristics
No. 300.0	Analog torque: Offset value	– 32,768 to +32,767	0 [-]	TRQ CTRL 0 100 – 2 BYTE

Function Use

Set the offset value where [Analog speed command - offset tuning method (No.302.2)] = 1(Manual tuning).
Adjust this parameter such that analog command value = 0% when the amplifier is connected to power for analog command and input voltage is 0 V.

■ Setup Procedure

① Use **Analog torque speed limit** (No.152.0) to set the value of a speed limit to a reasonable rotational speed such as 1,000 r/min.
② Set the analog voltage of the host controller to 0 V.
③ Turn the servo ON.
(If the offset is misaligned, the motor will rotate.)
④ Select a value for the offset observing the torque command value.

Prerequisite	Analog speed command: Offset tuning method (No.302.2) = 1 (Manual tuning)
Remark	Adjust this parameter with the motor alone. Never adjust it while the motor is installed in any equipment.
Related To	No.302.2

		Settings	Default	Characteristics
No. 302.0	Analog torque: Direction of rotation	0, 1	1	TRQ CTRL A B – 2 BYTE

Function Use

Specify the rotational direction of analog torque command input.

Settings	Negative Voltage Input	Positive Voltage Input
0	CCW Rotation	CW Rotation
1	CW Rotation	CCW Rotation

		Settings	Default	Characteristics
No. 302.1	Analog torque: Input filter switch	0, 1	1	TRQ CTRL ON OFF – 2 BYTE

Function Use

Enable/Disable Analog torque command input filter.

Enable if noise is significant in the analog command.

Settings	Input filter switch
0	Disable
1	Enable

No. 302.2	Analog torque: Offset tuning method	Settings	Default	Characteristics
		0, 1	1	TRQ CTRL AB – 2 BYTE

Function Use

Specify the offset tuning method for Analog Velocity command.

Settings	Tuning Method	Description
0	Auto Tuning	Automatically adjust the offset value such that torque command=0% at the input voltage at the time of servo on.
1	Manual Tuning	Manually adjust the offset value such that torque command=0% at 0 V input voltage.

No. 305.0	Voltage Sag Detection: Delay time	Range	Default	Characteristics
		20 to 50,000	80 [ms]	COMM ALM 0 100 – 2 BYTE

Function Use

Set the delay time to voltage sag of the primary circuit power supply.

(**voltage sag**=detect a dip in voltage)

Remark

Detection of a voltage sag will result in Alarm No.15.
Set this parameter suitable to your operating conditions.

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	AB	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

5. Parameters

<table>
<tr><td rowspan="2">No. 357.0</td><td rowspan="2">Position command filter 3:
Notch frequency</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>10 to 2,000</td><td>10
[0.1 Hz]</td><td>PLS SUPP 0 100 ⏻ 2BYTE</td></tr>
<tr><td>Function Use</td><td colspan="4">Set the notch frequency for Position Command Filter 3.</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Position command filter 3: Type (No.82.1) = 2 (Notch filter) or 3 (γ-Notch Filter)</td></tr>
<tr><td>Related To</td><td colspan="4">No.82.1, No.358.0, No.359.0, No.360.0</td></tr>
</table>

☞ 7 Tuning

<table>
<tr><td rowspan="2">No. 358.0</td><td rowspan="2">Position command filter 3:
Notch width</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>128 to 2,048</td><td>512
[-]</td><td>PLS SUPP 0 100 ⏻ 2BYTE</td></tr>
<tr><td>Function Use</td><td colspan="4">Set the width of notch of Position Command Filter3.<table><tr><th>Setting</th><th>Notch Width</th></tr><tr><td>Smaller</td><td>Narrower</td></tr><tr><td>Larger</td><td>Wider</td></tr></table></td></tr>
<tr><td>Prerequisite</td><td colspan="4">Position command filter 3: Type (No.82.1) = 2 (Notch filter)</td></tr>
<tr><td>Related To</td><td colspan="4">No.82.1, No.357.0, No.360.0</td></tr>
</table>

☞ 7 Tuning

<table>
<tr><td rowspan="2">No. 359.0</td><td rowspan="2">Position command filter 3:
High frequency gain</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>50 to 200</td><td>100
[-]</td><td>PLS SUPP 0 100 ⏻ 2BYTE</td></tr>
<tr><td>Function Use</td><td colspan="4">Set the high frequency gain for Position Command Filter3.<table><tr><th>Setting</th><th>Effect</th></tr><tr><td>50</td><td>x0.25</td></tr><tr><td>100</td><td>x1</td></tr><tr><td>200</td><td>x4</td></tr></table>Smaller setting value gives better vibration suppression.
Larger setting value gives faster motion.</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Position command filter 3: Type (No.82.1) = 3 (γ-Notch Filter)</td></tr>
<tr><td>Related To</td><td colspan="4">No.82.1, No.357.0, No.360.0</td></tr>
</table>

☞ 7 Tuning

<table>
<tr><td rowspan="2">No. 360.0</td><td rowspan="2">Position command filter 3:
Notch depth</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>0 to 100</td><td>0
[-]</td><td>PLS SUPP 0 100 ⏻ 2BYTE</td></tr>
<tr><td>Function Use</td><td colspan="4">Set the depth for Position Command Filter 3.<table><tr><th>Setting</th><th>Notch Depth</th></tr><tr><td>0</td><td>Complete shutoff of notch frequency input</td></tr><tr><td>100</td><td>100% pass-through</td></tr></table>Smaller setting value gives deeper filter.
Larger setting value gives shallower filter.</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Position command filter 3: Type (No.82.1) = 2 (Notch filter) or 3 (γ-Notch Filter)</td></tr>
<tr><td>Related To</td><td colspan="4">No.82.1, No.357.0, No.358.0, No.359.0</td></tr>
</table>

☞ 7 Tuning

No. 363.0	Position deviation warning detection: Value	Range	Default	Characteristics
		0 to 2,147,483,647	100 [pulse]	COMM ALM 0 100 – 4 BYTE

Function Use

Set the value to detect position deviation warning.

The position deviation warning will be detected when the position deviation exceeds this parameter value.

Prerequisite Position deviation error detection: Switch (No.65.0) = 2 (Warning output), or 3 (Alarm and Warning output)

Related To No.65.0, No.365.0

No. 365.0	Position deviation warning detection: Delay time	Range	Default	Characteristics
		0 to 65,535	(See below)	COMM ALM 0 100 – 2 BYTE

Function Use

Set the delay time to detect the position deviation warning.

■ Default

Each motor series have their own default values.

Motor Capacity	Default	Units	Converted to Time
50 W to 750 W	250	160 µs	40 ms
1 kW to 2 kW	200	200 µs	

Prerequisite Position deviation error detection: Switch (No.65.0) = 2 (Warning output), or 3 (Alarm and Warning output)

Related To No.65.0, No.363.0

No. 385.0	JOG operation: Acceleration time	Range	Default	Characteristics
		0 to 60,000	1,000 [ms]	COMM CTRL 0 100 – 2 BYTE

Function Use

Set the acceleration time for JOG operation.

This item indicates the amount of time for a speed command to change from 0 r/min to 1,000 r/min. With the default setting, it takes the rotational speed 3,000 ms to reach 3,000 r/min.

Related To JOG operation requires control power supply and the Servo ON signal input from the I/O connector.

No. 386.0	JOG operation: Deceleration time	Range	Default	Characteristics
		0 to 60,000	1,000 [ms]	COMM CTRL 0 100 – 2 BYTE

Function Use

Set the deceleration time for JOG operation.

This item indicates the amount of time for a speed command to change from 1,000 r/min to 0 r/min. With the default setting, when the motor is rotating at 3,000 r/min, it takes 3,000 ms to stop.

Remark JOG operation requires control power supply and the Servo ON signal input from the I/O connector.

No. 387.0	JOG operation: Target speed	Range	Default	Characteristics
		0 to Maximum rotational speed of motor	300 [r/min]	COMM CTRL 0 100 – 2 BYTE

Function Use

Set the target speed for JOG operation.

■ Maximum rotational speed of motor

Motor Capacity	Maximum rotational speed of motor [r/min]
50 W to 750 W	6,000
1 kW to 2 kW	3,000

Remark JOG operation requires control power supply and the Servo ON signal input from the I/O connector.

<table>
<tr><td rowspan="2">No. 388.0</td><td rowspan="2">Internal velocity:
Command method</td><td>Settings</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>0, 1</td><td>0</td><td>IN VEL, MODE, A B – 2 BYTE</td></tr>
<tr><td>Function Use</td><td colspan="4">Select the type of Internal Velocity Command.<table><tr><th>Settings</th><th>Method</th></tr><tr><td>0</td><td>Zero command</td></tr><tr><td>1</td><td>Trapezoid speed command (8 settings)</td></tr></table></td></tr>
<tr><td>Prerequisite</td><td colspan="4">The following two settings are necessary.
・Control Mode (No.2.0) = 1 (Velocity control mode)
・Command Mode (No.3.0) = 3 (Internal command mode)</td></tr>
<tr><td>Related To</td><td colspan="4">No.2.0, No.3.0, No.390.0, No.391.0, No.392.0 to 399.0</td></tr>
</table>

<table>
<tr><td rowspan="2">No. 390.0</td><td rowspan="2">Internal velocity:
Acceleration time</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>0 to 60,000</td><td>1,000
[ms]</td><td>IN VEL, CTRL, 0 100 – 2 BYTE</td></tr>
<tr><td>Function Use</td><td colspan="4">Set the acceleration time for internal velocity command to change the speed.
This item indicates the amount of time for a speed command to change from 0 r/min to 1,000 r/min.
With the default setting, it takes the rotational speed 3,000 ms to reach 3,000 r/min.</td></tr>
<tr><td>Prerequisite</td><td colspan="4">The following three settings are necessary.
・Control Mode (No.2.0) = 1 (Velocity control mode)
・Command Mode (No.3.0) = 3 (Internal command mode)
・Internal Velocity: Command Method (No.388.0) = 1 (Trapezoid speed command)</td></tr>
<tr><td>Related To</td><td colspan="4">No.388.0, No.391.0, No.392.0 to 399.0</td></tr>
</table>

<table>
<tr><td rowspan="2">No. 391.0</td><td rowspan="2">Internal velocity:
Deceleration time</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>0 to 60,000</td><td>1,000
[ms]</td><td>IN VEL, CTRL, 0 100 – 2 BYTE</td></tr>
<tr><td>Function Use</td><td colspan="4">Set the deceleration time for internal velocity command to change the speed.
This item indicates the amount of time for a speed command to change from 0 r/min to 1,000 r/min.
With the default setting, it takes the rotational speed 3,000 ms to reach 3,000 r/min.</td></tr>
<tr><td>Prerequisite</td><td colspan="4">The following three settings are necessary.
・Control Mode (No.2.0) = 1 (Velocity control mode)
・Command Mode (No.3.0) = 3 (Internal command mode)
・Internal Velocity: Command Method (No.388.0) = 1 (Trapezoid speed command)</td></tr>
<tr><td>Related To</td><td colspan="4">No.388.0, No.391.0, No.392.0 to 399.0</td></tr>
</table>

COMM	Common	PLS	Position Control Pulse Train Command	POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

No. 392.0 to No. 399.0	Internal velocity: Speed setting 1 to 8	Range	Default	Characteristics
		0 to Maximum rotational speed of motor	(See below) [r/min]	IN VEL CTRL 0 100 - 2 BYTE

Function Use

Select one of 8 levels for target speed of Internal velocity command input.

■ Default Units: [r/min]

Parameter No.	Speed setting	Default	
		50 W to 750 W	1 kW to 2 kW
392.0	1	500	
393.0	2	1,000	
394.0	3	1,500	
395.0	4	2,000	
396.0	5	2,500	
397.0	6	3,000	
398.0	7	4,000	3,000
399.0	8	6,000	3,000

■ Combination of Pin No.8, 9, and 10 of I/O connector (CN1)

Speed setting	Pin No. 8 (VCSEL1)	Pin No. 9 (VCSEL2)	Pin No. 10 (VCSEL3)
1	Open	Open	Open
2	Closed	Open	Open
3	Open	Closed	Open
4	Closed	Closed	Open
5	Open	Open	Closed
6	Closed	Open	Closed
7	Open	Closed	Closed
8	Closed	Closed	Closed

Closed : Contact with COM−
Open : No contact with COM−

The direction of rotation (CCW/CW) controls with No.6 pins (VCRUN1) and No.7 pins (VCRUN2) of I/O.

Prerequisite

The following three settings are necessary.
- Control Mode (No.2.0) = 1 (Velocity control mode)
- Command Mode (No.3.0) = 3 (Internal command mode)
- Internal Velocity: Command Method (No.388.0) = 1 (Trapezoid speed command)

Related To No.388.0, No.390.0, No.391.0

No. 642.0	Internal position: Operation mode	Settings	Default	Characteristics
		0, 1	0	IN POS MODE A B – 2 BYTE

Function Use

Set the operation mode for Position Control Mode (internal command).

Settings	Operation Mode
0	Point Table
1	Testing (Communication motion)

Prerequisite

The following two settings are necessary.
- Control Mode (No.2.0) = 0 (Position Control Mode)
- Command Mode (No.3.0) = 3 (Internal command mode)

Related To No.2.0, No.3.0

No. 643.0	Internal position: Overflow detection	Settings	Default	Characteristics
		0, 1	1	IN POS CTRL ON OFF ⏻ 2 BYTE

Function Use

Enable/Disable the multiturn encoder counter overflow detection function for Positioner Drive using ABS value.
This function is a protective measure against absolute position loss of the encoder.

If Internal Position Command exceeds the absolute value range (±1,073,741,823), or shift amount per one command exceeds the range (±2,147,487,647), overflow will be detected, resulting in Alarm No.10.

Settings	Overflow Detection
0	Disable (*1)
1	Enable (*2)

*1) For repeating rotations only in one direction, when you need absolute value of single-turn angle, set **Absolute system** (No.257.0) =1 (Multi-turn counter overflow detection disabled)

*2) When you set **Absolute system** (No.257.0) = 2 (Multi-rotation counter overflow detection enabled), Alarm No.11 occurs if multi-turn data exceeds the rated range (±32,767).
Select a value for internal position command not larger than the rated value.

Remark

- "Absolute Value" Operation using Positioner, and Testing.
  Set this parameter to "0" and the command method for point table to "relative value".
  Setting "absolute value" will result in Alarm No.10.
- When the setting was changed from "0" to "1", perform homing.

Related To No.257.0

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

		Settings	Default	Characteristics
No. 644.0	Internal position: Point table - Point number output method	0 to 2	1	IN POS, CTRL, A B - 2 BYTE

Function Use

Select the output timing for a point number (PM1 to 3) when using I/O assignment Option1 for Positioner Drive.

Settings	Output timing for Point Number
0	Upon motion start
1	Upon motion complete
2	Upon motion start of each point

Prerequisite

The following two settings are necessary.
- Control Mode (No.2.0) = 0 (Position Control Mode)
- Command Mode (No.3.0) = 3 (Internal command mode/Option I/O Setting)

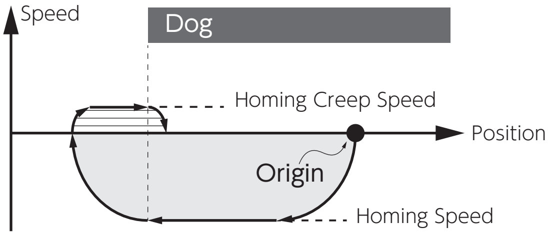
		Settings	Default	Characteristics
No. 645.0	Homing: Home reference signal selection	0 to 2	2	PLS, HOME, A B - 2 BYTE IN POS

Function Use

Select the signal that the home position will be referenced to.

Settings	Reference Signal 1
0	Any user specified position
1	Stopper
2	Home-dog-front-end (*)

*) Starting point is located on the dog
Regardless of the **Re-detection of Home position dog** (No.645.3) setting, this setting indicates a motion of at first moving backward to a position where homing can be performed.



		Settings	Default	Characteristics
No. 645.1	Homing: Encoder Z-phase selection	0, 1	1	PLS, HOME, ON OFF - 2 BYTE IN POS

Function Use

To add encoder Z-phase as the reference position after the Home Reference Signal is detected, set this parameter to 1.

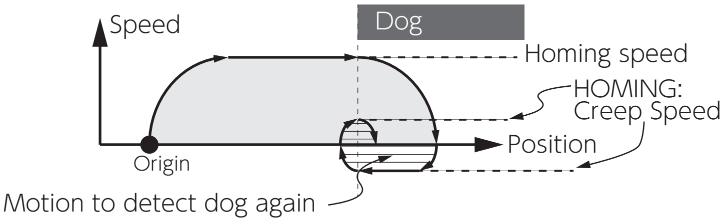
Settings	Encoder Z-phase Signal
0	Disable
1	Enable

No. 645.3	Homing: Re-detection of home position dog	Settings	Default	Characteristics
		0, 1	0	PLS HOME ON OFF - 2 BYTE

Function Use

Use this parameter, after detecting dog-front-end, to re-detect the dog-front-end at a speed specified with the homing creep speed parameter.

Settings	Re-detecting motion
0	Disable
1	Enable



Prerequisite Homing: Home reference signal selection (No.645.0): 2(home dog-front-end)

COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

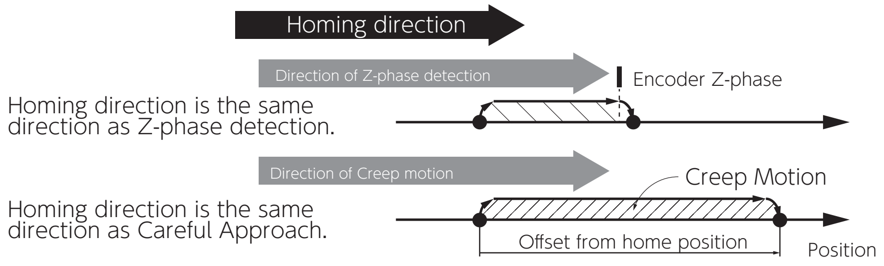
No. 646.0	Homing: Direction	Settings	Default	Characteristics
		0, 1	0	PLS HOME ON OFF - 2 BYTE IN POS

Function Use

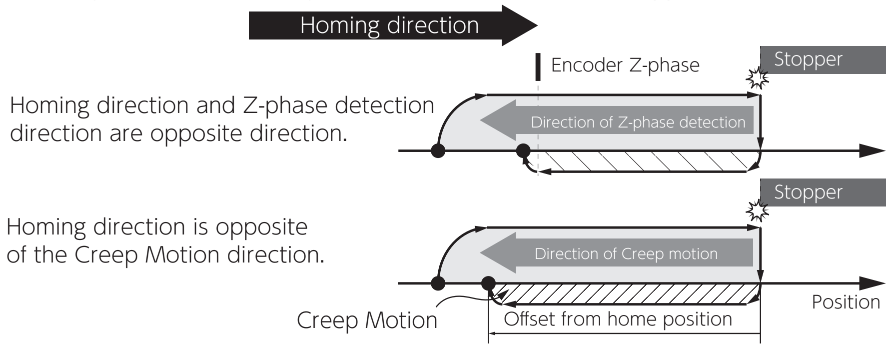
Specify the homing direction.

Settings	Direction of rotation
0	CCW
1	CW

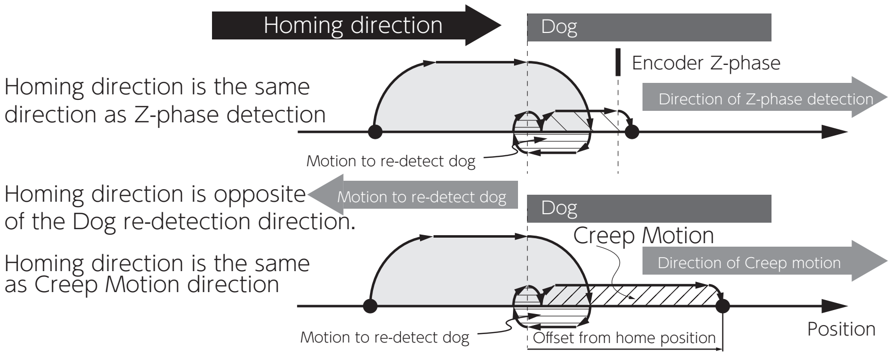
■ When Homing Home Reference Signal selection (No.645.0) = 0 (Any user specified position)



■ When Homing Home Reference Signal selection (No.645.0) =1 (Stopper)



■ When Homing Home Reference Signal selection (No.645.0) = 2 (home dog-front-end) AND Homing Re-detection of Home position dog (No.645.3) =1 (enable) (*)



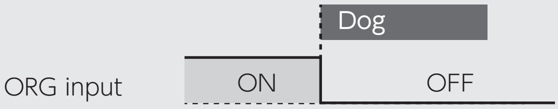
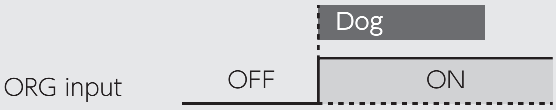
*) If the starting point is on the dog, the motion is automatically in the reverse direction of homing, and then the dog-front-end is detected upon machine's leaving the dog.

Related To No.645.0, No.645.1, No.645.3

No. 646.1	Homing: Sensor dog polarity	Settings	Default	Characteristics
		0, 1	0	PLS HOME AB – 2BYTE

Function Use

Select the polarity for the home sensor signal input ORG (Pin No.11) of CN1 to detect the dog-front-end.

Settings	Detection Polarity
0	Detect where ORG = OFF 
1	Detect where ORG = ON 

No. 646.2	Homing: Timeout switch	Settings	Default	Characteristics
		0, 1	1	PLS HOME ON OFF – 2BYTE IN-POS

Function Use

Enable/Disable Homing Timeout.
This item is a safety measure against collisions.

Settings	Timeout
0	Disable
1	Enable

When the time since homing started exceeds the setting of **Timeout Time** (No.659.0), Alarm No.10 (internal position command overflow fault / homing failure) is output leading to servo off.

No. 646.3	Internal position: Point table - Motion of point No.0	Settings	Default	Characteristics
		0, 1	0	IN-POS CTRL AB – 2BYTE

Function Use

Specify the motion upon PCSTART1 input by selecting Point No.0 with User I/O.

Settings	Motion of Point No.0
0	Homing
1	Motion per Point Table

Use this parameter for homing when the I/O assignments don't include homing input HOME.

No. 647.0	Homing: Torque command limit switch	Settings	Default	Characteristics
		0, 1	0	PLS HOME ON OFF – 2 BYTE IN POS

Function Use	Enable/Disable torque command limit during Homing. This item is a safety measure against collisions during Homing.
Remark	For Homing by using stopper, this parameter setting does not matter. The torque limit used for press detection will be always the setting of **Homing torque command limit value** (No.656.0) regardless of this parameter setting.
Related To	No.656.0

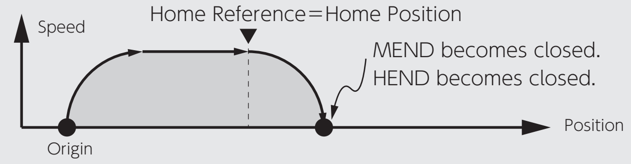
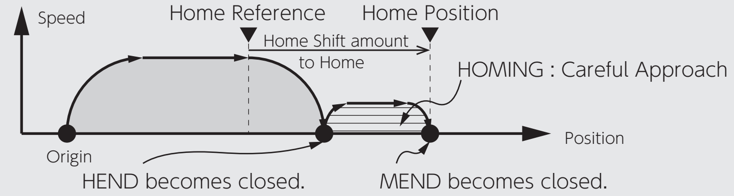
Settings	Torque Command Limit
0	Disable
1	Enable

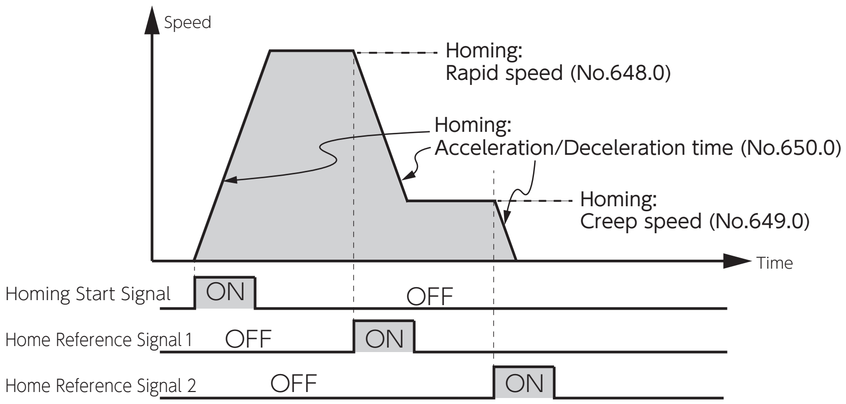
No. 647.1	Homing: Creep speed switch	Settings	Default	Characteristics
		0, 1	0	PLS HOME ON OFF – 2 BYTE IN POS

Function Use

Enable/Disable homing motion after home reference signal detection.

Set to 0 to only detect the home reference signal.
Set to 1 if any motions are intended after the reference signal detection.

Settings	Motion afterwards
0	None After home reference signal is detected, the motor decelerates to stop and homing completes. 
1	Move After home reference signal is detected and then the motor decelerates to stop, motion to carefully approach to the home position follows according to the parameter setting. 

No. 648.0	Homing: Rapid speed	Range	Default	Characteristics
		1 to Maximum rotational speed of motor	500 [r/min]	PLS HOME 0 100 – 2 BYTE IN POS
Function Use	Specify the speed value for rough approach motion before the home reference signal is detected.  			

No. 649.0	Homing: Creep speed	Range	Default	Characteristics
		1 to Maximum rotational speed of motor	10 [r/min]	PLS HOME 0 100 – 2 BYTE IN POS
Function Use	Specify the speed for careful approach after the home signal is detected. To improve accuracy to detect the home reference signal, select a lower speed.			
Prerequisite	Homing: Creep speed switch (No.647.1): 1 (Move)			
Related To	No.645.0, No.647.1, No.648.0			

No. 650.0	Homing: Acceleration/Deceleration time	Range	Default	Characteristics
		0 to 5,000	30 [ms]	PLS HOME 0 100 – 2 BYTE IN POS
Function Use	Set Acceleration/Deceleration Time for homing. This item indicates time amount for a speed to change 1,000 r/min. Applies to **Rapid Speed** (No.648.0) and **Creep Speed** (No.649.0)			
Remark	If the load is more than 10 times of inertia ratio, set this parameter to a value larger than the default. Otherwise, vibration may occur.			

No. 651.0	Homing: Amount of home position shift	Range	Default	Characteristics
		0 to 1,000,000,000	0 [command pulse]	PLS HOME 0 100 – 4 BYTE IN POS
Function Use	Use this parameter to set shift amount from home signal or encoder Z-phase to home.			
Related To	No.646.0			

		Range	Default	Characteristics
No. 653.0	Homing: Home position data	-1,000,000,000 to +1,000,000,000	0 [command pulse]	PLS HOME 0 100 – 4 BYTE IN POS
Function Use	This parameter value overwrites the home coordinate (ABS position feedback value) upon Homing complete.			

		Range	Default	Characteristics
No. 655.0	Homing: Time to detect press stopper	5 to 1,000	100 [ms]	PLS HOME 0 100 – 2 BYTE IN POS
Function Use	This parameter indicates the torque command limiting time, which is a time amount for home to be detected after the stopper was pressed.			
Related To	No.645.0, No.647.0			

		Range	Default	Characteristics
No. 656.0	Homing: Torque command limit value	10 to 3,000	500 [0.1%]	PLS HOME 0 100 – 2 BYTE IN POS
Function Use	This parameter indicates a ratio of torque command limit value (during homing) to the rated torque. The parameter is used as a safety measure against collisions during Homing. It is a torque command limit value in Homing by using stopper.			
Prerequisite	Homing: Home Reference Signal selection (No.645.0) = 1 (Stopper) or Torque command limit switch (No.647.0) = 1 (Enable)			
Related To	No.645.0, No.647.0			

		Range	Default	Characteristics
No. 657.0	Homing: Z-phase disabled distance	0 to 1,000,000,000	0 [command pulse]	PLS HOME 0 100 – 4 BYTE IN POS
Function Use	Set the shift amount between a detection position of home signal and a starting position of z-phase detection.			

		Range	Default	Characteristics
No. 659.0	Homing: Timeout time	0 to 60,000	60,000 [10 ms]	PLS HOME 0 100 – 2 BYTE IN POS
Function Use	Set the timeout time for homing. This is a safety measure in case of fault during homing.			
Prerequisite	Timeout Switch (No.646.2) = 1 (Disable)			
Related To	No.646.2			

No. 720.0 No. 740.0 to No. 1020.0	Internal Position: Point table Command method (*)	Settings	Default	Characteristics
		0, 1	0	IN POS CTRL ON OFF - 2 BYTE
Function Use	Select the **command method** for point table.			

Settings	Command Method	Position to be set
0	Absolute value	Target position
1	Relative value	Shit amount from the current position to the target position

*) See the Point Table Parameter List to look up a point number and its corresponding parameter numbers.

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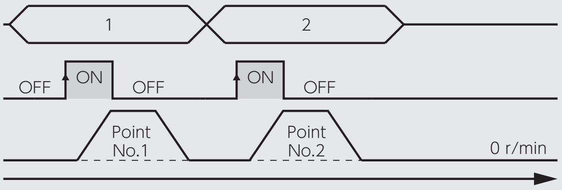
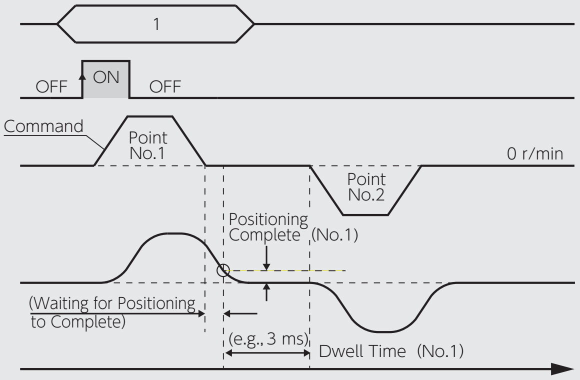
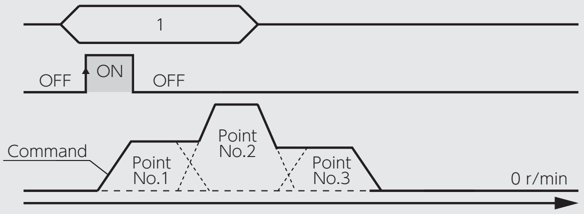
COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

<table>
<tr><td rowspan="2">No. 720.1
No. 740.1
to
No. 1020.1</td><td rowspan="2">Internal Position:
Point table Operation (*)</td><td>Settings</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>0, 1</td><td>0</td><td>IN POS CTRL A B - 2 BYTE</td></tr>
<tr><td>Function Use</td><td colspan="4">
Select the Running Motion of Point Table.
<table>
<tr><th>Settings</th><th>Running Motion</th></tr>
<tr><td>0</td><td>
Single
After the motion commanded by this point number is complete, the subsequent point numbers will not be executed.

Example: Point No.1 and 2 are set to "Single".
<table>
<tr><th>Description</th><th>Signal Name</th><th>Chart</th></tr>
<tr><td>Select Point No.</td><td>PCSEL1…4 Input</td><td rowspan="3">
</td></tr>
<tr><td>Start</td><td>PCSTART1 Input</td></tr>
<tr><td>Motor Rotational Speed</td><td>–</td></tr>
</table>
</td></tr>
<tr><td>1</td><td>
Continuous
The subsequent point number(s) will be executed one after another.

Example-1: The dwell time is set to 1 or above (for example, 3 ms).
Then positioning will be executed according to each point. After the positioning is determined to be completed, the next motion will not start until the dwell time elapses.
<table>
<tr><th>Description</th><th>Signal Name</th><th>Chart</th></tr>
<tr><td>Select Point No.</td><td>PCSEL1…4 Input</td><td rowspan="4">
</td></tr>
<tr><td>Start</td><td>PCSTART1 Input</td></tr>
<tr><td>Motor Rotational Speed</td><td>–</td></tr>
<tr><td>Position Deviation</td><td>–</td></tr>
</table>
Example-2: The dwell time is set to 0.
The motor will keep rotating and the rotational speed will continuously change.
<table>
<tr><th>Description</th><th>Signal Name</th><th>Chart</th></tr>
<tr><td>Select Point No.</td><td>PCSEL1…4 Input</td><td rowspan="3">
</td></tr>
<tr><td>Start</td><td>PCSTART1 Input</td></tr>
<tr><td>Motor Rotational Speed</td><td>–</td></tr>
</table>
</td></tr>
</table>
</td></tr>
</table>

*) See the Point Table Parameter List to look up a point number and its corresponding parameter numbers.

☞ Page 102

No.	Name	Settings	Default	Characteristics
No. 720.3 No. 740.3 to No. 1020.3	Internal Position: Point table Enable/Disable (*)	0, 1	0	IN POS, CTRL, ON OFF - 2 BYTE

Function Use

Enable/Disable Point Table.

Settings	Enable/Disable
0	Disable The point number assigned "disable" is not executed and any subsequent point numbers assigned "enable" are executed.
1	Enable The point number assigned "enable" is executed

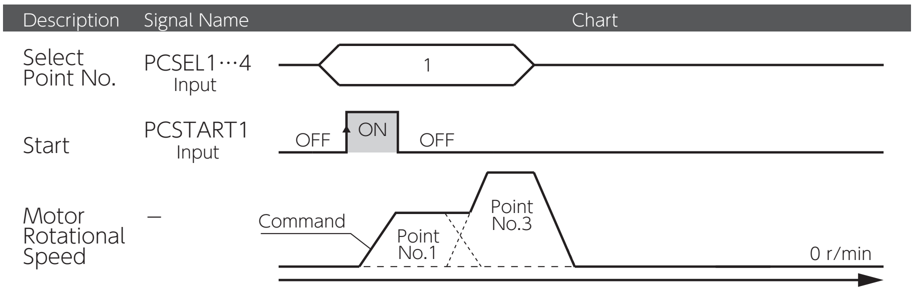
If the point number with the "disable" setting is specified,
among the subsequent point numbers, the first one with "enable" will be executed.

If there is a "disabled" point number during a series of "continuous" motions,
that "disabled" point number will not be executed and the first "enabled" subsequent point number will be executed.

If point number with "continuous" motion and "0" dwell time,
motions before and after that point number will be executed one after the other and the speed will change continuously.

Example
If Point No.1 is specified and Start signal is input were the following Point number settings are as follows, Point No.2 will not be executed and Point No.1 and No.3 will be executed continuously.

Point No.	Motion	Dwell time	Enable/Disable
1	Continuous	0	Enable
2	Continuous	(any value)	Disable
3	Single	(any value)	Enable



TIP

For the last point number set to "enable" (i.e. last to be executed), set its Running Motion to "single".
If you set "continuous" to the last enabled point number, Operation Complete output (MEND) will remain off and the next motion will be not be started. If that happens, perform the following.

User I/O operation
Turn the servo off or input Clear Deviation Counter.

"Servo Studio" operation
Turn the servo off or click the STOP button.

*) See the Point Table Parameter List to look up a point number and its corresponding parameter numbers.

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No. 722.0 No. 742.0 to No. 1022.0	Internal Position: Point table Position (*)	Range	Default	Characteristics
		− 1,073,741,823 to +1,073,741,823	0 [encoder pulse]	IN POS CTRL 0 100 - 4 BYTE
Function Use	Set the target position in Point Table. ■ If Relative Value is selected as the Command method, position data will determine the shift amount. Enter a positive value for CCW rotation or a negative value for CW rotation. ■ If Absolute Value is selected as the Command method, position data will determine the target position. This value corresponds to ABS Position Command value (Status No.74).			
Related To	No.643.0			

No. 724.0 No. 744.0 to No. 1024.0	Internal Position: Point table Rotational speed (*)	Range	Default	Characteristics
		0 to Maximum Rotational Speed of Motor	0 [r/min]	IN POS CTRL 0 100 - 4 BYTE
Function Use	Set the motor rotational speed for the Point Table. Set this to a speed no higher than the max rotational speed of the motor.			

No. 726.0 No. 746.0 to No. 1026.0	Internal Position: Point table Acceleration time (*)	Range	Default	Characteristics
		0 to 5,000	30 [ms]	IN POS CTRL 0 100 - 2 BYTE
Function Use	Set the acceleration time for the Point table. This item indicates the amount of time for a speed command to change from 0 r/min to 1,000 r/min. In the default setting, it takes 90 ms for the rotational speed to change from 0 r/min to 3,000 r/min.			

No. 727.0 No. 747.0 to No. 1027.0	Internal Position: Point table Deceleration time (*)	Range	Default	Characteristics
		0 to 5,000	30 [ms]	IN POS CTRL 0 100 - 2 BYTE
Function Use	Set the deceleration time for the Point Table. This item indicates the amount of time for a speed command to change from 0 r/min to 1,000 r/min. In the default setting, it takes 90 ms for the rotational speed to change from 3,000 r/min to 0 r/min.			

*) See the Point Table Parameter List to look up a point number and its corresponding parameter numbers.

☞ Page 102

No. 728.0 No. 748.0 to No. 1028.0	Internal Position: Point table Dwell time (*)	Range	Default	Characteristics
		0 to 20,000	1 [ms]	IN POS CTRL 0 100 - 2 BYTE
Function Use	Set the dwell time for the Point Table. Dwell time is the wait time for the next Point-Table motion to be executed after a Point-Table motion is complete. ■ Motion after the dwell time elapses: Single motion: MEND will be ON. Continuous motions: the motion commanded by the next point number will start. If Running Motion is "Continuous" and the dwell time is set to 0, the motion will be according to the speed assigned by point numbers -one after another continuously. If the dwell time is set to 0, the acceleration/deceleration setting in the first point number selected upon CW start PCSTART1 ON will be applied, and the settings of subsequent point numbers will be discarded. ☞ Page 101 Positioning Complete			

*) See the Point Table Parameter List to look up a point number and its corresponding parameter numbers.

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COMM	Common	PLS	Position Control Pulse Train Command	IN POS	Position Control Internal Command
VEL	Velocity Control Analog Command	IN VEL	Velocity Control Internal Command	TRQ	Torque Control Analog Command
COM	Communication	MODE	Operation Mode	CTRL	Operation Control
ALM	Alarm Detection	TUNE	Tuning	HOME	Homing
LIMIT	Torque Limit	STOP	Deceleration Stop and so on	SUPP	Vibration Control
ON OFF	Switch	A B	Selection	0 100	Numeric Value
⏻	Control Power Cycle	2 BYTE	2-Byte Data	4 BYTE	4-Byte Data

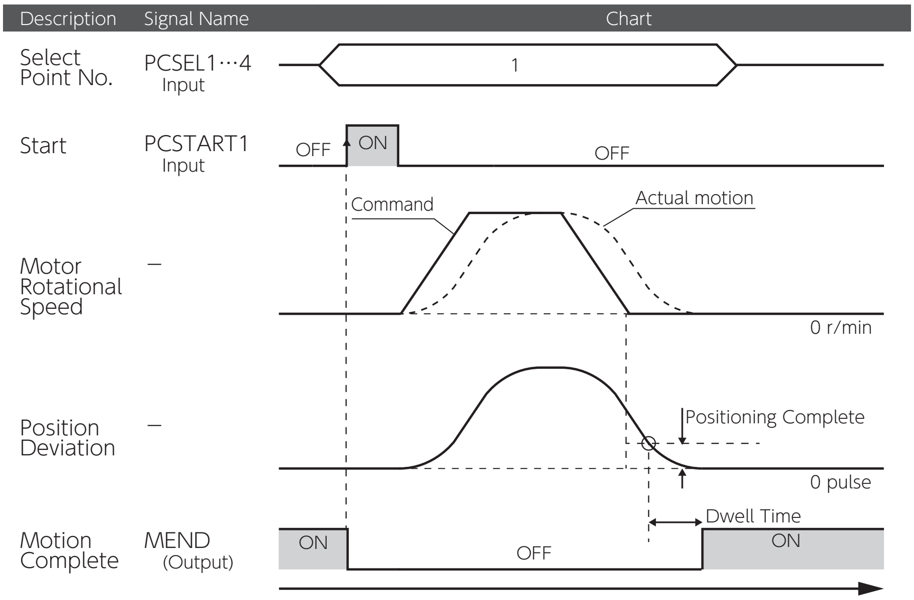
		Range	Default	Characteristics
No. 729.0 No. 749.0 to No. 1029.0	Internal Position: Point table Positioning completion (*)	0 to 32,767	20 [encoder pulse]	IN POS CTRL 0 100 - 4 BYTE

Function Use

Set the range for positioning complete by the Point table.

Set a position deviation threshold to determine whether or not positioning is complete.
After the motion specified by the point number has been complete, when the position deviation falls in the range set by this item and then the Dwell time elapses, the MEND (motion end) signal turns ON.

■ **Timing Diagram** of Positioning Complete and Dwell Time



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*) See the Point Table Parameter List to look up a point number and its corresponding parameter numbers.

☞ Page 102

5. Parameters

3. Point Table Parameter List

To configure point table data by using RS-485 Communications, refer to the cross table of point table items and their corresponding parameter numbers.

Point No.	Position [command pulse]	Rotational speed [r/min]	Acceleration time [ms]	Deceleration time [ms]	Command method [-]	Dwell time [ms]	Operation [-]	Positioning completion [encoder pulse]	Enable /Disable [-]
0	No. 722.0	No. 724.0	No. 726.0	No. 727.0	No. 720.0	No. 728.0	No. 720.1	No. 729.0	No. 720.3
1	No. 742.0	No. 744.0	No. 746.0	No. 747.0	No. 740.0	No. 748.0	No. 740.1	No. 749.0	No. 740.3
2	No. 762.0	No. 764.0	No. 766.0	No. 767.0	No. 760.0	No. 768.0	No. 760.1	No. 769.0	No. 760.3
3	No. 782.0	No. 784.0	No. 786.0	No. 787.0	No. 780.0	No. 788.0	No. 780.1	No. 789.0	No. 780.3
4	No. 802.0	No. 804.0	No. 806.0	No. 807.0	No. 800.0	No. 808.0	No. 800.1	No. 809.0	No. 800.3
5	No. 822.0	No. 824.0	No. 826.0	No. 827.0	No. 820.0	No. 828.0	No. 820.1	No. 829.0	No. 820.3
6	No. 842.0	No. 844.0	No. 846.0	No. 847.0	No. 840.0	No. 848.0	No. 840.1	No. 849.0	No. 840.3
7	No. 862.0	No. 864.0	No. 866.0	No. 867.0	No. 860.0	No. 868.0	No. 860.1	No. 869.0	No. 860.3
8	No. 882.0	No. 884.0	No. 886.0	No. 887.0	No. 880.0	No. 888.0	No. 880.1	No. 889.0	No. 880.3
9	No. 902.0	No. 904.0	No. 906.0	No. 907.0	No. 900.0	No. 908.0	No. 900.1	No. 909.0	No. 900.3
10	No. 922.0	No. 924.0	No. 926.0	No. 927.0	No. 920.0	No. 928.0	No. 920.1	No. 929.0	No. 920.3
11	No. 942.0	No. 944.0	No. 946.0	No. 947.0	No. 940.0	No. 948.0	No. 940.1	No. 949.0	No. 940.3
12	No. 962.0	No. 964.0	No. 966.0	No. 967.0	No. 960.0	No. 968.0	No. 960.1	No. 969.0	No. 960.3
13	No. 982.0	No. 984.0	No. 986.0	No. 987.0	No. 980.0	No. 988.0	No. 980.1	No. 989.0	No. 980.3
14	No. 1002.0	No. 1004.0	No. 1006.0	No. 1007.0	No. 1000.0	No. 1008.0	No. 1000.1	No. 1009.0	No. 1000.3
15	No. 1022.0	No. 1024.0	No. 1026.0	No. 1027.0	No. 1020.0	No. 1028.0	No. 1020.1	No. 1029.0	No. 1020.3

6 Operations

1. Configuring Operation Mode

This products are operated with any of the seven operating modes which are combinations of Control Mode and Command Mode. Configure parameters No. 2.0 and No. 3.0.

( )The numeric values in the parentheses represent parameter settings.

Control Mode (No2.0)	Command Mode (No. 3.0)	Command Input Signal Format
Position Control (0:Default)	Pulse Train Command (1:Default) In this operation mode, position commands are issued from the host controller with pulse input. ☞ Page 6–	· Differential · 24 V open collector · 5 V open collector
	Internal Position Command (3) An operation mode used in the Positioner Drive function that enables you to execute positioning command preset in the amplifier with I/O operation from the host controller. ☞ Page 18–	· I/O operation
Velocity Control (1)	Analog Velocity Command (2) In this operation mode, speed commands are issued from the host controller with analog voltage input. ☞ Page 10–	· Analog voltage
	Internal Velocity Command (3) This type of operation mode moves the machine according to the speed preset in the amplifier with I/O input from the host controller. ☞ Page 13–	· I/O operation
Torque Control (2)	Analog Torque Command (2) In this operation mode, torque commands are issued from the host controller with analog voltage input. ☞ Page 15–	· Analog voltage

⚠ CAUTION

Before performing wiring to each amplifier or motor, verify that all power sources are shut off.

All wiring work must be performed by certified electricians.

Before powering to each amplifier or motor, be sure that wiring has been performed correctly.

1. Common Parameters

The following are the parameters that must be configured for all operation modes.

Common

COMM MODE CTRL LIMIT

Name			No.	☞
Control mode			2.0	5-34
Command mode			3.0	5-34
Operation mode			9.0	5-35
Warning latch time			12.0	5-36
Alarm output timing			13.0	5-36
Torque command limit	Switch		144.0	5-62
	Value 1		147.0	5-63
	Value 2		148.0	5-63
Torque limit output			144.1	5-63
Servo OFF: Delay time			237.0	5-75
Bake release: Delay time			238.0	5-75
Absolute system			257.0	5-76
Encoder pulse output	Rotational direction		272.1	5-77
	Command pulse ratio	Numerator	276.0	5-78
		Denominator	278.0	5-78

Warning/Error Detection

COMM PLS ALM

Name		No.	☞
Position deviation Error detection	Switch	65.0	5-41
	Value	87.0	5-51
	Delay time	89.0	5-51
Position deviation Warning detection	Value	363.0	5-85
	Delay time	365.0	5-85
Speed deviation Error detection	Switch	65.1	5-41
	Value	90.0	5-51
	Delay time	91.0	5-51
Encoder pulse output Error detection	Frequency upper bound	285.0	5-79
	Delay time	286.0	5-79
Encoder Overheat detection	Switch	259.0	5-76
	Value	267.0	5-77
Encoder Battery Voltage drop detection	Switch	259.1	5-76
	Value	268.0	5-77
Voltage Sag Detection	Delay time	305.0	5-83

RS-485 Communications

COMM COM

Name	No.	☞
Switch	8.0	5-35
Address	4.0	5-34
Communication speed	6.0	5-34
Stop bit	6.1	5-35
Parity	6.2	5-35
Minimum response time	11.0	5-35

Deceleration Stop

COMM STOP

Name		No.	☞
Upon Servo Off	Method	224.0	5-68
	DBRK output after stopping	224.3	5-69
When alarm is on	Method	233.0	5-73
	DBRK output after stopping	233.1	5-74
Release conditions		224.1	5-68
Operating time		226.0	5-70
Cancellation speed		227.0	5-70
Upon control power failure	Switch	224.2	5-69
	Operating time	228.0	5-70
Torque command limit		151.0	5-64
Status during free-run		232.1	5-71
Short brake operation after a stop		232.2	5-72
Brake engagement	Timing	232.3	5-72
	Delay time	234.0	5-74
	Rotational speed	235.0	5-74

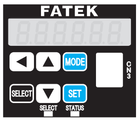
Drive Restriction Input

COMM PLS CTRL

Name	No.	☞
Setup	67.0	5-43
Deceleration method	67.1	5-43
Idling status	67.2	5-43
Retaining position deviation counter	67.3	5-43

For each operation mode, its supporting parameters must be configured. For details, refer to the subsequent sections describing each operation mode.

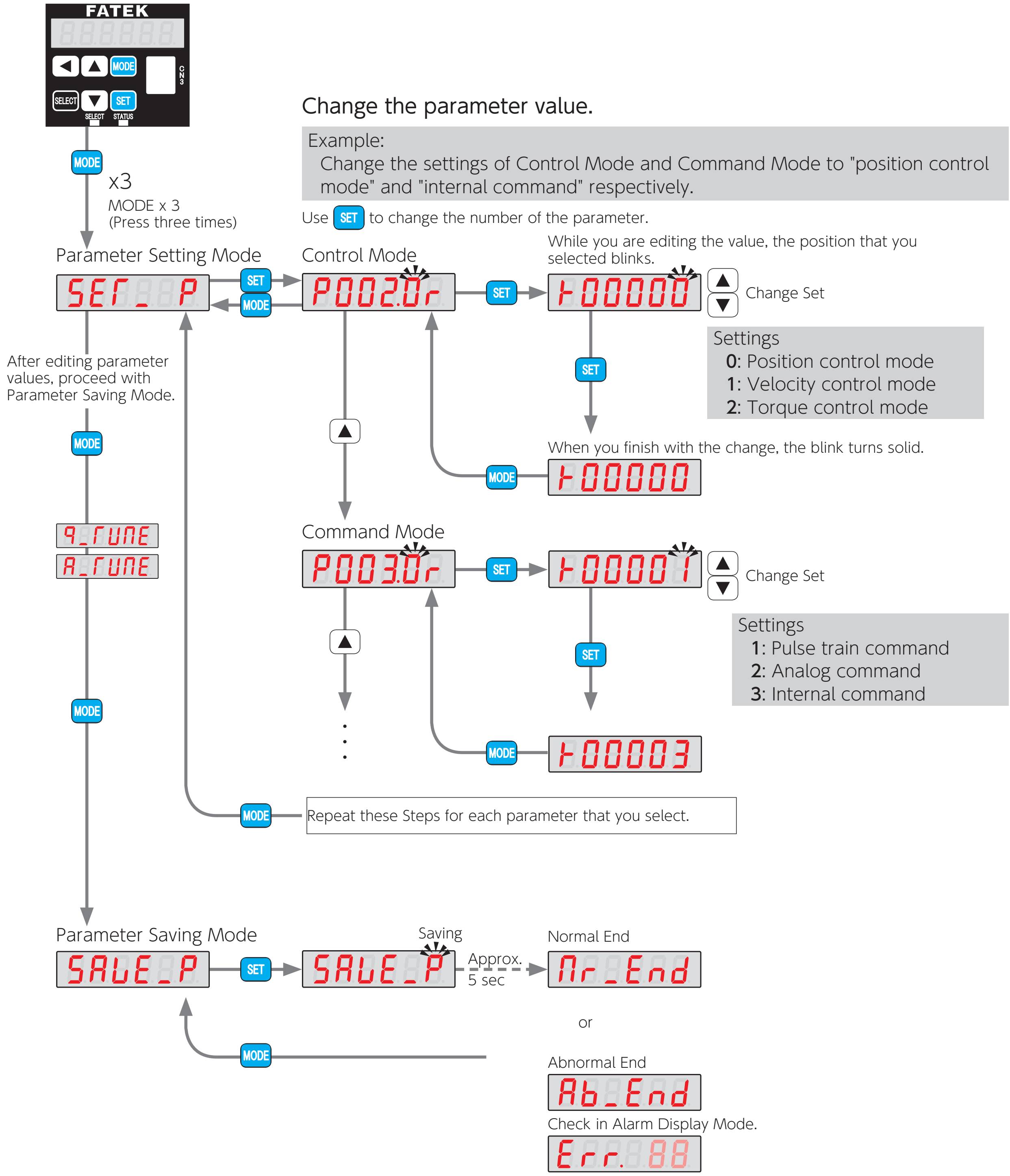
Parameter Tuning Methods

	Use the Setup Panel at the front of the amplifier for tuning.
STUDIO Servo Studio	Use the setup software "Servo Studio" for tuning. Install it on the user-supplied computer.

1. Configuring Operation Mode

2. Configuring Parameters

Using the Setup Panel



Change the parameter value.

Example:
Change the settings of Control Mode and Command Mode to "position control mode" and "internal command" respectively.

Use SET to change the number of the parameter.

While you are editing the value, the position that you selected blinks.

Settings
- **0**: Position control mode
- **1**: Velocity control mode
- **2**: Torque control mode

When you finish with the change, the blink turns solid.

Settings
- **1**: Pulse train command
- **2**: Analog command
- **3**: Internal command

Repeat these Steps for each parameter that you select.

Check in Alarm Display Mode.

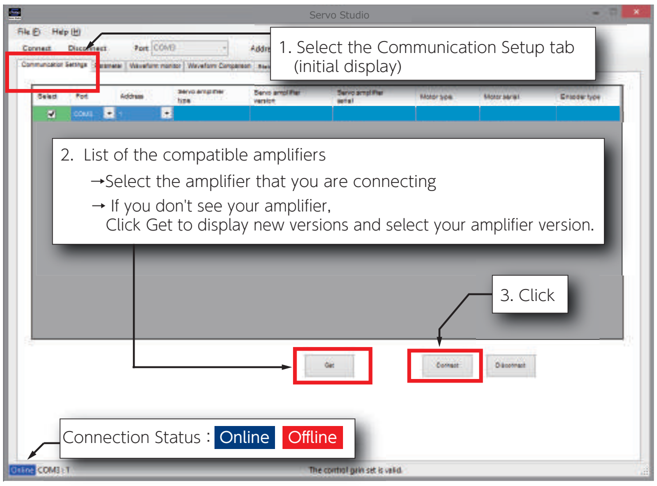
! Save the parameter settings in Parameter Saving mode to the amplifier. If you shut down the amplifier without saving them, the changes will not take effect.

1. Configuring Operation Mode

Using "Servo Studio"

Step1 Start

Double-click on



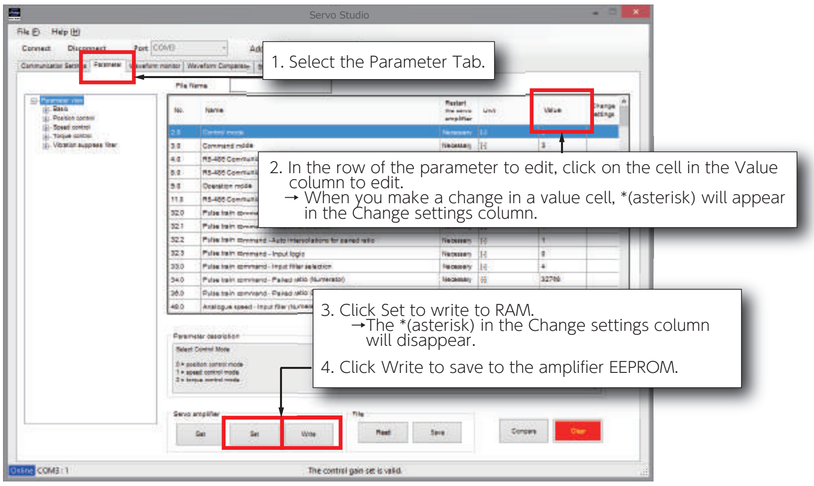
1. Select the Communication Setup tab (initial display)

2. List of the compatible amplifiers
   →Select the amplifier that you are connecting
   → If you don't see your amplifier,
   Click Get to display new versions and select your amplifier version.

3. Click

Connection Status : Online Offline

Step2 Set parameters



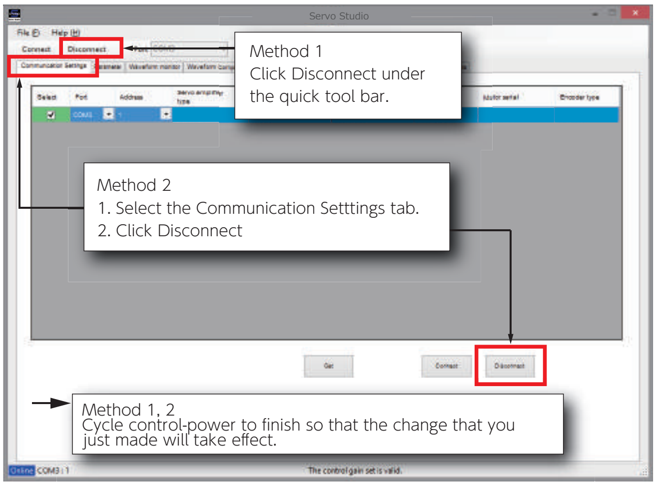
1. Select the Parameter Tab.

2. In the row of the parameter to edit, click on the cell in the Value column to edit.
   → When you make a change in a value cell, *(asterisk) will appear in the Change settings column.

3. Click Set to write to RAM.
   →The *(asterisk) in the Change settings column will disappear.

4. Click Write to save to the amplifier EEPROM.

Step3 Finish



Method 1
Click Disconnect under the quick tool bar.

Method 2
1. Select the Communication Setttings tab.
2. Click Disconnect

Method 1, 2
Cycle control-power to finish so that the change that you just made will take effect.

2. Position Control Mode

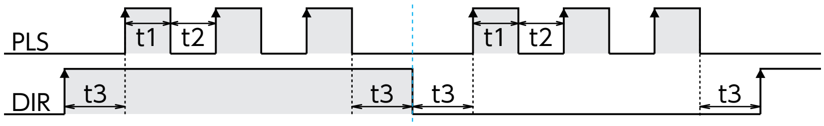
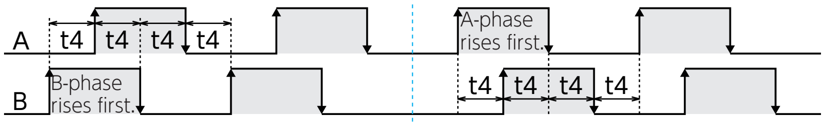
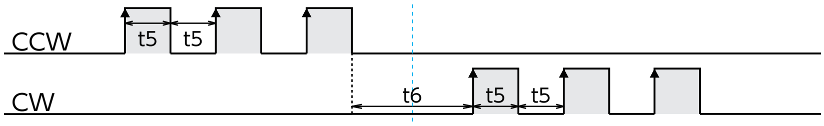
1. Pulse Train Command

Required Parameters

Set the operation mode with the following parameters.

Name	Setting	Parameter No.
Control Mode	0: Position Control Mode (Default)	2.0
Command Mode	1: Pulse Train Command Mode (Default)	3.0
Input pulse form (*)	Select one. 0: Pulse and direction (PLS & DIR) (Default) 1: Quadrature phase difference pulse (A-Phase & B-Phase) 2: Input in positive or negative pulse (CCW & CW)	32.0
Input Filter	Helps to reduce possible malfunctions caused by noise. You must configure this parameter in the case of command input by open collector. Default: 4 (150 ns) ☞ 5 Setting Parameters, 9 Appendices	33.0
Paired Pulse Ratio(Numerator)	32,768 pulse/rev Default:1,000 pulse/rev	34.0
Paired Pulse Ratio(Denominator)	Set to [pulse count of the host controller output] divided by 4 Default:1,000 pulse/rev	36.0

*) Pulse command input form (see the table above) and Minimum Time Interval (see the table below).

Parameters No. 32.0	Positive direction command	Negative direction command
0 (Default) Pulse and Direction (PLS + DIR)		
1 Quadrature phase Difference pulse (A-phase + B-phase)		
2 Positive or Negative pulse (CCW + CW)		

Input pulse signal	Maximum command pulse frequency	Minimum time interval [μs]					
		t1	t2	t3	t4	t5	t6
Differential	4 Mpps	0.125	0.125	2.5	0.25	0.125	0.125
Open collector	200 kpps	2.5	2.5	2.5	2.5	2.5	2.5

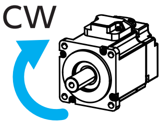
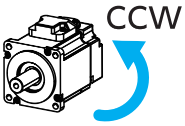
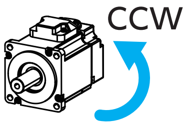
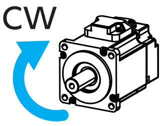
The amount of time needed for rising or falling edge of the command pulse input signal must be 0.1 μs or below. The number of pulses is counted at the rising edge (from low level to high level).
The input logic can be changed with Parameter No. 32.3.

Optional Parameters

The following parameters are optional. Configure them, as necessary.

Name		Setting	Parameter No.
Pulse Train Command	Direction of Rotation	See below	32.1
	Input Logic	Select the pulse train input logic Default:1(Negative logic)	32.3
Positioning Complete	Determination Method	Specify the conditions for Positioning Complete ☞ 5 Setting Parameters	64.0
	Detection Criteria (Range)		68.0
	Detection Criteria (Speed)		69.0
	Detection Criteria (Command input)		70.0
	Detection Time Delay		71.0

Configuration of Parameter No. 32.1 and Rotational Direction of the Motor

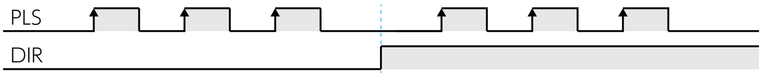
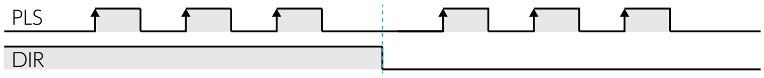
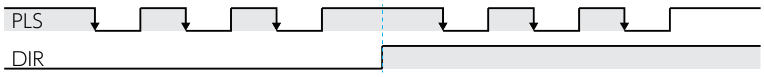
Parameter No. 32.1	Command pulse from the controller	
	Positive direction command	Negative direction command
0		
1 (Default)		

2. Position Control Mode

Input Pulse Form and Parameter Setting

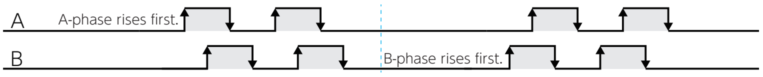
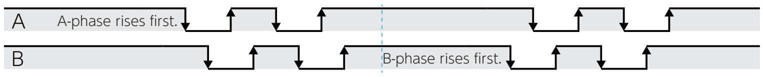
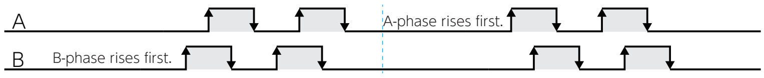
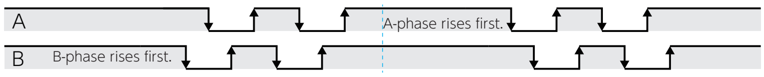
The command pulse is counted at the rising edge in the positive logic and the falling edge in the negative logic.

Pulse and Direction(PLS + DIR)(No. 32.0 = 0)

Parameter No. 32.1	Parameter No. 32.3	Command input waveform CCW CW
0	0 (Default)	
	1	
1 (Default)	0 (Default)	
	1	

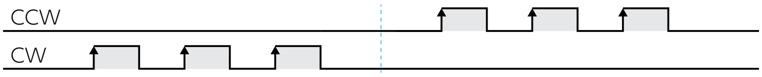
- Changing the setting of Parameter No. 32.3 will reverse the direction signal (DIR) logic.
- Change the direction signal (DIR) when PLS is LOW where No. 32.3=0 and PLS is HIGH where No. 32.3=1.

Quadrature phase Difference pulse(A-phase + B-phase)(No. 32.0 = 1)

Parameter No. 32.1	Parameter No. 32.3	Command input waveform CCW CW
0	0 (Default)	
	1	
1 (Default)	0 (Default)	
	1	

- No direction signal logic change by Parameter No. 32.3.

Positive or Negative pulse(CCW + CW)(No. 32.0 = 2)

Parameter No. 32.1	Parameter No. 32.3	Command input waveform CCW CW
0	0 (Default)	
	1	
1 (Default)	0 (Default)	
	1	

Precautions for Testing

❗	Before powering to each amplifier or motor, be sure that all wiring has been performed properly.	⚠ ⚠ ⚠ ⚠
	Set the parameters correctly before testing.	⚠ ⚠
	Check motor motions first with no machines being connected.	⚠ ⚠
	For a brake-equipped motor, be sure to disengage the brake before driving the motor.	⚠

Testing Procedure

Step	Operation
Step 1	Verify that wiring has been performed correctly.
Step 2	Turn on the control power to the amplifier.
Step 3	Turn on the primary circuit power to the amplifier.
Step 4	Connect the SVON pin on CN1 connector to COM- to turn the servo on.
Step 5	Input the position command pulse from the host controller in low frequency, and run the motor at low speed (around100 r/min). Be sure that the actual rotational direction of the motor agrees with the direction setting. Verify that stopping the command pulse does stop the motor.
Step 6	After ensuring safety of actual motions, increase the frequency of position command pulse gradually and check motor motions. If vibration occurs, increase the inertia ratio.

☞ 8 Troubleshooting

3. Velocity Control Mode

1. Analog Velocity Command

Required Parameters

Start testing only after configuring the parameters.

Set the operation mode.

Name	Setting	Parameter No.
Control Mode	1: Velocity Control mode (Default: 0 Position control mode)	2.0
Command Mode	2: Analog command (Default: 1 Pulse train command)	3.0

Optional Parameters

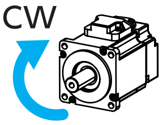
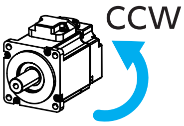
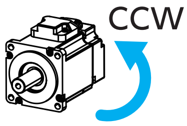
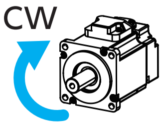
The following parameters are optional. Configure them as necessary.

Name			Setting	Parameter No.
Offset	Adjustment		Adjust the offset, such that the motor speed becomes 0 r/min when the command input is 0 V.	62.2
	Value			60.0
Direction of Rotation (*1)			Select CCW or CW.	62.0
Input Filter	Switch		Apply this parameter to filter the noise component of input command voltage.	62.1
	Numerator			48.0
	Denominator			49.0
Input gain (*2)	Numerator		Set the rotational speed at max command input voltage (± 10 V).	50.0
	Denominator			51.0
Speed limit (*3)	CCW	Numerator	Set the speed limit for CCW rotations.	52.0
		Denominator		53.0
	CW	Numerator	Set the speed limit for CW rotations.	54.0
		Denominator		55.0
Smoothing Filter	Switch		Apply this filter to reduce the variance of the motor speed.	77.0
	Moving Average Time			78.0

☞ 5 Setting Parameters

3. Velocity Control Mode

*1) Configuration of Parameter No. 62.0 and Rotational Direction of the Motor

Parameter No. 62.0	Input Analog Command Voltage	
	Positive Voltage	Negative Voltage
0		
1 (Default)		

*2) Example of Input Gain Configuration

Input Gain is configured with the following two parameters:
Numerator (No. 50.0): desired max rotational speed
Denominator (No. 51.0): max rotational speed of the motor

Example of setting the max command input voltage (± 10 V) to 3,000 r/min for the motor with 5,000 r/min max rotational speed.

Configuration		Setting	Parameter No.
Numerator	desired max rotational speed	3,000 r/min	50.0
Denominator	max rotational speed of the motor	5,000 r/min	51.0

*3) Example of Speed Limit Configuration

Speed limit is configured with the following two parameters:
分 Numerator (CCW: No. 52.0, CW: No. 54.0): desired max rotational speed limit
Denominator (CCW: No. 53.0, CW: No. 55.0): max rotational speed of the motor

Example of setting the max rotational speed limit to 3,000 r/min for the motor of 5,000 r/min max rotational speed.

Direction of Rotation	Configuration		Setting	Parameter No.
CCW	Numerator	desired max rotational speed	3,000 r/min	52.0
	Denominator	max rotational speed of the motor	5,000 r/min	53.0
CW	Numerator	desired max rotational speed	3,000 r/min	54.0
	Denominator	max rotational speed of the motor	5,000 r/min	55.0

3. Velocity Control Mode

Precautions for Testing

❗	Before powering to each amplifier or motor, be sure that all wiring has been performed properly.	⚠ ⚠ ⚠ ⚠
	Set the parameters correctly before testing.	⚠ ⚠
	Check motor motions first with no machines being connected.	⚠ ⚠
	For a brake-equipped motor, be sure to disengage the brake before operating the motor.	⚠

Testing Procedure

Step	Operation
Step 1	Verify that wiring has been performed correctly.
Step 2	Turn on the control power to the amplifier.
Step 3	Turn on the primary circuit power to the amplifier.
Step 4	Connect the SVON pin of CN1 connector to COM- to turn the servo on.
Step 5	Input the analog velocity command voltage with a low voltage to run the motor at a low speed. Be sure that the actual rotational direction of the motor agrees with the direction setting. Verify that the motor speed changes depending on the input voltage.
Step 6	After ensuring safety of actual motions, increase the command voltage gradually and check motor motions. Verify that the rotational speed has reached the specified speed. If vibration occurs, increase the inertia ratio.

3. Velocity Control Mode

2. Internal Velocity Command

Required Parameters

Start testing only after configuring the parameters.

Set the operation mode.

Name	Setting	Parameter No.
Control Mode	1: Velocity Control Mode (Default: 0 Position control mode)	2.0
Command Mode	3: Internal Command (Default: 1 Pulse train command)	3.0
Internal Velocity: Command Method	1: Trapezoidal Speed Command (8 settings) (Default: 0 Zero command)	388.0

Optional Parameters

The following parameters are optional. Configure them as necessary.

Name		Setting	Parameter No.
Acceleration Time		amount of time for speed command to increase the speed from 0 r/min to 1,000 r/min Default: 1,000 ms	390.0
Deceleration Time		amount of time for the speed command to decrease the speed from 1,000 r/min to 0 r/min Default: 1,000 ms	391.0
Speed Setting 1 to 8		Target speed Default: See below	392.0 to 399.0
Smoothing Filter	Switch	Apply this filter to reduce the speed variation of the motor. Default: No. 77.0 = 0(Disable) No. 78.0 = 100 ms	77.0
	Moving Average Time		78.0

Speed Setting	Default [r/min] 50 W to 750 W	1 kW to 2 kW	Parameter No.
1	500		392.0
2	1,000		393.0
3	1,500		394.0
4	2,000		395.0
5	2,500		396.0
6	3,000		397.0
7	4,000	3,000	398.0
8	6,000	3,000	399.0

3. Velocity Control Mode

Precautions for Testing

Before powering to each amplifier or motor, be sure that all wiring has been performed properly.

Set the parameters correctly before testing.

Check motor motions first with no machines being connected.

For a brake-equipped motor, be sure to disengage the brake before operating the motor.

Testing Procedure

Step	Operation
Step 1	Verify that wiring has been performed correctly.
Step 2	Turn on the 24 VDC control power to the amplifier.
Step 3	Turn on the primary circuit power to the amplifier.
Step 4	Connect the SVON pin of CN1 connector to COM- to turn the servo on.
Step 5	Select one of target speeds with open/closed combinations of VCSEL1, VCSEL2, and VCSEL3, and turn either VCRUN1 or VCRUN2 ON. The motor will rotate accordingly. Refer to the following "Motor Rotational Direction" and "Speed Settings" to operate the motor. Be sure that the actual rotational direction of the motor agrees with your direction setting. Verify that has the rotational speed has reached your speed setting. If vibration occurs, increase the inertia ratio.

RUN Operation and Rotational Direction of the Motor

Motor Rotational Direction	Operation VCRUN1	VCRUN2
CCW	Closed	Open
CW	Open	Closed
Stop	Open	Open
Stop	Closed	Closed

Closed :Contact with COM-

Open :No contact with COM-

Speed Settings

Target Speed	VCSEL1 CN1 Pin No. 8	VCSEL2 CN1 Pin No. 9	VCSEL3 CN1 Pin No. 10
1	Open	Open	Open
2	Closed	Open	Open
3	Open	Closed	Open
4	Closed	Closed	Open
5	Open	Open	Closed
6	Closed	Open	Closed
7	Open	Closed	Closed
8	Closed	Closed	Closed

4. Torque Control Mode

1. Analog Torque Command

Required Parameters

Set the parameters before testing.
Set the operation mode.

Name	Setting	Parameter No.
Control Mode	2: Torque Control Mode (Default: 0 Position control mode)	2.0
Command Mode	2: Analog Command (Default: 1 Pulse train command)	3.0

Optional Parameters

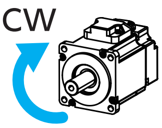
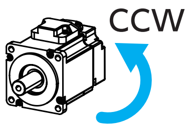
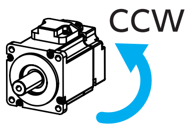
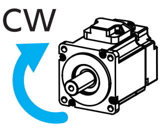
The following parameters are optional. Configure them as necessary.

Name			Explanation	Parameter No.
Offset	Adjustment		Adjust the offset, such that the motor torque command becomes 0 [0.1%] when the command input is 0 V.	302.2
	Value			300.0
Direction of Rotation (*1)			Select the CCW or CW.	302.0
Input Filter	Switch		Apply this parameter to filter the noise component of input command voltage.	302.1
	Numerator			288.0
	Denominator			289.0
Input Gain (*2)	Numerator		Set the torque at the max command input voltage (±10 V).	290.0
	Denominator			291.0
Torque Limit (*3)	CCW	Numerator	Set the torque limit during CCW rotation.	292.0
		Denominator		293.0
	CW	Numerator	Set the torque limit during CW rotation.	294.0
		Denominator		295.0
Speed Limit			Set the speed limit.	152.0

☞ 5 Setting Parameters

4. Torque Control Mode

*1) Configuration of Parameter No. 302.0 and Rotational Direction of the Motor

Parameter No. 302.0	Input Analog Command Voltage	
	Positive Voltage	Negative Voltage
0		
1 (Default)		

*2) Example of Input Gain Configuration

Input Gain is configured with the following two parameters:
Numerator (No. 290.0): desired max torque
Denominator (No. 291.0): max torque of the motor

Example: the parameter settings (for a motor with the 300% max torque) to 100% at the max command

Configuration		Setting	Parameter No.
Numerator	desired max torque	1,000 [0.1%]	290.0
Denominator	max torque of the motor	3,000 [0.1%]	291.0

*3) Example of Torque Limit Configuration

Torque Limit is configured with the following two parameters:
Numerator (CCW: No. 292.0, CW: No. 294.0): desired torque limit
Denominator (CCW: No. 293.0, CW: No. 295.0): max torque limit of the motor

Example: Setting the max torque limit to 100% for the motor of the 300% max torque

Direction of Rotation	Configuration		Setting	Parameter No.
CCW	Numerator	desired torque limit	1,000 [0.1%]	292.0
	Denominator	max torque limit of the motor	3,000 [0.1%]	293.0
CW	Numerator	desired torque limit	1,000 [0.1%]	294.0
	Denominator	max torque limit of the motor	3,000 [0.1%]	295.0

4. Torque Control Mode

Precautions for Testing

❗	Before powering to each amplifier or motor, be sure that all wiring has been performed properly.	⚠ ⚠ ⚠ ⚠
	Set the parameters correctly before testing.	⚠ ⚠
	Check motor motions first with no machines being connected.	⚠ ⚠
	For a brake-equipped motor, be sure to disengage the brake before operating the motor.	⚠

Testing Procedure

Step	Operation
Step 1	Verify that wiring has been performed correctly.
Step 2	Turn on the control power to the amplifier.
Step 3	Turn on the primary circuit power to the amplifier.
Step 4	Set Analog torque: Speed limit (No. 152) to a sufficiently small value (around 500 r/min).
Step 5	Connect the SVON pin of CN1 connector to COM- to turn the servo on.
Step 6	Set [Analog torque: Speed limit (No. 152)] to the value to be used in actual operation.
Step 7	Input the analog torque command voltage with a low voltage to run the motor with a low torque. Be sure that the actual rotational direction of the motor agrees with the direction setting. Verify that the motor speed changes according to the input voltage.
Step 8	After ensuring safety for actual motions, increase the command voltage gradually and check motor motions.

5. Position Control Mode

1. Internal Position Command(Point Table)

Internal Position Command is used for the Positioner Drive function.
This function enables you to preset data for the Point Table in the amplifier and set up Point Numbers that you want to execute with I/O input from the host controller. When the start signal is input, positioning starts based on the user-selected Point No.

Positioner Drive

The Positioner Drive is a function for positioning operation based on I/O commands issued by the host controller such as PLC.
Homing can be performed in the user-equipment in which this product is installed.
The Point Table stores motion patterns and "Servo Studio" is used for the Point Table setup.
Testing the Positioner operation can be done with "Servo Studio".

1. Configuring Parameters

☞ Page 19 Required Parameters

2. Creating Point Table and Testing

To enable Positioner Drive, set the point table parameters. Use "Servo Studio" for the point table configuration.

☞ Page 20 Creating Point Table
☞ Page 25 Testing

Test the point table operation with "Servo Studio" before operation with user I/O.

☞ "Servo Studio" User's guide

3. Operation by User I/O

You can select a motion pattern from five typical motion patterns.

☞ Page 26 Operation by User I/O

Precautions

1. In case of the following, the motion started by the point table will be stopped and the remaining commands will be canceled.
   - ・The servo turns off.
   - ・Clear Deviation Counter is executed.
     (When Clear Deviation Counter is executed, the motor will make a quick stop.)

2. The motor moves according to the point table settings at the start time of Positioner operation. The current motion is not be affected by any changes made to the point table in the middle of the motion.

Required Parameters

1. Configuring Parameters

Set the operation mode.

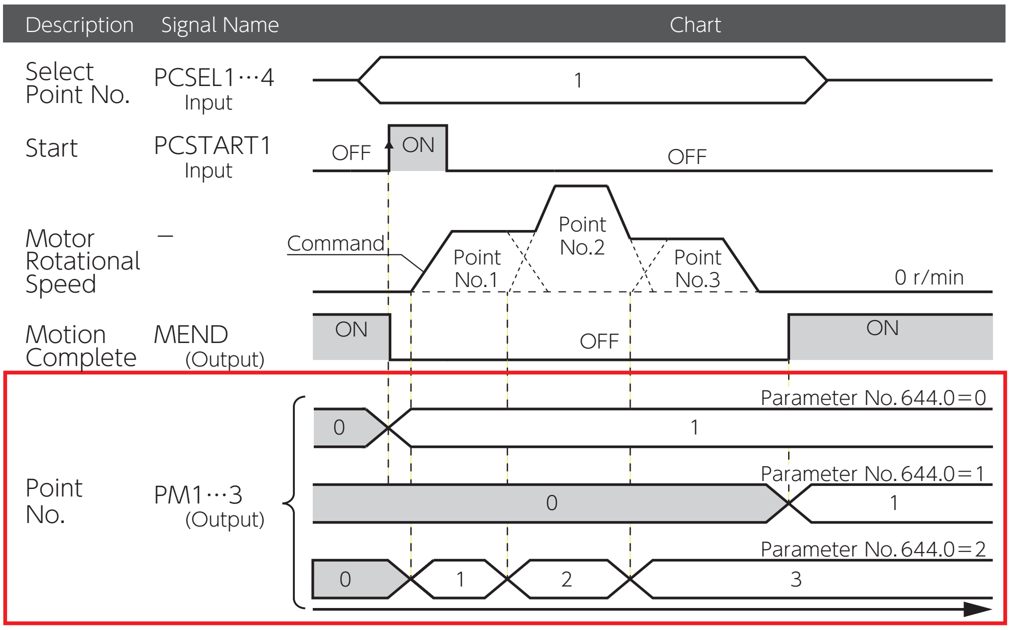
Name	Setting	Parameter No.
Control Mode	0: Position Control Mode (Default)	2.0
Command Mode	1: Pulse train command (Default) 3: Internal Command	3.0
Operation Mode (*1)	0: Using I/O input (Default) 1: Using Communication ("Servo Studio")	9.0
Internal Position Operation Mode	0: Point Table (Default)	642.0
Internal Position Overflow Detection	1: Enable overflow detection (Default)	643.0
Internal Position Point No. Output Method	Select the output timing for a point number. (Default:1 Upon motion complete) Set up this parameter when the I/O setting type is "Option 1". (*2) Otherwise, no need to be configured.	644.0

*1)The setting is 0 (I/O Operation) upon amplifier power on.
You can set this item only with "Servo Studio", not on the Setup Panel.

*2)You can specify output timing of subsequent point numbers.
The point number output format is illustrated at the bottom of the timing diagram below.

Example: Point Table Setting and Timing Diagram of the Point No. Output

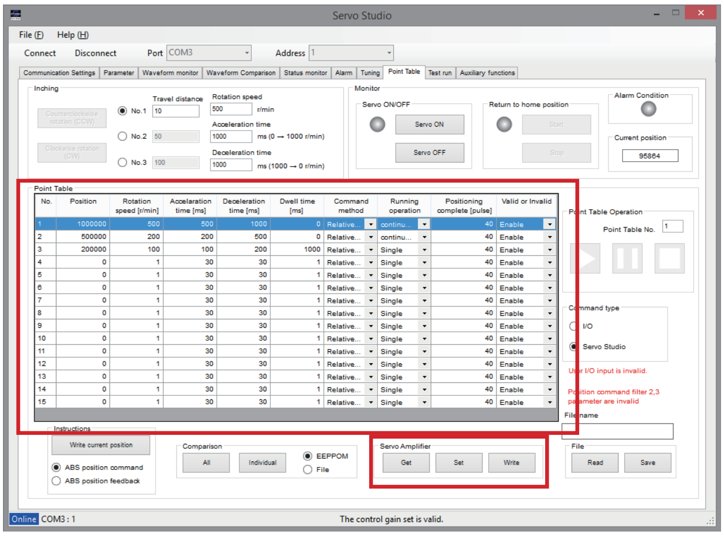
Point No.	Running Operation	Dwell Time
1	continuous	0
2	continuous	0
3	single	(any value)



Creating Point Table

Set the following items for the point table. Use "Servo Studio" for editing point table edit.
Set and Write the point table you created to the amplifier.

☞ "Servo Studio" User's guide



Port: COM3
Address: 1

● No.1 Travel distance: 10
○ No.2 50
○ No.3 100

Rotation speed: 500 r/min
Acceleration time: 1000 ms (0 → 1000 r/min)
Deceleration time: 1000 ms (1000 → 0 r/min)

Current position: 95864

Point Table

No.	Position	Rotation speed [r/min]	Accelaration time [ms]	Deceleration time [ms]	Dwell time [ms]	Command method	Running operation	Positioning complete [pulse]	Valid or Invalid
1	1000000	500	500	1000	0	Relative...	continu...	40	Enable
2	500000	200	200	500	0	Relative...	continu...	40	Enable
3	200000	100	100	200	1000	Relative...	Single	40	Enable
4	0	1	30	30	1	Relative...	Single	40	Enable
5	0	1	30	30	1	Relative...	Single	40	Enable
6	0	1	30	30	1	Relative...	Single	40	Enable
7	0	1	30	30	1	Relative...	Single	40	Enable
8	0	1	30	30	1	Relative...	Single	40	Enable
9	0	1	30	30	1	Relative...	Single	40	Enable
10	0	1	30	30	1	Relative...	Single	40	Enable
11	0	1	30	30	1	Relative...	Single	40	Enable
12	0	1	30	30	1	Relative...	Single	40	Enable
13	0	1	30	30	1	Relative...	Single	40	Enable
14	0	1	30	30	1	Relative...	Single	40	Enable
15	0	1	30	30	1	Relative...	Single	40	Enable

Point Table No. 1

Command type
○ I/O
● Servo Studio

User I/O input is invalid.

Position command filter 2,3 parameter are invalid

File name

● ABS position command
○ ABS position feedback

● EEPPOM
○ File

COM3 : 1

The control gain set is valid.

Item	No.	Range	Units
		(Fixed)	[-]
Description	This item indicates the point number specified by I/O command. By default, Homing is assigned to Point No. 0. The point table has 15 points. If you are not using the Homing function, Point No. 0 becomes available and the table can have 16 points. When the type of I/O assignments is "Option 1", the motion (No. 646.3) corresponding to Point No. 0 is set to 1 (point table motion).		

Item	Position	Range	Units
		−1,073,741,823 to +1,073,741,823	[encoder pulse]
Description	If Relative is selected as the Command method, The position data will determine the shift amount. A positive value indicates CCW rotation, a negative CW. If Absolute is selected as Command method, The position data will determine the target position. This value corresponds to ABS Position Command value (Status No. 74). Related to: Internal position: Overflow detection(No. 643.0)		

Item	Rotation speed	Range	Units
		1 to Maximum Rotational Speed of Motor	[r/min]
Description	Set the motor rotational speed during the Positioner operation. Set this item to a speed no higher than the max rotational speed of the motor.		

Item	Acceleration time	Range	Units
		0 to 5,000	[ms]
Description	Set this item to amount of time for rotational speed to increase from 0 r/min to 1,000 r/min.		

Item	Deceleration time	Range	Units
		0 to 5,000	[ms]
Description	Set this item to amount of time for the rotational speed to decrease from 1,000 r/min to 0 r/min.		

Item	Dwell time	Range	Units
		0 to 20,000	[ms]
Description	Set the wait time after Positioning Complete per the selected Point No. ■ Motion after the dwell time elapses "Single" Motion: MEND will be ON. "Continuous" Motion: the motion per the next point number will start. If Running Motion is "Continuous" and the dwell time is set to 0, the motion will be according to the speed specified by point numbers, one after another continuously. If the dwell time is set to 0, the acceleration/deceleration setting in the first point number selected upon CW start PCSTART1 ON will be applied, and the acceleration/deceleration time settings of subsequent point numbers will be discarded. ☞ Page 23 Positioning complete		

Item	Command method	Range	Units
		Relative, Absolute	[-]
Description	Absolute: the setting of Position will be the shift amount from the current position to the target position. Relative: the setting of Position will be the target position.		

5. Position Control Mode

Item	Running operation	Settings	Units
		Continuous, Single	[-]

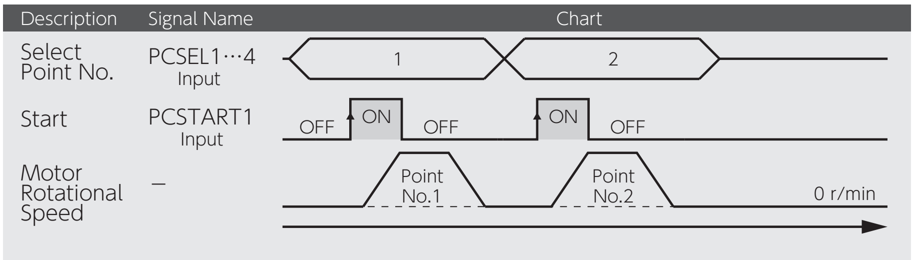
Description

Configuring Running Motion in the Point Table enables you to execute a series of continuous positioning motions and continuous speed changes.

☞ Page 24 Valid or Invalid

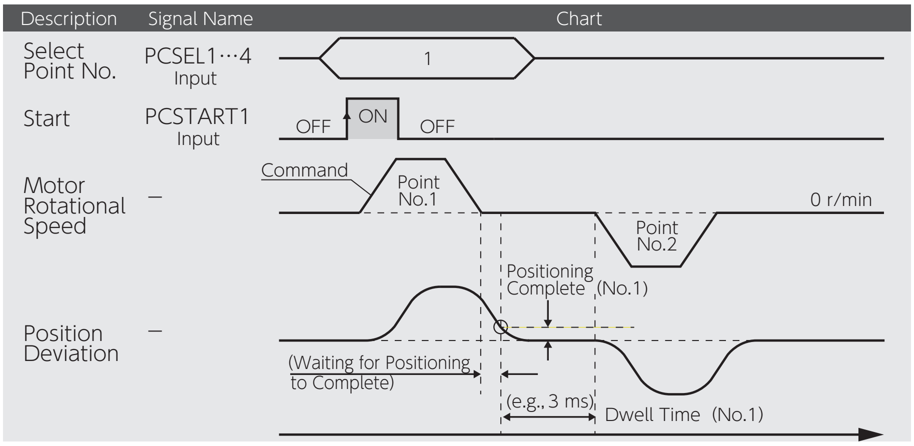
Single: After the motion specified by this point number is complete, the subsequent point numbers will not be executed.

Example: Point No. 1 and 2 are set to "Single".

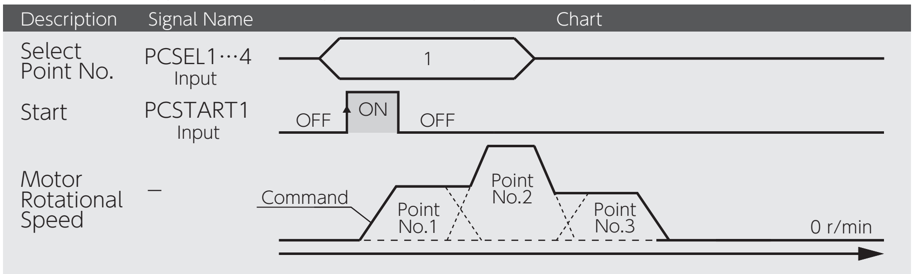


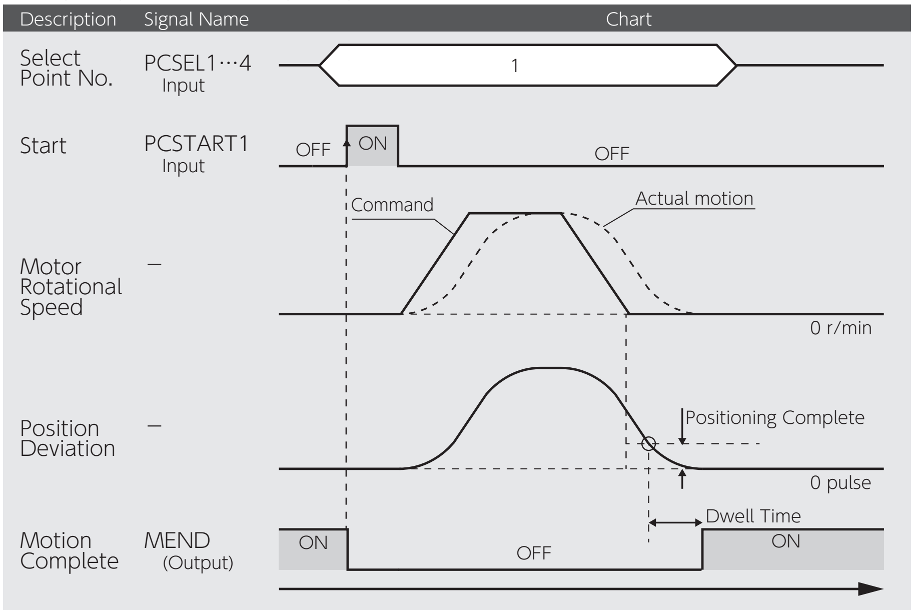
Continuous: the subsequent point number(s) will be executed.

Example If Running Motion = continuous and Dwell Time = 1 or above (for example, 3ms), then positioning will be executed according to each point. After whether or not the positioning is completed is determined, the motor will wait for the time-length of the Dwell time setting, and then will start the next motion.



Example If Running Motion = continuous and Dwell Time = 0, the motor will not stop and the rotational speed will change continuously.



Item	Positioning complete	Range	Units
		0 to 32,767	[encoder pulse]
Description	**Set a position deviation threshold to determine whether or not positioning is complete.** After the motion specified by the point number has been complete, when the position deviation falls in the range set by this item and then the Dwell time elapses, the MEND (motion end) signal turns ON. Timing Diagram (Positioning complete and Dwell time)  		

5. Position Control Mode

Item	Valid or Invalid	Setting	Units
		Enable, Disable	[-]

Description

This item indicates whether motion per a point number is enabled or disabled.

Settings

Disable:

The motion per the point number will not be executed and any subsequent point numbers that are enabled will be executed.

Enable:

The motion per the point number will be executed.

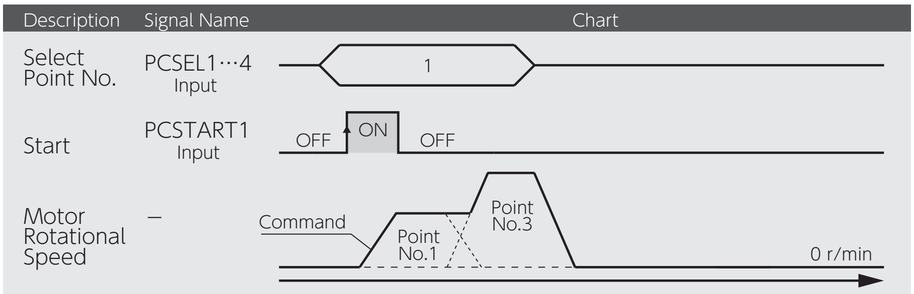
If you start with a point number that is "disabled",
The first subsequent point number that is "enabled" will be executed.

If a "disabled" point number is specified while one motion is being executed,
Motion per the "disabled" point number will not be executed and motion per the first "enabled" point number among the subsequent ones will be executed.

If Dwell time = "0" for a point number assigned "continuous"
The rotational speed will change continuously in motions per "enabled" point numbers before/after the "disabled" point number.

Here is an example.
In instructions with the Point Table settings below, if you specify Start signal input to Point No. "1", Point No. 2 won't be executed and Point No. 1 and 3 will be continuously executed.

Point No.	Running operation	Dwell Time	Enable/Disable
1	continuous	0	Enable
2	continuous	(optional)	Disable
3	single	(optional)	Enable



TIP

For a point number with "enable" to be the last motion, set Running Motion = "single". Otherwise (i.e. "continuous" setting to the last point number), its "enable" setting will keep the motion end signal (MEND) off and the next motion instruction will be not be executed. If this happened, do one of the following.

With User I/O
Turn the servo off or input Clear Deviation Counter.

With "Servo Studio"
Turn the servo off or click the STOP button.

Precautions for Testing

Before powering to each amplifier or motor, be sure that wiring has been performed correctly.

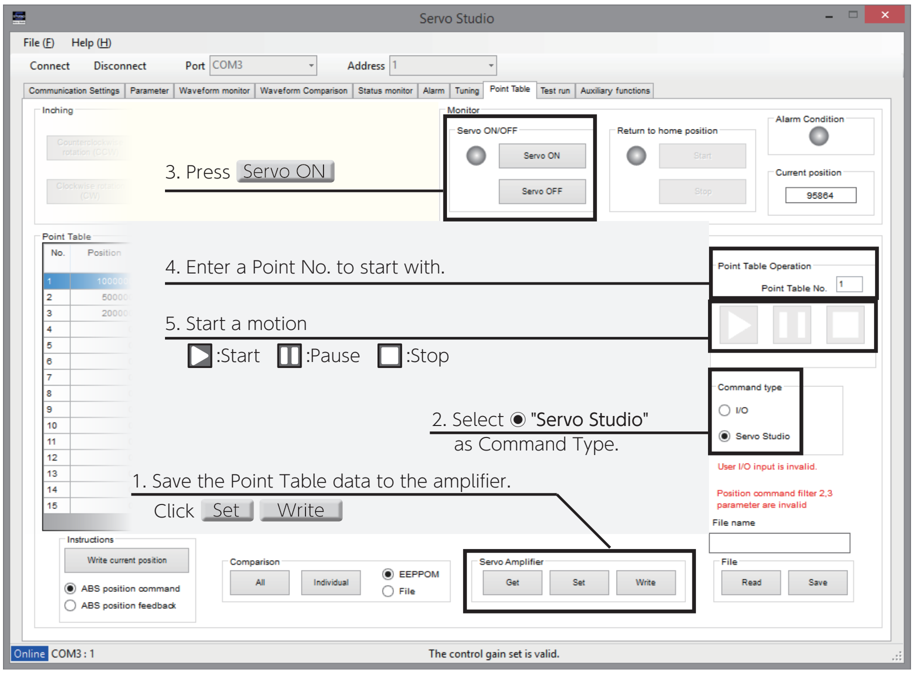
Set the parameters correctly before testing.

Check motor motions first with no machines being connected.

For a brake-equipped motor, be sure to disengage the brake before driving the motor.

Testing

Using "Servo Studio", check motions per the point table that you created.



1. Save the Point Table data to the amplifier.
Click Set Write

2. Select ● "Servo Studio" as Command Type.

3. Press Servo ON

4. Enter a Point No. to start with.

5. Start a motion
▶:Start ⏸:Pause ■:Stop

User I/O input is invalid.

Position command filter 2,3 parameter are invalid

The control gain set is valid.

☞ "Servo Studio" User's guide

5. Position Control Mode

Operation by User I/O

Refer to the corresponding pages of the following five typical motion patterns to set up a point table.

Motion Pattern		Refer to
Single-motion positioning		Page 28
Continuous positioning motions		Page 29
Continuous speed changes	One-direction motion	Page 30
	Opposite direction motion	Page 31
Press motion		Page 32

Procedure (Positioner operation by User I/O input)

Step	Description	Explanation
Step 1	Check if ready to start.	Check if MEND is closed. If it' s open, wait.
Step 2	Select Point No.	Input PCSEL1...4 to specify a Point No. to execute.
Step 3	Starting Positioner operation	Wait for at least 10ms after PCSEL1-4 input, and then change PCSTART1 from open to closed. Start driving the system according to the command per the point number specified. (*)
Step 4	Check command execution	Wait till MEND becomes open. When MEND is open, change PCSTART1 back to open.
Step 5	Check Operation Complete	Verify with MEND that the motion command execution is complete. MEND turning from open to closed indicates that the operation is complete.

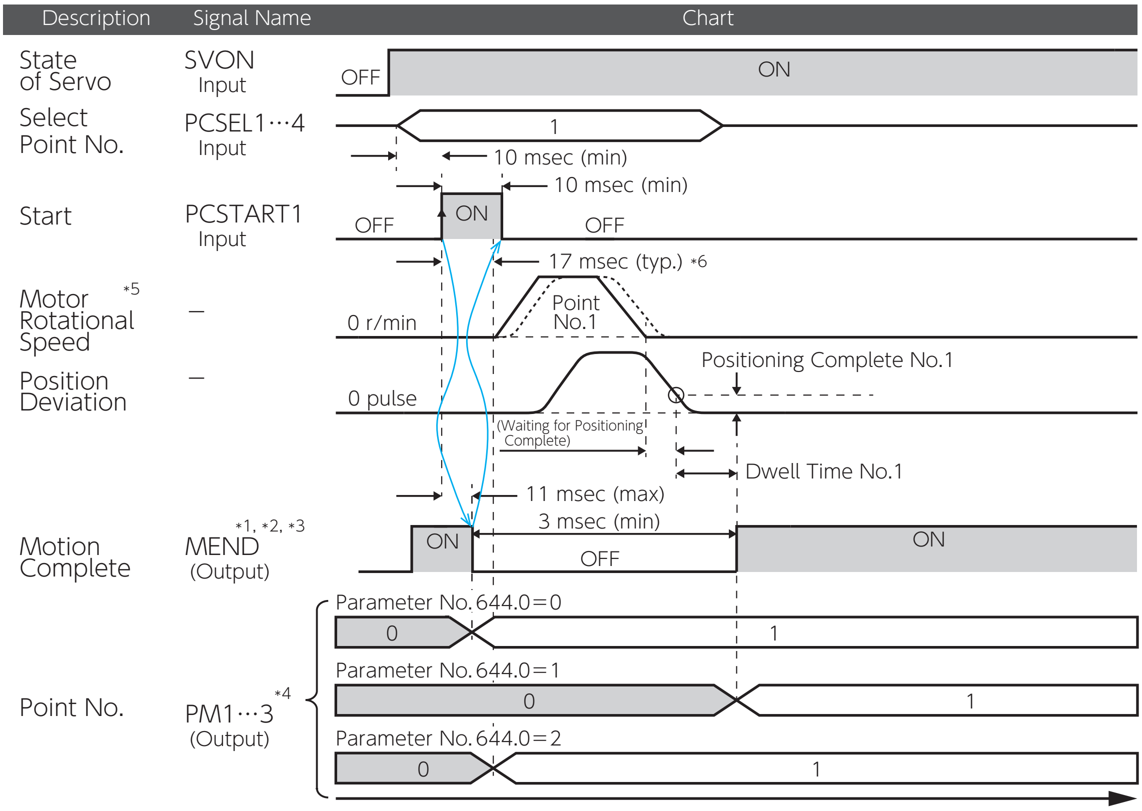
*) For more information about user I/O operation, refer to the timing diagrams shown in the operation examples.

Timing Diagram and Point Table Items

Create a point table entry for each motion command. Refer to the following timing diagram for single-motion.

Example of Point Table Setting (Single-Motion)

No.	Position	Rotational Speed [r/min]	Acceleration Time [ms]	Deceleration Time [ms]	Dwell Time [ms]	Command Method	Running Motion	Positioning Complete [pulse]	Enable/ Disable
1	5,000	300	100	150	1	Relative	single	(any value)	enable



*1) If you want to check the motion end signal (MEND) with the User I/O output "MEND/T-LIMIT", turn T-LIMIT output OFF, by parameter configuration and TLSEL1 OFF.

☞ 4 Connections

*2) The MEND output is OFF at Servo OFF.
*3) The PCSTART1 input is ignored when MEND output is OFF.
*4) This is enabled at the User I/O setting Option 1.
The Point No. output method depends on the [Point No. Output Method (No644.0)] setting at the time of PCSTART1 input.
*5) Any changes made to the point table setting during a motion will not be applied to the motion.
*6) The startup timing depends on other conditions.

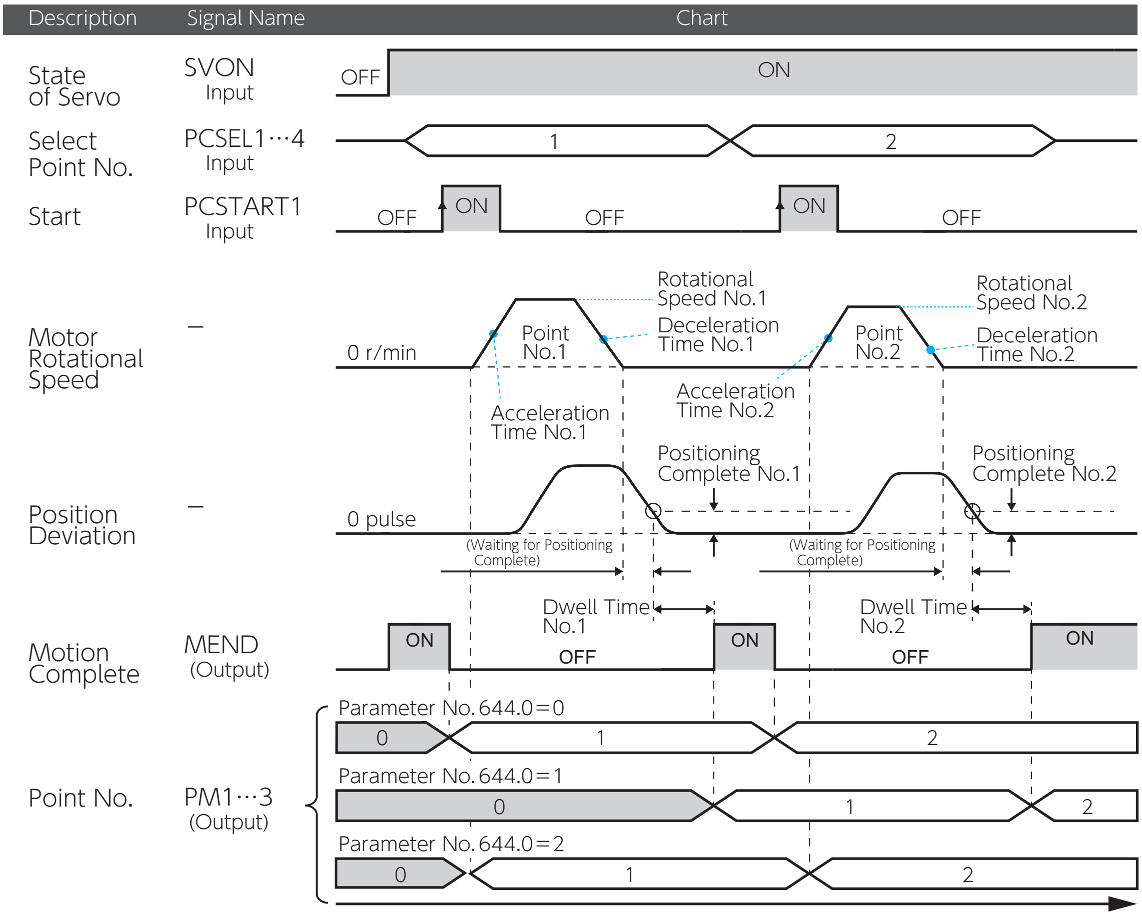
5. Position Control Mode

Example of Operation 1 Single-Motion Positioning

Motor motion stops when motion per a selected point number ends if its Running Motion setting = single.

Example of Point Table Setting (Single-Motion Positioning)

No.	Position	Rotational Speed [r/min]	Acceleration Time [ms]	Deceleration Time [ms]	Dwell Time [ms]	Command Method	Running Motion	Positioning Complete [pulse]	Enable/ Disable
1	5,000	300	100	150	100	Absolute	**Single**	20	enable
2	3,000	200	100	100	50	Relative	**Single**	20	enable



Example of Operation 2 Continuous Positioning Motions

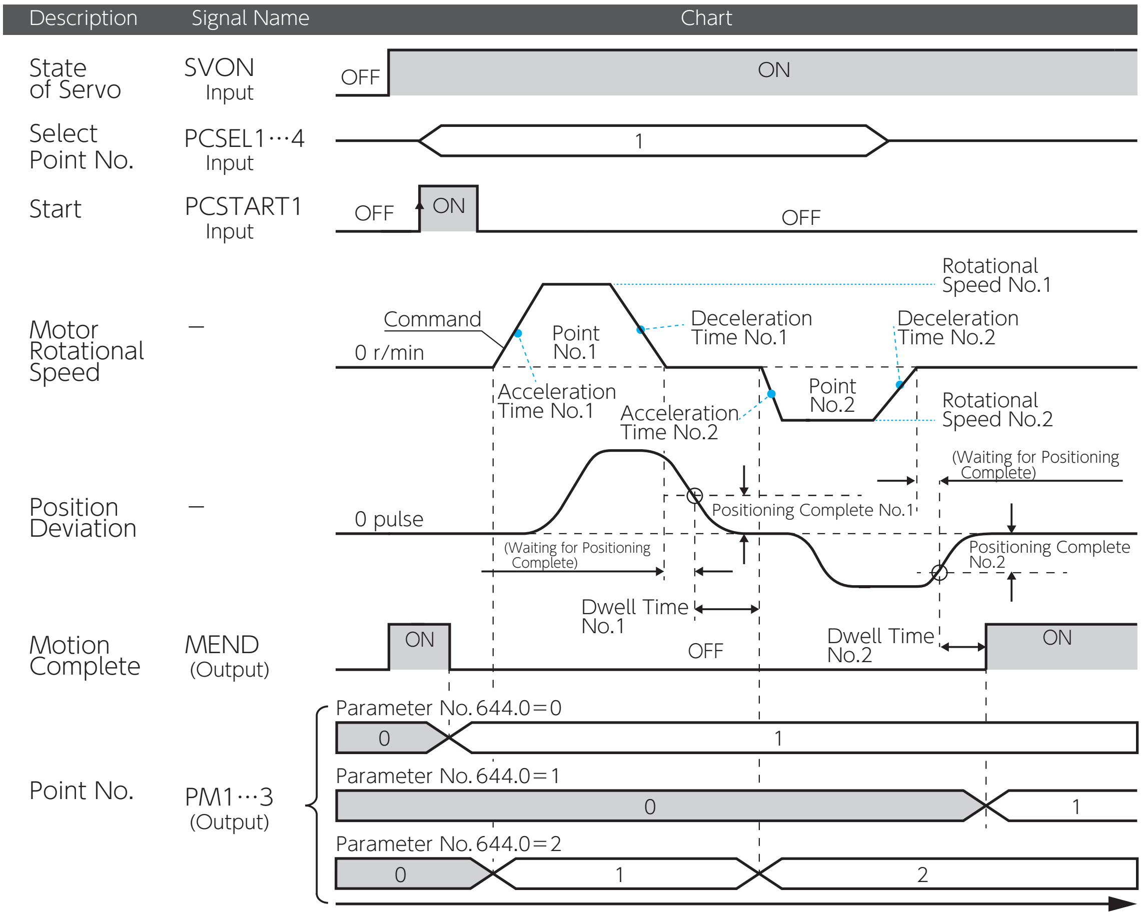
This procedure executes a series of positioning motions in order of the point numbers.
Set Running Motion of "enabled" point numbers to "continuous", and specify the first point number for turning on the CW drive signal PCSTART1.

For this motion group, set Dwell Time = 1 ms or higher.

Example of Point Table Setting (Continuous Positioning Operations)

No.	Position	Rotational Speed [r/min]	Acceleration Time [ms]	Deceleration Time [ms]	Dwell Time [ms]	Command Method	Running Motion	Positioning Complete [pulse]	Enable/ Disable
1	5,000	300	100	150	100	Absolute	continuous	20	enable
2	−6,000	200	100	100	50	Relative	Single	20	enable

For the last "enabled" point number, set Running Motion = "single".
he acceleration/deceleration setting of the first point number that is selected upon CW start PCSTART1 ON will be applied, and the settings of subsequent point numbers will be discarded.



Example of Operation 3 Continuous Speed Changes (Positioning in One Direction)

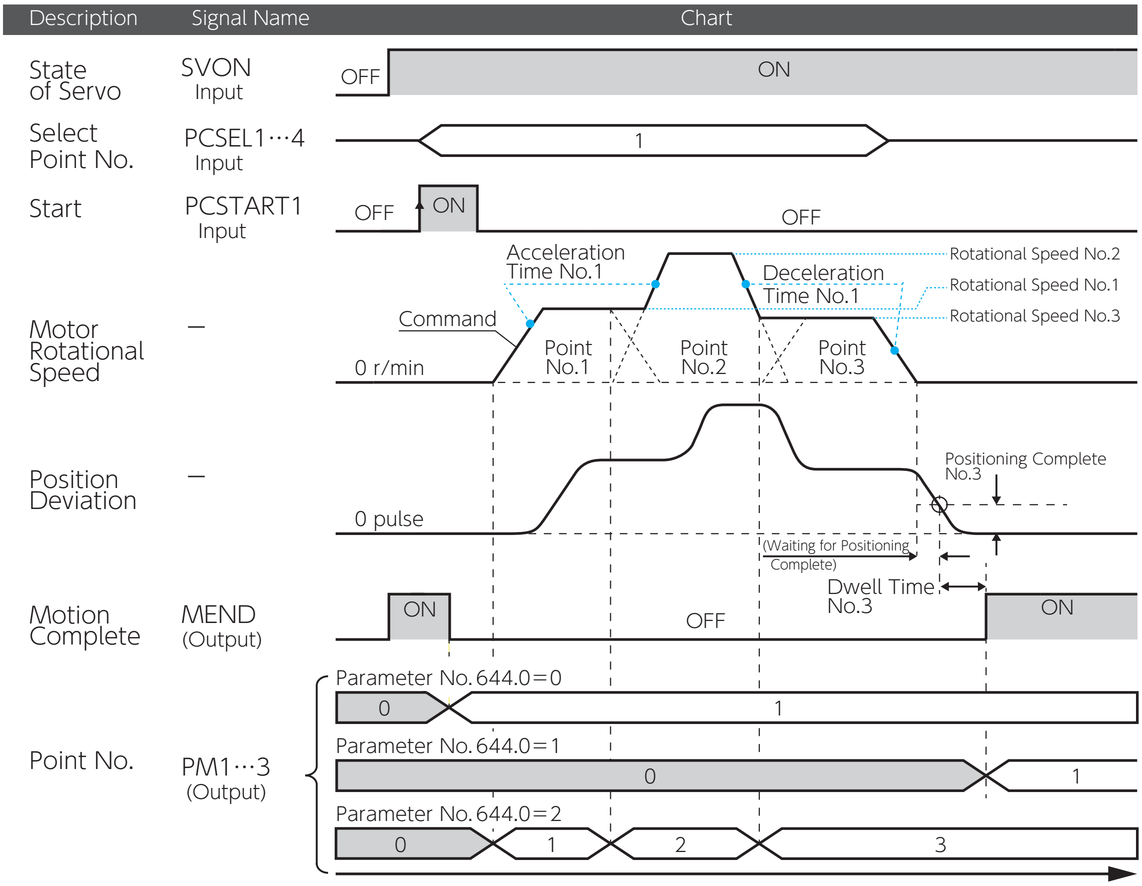
This procedure executes a series of positioning motions in order of the point numbers. Motion instructions per point numbers are executed with no interruptions and the rotational speed changes continuously. Positioning motions will continue up to (not including) the point number whose Running Motion is "single".
Set Running Motion of all enabled point numbers to "continuous", and specify the first point number for turning on CW drive signal PCSTART1.

For this motion group, set Dwell Time = 0 ms.

Example of Point Table Setting (for motions with continuous speed changes in one direction)

No.	Position	Rotational Speed [r/min]	Acceleration Time [ms]	Deceleration Time [ms]	Dwell Time [ms]	Command Method	Running Motion	Positioning Complete [pulse]	Enable/ Disable
1	5,000	200	100	200	0	Relative	continuous	20	enable
2	3,000	300	(disable)	(disable)	0	Relative	continuous	20	enable
3	2,000	100	(disable)	(disable)	20	Relative	Single	20	enable

For the last enabled point number, set Running Motion = "single".
If Dwell Time = 0, the acceleration/deceleration setting of the first point number that is selected upon CW start PCSTART1 ON will be applied, and the settings of subsequent point numbers will be discarded.



Example of Operation 4 Continuous Speed Changes (Positioning to Opposite Direction)

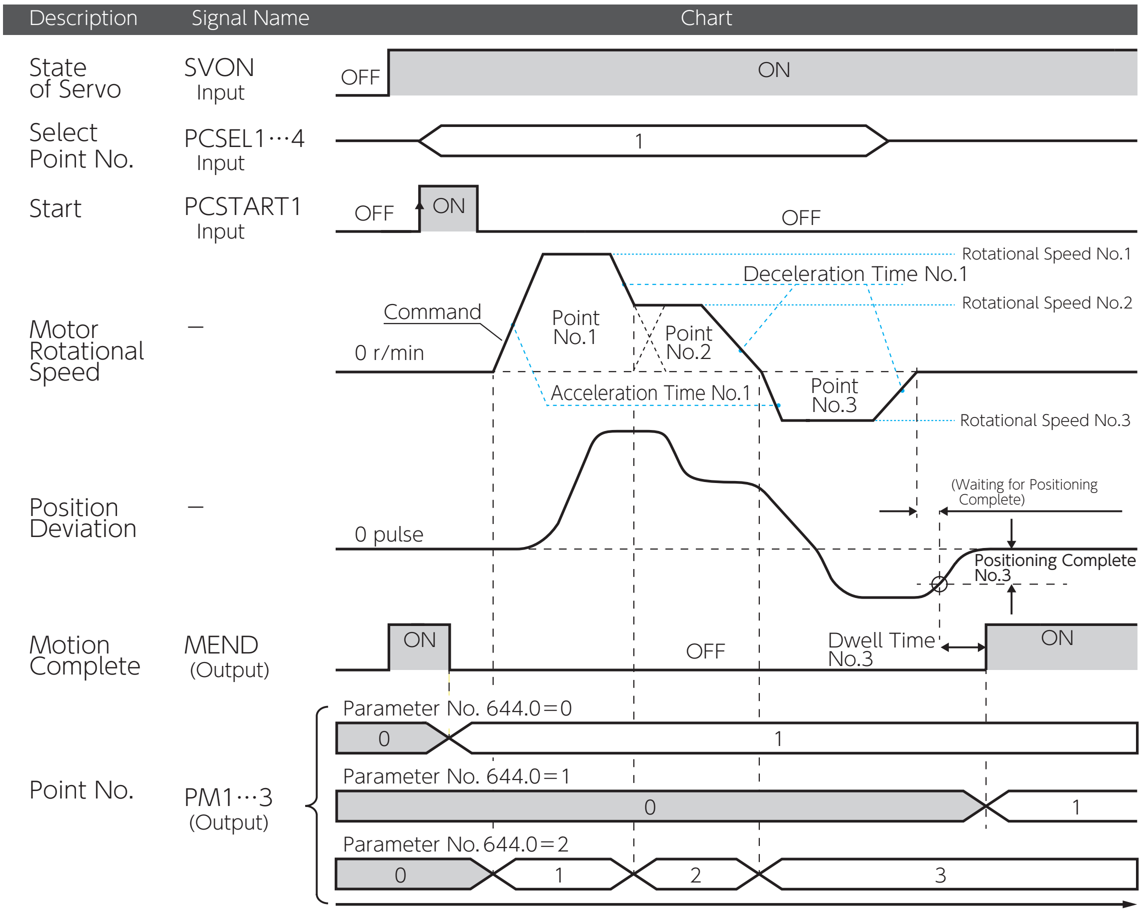
This procedure executes a series of positioning motions in order of the point numbers. Motion instructions per point numbers are executed with no interruptions and the rotational speed changes continuously. Positioning motions will continue up to (not including) the point number whose Running Motion is "single".
Set Running Motion of all enabled point numbers = "continuous", and specify the first point number for turning on CW drive signal PCSTART1.

For this motion group, set Dwell Time = 0 ms.

Example of Point Table Setting (for motions with continuous speed changes in reverse direction)

No.	Position	Rotational Speed [r/min]	Acceleration Time [ms]	Deceleration Time [ms]	Dwell Time [ms]	Command Method	Running Motion	Positioning Complete [pulse]	Enable/ Disable
1	5,000	300	100	200	**0**	Relative	**continuous**	20	enable
2	3,000	200	(disable)	(disable)	**0**	Relative	**continuous**	20	enable
3	−4,000	100	(disable)	(disable)	**20**	Relative	**Single**	20	enable

For the last enabled point number, set Running Motion = "single".
The acceleration/deceleration setting of the first point number that is selected upon CW start PCSTART1 ON will be applied, and the settings of subsequent point numbers will be discarded.



Example of Motion 5 Press Motion

This operation involves motion to approach to workpiece at high speed, then execute a press motion to the workpiece after changing the values of speed and torque.
You can use this type of operation only when User I/O is the Option I/O Configuration.

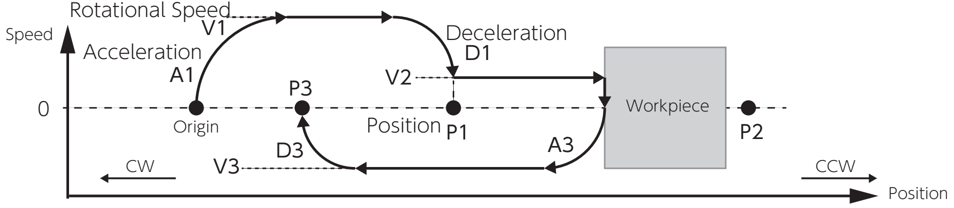
Set the following parameters.

Name		Explanation	Parameter No.
Torque command limit	Switch	Set to 1 (enable).	144.0
	Value 1	Set the torque limit value for motion of approaching to the workpiece at high speed and leaving the workpiece.	147.0
	Value 2	Set the torque command limit to be applied at the time of press-to-workpiece motion.	148.0
Torque limiting output		2: Set Torque command limit: Value 2 (No. 148.0) = Enable	144.1
Position Deviation Error Detection	Switch	Specify what to output when excessive position deviation is detected.	65.0
	Value	This parameter sets a threshold value for a position deviation error detection. To let the detection function work, set a value larger than the distance between the target location of press motion and the workpiece.	87.0
	Delay time	Specify how long a position deviation error waits to be output after position deviation exceeds the Position deviation error detection: Value (No. 87.0) setting.	89.0
Speed Deviation Error Detection	Switch	Enable/Disable Speed Deviation Error Detection.	65.1
	Value	This parameter sets a threshold value for a speed deviation error detection.	90.0
	Delay time	Specify how long a speed deviation error waits to be output after the speed deviation exceeds the Speed deviation error detection: Value (No. 90.0) setting.	91.0
Point Table Point Number Output Method		Set to 2: output the point number at its motion start.	644.0

☞ 5 **Setting Parameters**

5. Position Control Mode

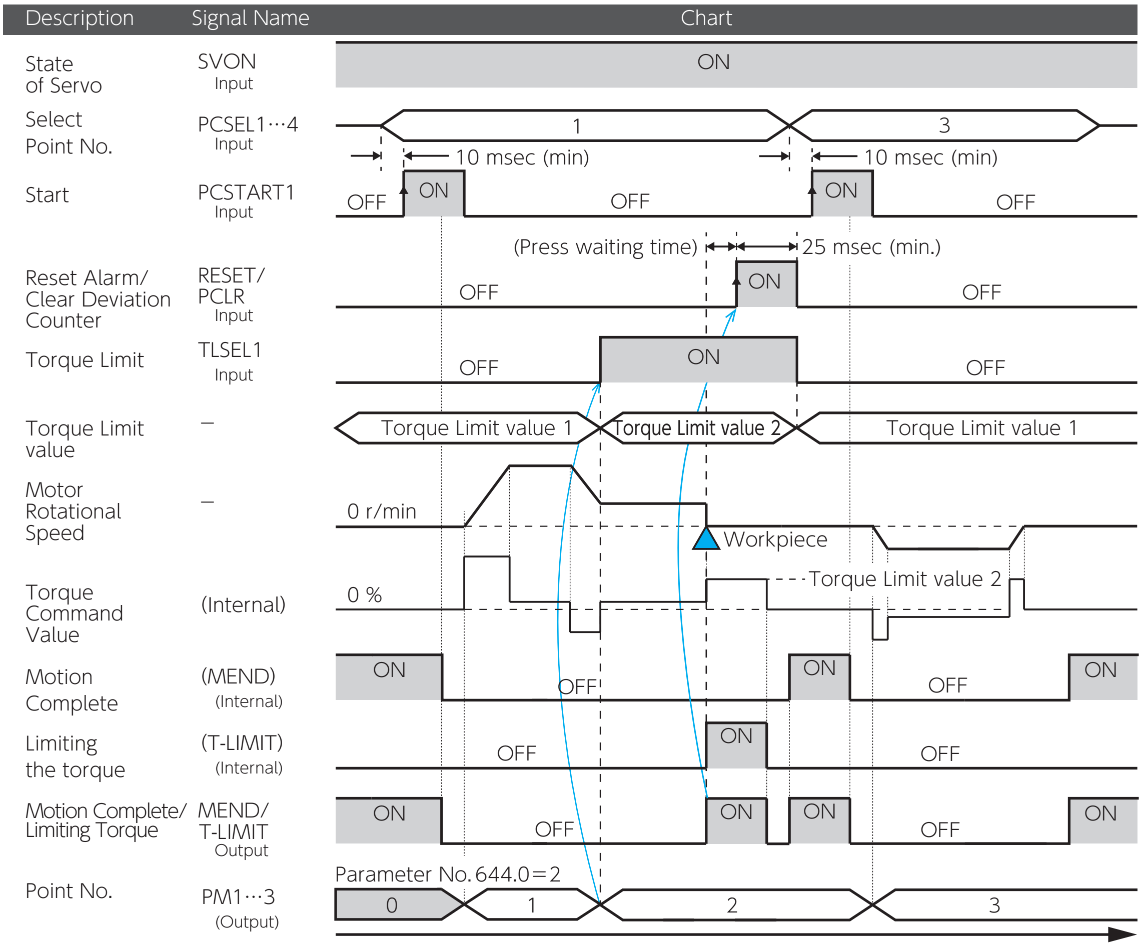
The following example illustrates Point Table settings with Point No. 1 (P1) for motion of approaching to a workpiece, Point No. 2 (P2) for motion of pressing the workpiece, Point No. 3 (P3) for motion of parting from the workpiece.



Example of Point Table Setting (Press Motion)

No.	Position	Rotational Speed [r/min]	Acceleration Time [ms]	Deceleration Time [ms]	Dwell Time [ms]	Command Method	Running Motion	Positioning Complete [pulse]	Enable/ Disable
1	**(P1)**	**(V1)**	(A1)	(D1)	0	Absolute	continuous	0	enable
2	**(P2)**	**(V2)**	(disable)	(disable)	(disable)	Absolute	Single	0	enable
3	**(P3)**	**(V3)**	(A3)	(D3)	(any value)	Absolute	Single	(any value)	enable

P1: Specify the target location with high-speed approach.
V1: Specify the speed of approaching to the workpiece.
P2: Specify the location across the workpiece.
V2: Specify the speed of pressing the workpiece.
P3: Destination



Procedure for Press Motion

Step	Operation
Step 1	**Check if ready to start.** Open TLSEL1 and select Torque Limit 1 as torque limit value. Verify that MEND/T-LIMIT is closed. Wait if it's open. ☞ Page 24 Valid or Invalid
Step 2	**Select Point No.** Input the point number for approach-to-workpiece motion to PCSEL1...3. (Point No. 1 in this example)
Step 3	**Start Point Table Motion** Wait for at least 10 ms after input of PCSEL1...3, and then change the PCSTART1 status from open to closed. The motion starts per the setting of the point number specified.
Step 4	**Check command execution** Wait until MEND/T-LIMIT becomes open. If it's open, reset PCSTART1 to open.
Step 5	**Verity the start Point No. with** Verify the point number that was started by the PM1...3 input. When the point number of Press motion is output (No. 2 in this example), close TLSEL1, and select Torque Limit Value 2 as the torque limit value.
Step 6	**Check Torque Limit Status** Check the torque limit status with MEND/T-LIMIT and wait until it becomes closed.
Step 7	**Clear Deviation Counter** After MEND/T-LIMIT becomes closed, wait for the desired press time, then close RESET/PCLR to execute Clear Deviation Counter. Wait for at least 25 ms after RESET/PCLR, input, and then reset RESET/PCLR to open.
Step 8	**Check if ready to start.** Open TLSEL1 and select Torque Limit 1 as the torque limit value. Verify that MEND/T-LIMIT is closed.
Step 9	**Select Point No.** Input a point number for the leaving-workpiece motion to PCSEL1···3. (No. 3 in this example)
Step 10	**Start Point Table Motion** Wait for at least 10 ms after input of PCSEL1...3, and then change the PCSTART1 status from open to closed. Motion starts according to the specified Point No. settings.
Step 11	**Check command execution** Wait until the MEND/T-LIMIT becomes open. If it's open, change PCSTART1 back to open.
Step 12	**Check Operation Complete** Verify with MEND/ T-LIMIT that the motion command execution is complete. MEND/T-LIMIT turning from open back to closed indicates that the motion is complete.

2. Homing

Homing is an operation to make the coordinate per command in the amplifier and the coordinate of machine agree. When you are using the Positioner function of the amplifier, perform homing, as necessary.

In incremental systems:

homing is necessary every time the system is powered on.

In absolute systems:

encoder data is retained by the backup batter. Once you perform homing at the time of installation, homing is unnecessary at power on even after the control power turns off.

☞ 9 Appendices Absolute System

■ Homing Methods

User I/O input	☞ Page 36
"Servo Studio"	☞ Page 37

■ Types of Homing

There are three patterns of homing.
Select the parameters to set depending on the motion patterns that you need for homing.

User-Specified Position	☞ Page 40
Press (Stopper)	☞ Page 42
Home Sensor (Dog) (*)	☞ Page 44

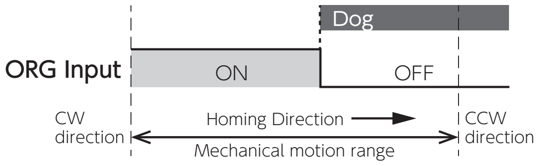
*) To perform Homing by using Home Sensor, use I/O input. "Servo Studio" doesn't not support Homing with Home Sensor.

Precautions

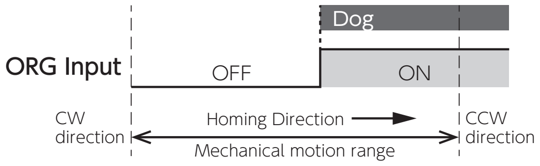
Homing based on home position dog-front-end

Install the home position dog at the machine-end. Set **HOMING: Movement direction** (No. 646.0) to the direction of moving from the front of the dog towards the dog-front-end.
Setting the homing direction to the leaving-dog direction (to the left of dog below) may result in a collision to the machine end.

Parameter No. 646.1 = 0
Detecting the home dog when ORG input= OFF



Parameter No. 646.1=1
Detecting the home dog when ORG input = ON



If you changed the command paired-pulse ratio value,

perform homing again after saving the parameters and power cycling.

If you execute Homing by using encoder Z-phase,

configure the start point of Z-phase detection not close to motor Z-phase. Otherwise, the detection position of Z-phase may become inconsistent. The Z-phase position can be checked by the position where the "encoder single-turn data" becomes 0.

If any of the following occurs during homing involving instructed motions,

homing will be interrupted resulting in a Homing Incomplete state.

- Servo turns off.
- Clear Deviation Counter is executed. When Clear Deviation Counter is executed, the motor will make a quick stop.
- Drive Restriction is input and Clear Deviation Counter is executed.

5. Position Control Mode

Homing with User I/O Input

Required Parameters

Set the operation mode.

Name	Setting	Parameter No.
Control Mode	0: Position Control Mode	2.0
Command Mode	3: Internal Command Mode	3.0
Operation Mode (*)	0: I/O input 1: Communication ("Servo Studio") input	9.0
Internal Position Operation Mode	0 : Point Table	642.0

*)Operation Mode (No. 9.0) = 0 (I/O) upon amplifier power on.
The Setup Panel does not support display or setup of Operation Mode.

Step	Operation
Step 1	**Set Homing related parameter values** Set the values of Homing Speed, Homing Creep Speed, and Homing Acceleration/Deceleration Time.
Step 2	**Check if Homing can be started.** Check if MEND is closed. If it's open, wait.
Step 3	**Specify the Point Number (in the standard I/O setting only)** Open all four of PCSEL1…4 to specify Point No. 0. (This step is not necessary for the Option I/O setting.)
Step 4	**Start Homing motions** Verify that MEND is closed in a servo-on state, and then start Homing. If MEND is open in a servo-on state, the start command will not be accepted. In Standard I/O Setting Close PCSTART1 input. (at least 10 ms after Step 3) In Option I/O Setting Set HOME to closed. (at least 10 ms after Step 3)
Step 5	**Check Command Execution** Wait for MEND to become open. Open PCSTART1 or HOME after verifying that MEND is open.
Step 6	**Check Operation Complete** Use MEND to see if the motion command execution is complete. MEND turning from open to close indicates that the motion is complete.
Step 7	**Check Homing Complete** After the motion is complete, use HEND to see if Homing is complete. HEND turning from open to closed indicates that the homing procedure is complete.

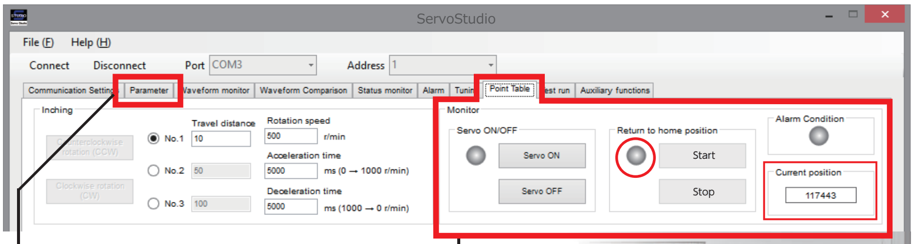
Homing with "Servo Studio"

Required Parameters

Set the operation mode.

Name	Setting	Parameter No.
Control Mode	0: Position Control Mode	2.0
Command Mode	3: Internal Command Mode	3.0
Operation Mode (*)	0: I/O input 1: Communication ("Servo Studio") input	9.0
Internal Position Operation Mode	0: Point Table	642.0

*)Operation Mode (No. 9.0) = 0 (I/O) upon amplifier power on.
The Setup Panel does not support display or setup of Operation Mode.



Port COM3
Address 1
Travel distance: ● No.1 10; ○ No.2 50; ○ No.3 100
Rotation speed 500 r/min
Acceleration time 5000 ms (0 → 1000 r/min)
Deceleration time 5000 ms (1000 → 0 r/min)
Current position 117443

1. Parameter Tab

Setting homing parameters

2. Point Table Tab

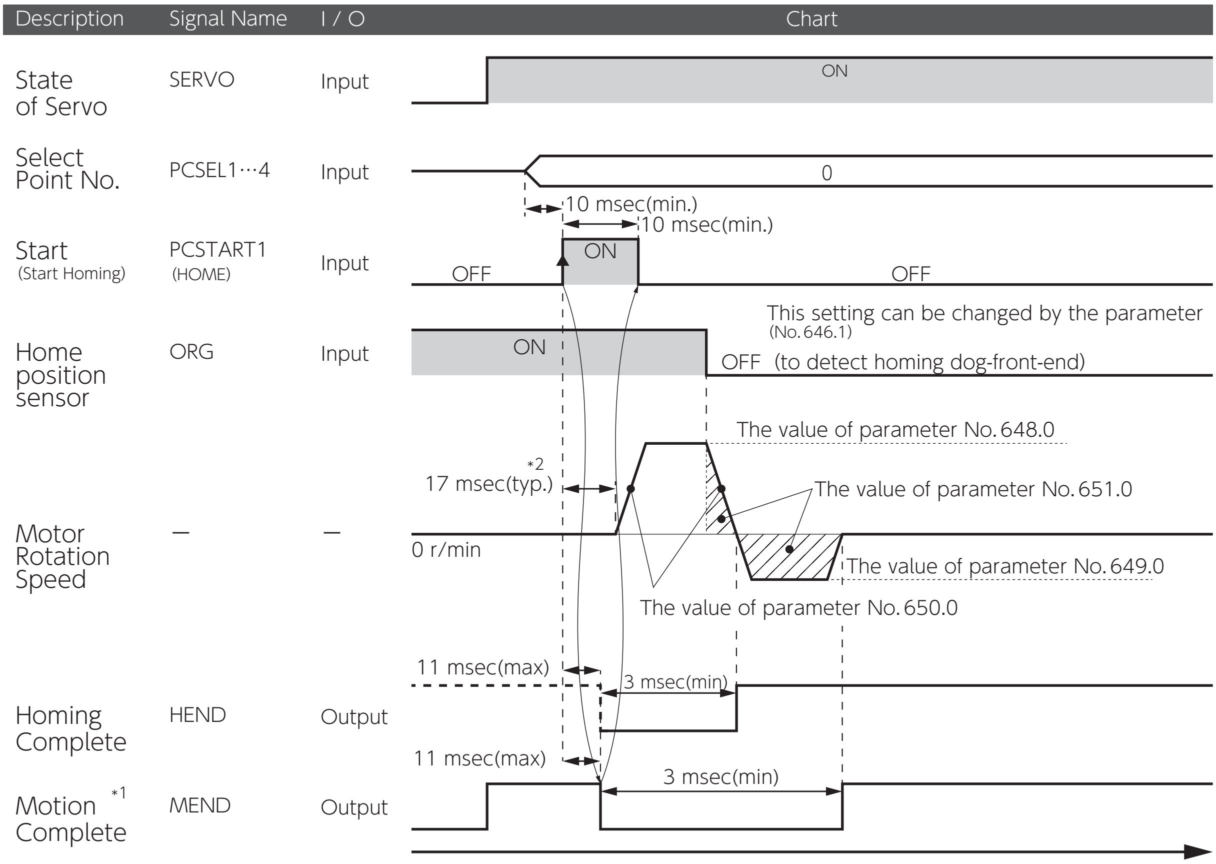
Click Servo ON
(Have the motor in a Servo-ON state)

3. Click Start to start homing

- Click Pause to pause homing.
- When homing is completed, the indicator to the left of the Start button will turn green and the Current position cell will show the current position resulting from homing.

Timing diagram

The following illustrates how to perform Homing with User I/O Input. Homing based on home-dog-front-end is used in the example below.



*1) If you want to check the operation end signal (MEND) with the User I/O output "MEND/T-LIMIT", turn T-LIMIT output OFF, by parameter configuration and TLSEL1 OFF.
*2) The startup timing depends on other conditions.

Types of Homing Motions

Homing movement comprises two segments: Rough Approach and Careful Approach. Specify the motion type by configuring multiple parameters differently.

Homing = Rough Approach (Lunge motion) + Careful Approach (Creep motion)

Rough Approach (Lunge motion)

Indicates a motion type to detect the stopper or the dog. Configure this part of homing so that homing will be as accurate as possible in the second segment of homing.

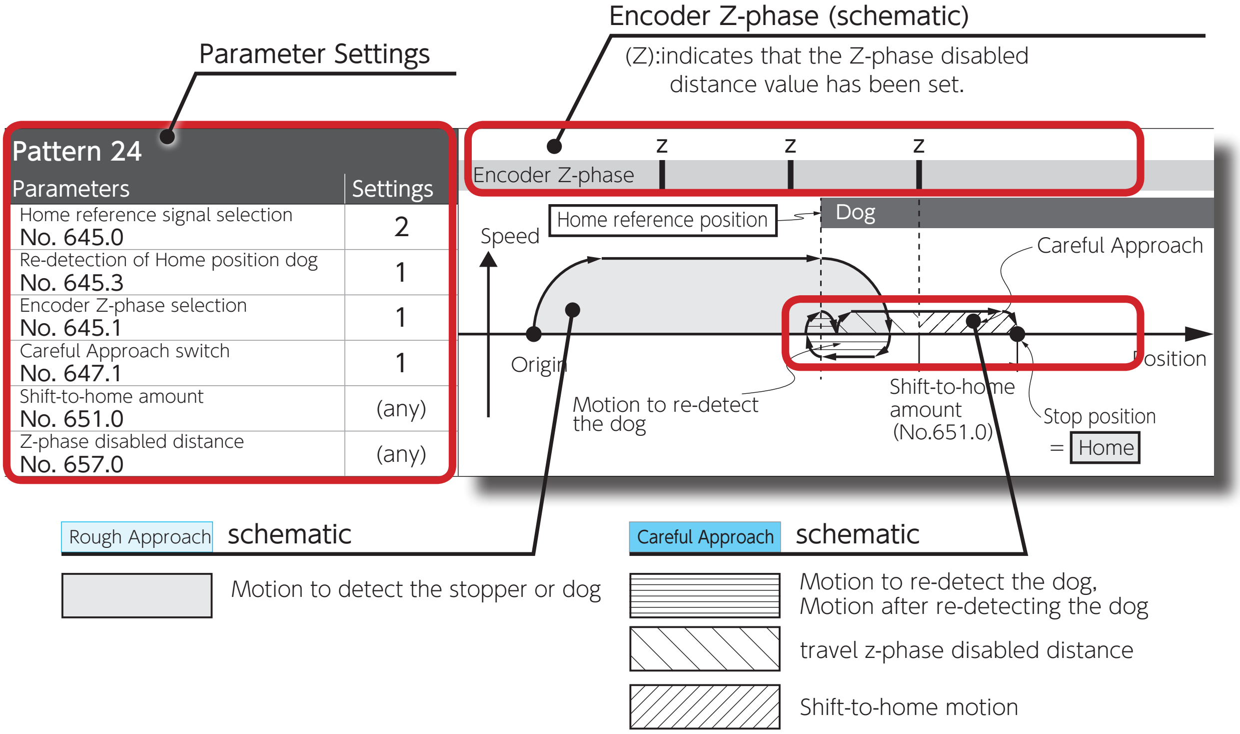
Careful Approach (Creep motion)

Indicates a motion type to approach to the home position slowly and accurately after the detection of stopper, dog or base signal.

This motion group includes the following:

- motion to detect Z-phase
- travel over the Z-phase disabled distance
- movement from the base to home after base signal detected.
- motion to detect the dog again
- motion after re-detecting the dog

How to read homing motion patterns



Pattern 24

Parameters	Settings
Home reference signal selection No. 645.0	2
Re-detection of Home position dog No. 645.3	1
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	(any)
Z-phase disabled distance No. 657.0	(any)

Rough Approach schematic

▭	Motion to detect the stopper or dog

Careful Approach schematic

☰	Motion to re-detect the dog, Motion after re-detecting the dog
▧	travel z-phase disabled distance
▨	Shift-to-home motion

Homing Based on User-Specified Position(No. 645.0=0)

This operation indicates the type of homing based on the starting point.

This type of homing operation enables you to specify any position as the home position without turning the servo on, for example, by manually moving the machine to any desired home position. In addition, this method enables the encoder z-phase to be detected without involving stopper or dog.
This type of homing does not involve the Rough Approach motion group.

Set the following related parameters.

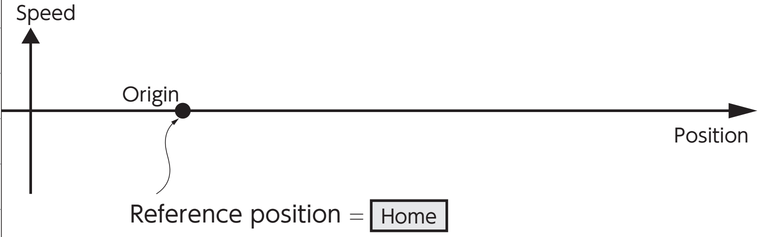
Group	Name	Parameter No.
Homing Overall	Home reference signal selection (arbitrary position, stopper, dog)	645.0 (*)
	Movement direction	646.0
	Acceleration/Deceleration time (Common in "Rough approach speed" and "Careful approach speed")	650.0
	Home position data	653.0
Careful approach	Careful approach switch	647.1 (*)
	Encoder Z-phase Selection	645.1 (*)
	Z-phase disabled distance	657.0 (*)
	Careful approach speed	649.0
	Amount of position shift to home (travel distance from base signal or z-phase to home)	651.0 (*)
Common	Internal Position - Motion of Point No. 0	646.3
	Homing: Torque command limit	647.0
	Homing: Timeout Switch	646.2
	Homing: Timeout Time	659.0

*) Parameters to define the homing pattern.

Refer to the patterns from 1 to 6 below to set the parameters.

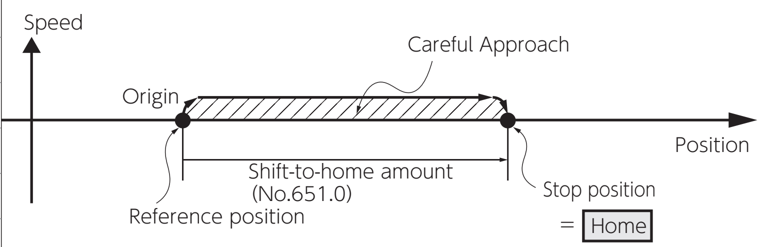
Pattern 1

Parameters	Settings
Home reference signal selection No. 645.0	0
Encoder Z-phase selection No. 645.1	0
Careful Approach switch No. 647.1	0
Shift-to-home amount No. 651.0	0
Z-phase disabled distance No. 657.0	0



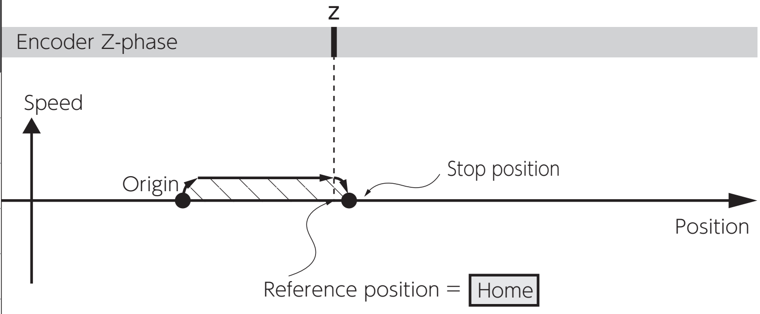
Pattern 2

Parameters	Settings
Home reference signal selection No. 645.0	0
Encoder Z-phase selection No. 645.1	0
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	(any)
Z-phase disabled distance No. 657.0	0



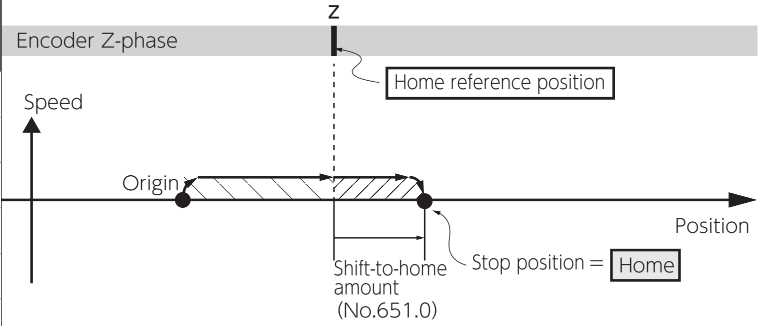
Pattern 3

Parameters	Settings
Home reference signal selection No. 645.0	0
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	0
Z-phase disabled distance No. 657.0	0



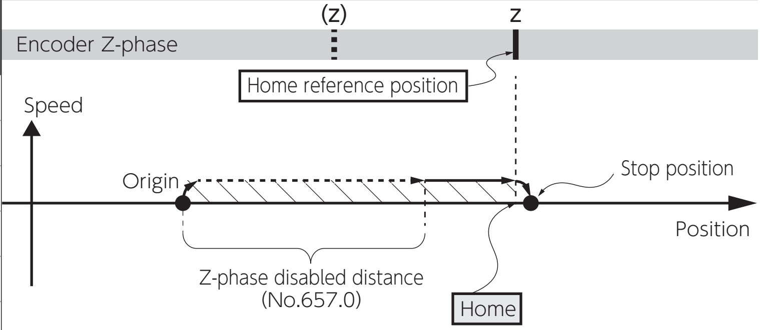
Pattern 4

Parameters	Settings
Home reference signal selection No. 645.0	0
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	(any)
Z-phase disabled distance No. 657.0	0



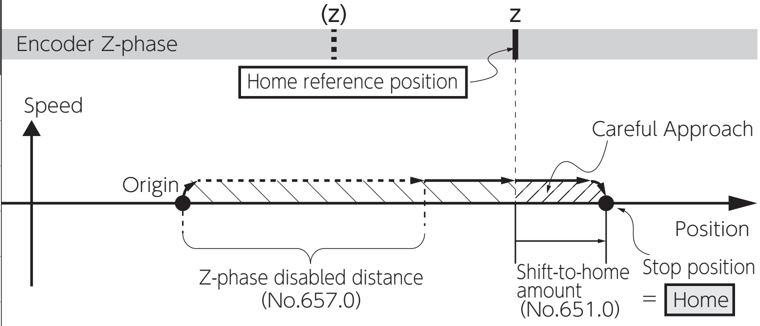
Pattern 5

Parameters	Settings
Home reference signal selection No. 645.0	0
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	0
Z-phase disabled distance No. 657.0	(any)



Pattern 6

Parameters	Settings
Home reference signal selection No. 645.0	0
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	(any)
Z-phase disabled distance No. 657.0	(any)



Homing based on Press (Stopper)(No. 645.0=1)

This operation indicates the type of homing based on the stopper position.

You can use this type of homing by setting the home based on the position of the stopper being pressed per the motor movement.
There are three options for what to be set as "home" (after detection of stopper pressed motion): 1) stopper position, 2) encoder z-phase, 3) user-specified position shifted from stopper or z-phase.

Set the following parameters related to this type of homing.

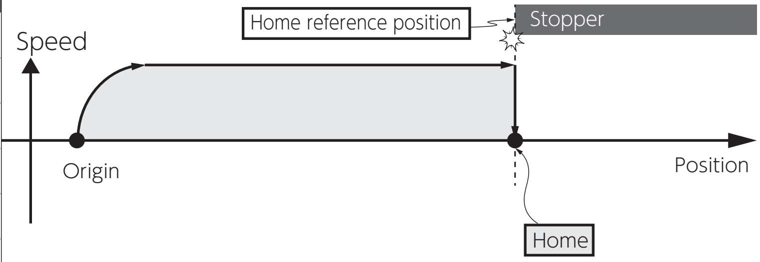
Group	Name	Parameter No.
Homing Overall	Home reference signal selection (arbitrary position, stopper, dog)	645.0 (*)
	Movement direction	646.0
	Acceleration/Deceleration time (Common in "Rough approach speed" and "Careful approach speed")	650.0
	Home position data	653.0
Rough approach	Rough approach speed	648.0
	Stopper pressed detection time	655.0
	Torque command limit: Value	656.0
Careful approach	Careful approach switch	647.1 (*)
	Encoder Z-phase Selection	645.1 (*)
	Z-phase disabled distance	657.0 (*)
	Careful approach speed	649.0
	Amount of position shift to home (travel distance from base signal or z-phase to home)	651.0 (*)
Common	Internal Position: Motion of Point No. 0	646.3
	Homing: Torque command limit	647.0
	Homing: Timeout Switch	646.2
	Homing: Timeout Time	659.0

*) Parameters to define the homing patterns.

Refer to the patterns 7 to 12 to configure the parameters.

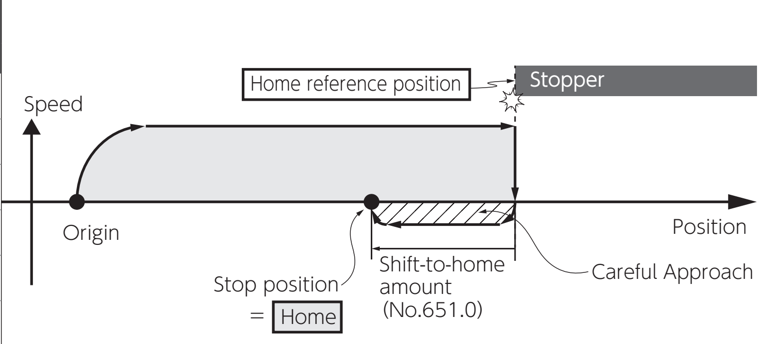
Pattern 7

Parameters	Settings
Home reference signal selection No. 645.0	1
Encoder Z-phase selection No. 645.1	0
Careful Approach switch No. 647.1	0
Shift-to-home amount No. 651.0	0
Z-phase disabled distance No. 657.0	0



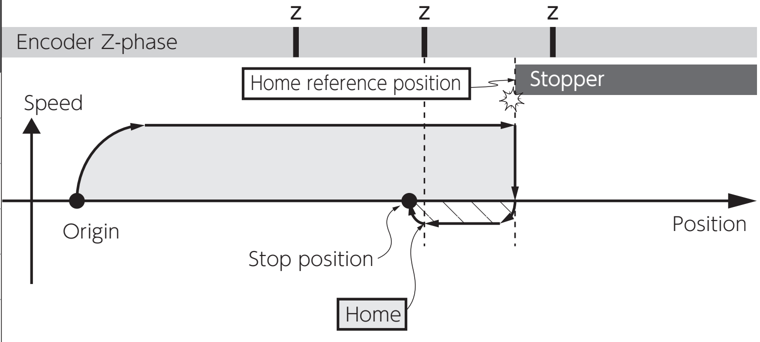
Pattern 8

Parameters	Settings
Home reference signal selection No. 645.0	1
Encoder Z-phase selection No. 645.1	0
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	(any)
Z-phase disabled distance No. 657.0	0



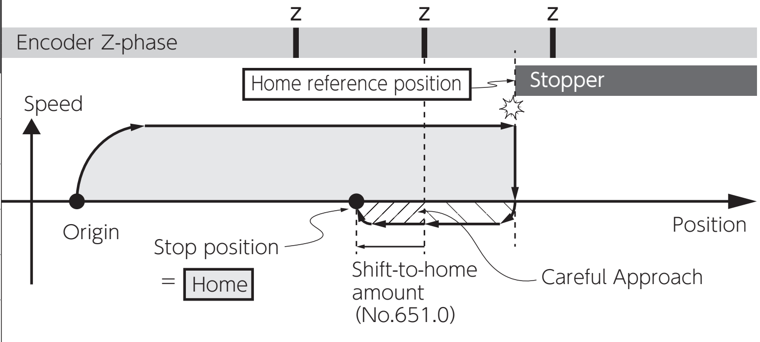
Pattern 9

Parameters	Settings
Home reference signal selection No. 645.0	1
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	0
Z-phase disabled distance No. 657.0	0



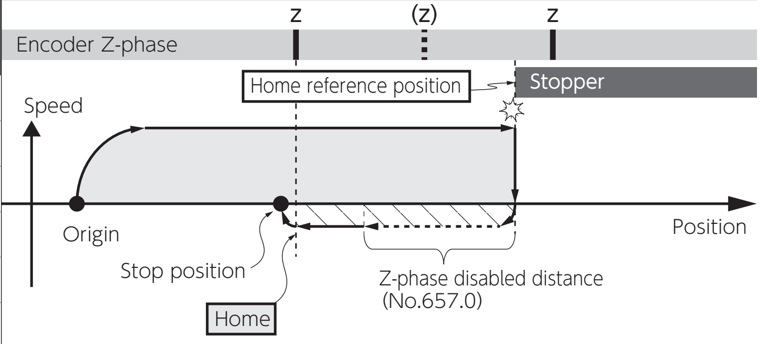
Pattern 10

Parameters	Settings
Home reference signal selection No. 645.0	1
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	(any)
Z-phase disabled distance No. 657.0	0



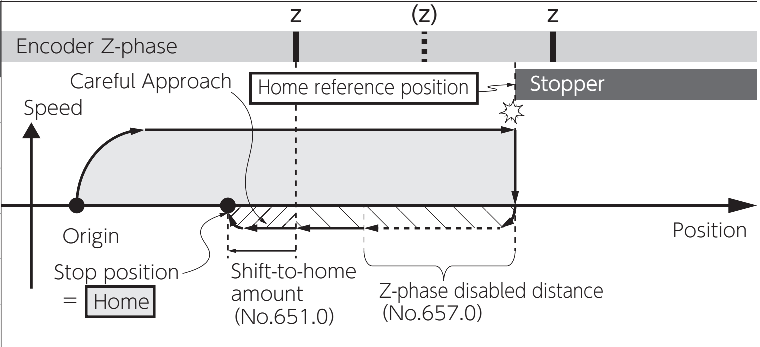
Pattern 11

Parameters	Settings
Home reference signal selection No. 645.0	1
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	0
Z-phase disabled distance No. 657.0	(any)



Pattern 12

Parameters	Settings
Home reference signal selection No. 645.0	1
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	(any)
Z-phase disabled distance No. 657.0	(any)



5. Position Control Mode

Homing Based on Home Sensor (no dog re-detection)(No. 645.0=2, No. 645.3=0)

This operation indicates the type of homing based on the home position sensor.

No detection of the dog-front-end after the first detection.

You can use this type of homing to set the point of machine passing the dog as the home base.
There are three options for what to be set as "home" (after detection of passing the dog): 1) dog position, 2) encoder z-phase, 3) any position shifted from dog or z-phase.

Set the following parameters related to this homing method.

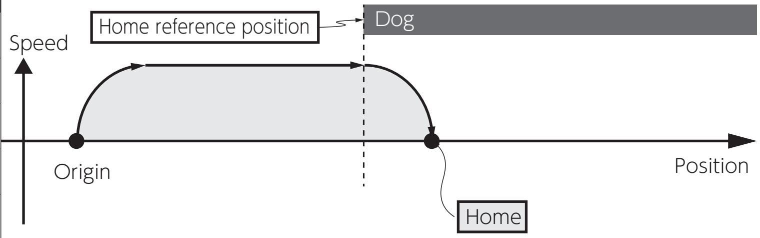
Group	Name	Parameter No.
Homing Overall	Home reference signal selection (arbitrary position, stopper, dog)	645.0 (*)
	Movement direction	646.0
	Acceleration/Deceleration time (Common in "Rough approach speed" and "Careful approach speed")	650.0
	Home position data	653.0
Rough approach	Sensor dog polarity	646.1
	Rough approach speed	648.0
Careful approach	Careful approach switch	647.1 (*)
	Encoder Z-phase Selection	645.1 (*)
	Z-phase disabled distance	657.0 (*)
	Re-detection of home position dog	645.3 (*)
	Careful approach speed	649.0
	Amount of position shift to home (travel distance from base signal or z-phase to home)	651.0 (*)
Common	Internal Position: Motion of Point No. 0	646.3
	Homing: Torque command limit	647.0
	Homing: Timeout Switch	646.2
	Homing: Timeout Time	659.0

*) Parameters to define the homing patterns.

Refer to the patterns from 13 to 18 below to set the parameters.

Pattern 13

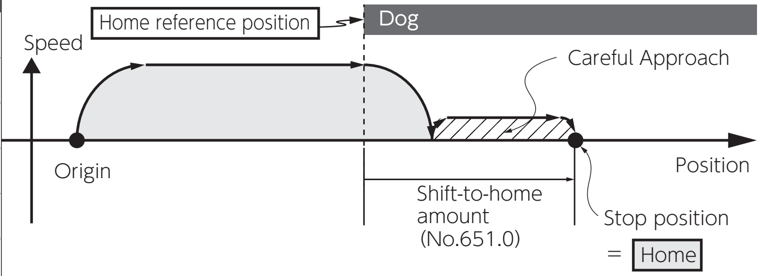
Parameters	Settings
Home reference signal selection No. 645.0	2
Re-detection of Home position dog No. 645.3	0
Encoder Z-phase selection No. 645.1	0
Careful Approach switch No. 647.1	0
Shift-to-home amount No. 651.0	0
Z-phase disabled distance No. 657.0	0



5. Position Control Mode

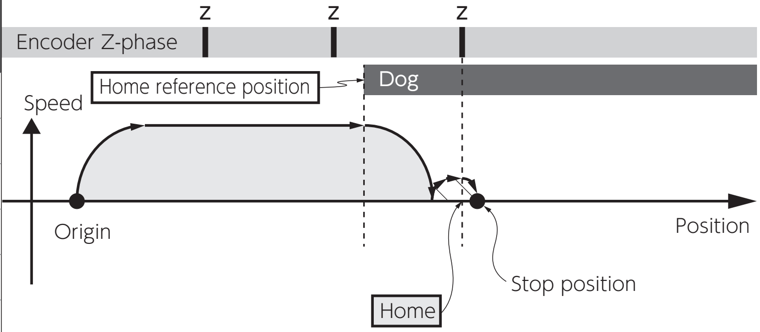
Pattern 14

Parameters	Settings
Home reference signal selection No. 645.0	2
Re-detection of Home position dog No. 645.3	0
Encoder Z-phase selection No. 645.1	0
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	(any)
Z-phase disabled distance No. 657.0	0



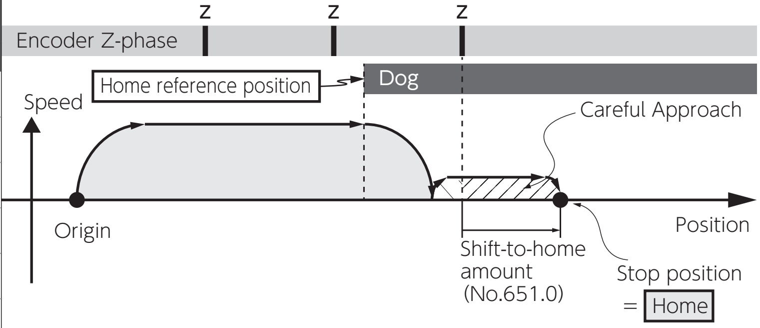
Pattern 15

Parameters	Settings
Home reference signal selection No. 645.0	2
Re-detection of Home position dog No. 645.3	0
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	0
Z-phase disabled distance No. 657.0	0



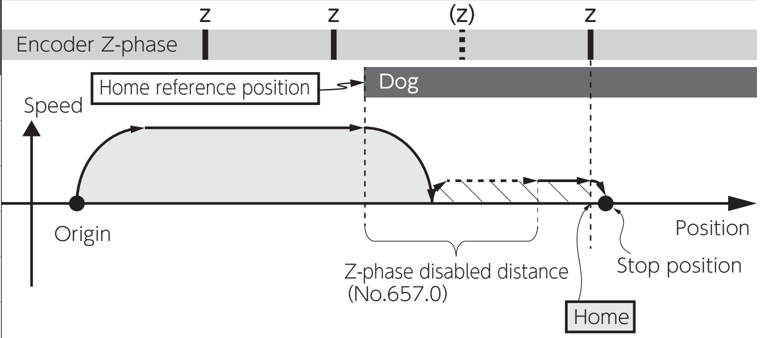
Pattern 16

Parameters	Settings
Home reference signal selection No. 645.0	2
Re-detection of Home position dog No. 645.3	0
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	(any)
Z-phase disabled distance No. 657.0	0



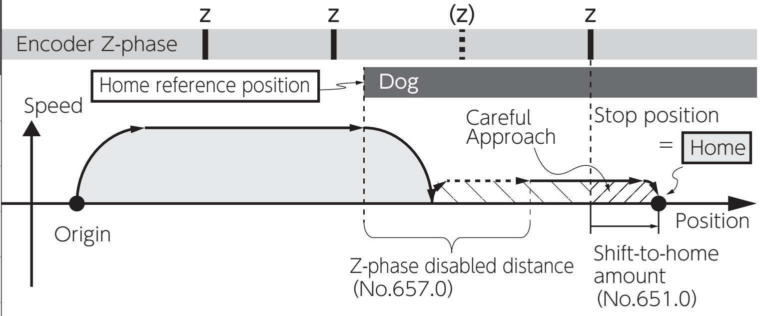
Pattern 17

Parameters	Settings
Home reference signal selection No. 645.0	2
Re-detection of Home position dog No. 645.3	0
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	0
Z-phase disabled distance No. 657.0	(any)



Pattern 18

Parameters	Settings
Home reference signal selection No. 645.0	2
Re-detection of Home position dog No. 645.3	0
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	(any)
Z-phase disabled distance No. 657.0	(any)



Homing Based on Home Sensor (with dog to be re-detected)(No. 645.0=2, No. 645.3=1)

This operation indicates the type of homing based on the home position sensor.

another detection of the dog-front-end after the first detection

You can use this homing type to set the point of machine passing the dog as the home base. Re-detection of the dog improves the accuracy in setting the home position.
There are three options for what to be set as "home" (after detection of passing-dog position): 1) dog position, 2) encoder z-phase, 3) any position shifted from dog or z-phase.

Set the following parameters related to this homing method.

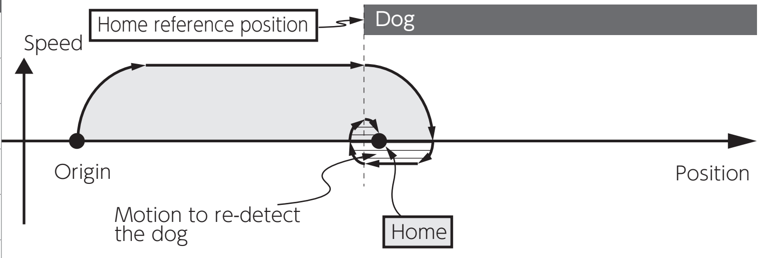
Group	Name	Parameter No.
Homing Overall	Home reference signal selection (arbitrary position, stopper, dog)	645.0 (*)
	Movement direction	646.0
	Acceleration/Deceleration time (Common in "Rough approach speed" and "Careful approach speed")	650.0
	Home position data	653.0
Rough approach	Sensor dog polarity	646.1
	Rough approach speed	648.0
Careful approach	Careful approach switch	647.1 (*)
	Encoder Z-phase Selection	645.1 (*)
	Z-phase disabled distance	657.0 (*)
	Re-detection of Home position dog	645.3 (*)
	Careful approach speed	649.0
	Amount of position shift to home (travel distance from base signal or z-phase to home)	651.0 (*)
Common	Internal Position: Motion of Point No. 0	646.3
	Homing: Torque command limit	647.0
	Homing: Timeout Switch	646.2
	Homing: Timeout Time	659.0

*) Parameters to define the homing patterns.

Refer to the patterns 19 to 24 to configure the parameters.

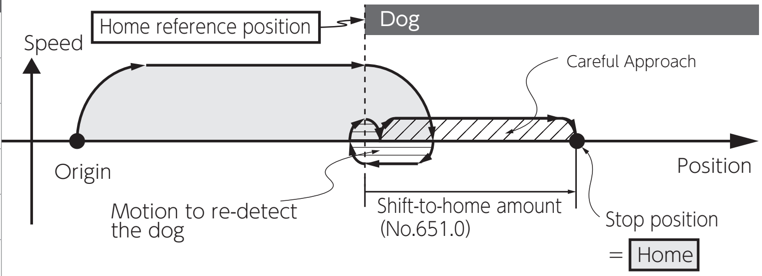
Pattern 19

Parameters	Settings
Home reference signal selection No. 645.0	2
Re-detection of Home position dog No. 645.3	1
Encoder Z-phase selection No. 645.1	0
Careful Approach switch No. 647.1	0
Shift-to-home amount No. 651.0	0
Z-phase disabled distance No. 657.0	0



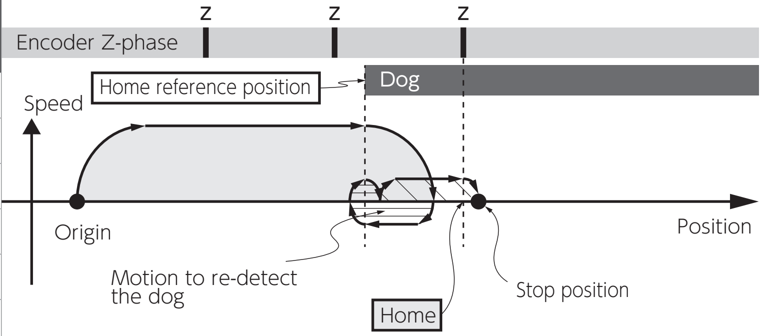
Pattern 20

Parameters	Settings
Home reference signal selection No. 645.0	2
Re-detection of Home position dog No. 645.3	1
Encoder Z-phase selection No. 645.1	0
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	(any)
Z-phase disabled distance No. 657.0	0



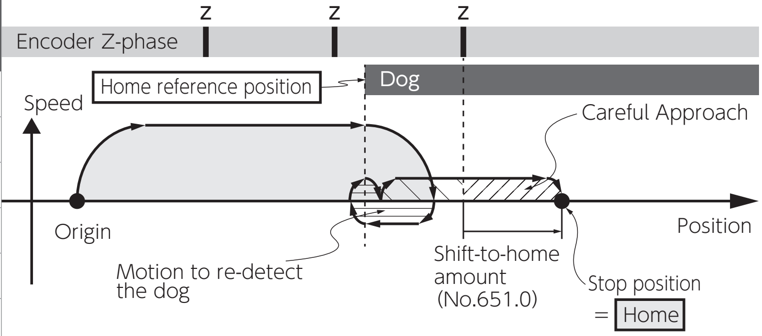
Pattern 21

Parameters	Settings
Home reference signal selection No. 645.0	2
Re-detection of Home position dog No. 645.3	1
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	0
Z-phase disabled distance No. 657.0	0



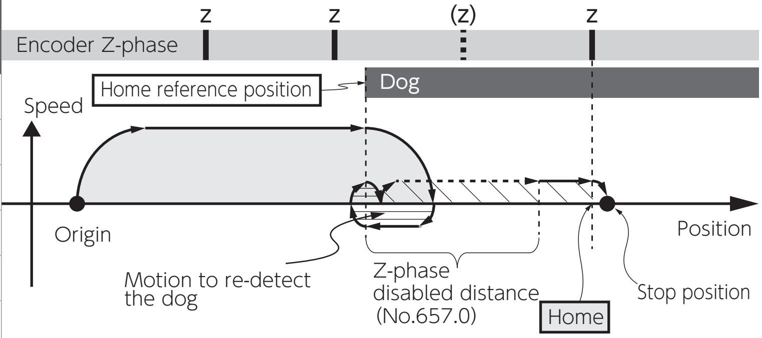
Pattern 22

Parameters	Settings
Home reference signal selection No. 645.0	2
Re-detection of Home position dog No. 645.3	1
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	(any)
Z-phase disabled distance No. 657.0	0



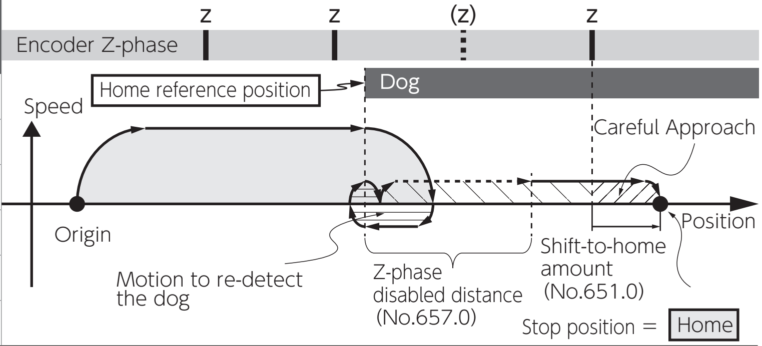
Pattern 23

Parameters	Settings
Home reference signal selection No. 645.0	2
Re-detection of Home position dog No. 645.3	1
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	0
Z-phase disabled distance No. 657.0	(any)



Pattern 24

Parameters	Settings
Home reference signal selection No. 645.0	2
Re-detection of Home position dog No. 645.3	1
Encoder Z-phase selection No. 645.1	1
Careful Approach switch No. 647.1	1
Shift-to-home amount No. 651.0	(any)
Z-phase disabled distance No. 657.0	(any)



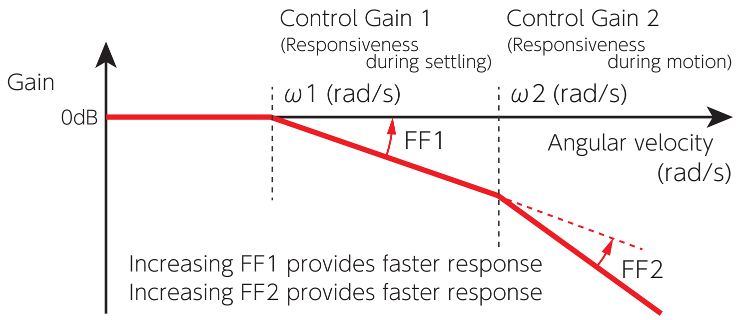
MEMO

7 Tuning

1. Introduction

1. Overview

The goal of amplifier tuning is having a good control over the motor and optimizing equipment performance in responding to commands from the host controller.
The position control method employs two degrees of freedom with the model-matching control. This method enables you to adjust command response and turbulence response independently without compromising the stability of your equipment.
SD3 Series is a servo system that does not let overshooting and undershooting happen when the equipment inertia ratio is set appropriately.
SD3 Series features response models with two cutoff frequencies: ω 1 (Control Gain 1) and ω 2 (Control Gain 2)



Response model for position control and two cutoff frequencies

Code	Effect
ω 1 Control Gain 1	Responsiveness at settling Increasing this item will reduce the position deviation at settling (after command ends).
ω 2 Control Gain 2	Responsiveness during operation Increasing this item will reduce the position deviation during operation (while command being input).
FF1 FF Compensation 1	Command compensation for ω 1 Increasing this item will improve the ω 1 response.
FF2 FF Compensation 2	Command compensation for ω 2 Increasing this item will improve the ω 2 response.

The relation between cutoff frequencies and control gain parameters.

- Position loop gain(*1): $\frac{\omega 1 \omega 2}{\omega 1 + \omega 2}$
- Velocity loop gain(*2): $\omega 1 + \omega 2$

---

*1)Position loop gain: It is equivalent to the "Kp" in a P-PI control.
*2)Velocity loop gain: It is equivalent to the "Kv" in a P-PI control.

1. Introduction

Control Gain Set

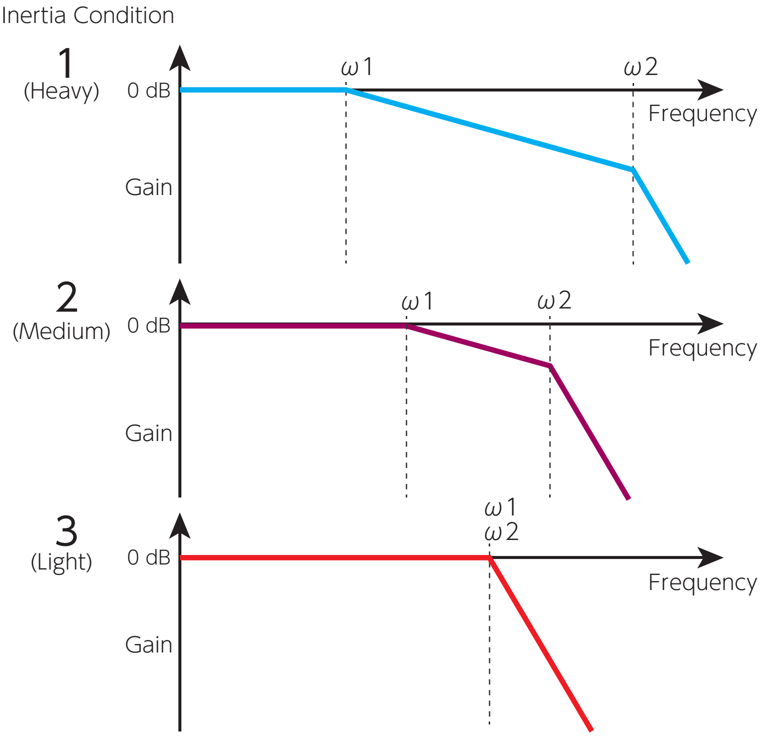
The following prearranged sets of parameters for each control mode enable you to perform tuning easily. (*)

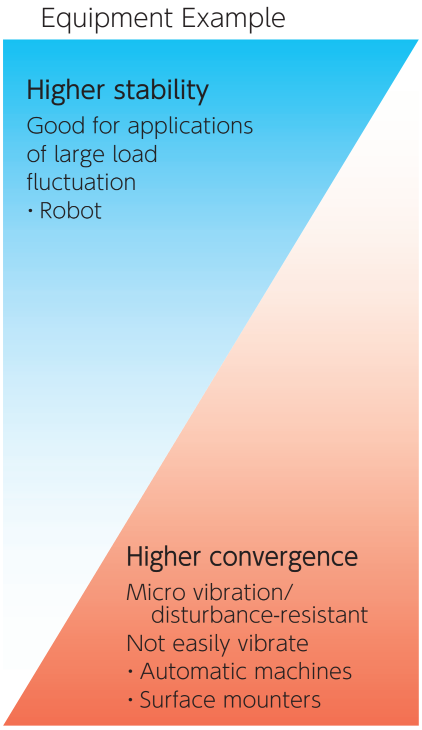
*)If the **Torque command filter: Low-pass filter auto setting** (No.160.2) is set to 1(auto setting ON), "Torque command filter: Low-pass filter" will be included in the gain set.

Control Mode	Parameter Set
Position Control Mode PLS IN POS	Control Gain 1, Control Gain 2, Integral Gain
Velocity Control Mode VEL IN VEL	Control Gain 1, Integral Gain

Inertia Condition

SD3 Series features three response models to support a variety of equipment. Three models are different in ratios of Control Gain 1 (ω 1) and Control Gain 2 (ω 2) and you can select the one suitable to the stability and convergence of your equipment.

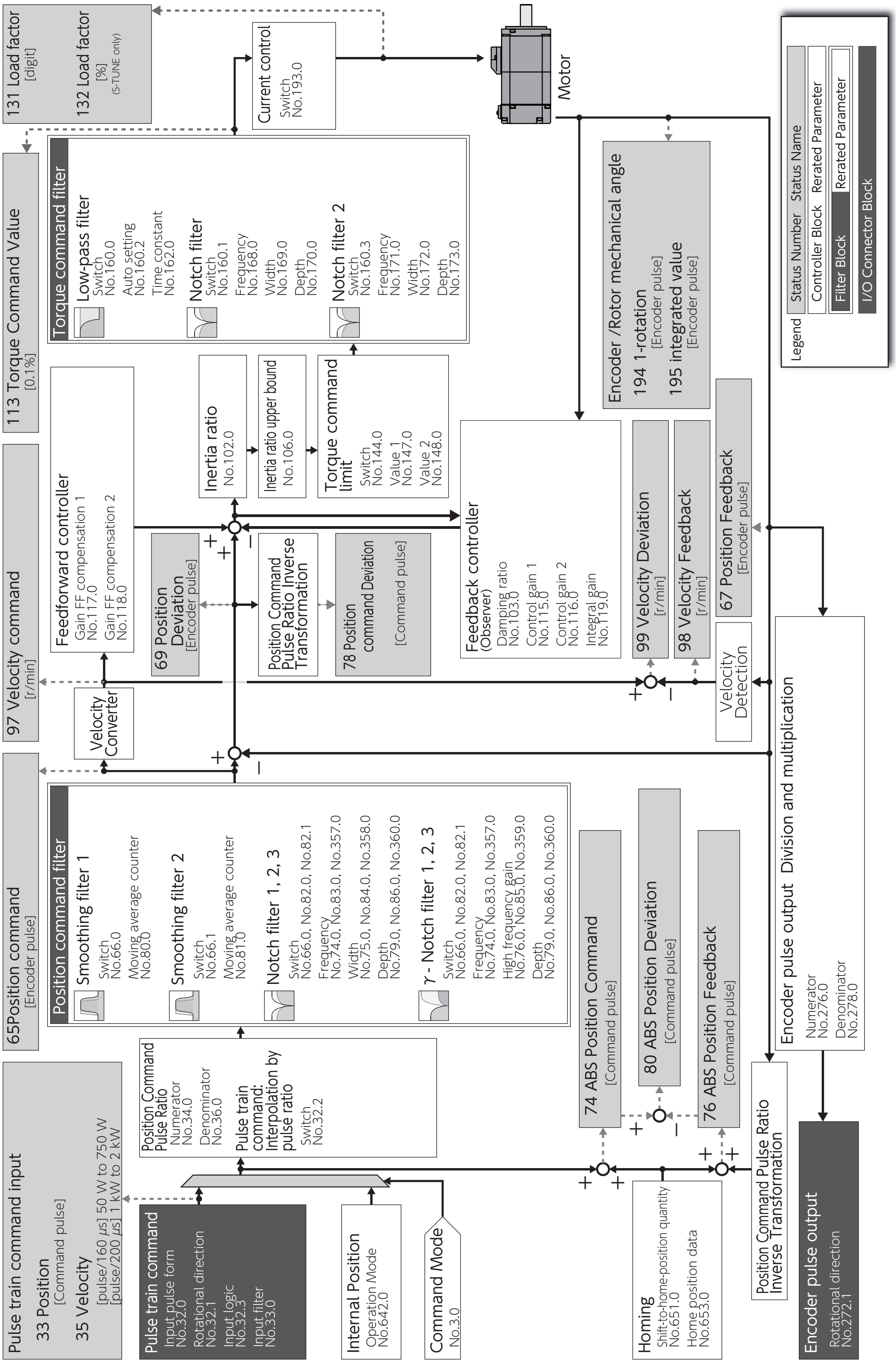




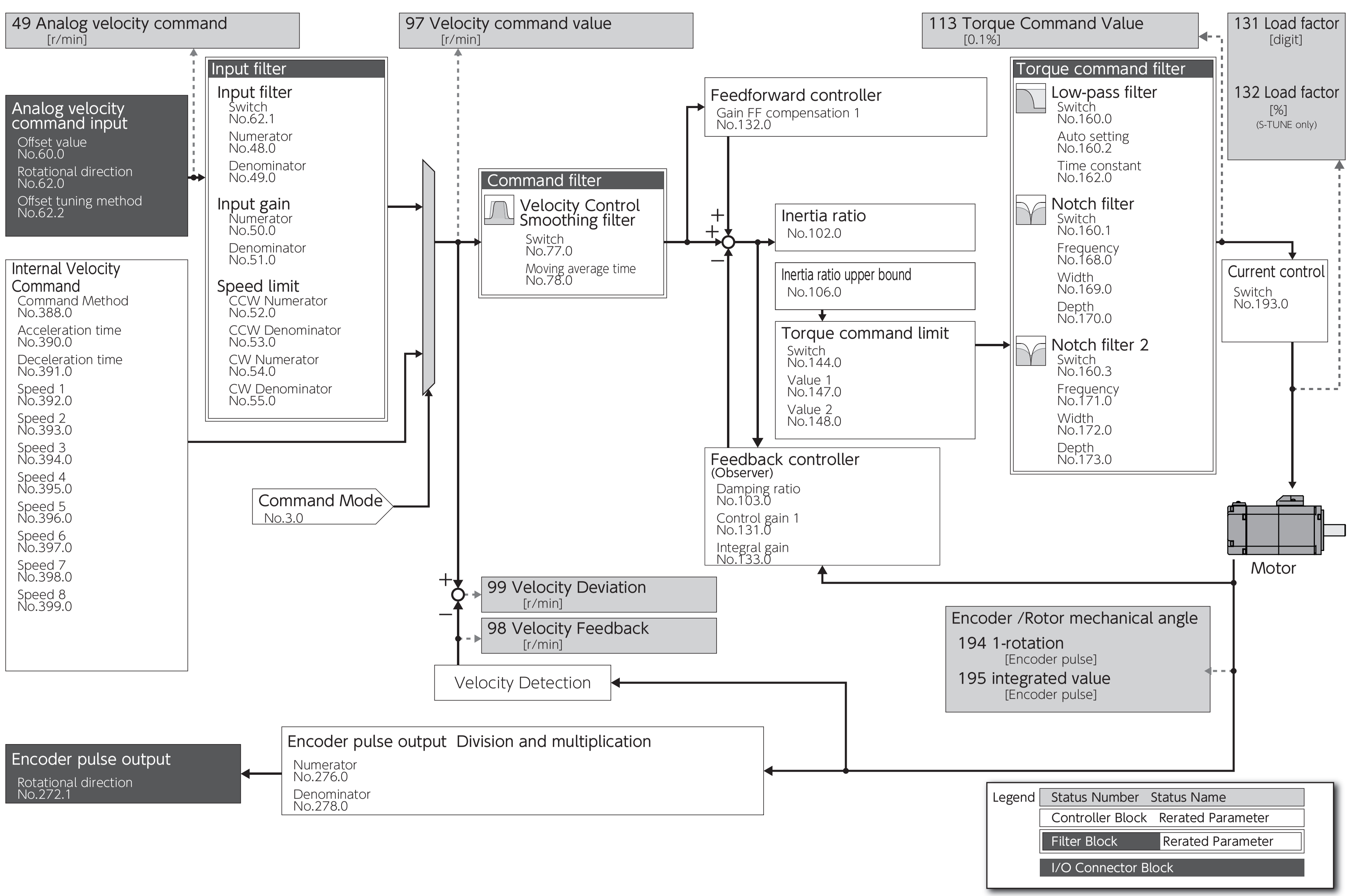
1. Introduction

2. Control Block Diagram

Position Control Mode

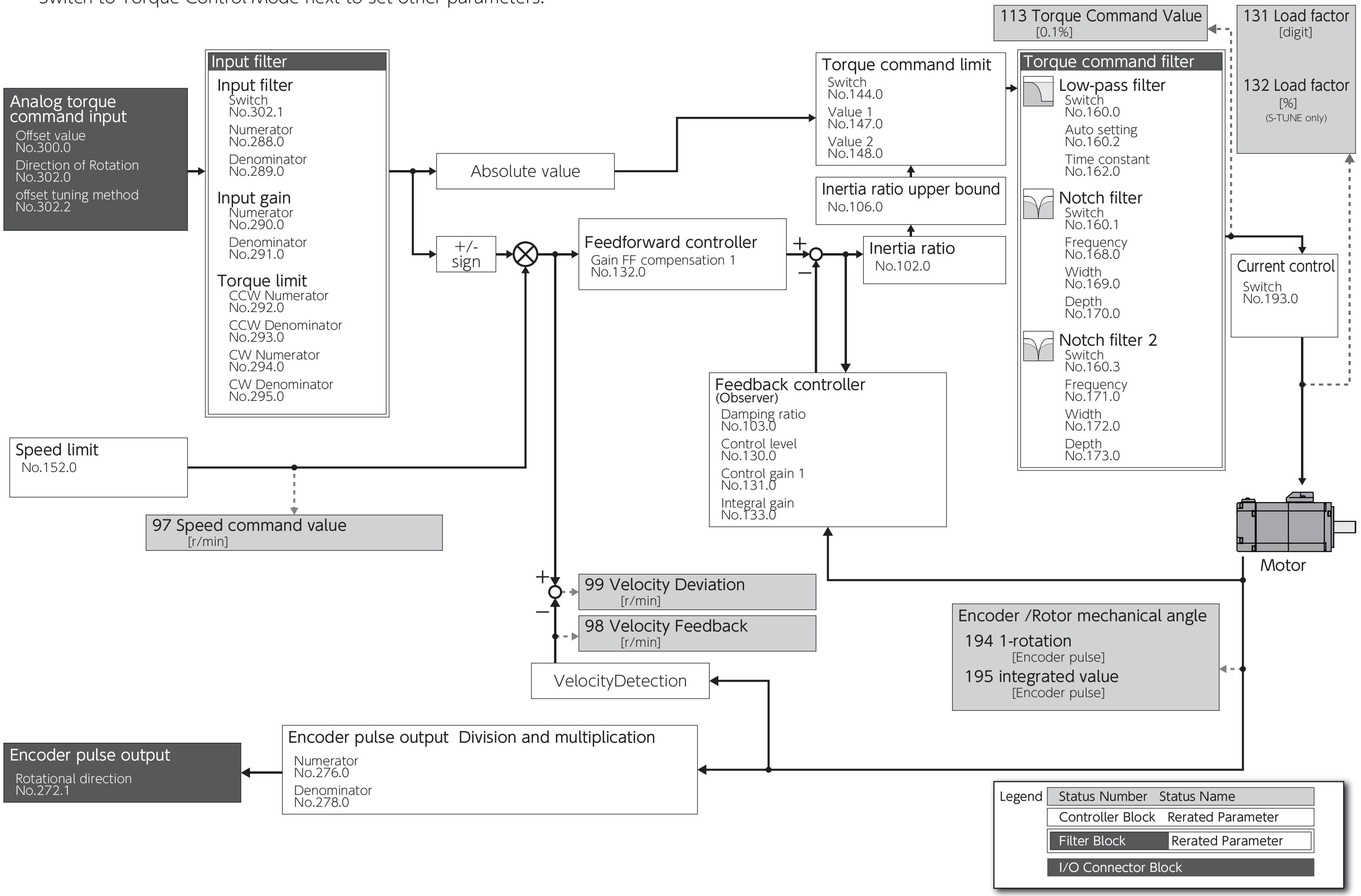


Velocity Control Mode



Torque Control Mode

Set the tuning parameters in Speed Control Mode first.
Switch to Torque Control Mode next to set other parameters.



2. Tuning Procedure

❗	Before getting started with tuning, be sure to implement safety measures such as hazard prevention, quick stop and impact mitigation measures.	⚠ ⚠ ⚠
❗	When operating the servo motor for tuning, start with acceleration/deceleration speeds slower than your target speed. Ensure safety first, then gradually increase the speed and perform tuning each time.	
🚫	While tuning with "Servo Studio", do not use the Setup Panel.	
🚫	While tuning with the Setup Panel, do not operate the motor with "Servo Studio".	

For optimal performance of amplifier functions and features, you need set the parameters to the amplifier. Wrong parameter settings will cause unexpected behaviors or troubles to the motor. Please read the Instruction Manuals very carefully to figure out the settings that will best suit to your operational conditions.

Step	Operation	
1	Verify that all wiring has been performed properly.	
2	Turn on the control power to the amplifier.	
3	Turn on the primary circuit power to the amplifier.	
4	To turn the servo ON, connect the SVON pin on the CN1 connector to COM-.	
5	Operate the motor at lower speeds according to the command pulse from the host controller.	
6	Start tuning with one of the following methods.	
	STUDIO Servo Studio	Use the setup support software "Servo Studio". Install it on a user-supplied computer.
		Use the Setup Panel at the front of the amplifier.

Any of the following may interrupt proper performance of Quick Tuning or Auto Tuning.
The inertia ratio is less than 3 or above 20. (*1)
The load inertia is fluctuating.
Machine rigidity is extremely low.
Non-linear characteristics such as backlash exist.
The speed is low (800 r/min or lower). (*2)
The acceleration or deceleration speed is moderate (around 2,000 r/min/s).
The torque is extremely large or small.
In those situations, set the inertia ratio manually based on calculated values.

*1)When a too big load inertia is connected, the estimated inertia ratio value will be restricted by the upper limit value settled by the upper limit value of the inertia ratio (No.106.0).
*2)Proper tuning may not be possible in the case of 300 r/min or below.

2. Tuning Procedure

1. Overview

Position Control Mode

PLS IN POS

Stage 1

Quick Tuning

Setting the Inertia ratio and Optimizing Control Gain Set

The inertia ratio value is presumed automatically.
The control gain set will be automatically adjusted according to the auto estimate of inertia ratio.
This method does not generate noise caused by disagreement between the inertia ratio and the gain set.

☞ Page 9 Quick Tuning on "Servo Studio"
☞ Page 14 Quick Tuning on Setup Panel

Stage 2

Final Tuning

(Performed by "Servo Studio")

Optimizing the settling time and deviation Suppressing vibration and noise

After Quick Tuning was performed, you might need further adjustments for some of the parameters individually.
Final Tuning will improve responsiveness, settling time, and degree of freedom to achieve optimal performance of equipment.

☞ Page 12 Final Tuning: position control mode

Velocity Control Mode

A VEL IN VEL

Stage 1

Auto Tuning

Setting the Inertia ratio and Optimizing Control Gain Set

The inertia ratio value is presumed automatically.
You can select one of the control gain sets according to your equipment.
Auto estimated inertia ratio will be applied.

☞ Page 17 Auto Tuning on "Servo Studio"
☞ Page 22 Auto Tuning on Setup Panel

Stage 2

Final Tuning

(Performed by "Servo Studio")

Optimizing the settling time and deviation Suppressing vibration and noise

After Auto Tuning was performed, you might need further adjustments for some of the parameters individually.
Final Tuning will improve responsiveness, settling time, and degree of freedom to achieve optimal performance of equipment.

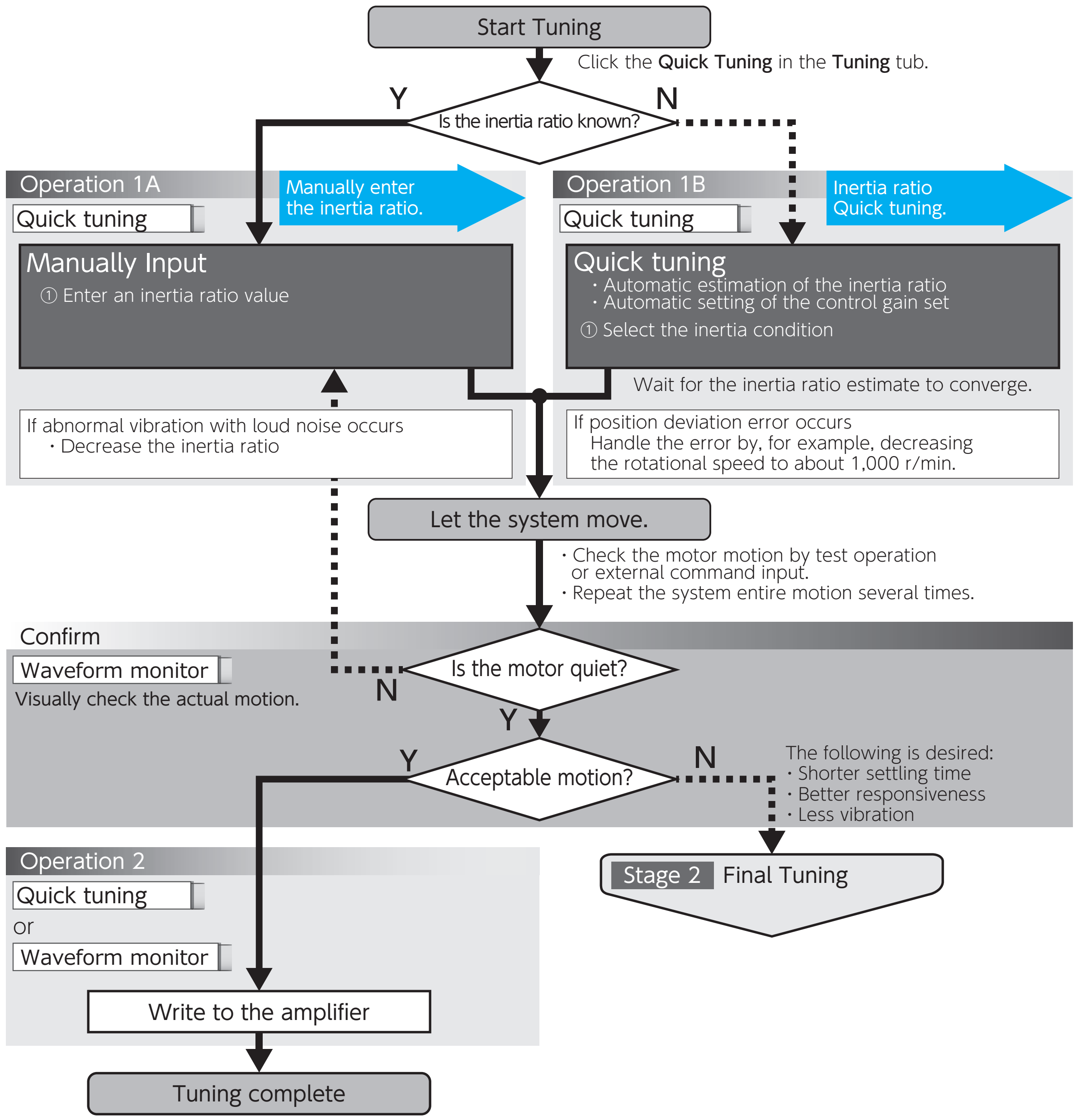
☞ Page 20 Final Tuning: Velocity control mode

2. Tuning Procedure

2. Position Control Mode

Quick Tuning on "Servo Studio"

Stage 1 Setting the Inertia ratio and Optimizing Control Gain Set



Click the **Quick Tuning** in the **Tuning** tub.

① Enter an inertia ratio value

- Automatic estimation of the inertia ratio
- Automatic setting of the control gain set

① Select the inertia condition

Wait for the inertia ratio estimate to converge.

If abnormal vibration with loud noise occurs
- Decrease the inertia ratio

If position deviation error occurs
Handle the error by, for example, decreasing the rotational speed to about 1,000 r/min.

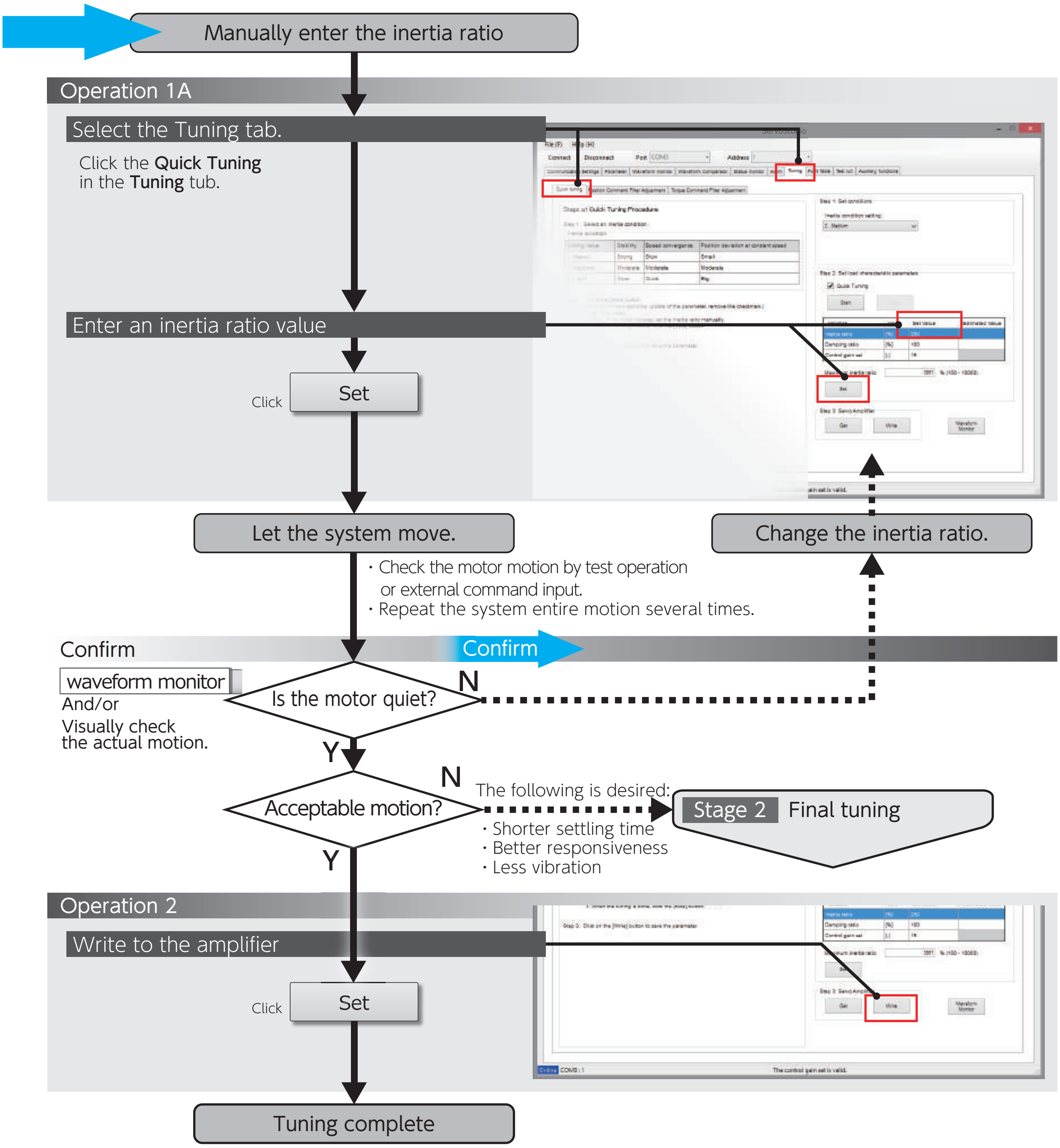
- Check the motor motion by test operation or external command input.
- Repeat the system entire motion several times.

Visually check the actual motion.

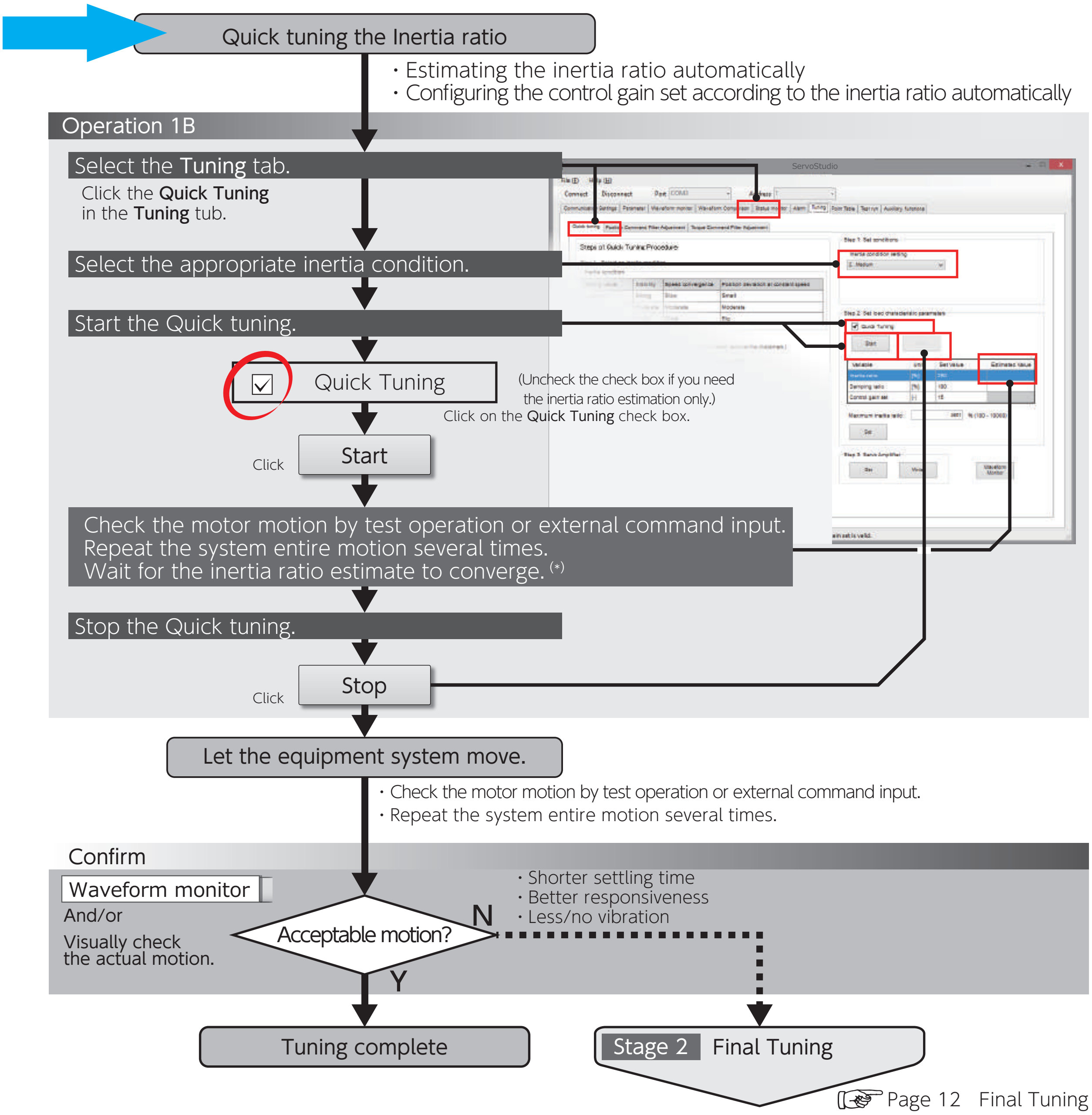
The following is desired:
- Shorter settling time
- Better responsiveness
- Less vibration

2. Tuning Procedure

Quick Tuning on "Servo Studio": Operation 1A



Quick Tuning on "Servo Studio": Operation 1B



☞ Page 12 Final Tuning

*)Extremely large load may cause vibration. In such a case, decrease the parameter setting of Tuning: Control gain set - Tuning constant (No.121.0).

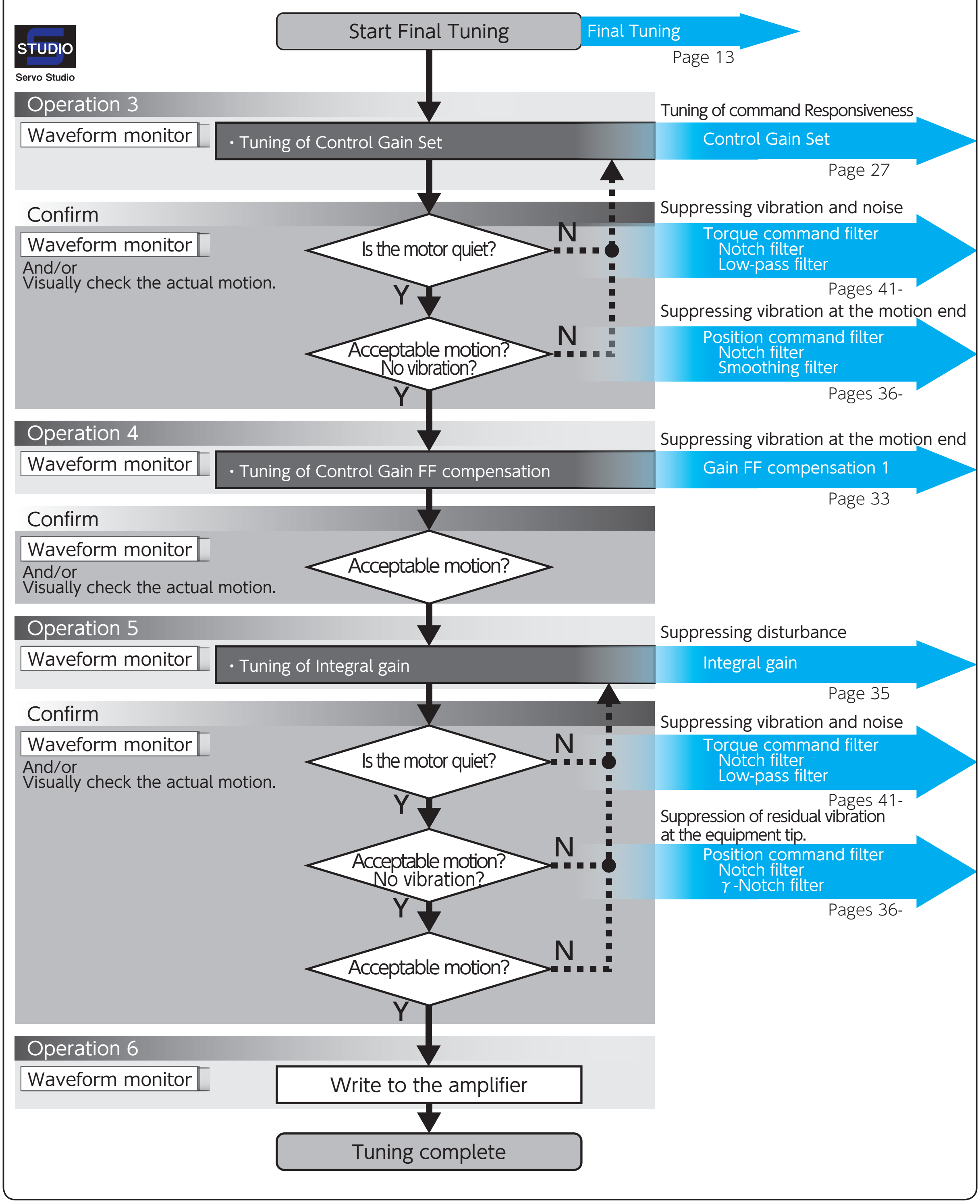
Make sure to click on Stop to finish Quick Tuning.

Starting Final Tuning Mode while Quick Tuning is still in process will make the tuning difficult because of inertia ratio changes.

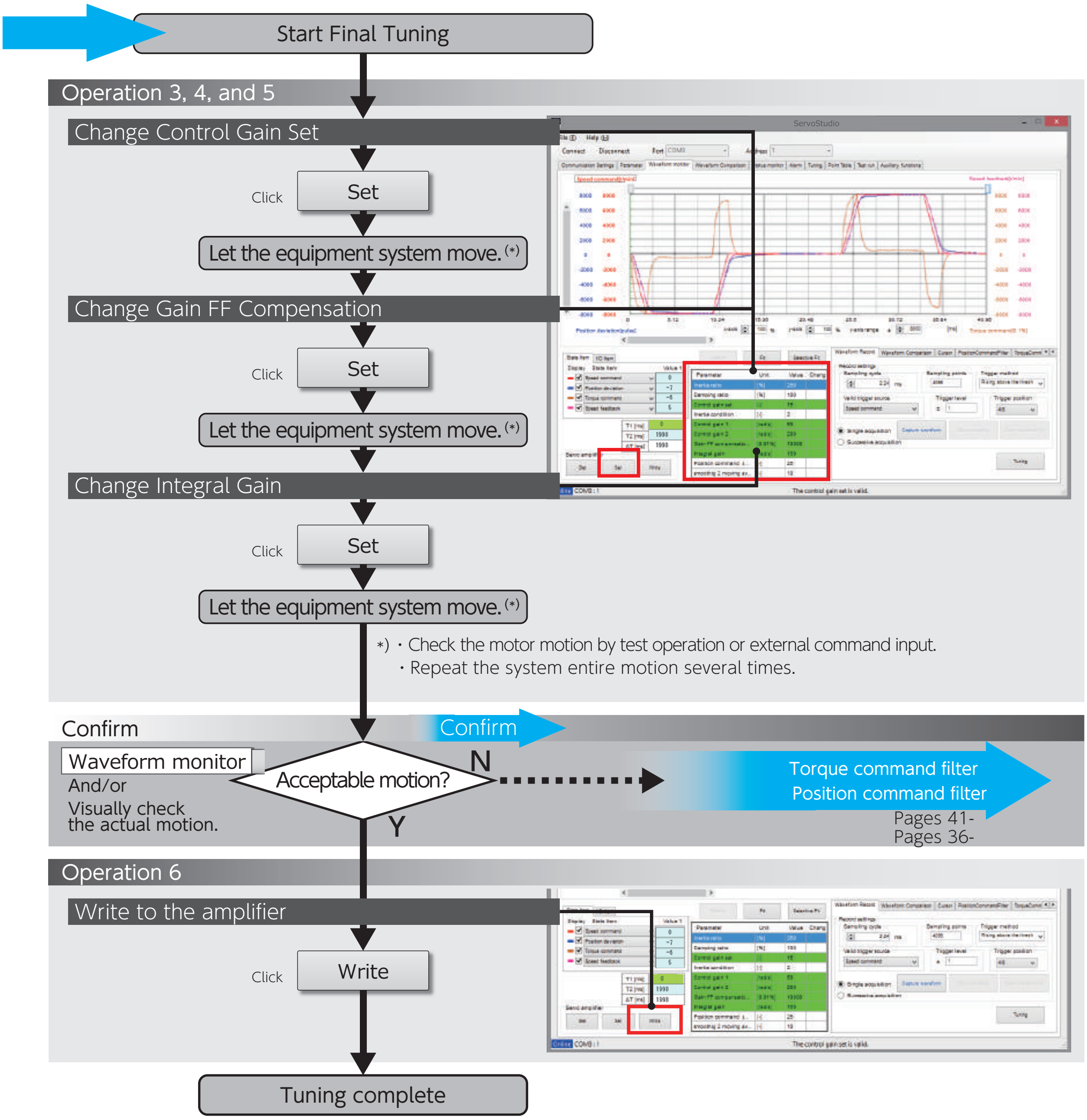
2. Tuning Procedure

Final Tuning: Position Control Mode

Stage 2 Optimizing the settling time and deviation Suppressing vibration and noise



Final Tuning



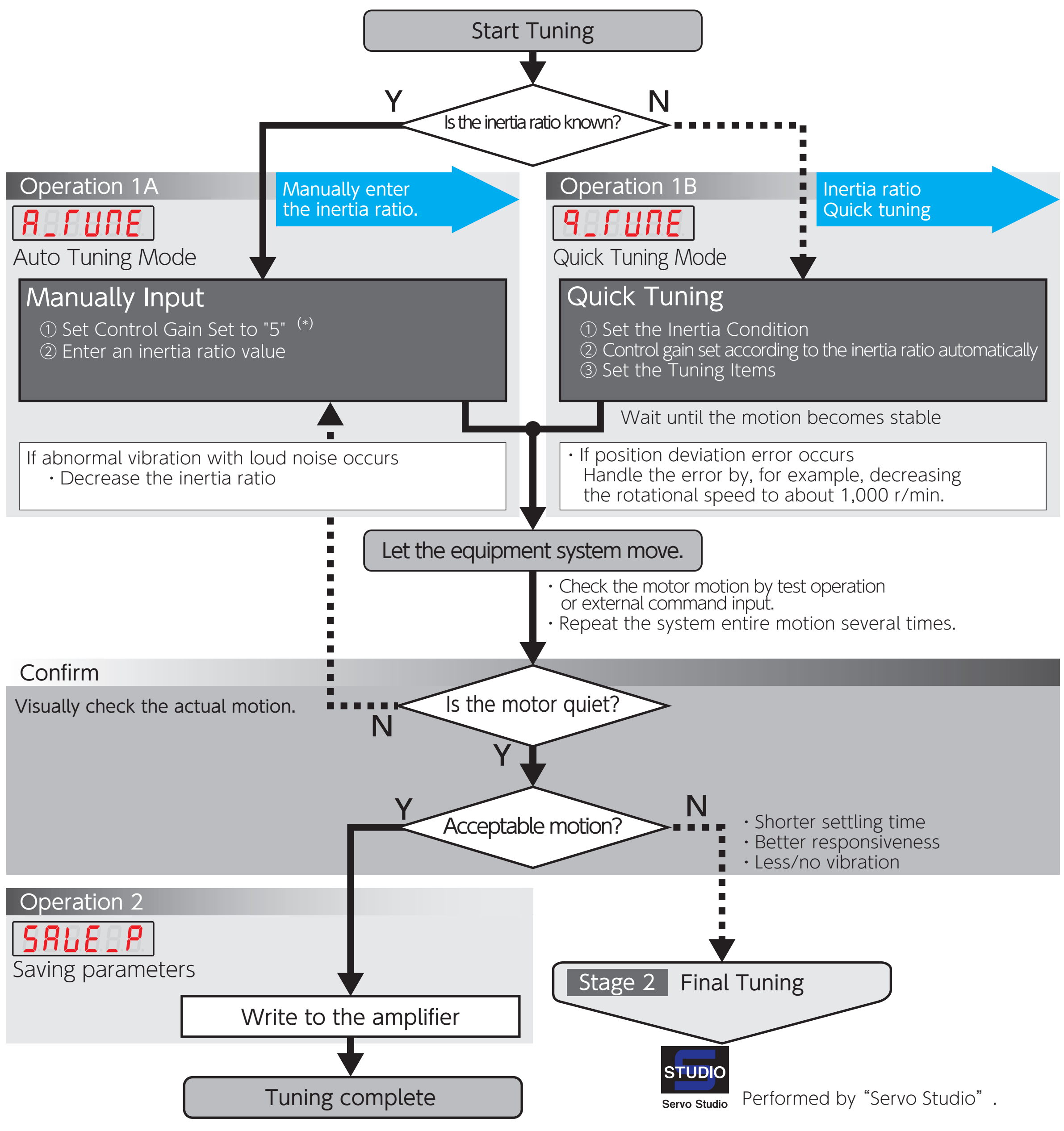
*) ・Check the motor motion by test operation or external command input.
・Repeat the system entire motion several times.

2. Tuning Procedure

Quick Tuning on Setup Panel

PLS POS VEL VEL TRQ

Stage 1 Setting the Inertia ratio and Optimizing Control Gain Set



Manually Input
① Set Control Gain Set to "5" (*)
② Enter an inertia ratio value

Quick Tuning
① Set the Inertia Condition
② Control gain set according to the inertia ratio automatically
③ Set the Tuning Items

Wait until the motion becomes stable

If abnormal vibration with loud noise occurs
- Decrease the inertia ratio

- If position deviation error occurs
Handle the error by, for example, decreasing the rotational speed to about 1,000 r/min.

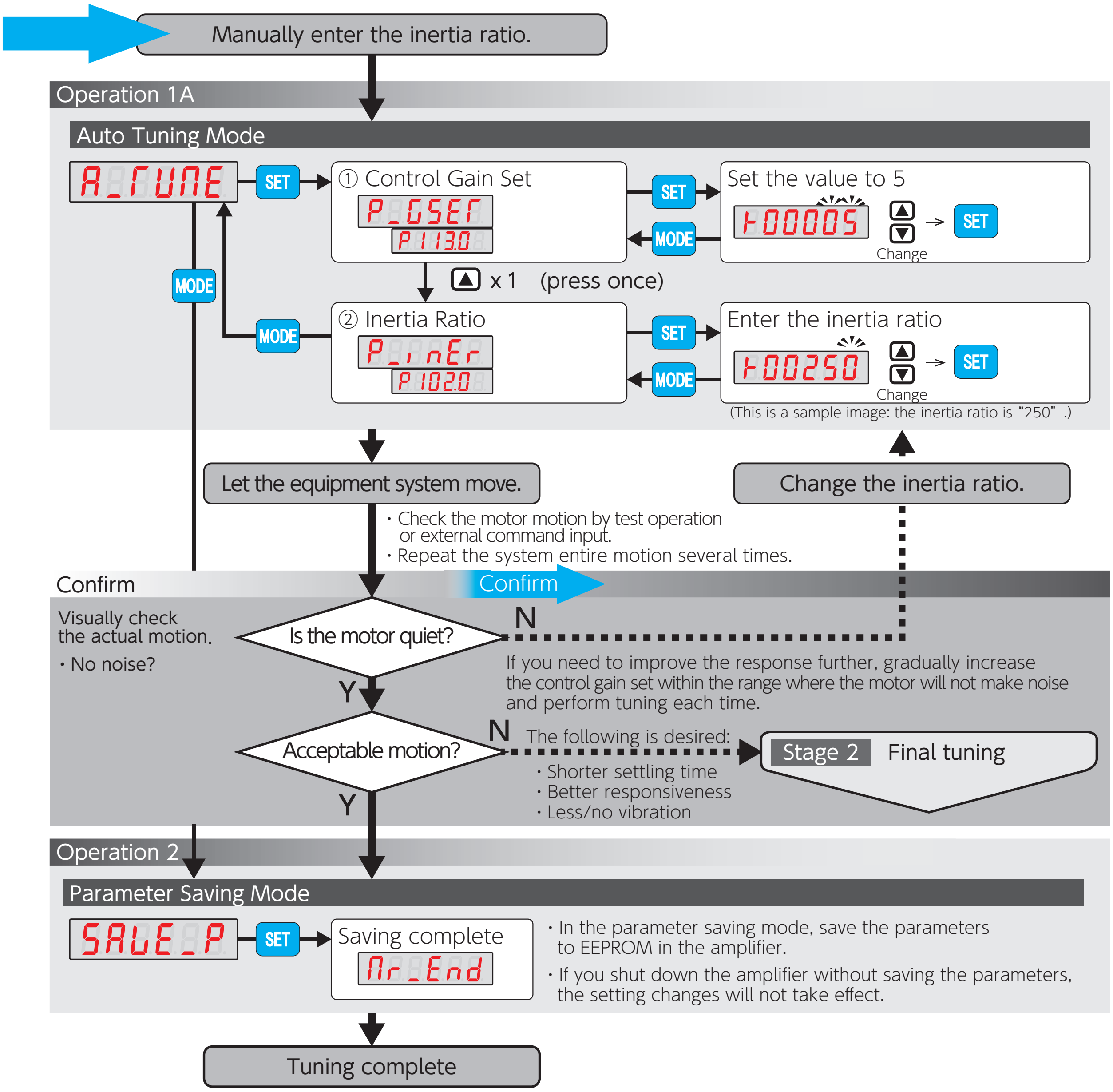
- Check the motor motion by test operation or external command input.
- Repeat the system entire motion several times.

- Shorter settling time
- Better responsiveness
- Less/no vibration

Performed by "Servo Studio" .

*) Starting tuning with a low setting of the controller gain set will enable successful tuning with no vibrations accompanied by noise.

Quick Tuning on Setup Panel: Operation 1A



(This is a sample image: the inertia ratio is “250” .)

- Check the motor motion by test operation or external command input.
- Repeat the system entire motion several times.

Visually check the actual motion.

- No noise?

If you need to improve the response further, gradually increase the control gain set within the range where the motor will not make noise and perform tuning each time.

The following is desired:

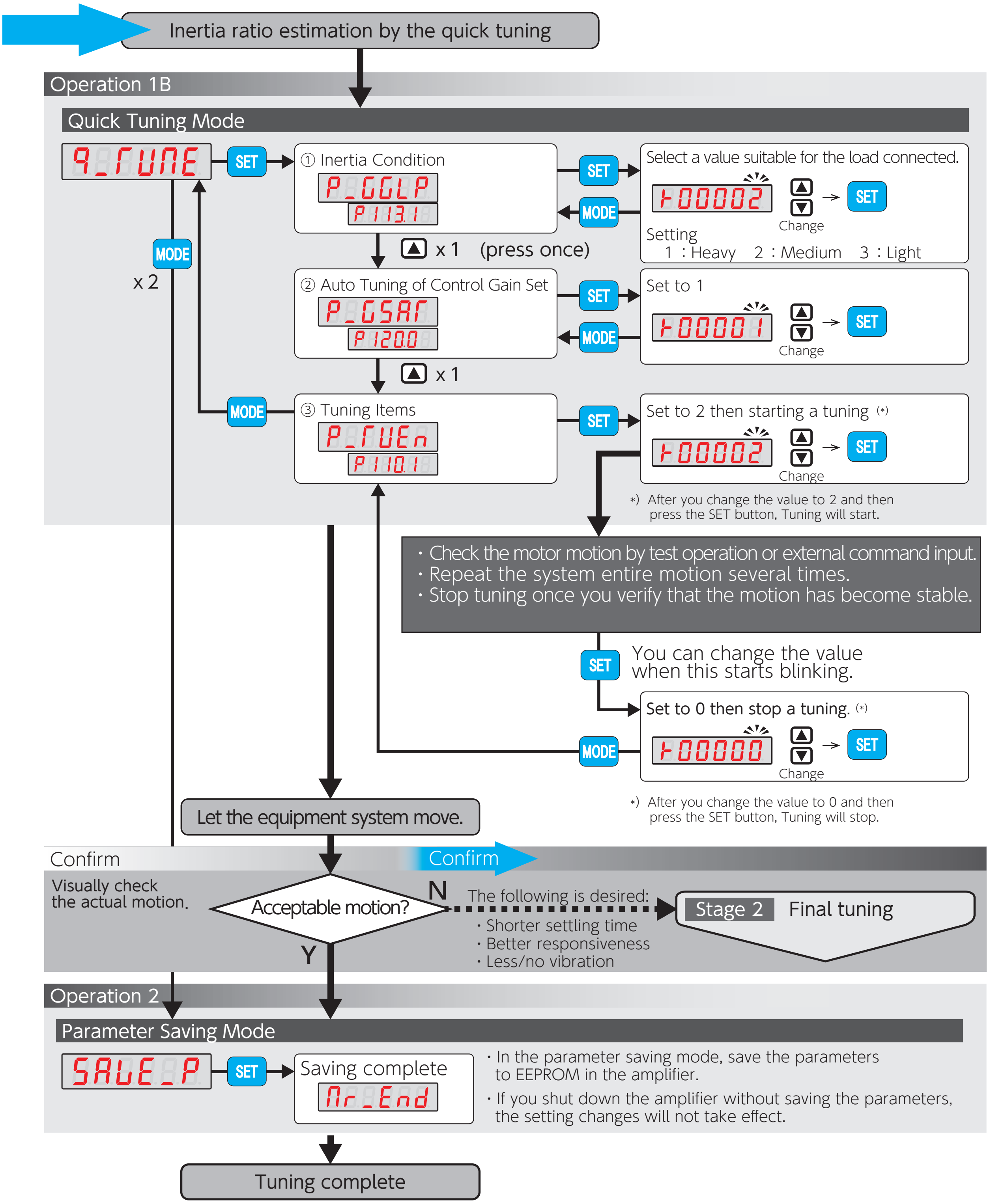
- Shorter settling time
- Better responsiveness
- Less/no vibration

- In the parameter saving mode, save the parameters to EEPROM in the amplifier.
- If you shut down the amplifier without saving the parameters, the setting changes will not take effect.

2. Tuning Procedure

PLS POS VEL IN VEL TRQ

Quick Tuning on Setup Panel: Operation 1B



Select a value suitable for the load connected.

Setting
1 : Heavy 2 : Medium 3 : Light

Set to 1

Set to 2 then starting a tuning (*)

*) After you change the value to 2 and then press the SET button, Tuning will start.

- Check the motor motion by test operation or external command input.
- Repeat the system entire motion several times.
- Stop tuning once you verify that the motion has become stable.

You can change the value when this starts blinking.

Set to 0 then stop a tuning. (*)

*) After you change the value to 0 and then press the SET button, Tuning will stop.

Visually check the actual motion.

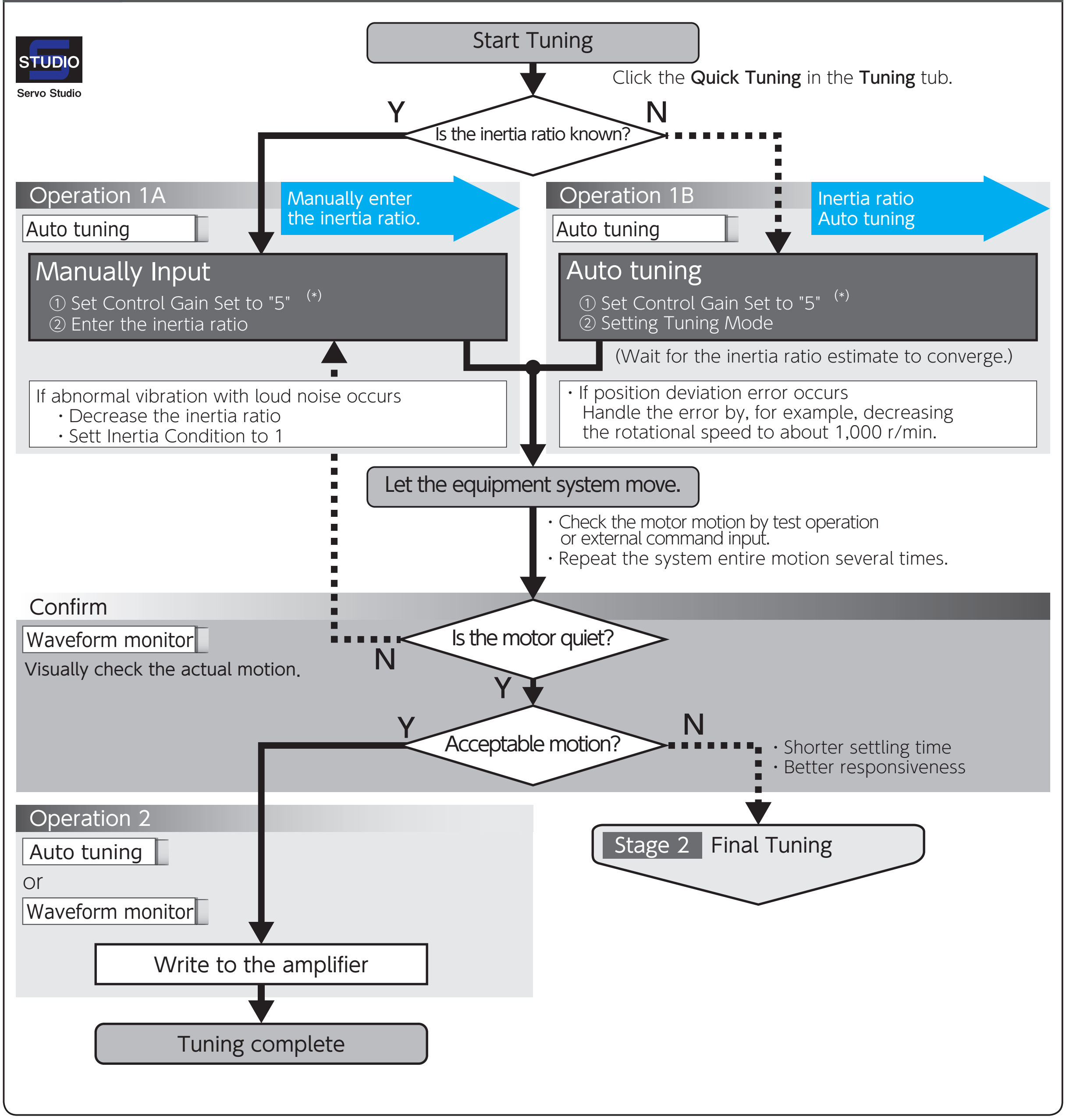
The following is desired:
- Shorter settling time
- Better responsiveness
- Less/no vibration

- In the parameter saving mode, save the parameters to EEPROM in the amplifier.
- If you shut down the amplifier without saving the parameters, the setting changes will not take effect.

3. Velocity Control Mode

Auto Tuning on "Servo Studio"

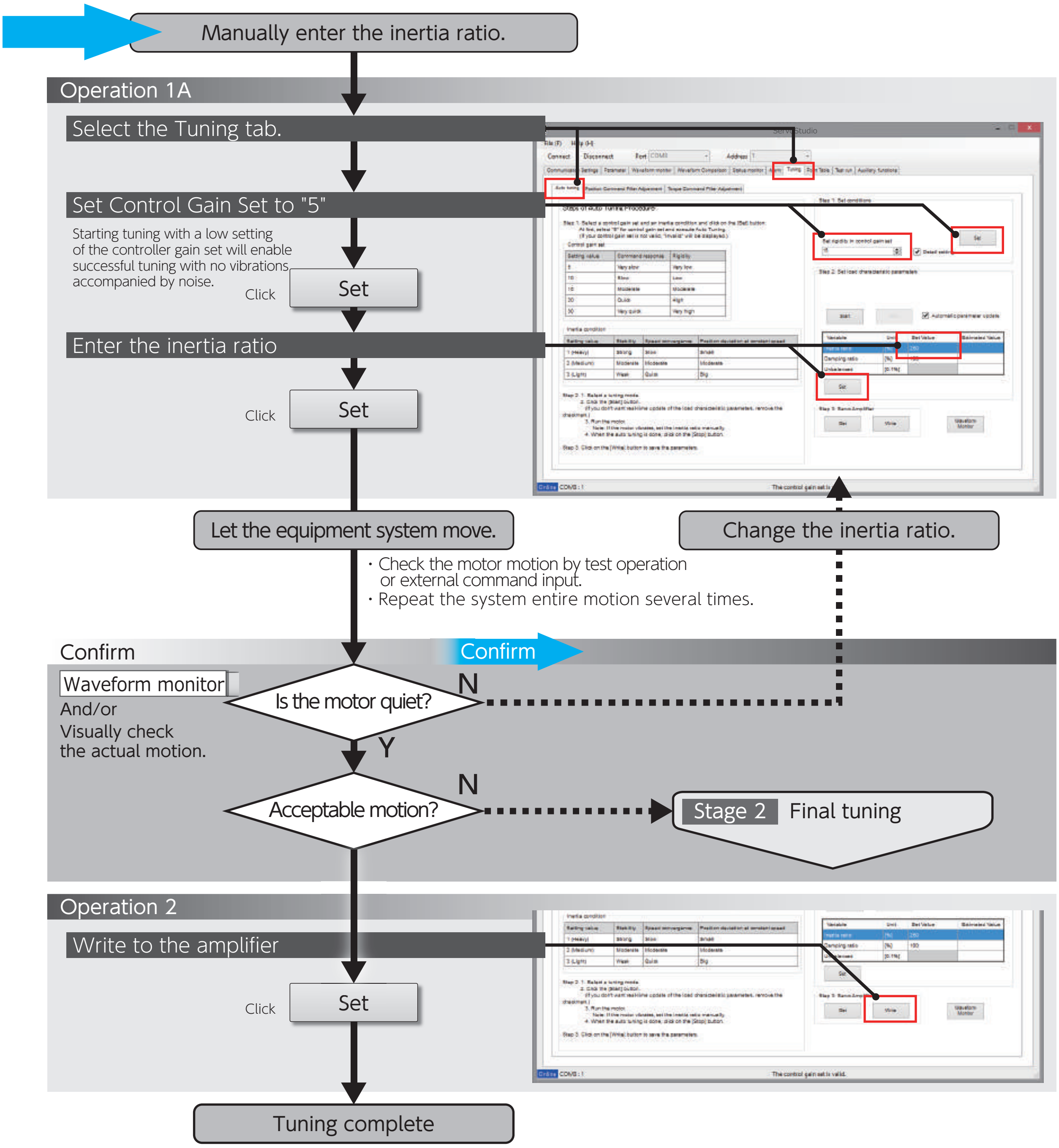
Stage 1 Setting the Inertia ratio and Optimizing Control Gain Set



*) Starting tuning with a low setting of the controller gain set will enable successful tuning with no vibrations accompanied by noise.

2. Tuning Procedure

Auto Tuning on "Servo Studio": Operation 1A



Starting tuning with a low setting of the controller gain set will enable successful tuning with no vibrations accompanied by noise.

- Check the motor motion by test operation or external command input.
- Repeat the system entire motion several times.

2. Tuning Procedure

Auto Tuning on "Servo Studio": Operation 1B

Inertia ratio estimation by the auto tuning

Operation 1B

Select the Tuning tab

Set Control Gain Set to "5"

Starting tuning with a low setting of the controller gain set will enable successful tuning with no vibrations accompanied by noise.

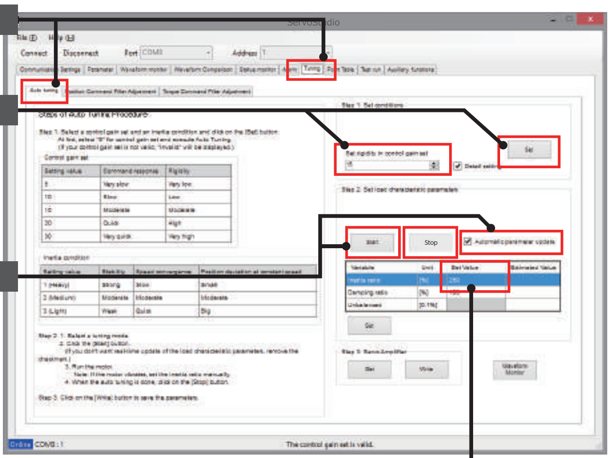
Click [Set]

Start the Auto tuning

☑ Automatic parameter update

Click on the check box.

Click [Start]



Check the motor motion by test operation or external command input.
Repeat the system entire motion several times.
Wait for the inertia ratio estimate to converge.

Stop the Auto tuning

Click [Stop]

Confirm

Waveform monitor
And/or
Visually check the actual motion.

Is the motor quiet? — N → Manually enter the inertia ratio.

Y ↓

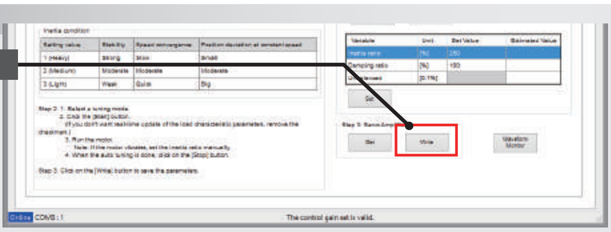
Acceptable motion? — N → Stage 2 Final tuning
- Shorter settling time
- Better responsiveness

Y ↓

Operation 2

Write to the amplifier

Click [Set]



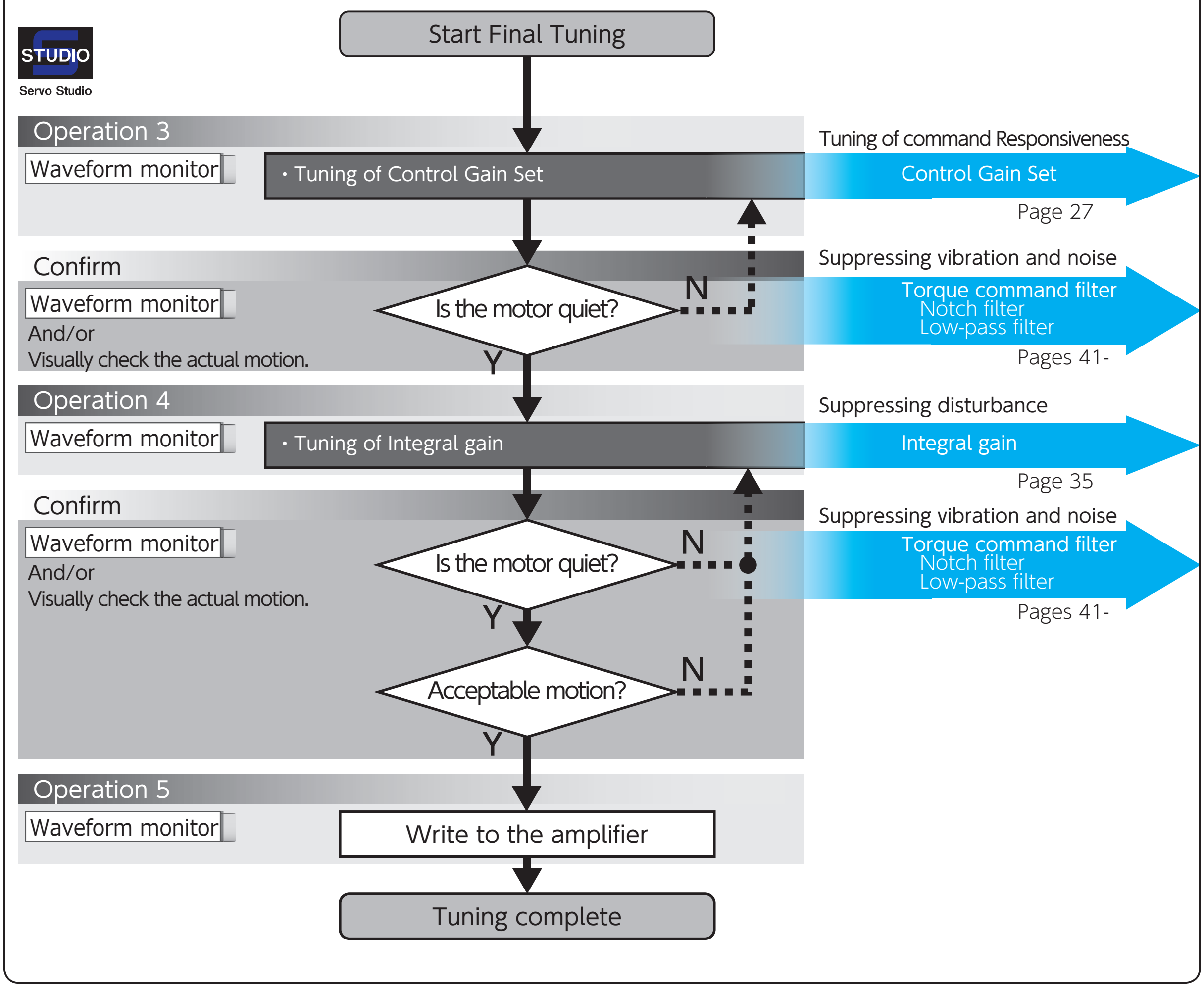
Tuning complete

Make sure to click on [Stop] to finish Auto Tuning.

Starting Final Tuning Mode while Auto Tuning is still in process will make the tuning difficult because of inertia ratio changes.

Final Tuning: Velocity Control Mode

Stage 2 Optimizing the settling time and deviation Suppressing vibration and noise



2. Tuning Procedure

PLS POS VEL VEL TRQ

Final Tuning

Start Final Tuning

Operation 3 and 4

Change Control Gain Set

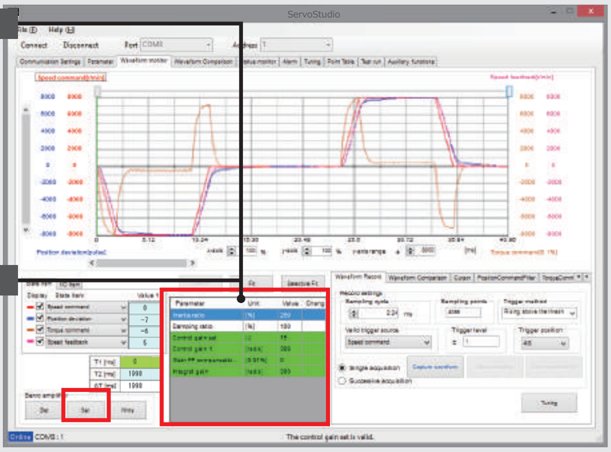
Click Set

Let the equipment system move.(*)

Change Integral Gain

Click Set

Let the equipment system move.(*)



*) ・Check the motor motion by test operation or external command input.
・Repeat the system entire motion several times.

Confirm

Waveform monitor
And/or
Visually check
the actual motion.

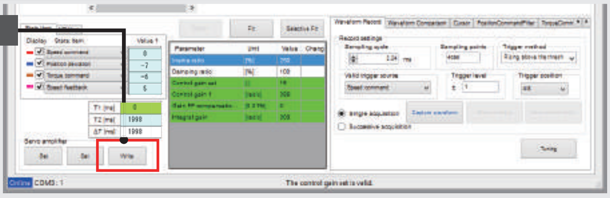
Acceptable motion?

N → Torque command filter
Notch filter
Low-pass filter
Pages 41-

Y

Operation 5

Click Write

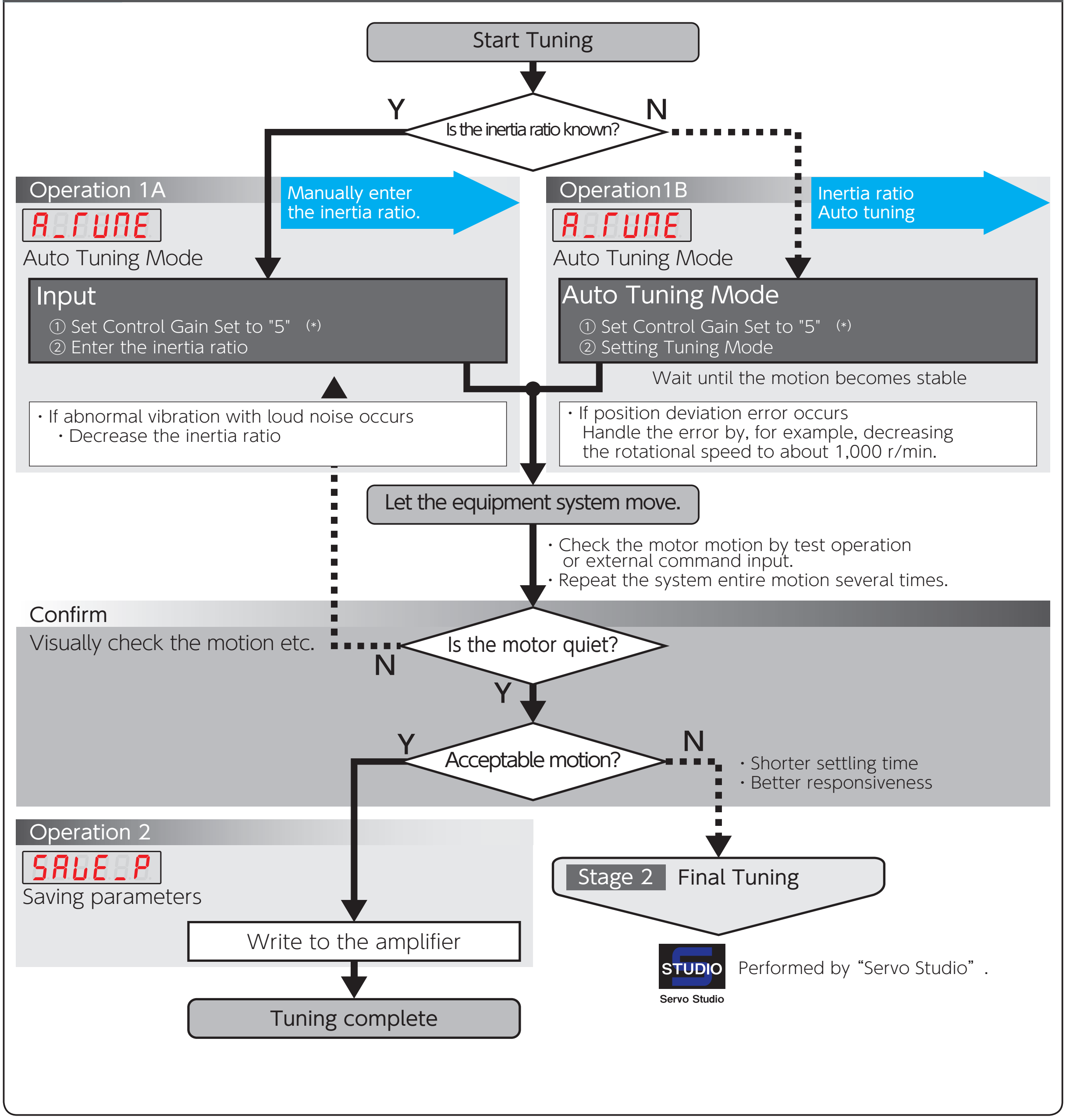


Tuning complete

2. Tuning Procedure

Auto Tuning on Setup Panel

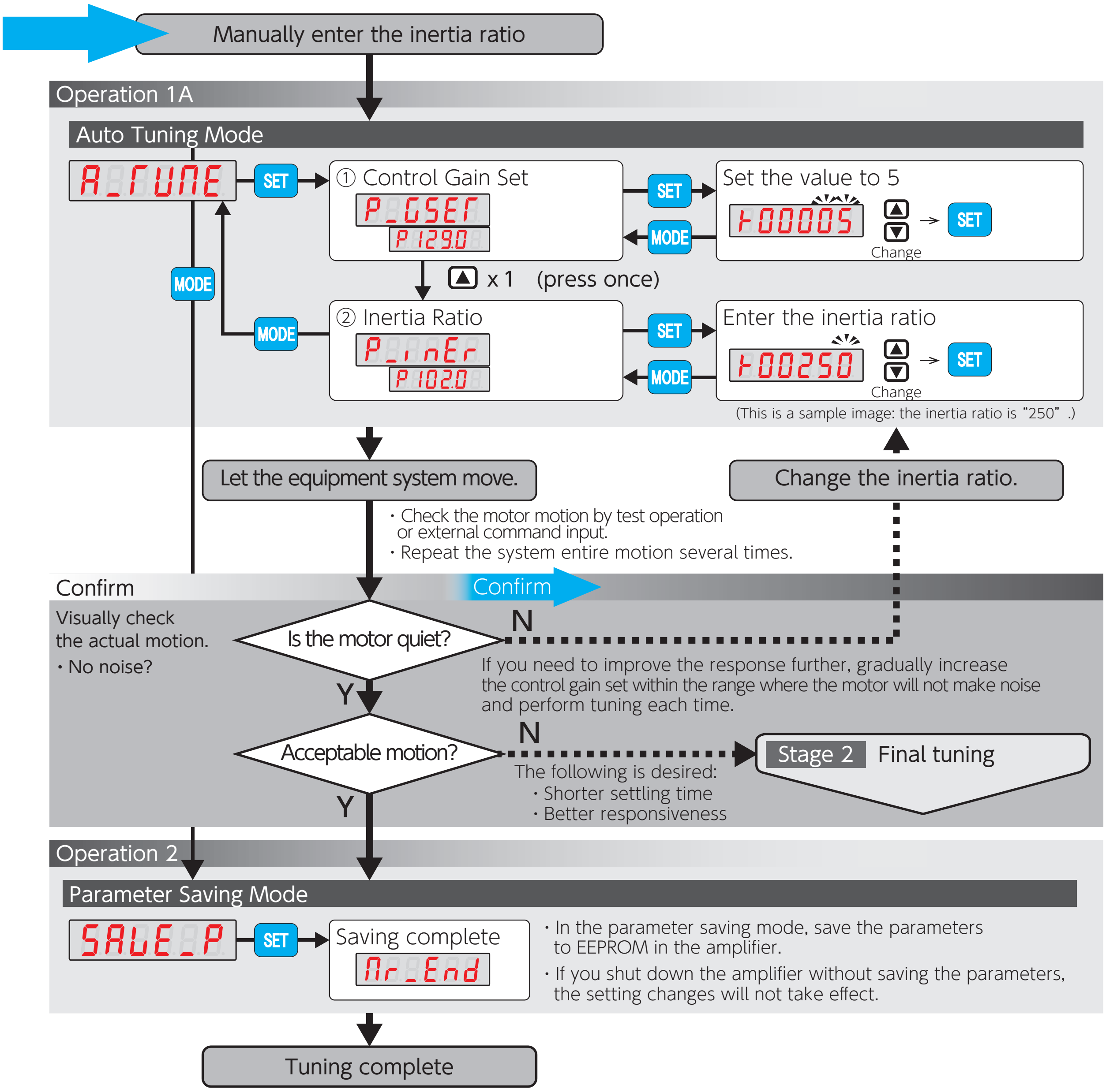
Stage 1 Setting the Inertia ratio and Optimizing Control Gain Set



*) Starting tuning with the lowest setting of the controller gain set will provide successful tuning with no vibrations accompanied by noise.

2. Tuning Procedure

Auto Tuning on Setup Panel: Operation 1A



(This is a sample image: the inertia ratio is “250” .)

- Check the motor motion by test operation or external command input.
- Repeat the system entire motion several times.

Visually check the actual motion.
- No noise?

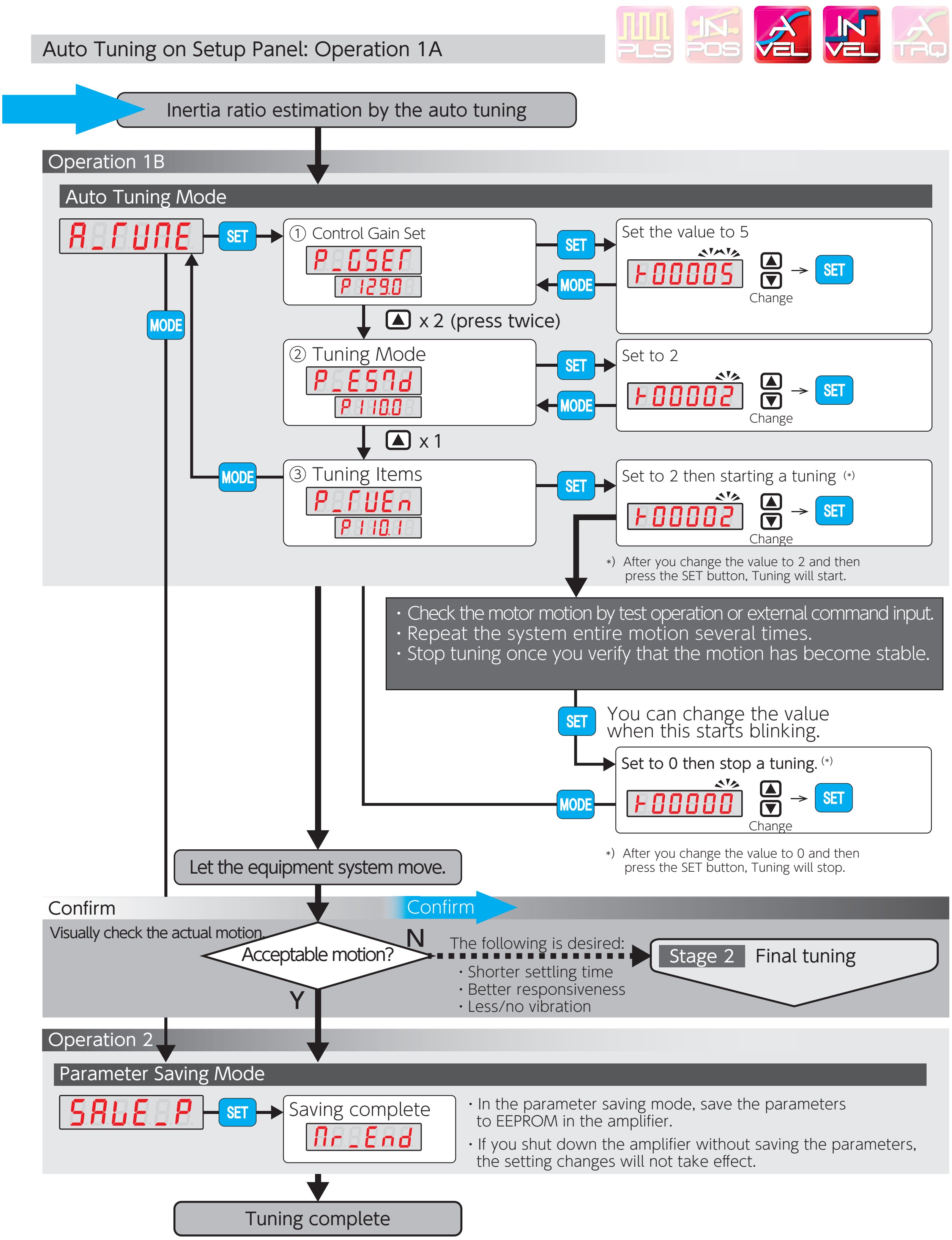
If you need to improve the response further, gradually increase the control gain set within the range where the motor will not make noise and perform tuning each time.

The following is desired:
- Shorter settling time
- Better responsiveness

- In the parameter saving mode, save the parameters to EEPROM in the amplifier.
- If you shut down the amplifier without saving the parameters, the setting changes will not take effect.

2. Tuning Procedure

Auto Tuning on Setup Panel: Operation 1A



*) After you change the value to 2 and then press the SET button, Tuning will start.

- Check the motor motion by test operation or external command input.
- Repeat the system entire motion several times.
- Stop tuning once you verify that the motion has become stable.

*) After you change the value to 0 and then press the SET button, Tuning will stop.

The following is desired:

- Shorter settling time
- Better responsiveness
- Less/no vibration

- In the parameter saving mode, save the parameters to EEPROM in the amplifier.
- If you shut down the amplifier without saving the parameters, the setting changes will not take effect.

Confirm

PLS POS VEL VEL TRQ

Check the machine motion

Check the motor motions in test operation or by external command input.
Repeat the previous steps from the beginning.

Confirm

Select the Tuning tab

Waveform monitor tab

Select items to measure.

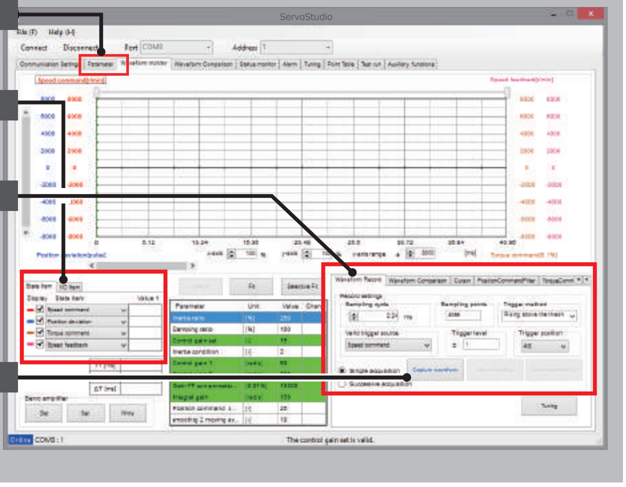
State Item tab

Select measurement conditions.

Waveform Record tab

Start Measuring

Click Capture waveform



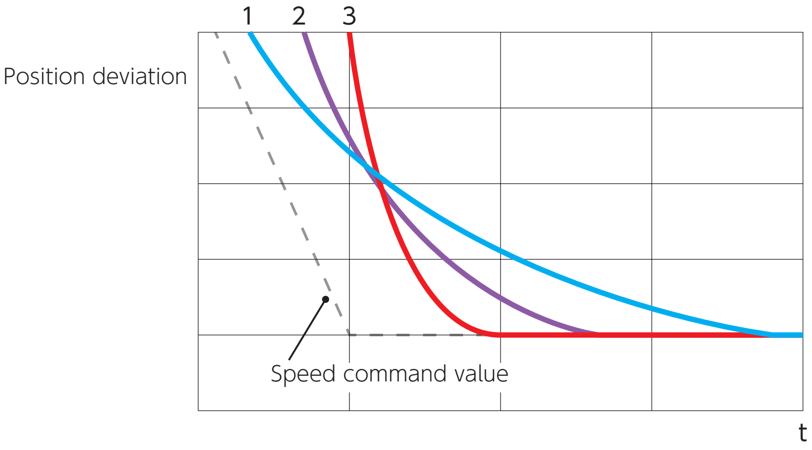
3. Tuning Parameters

1. Tuning

Inertia Condition

Function	To make the tuning operation easier, select the inertia condition suitable to your equipment. The inertia conditions that you select will determine the Control Gain 1-2 combination and their ratio.
Parameter No.113.1	Position Control Mode: Inertia conditions
Tuning Tip	Prioritize either stability or convergence according to the load and rigidity of your equipment. Be aware of the trade-off between stability and convergence.

Settings	Intended Use	Effect
1	heavy-load, high fluctuation equipment low-rigid equipment robot arms etc.	Better Stability ↕ Better Convergence
2 (Default)	(moderate setting) general transport machines	
3	light-load equipment equipment that demands high-speed operation or settling-required	

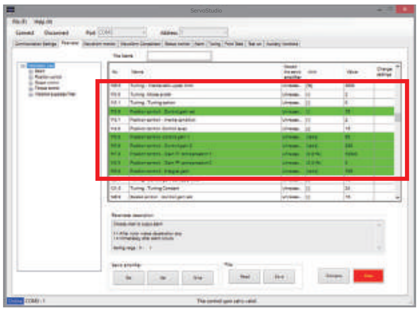


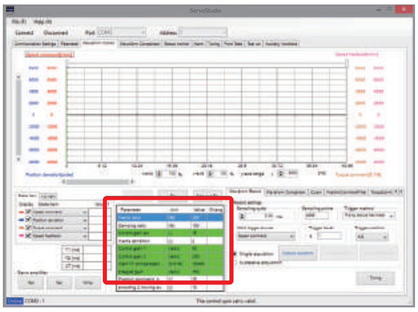
Difference in convergence characteristics depending on the inertia condition settings

Control Gain Set

Function	With this parameter, a set of the tuning parameters can be set to their defaults all at once. (*1) Increasing the value of this parameter will improve the command response, position deviation during motion, settling time, and control rigidity.		
Parameter Set	No.113.0 (Position Control Mode)	Control level	No.114.0
		Control Gain 1	No.115.0
		Control Gain 2	No.116.0
		Integral gain	No.119.0
		Torque command filter: Low-pass filter time constant (*2)	No.162.0
	No.129.0 (Velocity Control Mode)	Control level	No.130.0
		Control Gain 1	No.131.0
		Integral gain	No.133.0
		Torque command filter: Low-pass filter time constant (*2)	No.162.0
Remark	Too high a setting will cause noise. When increasing the value, check the resulting operation to avoid oscillation or vibration.		
Tuning Tip	• Set the value to 5 first to fix the inertia ratio. • Gradually increase the setting value while watching the motion. If noise occurs, use a notch filter or decrease the low-pass filter setting. ☞ Page 42 Torque Command Filter: Notch filter ☞ Page 43 Torque Command Low-Pass Filter		

*1) In the "Servo Studio" parameters grouped in the control gain set are highlighted in green.





*2) This is when Low-pass filter auto Setting (160.2) = 1 (auto setting ON)

Control gain set settings	Command Responsiveness	Rigidity	Settling Time	Noise
5	Slow	Low	Long	Unlikely
10	↑	↑	↑	↑
15 (Default)				
20	↓	↓	↓	↓
30	Quick	High	Short	Likely

Under the Auto Tuning tab, tick the detail setup box, and then select from 1-46 one by one.

3. Tuning Parameters

Mode Switch

PLS IN POS VEL IN VEL TRQ

Function	Change the mode based on the direction of the load inertia and whether offset load is present or not.		
Parameter No.110.0	Settings	Mode	Balanced load or unbalanced load
	1	Standard Mode	Balanced load (horizontal motion)
	2 (Default)	Unbalanced Load Mode	Unbalanced load such as gravity is present
Remark	Use the Unbalanced Load Mode even for the case of balanced load (horizontal-axis motion).		
Prerequisite	Position Control Mode, Velocity Control Mode		

Tuning Items

PLS IN POS VEL IN VEL TRQ

Function	Setting the item(s) to be estimated during tuning.		
Parameter No.110.1	Settings(Tuning)	Estimate items	
		Inertia ratio	Damping ratio
	0(Tuning Stop) (Default)	Do not estimate	Do not estimate
	1(Tuning Start)	Estimate	
	2(Tuning Start)		Estimate
Prerequisite	Position Control Mode, Velocity Control Mode		

3. Tuning Parameters

2. Final Tuning

Inertia Ratio

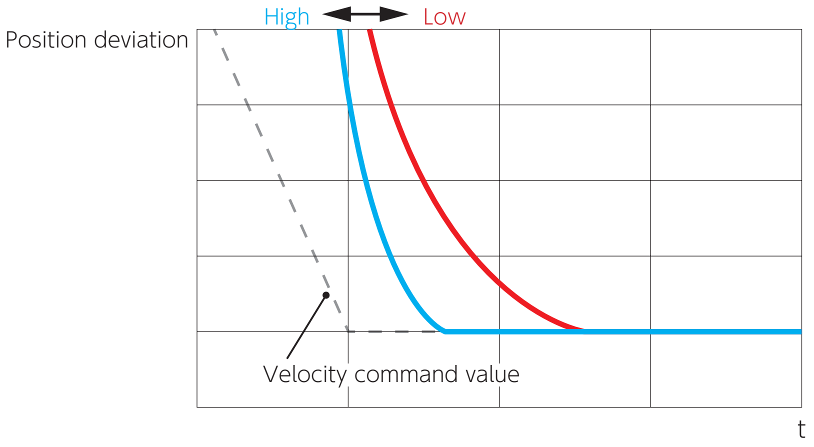
PLS IN POS VEL IN VEL TRQ

Function	Set the ratio of the load inertia to the rotor inertia of the motor. This item represents the ratio of the motor axis moment of inertia to the load moment of inertia. The inertia ratio used in SD3 Series motor includes the motor rotor inertia (=100%). Example: inertia ratio 200% = motor rotor inertia 100% + output axis load 100% inertia ratio 1100% = motor rotor inertia 100% + output axis load 1000% $\text{Inertia ratio} = \dfrac{\text{(load inertia)+(Rotor inertia)}}{\text{(Rotor inertia)}} \times 100\%$	
Parameter No.102.0	Default:	250%
	Setting range:	100 to 10,000
Remark	Settings that are not right for the equipment will cause noise or vibration.	
Tuning Tip	Start with setting a right inertia ratio which will make your tuning easier. The auto estimate of inertia ratio during Quick Tuning will be capped by the **upper bound limit** (No.106.0). If the estimate value of the inertia ratio is higher than the upper limit, manually enter the estimated value after suppressing the vibration and noise with a notch filter first. Select the best inertia condition and set the **control gain set** (No.113.0, No.129.0) to 5 to perform the quick-tuning and auto-tuning. In case of vibrations at settling, perform damping adjustment and perform tuning again. Because this tuning must be performed under the condition where the inertia can be estimated, we recommend that you obtain the ratio estimate in test operation.	

Position Control Mode: Control Gain 1

PLS IN POS VEL IN VEL TRQ

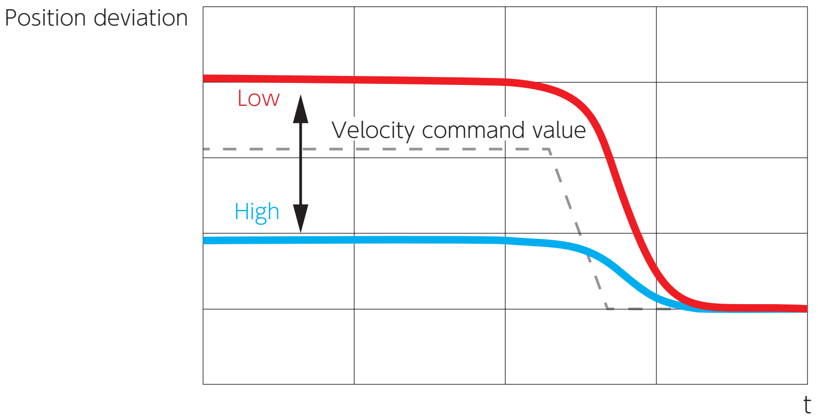
Function	Increasing this parameter value will reduce the position deviation after the command becomes zero. Increase when the convergence of the position deviation at settling is not good.
Parameter No.115.0	Default: 50 rad/s Setting range: 5 to 1,000
Remark	Select a value no higher than **Position Control Mode: Control Gain 2** (No.116.0). Set a value smaller than the value of **Control Gain 2** (No.116.0). Making a change to any of the following will also change other tuning parameters (such as Control Gain 2) to the prearranged parameter set all at once. ・**Control Gain Set**(No.113.0) ・**Inertia conditions**(No.113.1) ・**Control Level**(No.114.0)
Tuning Tip	Increasing this parameter setting will improve the settling time in cases when increasing the control gain set or control level does not resolve poor convergence of position deviation, or noise is too much that the control gain set or control level should not be increased.



Differences in Position Deviation Convergence

Position Control Mode: Control Gain 2

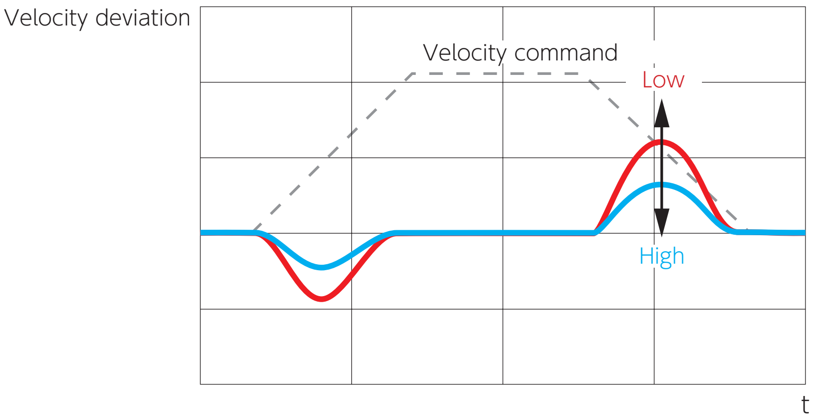
Function	Increasing this parameter value will reduce the position deviation during command input. Increasing the parameter value provides faster command response; however, too large a value may result in noise.
Parameter No.116.0	Default: 200 rad/s Setting range: 80 to 5,000
Remark	Set a value larger than the value of **Control Gain 1** (No.115.0). To reduce position deviations after the command becomes zero, increase the value of **Control Gain 1** (No.115.0). The tuning parameters such as the **Control gain 1** will be changed to the group of the preset value depending on changing the following parameters. ・**Control gain set**(No.113.0) ・**Inertia conditions**(No.113.1) ・**Control level**(No.114.0)
Tuning Tip	Use this parameter when the load inertia or the load fluctuation is large. The responsiveness will be improved and the movement will be smoother. Noise Solutions ① Use **Torque command filter: Notch filter** (such as No.160.1). ② Lower **Torque command filter: Low-pass filter constant** (No.162.0). ③ Lower **Integral gain** (No.119.0). When no improvement have been seen if these ①, ②, and ③ method had been performed, please decrease the 116.0 value.



Differences in Position Deviation Convergence

Velocity Control Mode: Control Gain 1

Function	Increasing this parameter value will reduce the velocity deviation during the acceleration/deacceleration. Increasing the parameter value provides faster command response; however, too large a value may result in noise.
Parameter No.131.0	Default: 399 rad/s Setting range: 100 to 6,000
Remark	Making a change to any of the following will also change other tuning parameters (such as **Gain FF Compensation 1**) to the prearranged parameter set all at once. ・**Control gain set** (No.129.0) ・**Control level** (No.130.0)
Tuning Tip	Use this parameter when the load inertia or the load fluctuation is large. The responsiveness will be improved and the movement will be smoother. Noise Solutions ① Use **Torque command filter: Notch filter** (such as No.160.1). ② Lower **Torque command filter: Low-pass filter constant** (No.162.0). ③ Lower **Integral gain** (No.133.0) When no improvement have been seen if these ①, ②, and ③ method had been performed, please decrease the No.131.0 value.

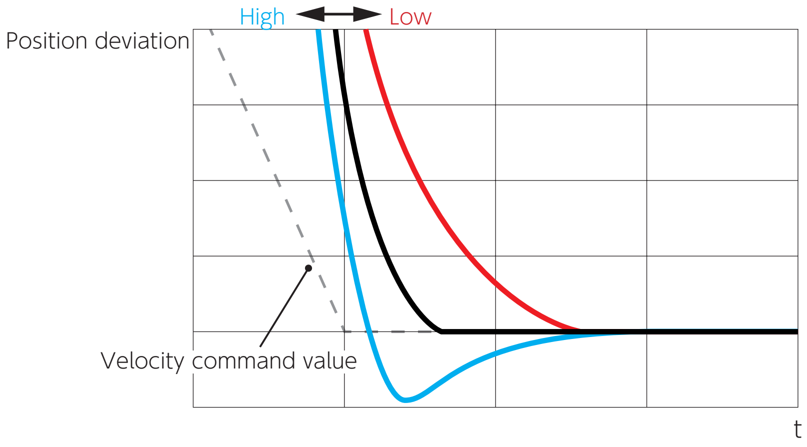


Differences in Velocity Deviation Convergence

Position Control Mode: Gain FF Compensation 1

PLS POS VEL VEL TRQ

Function	This parameter will improve the responsiveness at a low gains setting. Set the Field Forward Compensation Rate (velocity) with respect to **Control Gain 1** (No.115.0) for Position Control Mode. Using this parameter is effective to shorten the settling time.
Parameter No.117.0	Default: 10,000 [0.01%]
	Setting range: 0 to 15,000
Remark	Guideline for Tuning If the inertia ratio is right, setting this parameter to 10,000 will not cause overshooting nor undershooting.
Tuning Tip	· Set the following before adjusting this parameter: **Inertia ratio** (No.102.0), **Control gain set** (No.113.0), **Control level** (No.114.0), **Control Gain 1** (No.115.0), and **Control Gain 2** (No.116.0) · Setting this parameter too low will result in undershooting, too high in overshooting. Target the value which would make the settling time shorter. · Too high a value of this parameter will result in overshooting, and too low in undershooting. Set relatively a moderate value. Inertia condition — Coarse tuning amount 1: increment by 10 2: increment by 100

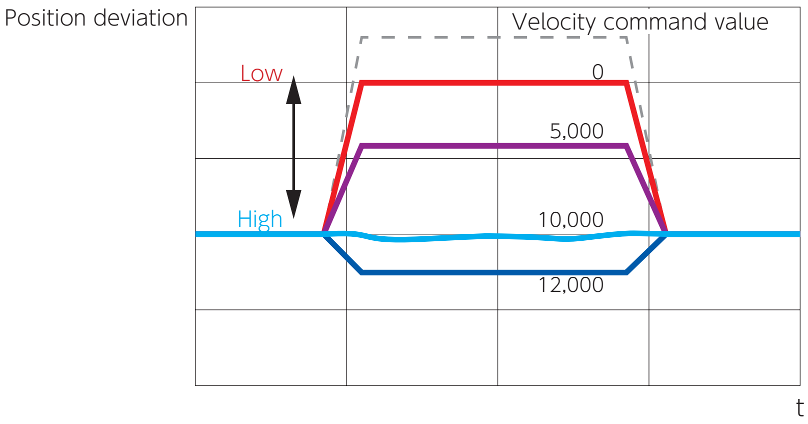


Differences in Position Deviation Convergence

Position Control Mode: Gain FF Compensation 2

PLS IN POS VEL IN VEL TRQ

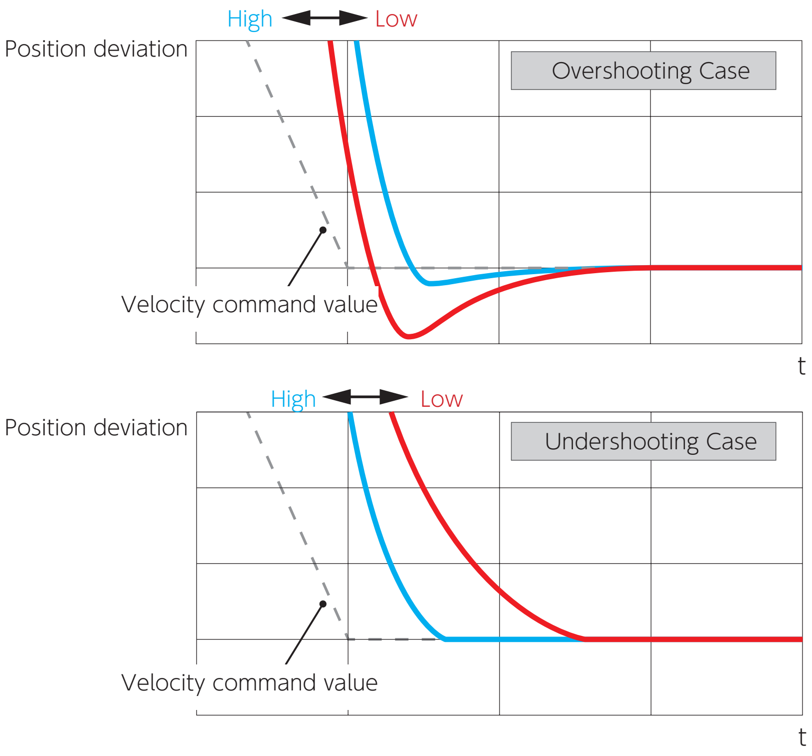
Function	Increasing this parameter value will reduce the position deviation of the motor running at a constant speed. Raise the value of this item only after reducing the position deviation, by using **Gain FF Compensation 1** (No.117.0) at settling.	
Parameter No.118.0	Default:	0 [0.01%]
	Setting range:	0 to 15,000
Remark	If this parameter value is above 10,000, the position deviation will start appearing in a negative range. When the command resolution is low, increasing this parameter value will result in louder running sound.	
Tuning Tip	With a right inertia ratio setting, setting this parameter to 10,000 minimizes the position deviation. Noise Solutions Adjusting **Filter 4: Smoothing 2- Moving average counter** (No.81.0) may reduce the noise.	



Differences in Position Deviation Convergence

Integral Gain

Function	Set the Integral Gain. Increasing the integral gain will improve poor convergence due to friction and load fluctuation at settling and reduce the position deviations. This will result in rigid and sensitive motions.		
Parameter No.119.0	Position Control Mode	Default:	160 rad/s
		Setting range:	45 to 5,000
Parameter No.133.0	Velocity Control Mode	Default:	300 rad/s
		Setting range:	45 to 5,000
Remark	This parameter will reset to the default if the Control Gain Set is changed. Too high an integral gain will cause noise. Adjust the value within the range of no noise to achieve your desired responsiveness.		
Tuning Tip	Adjust the integral gain after setting the **control level** (or adjust Control Gain 1 and 2 each) and FF compensation. Noise Solutions ① **Use Torque command filter: Notch filter** (such as No.160.1) ② Decrease the value of **Integral Gain**. If noise occurs, decrease the setting of this parameter or apply a torque command notch filter. ☞ Page 42 Torque Command Notch Filter		



Differences in Position Deviation Convergence

3. Position Command Filter

Optimizing the settling time and deviation Suppressing vibration and noise

Check the following before using Position command filter

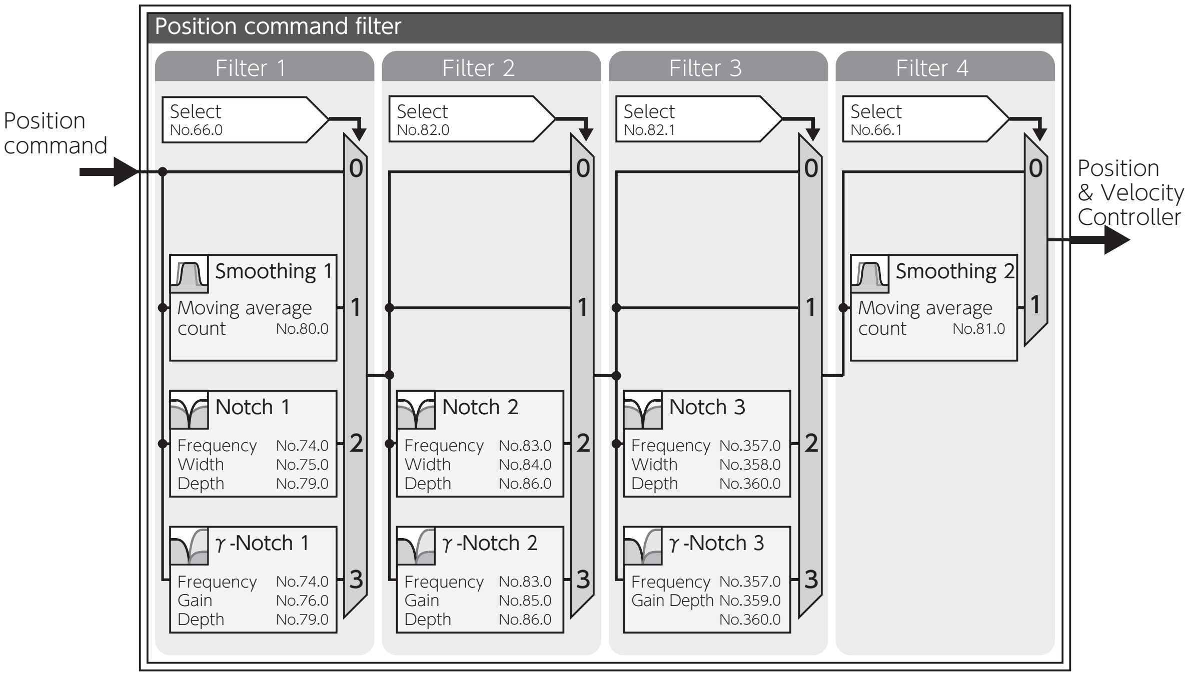
- The command from the host controller is correct.
- The equipment is installed firmly and properly.
- The gain parameters such as inertia ratio are correctly set.
- The command smoothing filters 2 (and 1) are set.
- Vibration is now unlikely to occur thanks to the decreased integral gain.

Filter	Overview	Refer to
Smoothing	**Position Command Smoothing Filter** Effective in smoothing the position command and suppressing vibration at the time of positioning.	Page 38

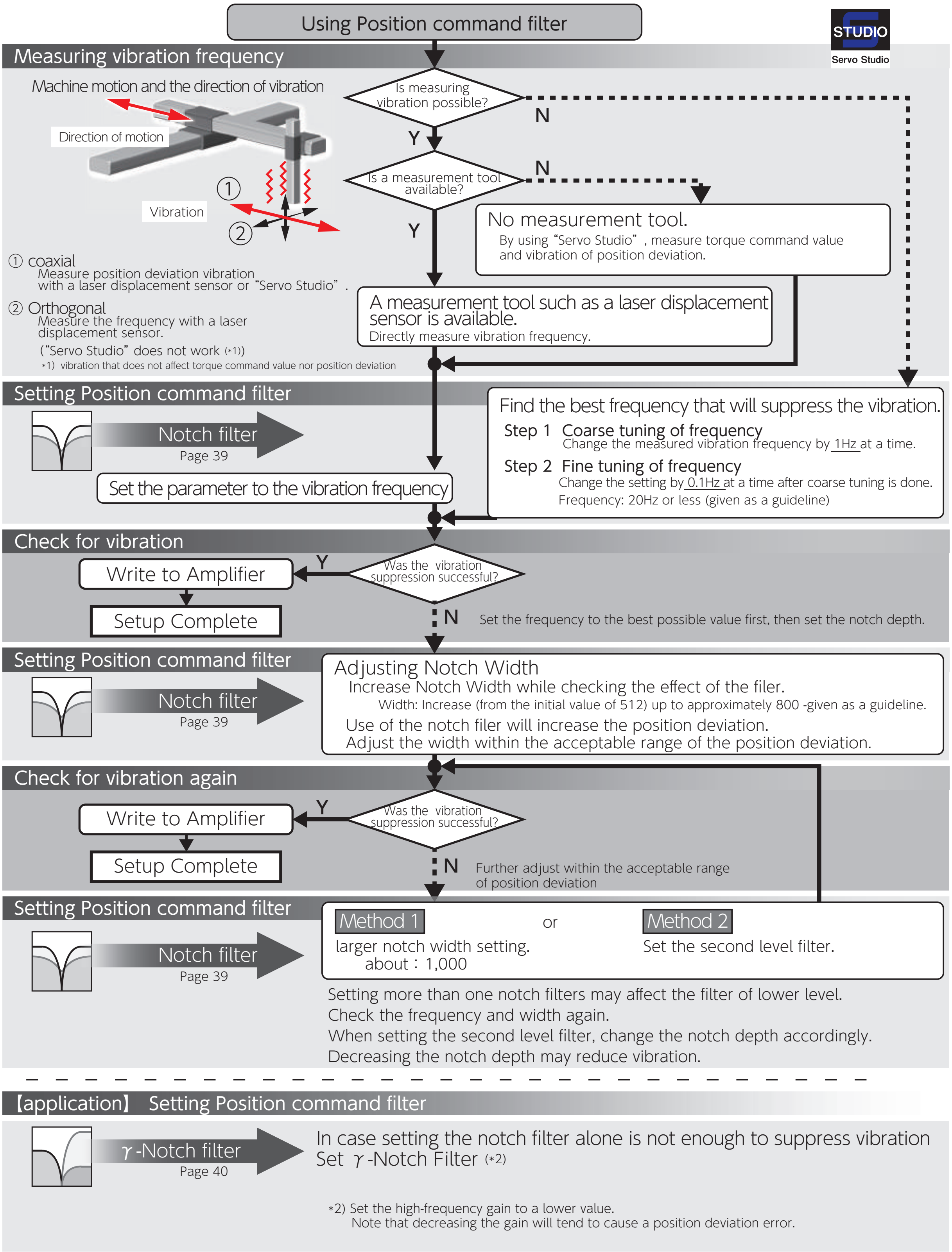
Apply the following notch filters if the machine end point is still vibrating after sufficient tuning was performed and the smoothing filter was set.

Filter	Overview	Refer to
Notch	**Position Command Notch filter** Effective in suppressing vibration of mechanical systems where the vibration does not appear in the torque output waveform. When compared to the command smoothing filter, the position command filter is more effective in reducing the absolute position deviation (Status No.80).	Page 37 Page 39
γ -Notch	**Position Command γ -Notch Filter** Effective in suppressing vibration of mechanical systems where the vibration does not appear in the torque output waveform. This filter has flexibility of changing the gain setting in the range higher than notch frequencies. This item will reduce the position deviation impacted by use of notch filer.	Page 37 Page 40

Up to four levels of Position command filter are available.



Block Diagram of Position Command Filter (Details)



① coaxial
Measure position deviation vibration with a laser displacement sensor or "Servo Studio".

② Orthogonal
Measure the frequency with a laser displacement sensor.
("Servo Studio" does not work (*1))

*1) vibration that does not affect torque command value nor position deviation

No measurement tool.
By using "Servo Studio", measure torque command value and vibration of position deviation.

A measurement tool such as a laser displacement sensor is available.
Directly measure vibration frequency.

Set the parameter to the vibration frequency

Find the best frequency that will suppress the vibration.

Step 1 Coarse tuning of frequency
Change the measured vibration frequency by 1Hz at a time.

Step 2 Fine tuning of frequency
Change the setting by 0.1Hz at a time after coarse tuning is done.
Frequency: 20Hz or less (given as a guideline)

Set the frequency to the best possible value first, then set the notch depth.

Adjusting Notch Width
Increase Notch Width while checking the effect of the filer.
Width: Increase (from the initial value of 512) up to approximately 800 -given as a guideline.
Use of the notch filer will increase the position deviation.
Adjust the width within the acceptable range of the position deviation.

Further adjust within the acceptable range of position deviation

Method 1
larger notch width setting.
about : 1,000

or

Method 2
Set the second level filter.

Setting more than one notch filters may affect the filter of lower level.
Check the frequency and width again.
When setting the second level filter, change the notch depth accordingly.
Decreasing the notch depth may reduce vibration.

In case setting the notch filter alone is not enough to suppress vibration
Set γ-Notch Filter (*2)

*2) Set the high-frequency gain to a lower value.
Note that decreasing the gain will tend to cause a position deviation error.

Position Command: Smoothing Filters 1 and 2

PLS IN POS VEL IN VEL TRQ

Function	The smoothing filters smooth the position command and suppress vibrations.		
Parameter	Smoothing Filters		
	Position command filter 1: Type Select	Default: 0 Setting range: 0 to 3	No.66.0
	Position command filter 4: Switch Select	Default: 1 Settings 0, 1	No.66.1
	Position command filter 1: Smoothing 1 -Moving average counter	Default: 25 (less than 750 W) 20 (over 1 kW) Setting range: 1 to 6,250	No.80.0
	Position command filter 4: Smoothing 2 -Moving average counter	Default: 10 Setting range: 1 to 1,250	No.81.0
Remark	Before setting any of the parameters, wait for at least 3 secs after the motor stops and then set it while the command pulse is not being input. Changing the parameter setting during pulse input or with presence of pulse residue could cause shift in position. The larger setting will result in longer command time delay.		

Tuning Tip

- Set **Position command filter 1: Type** (No.66.0) and **Position command filter 4: Switch** (No.66.1) to "1".
- Measure the vibration frequency on the torque command waveform or position deviation, and set **Position command filter 1 (and 4): Smoothing 1 (and 2) -Moving average count** (No.80.0 (and No.81.0) to the value derived from the vibration frequency.

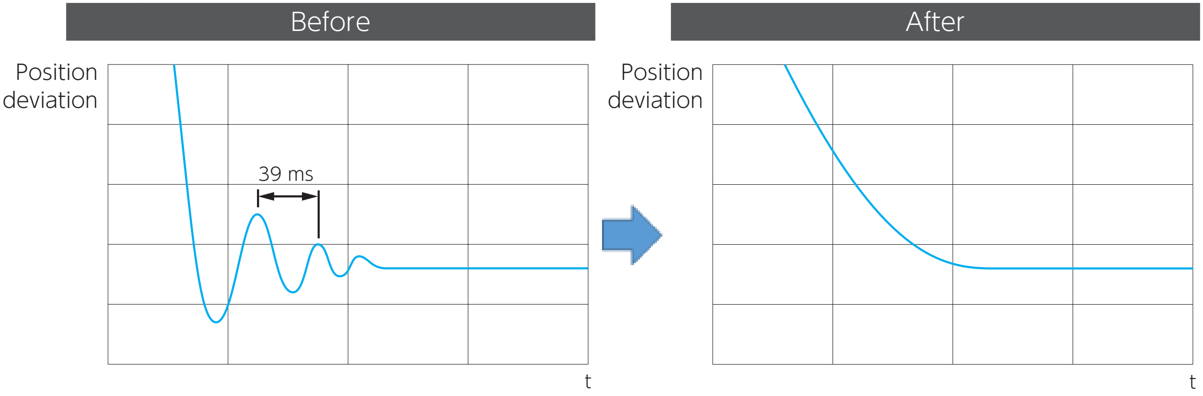
Calculation formula:

Motor Output Capacity	Moving Average Count Derived from Vibration Frequency	
50 W to 750 W :	6,250	× (vibration frequency[s]) = parameter value
1 kW to 2 kW :	5,000	

In the example below, when the vibration frequency is 39 ms, the average count = 6,250 x 0.039 = 242; the delay time will be 39 ms.

☞ 5 **Setting Parameters** List of Parameters

Example: 50 W to 750 W



Effect of Smoothing Filter

Position Command: Notch Filter

PLS POS VEL VEL TRQ

Function

Apply this filter if the machine end point is still vibrating after sufficient tuning was performed and the smoothing filter was applied.
Has vibration suppression effect on mechanical systems where the vibrations don't appear in the torque output waveform.
When compared to the command smoothing filter, the position command filter is more effective in reducing the absolute position deviation (Status No.80).

Parameter

Notch Filter			Filter 1	Filter 2	Filter 3
Frequency	Default:	10 [0.1 Hz]	No.74.0	No.83.0	No.357.0
	Setting range:	10 to 2,000			
Width	Default:	512	No.75.0	No.84.0	No.358.0
	Setting range:	128 to 2,048			
Depth	Default:	0	No.79.0	No.86.0	No.360.0
	Setting range:	0 to 100			

Remark

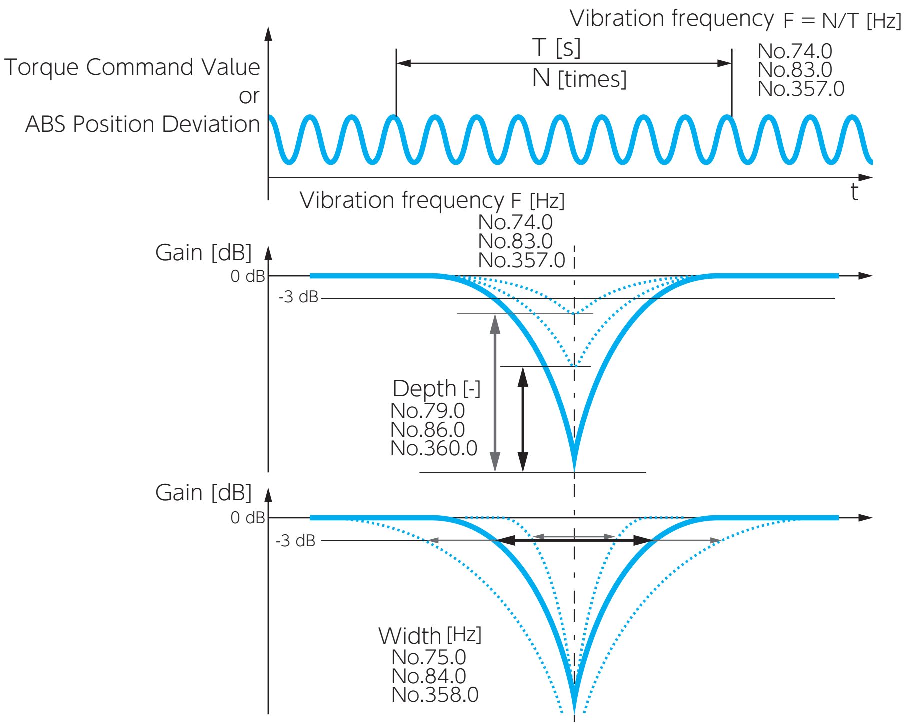
Increasing the notch width will make the position deviation large.
Too large a notch width or setting the second level notch filter will result in better vibration suppression; however, the position deviation will be larger. Set this filter within the acceptable range of position deviation.

Tuning Tip

Check the following before applying the filter
- The command from the host controller is reasonable
- The equipment is installed firmly and properly.
- The gain parameters such as inertia ratio are properly set.
- The command smoothing filters 2 (and 1) are set.
- The integral gain has been decreased and vibrations are unlikely to occur.

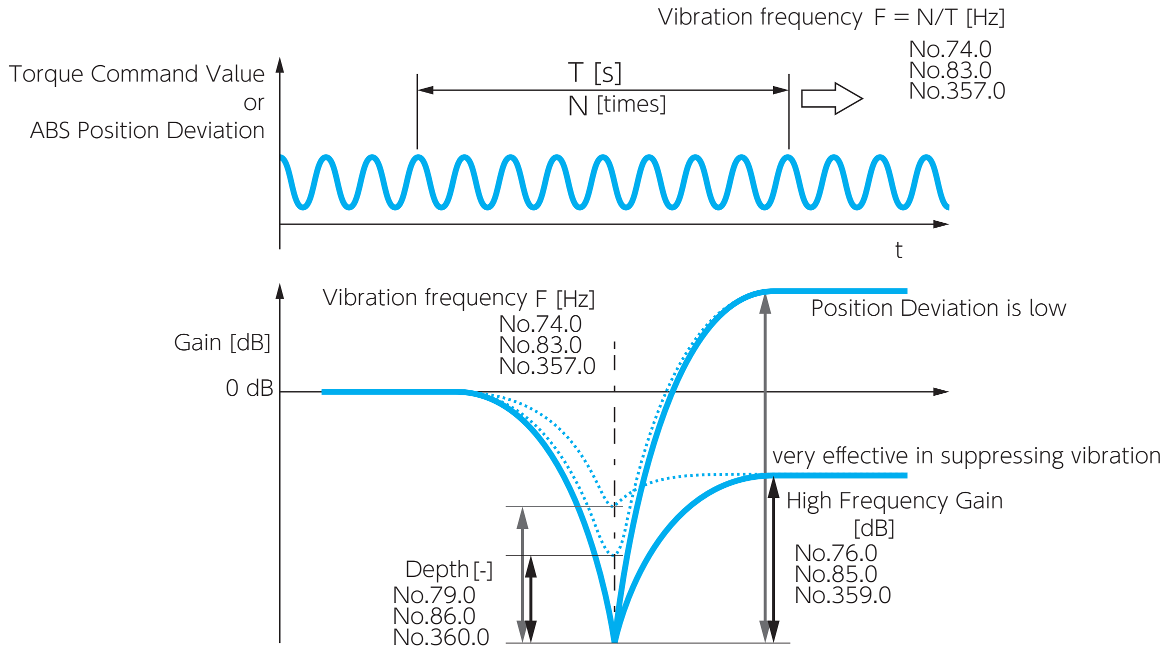
Start the equipment operation and apply the vibration frequency (measured at the equipment end) to the notch frequency. If the vibration cannot be suppressed, increase the notch width (by 800 as a rough standard). To reduce the position deviation during operation, increase the notch depth of a smaller vibration frequency.

☞ 5 **Setting Parameters** List of Parameters



Position Command: γ -Notch Filter

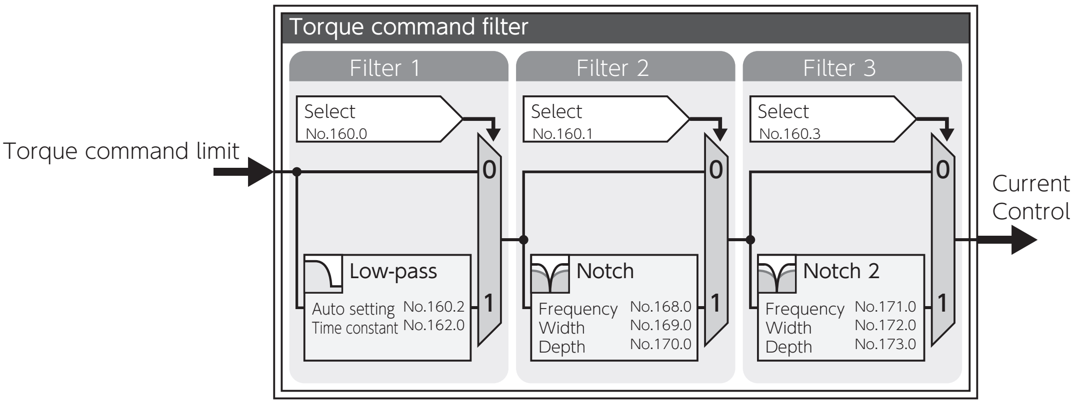
Function	Use this filter, if the machine end point is still vibrating even after applying a notch filter in addition to sufficient tuning and a smoothing filter. This filter has vibration suppression effect on mechanical systems where the vibrations don't appear in the torque output waveform. It has flexibility of changing the gain setting in a range higher than notch frequency. Use this filter when it's expected that using a notch filter will reduce the position deviation.
Remark	Increasing the high frequency gain too much may result in noise. Decreasing the high frequency gain too much will tend to cause position deviation error. Set this filter within the acceptable range.
Tuning Tip	Check the following before applying the filter ・The command from the host controller is reasonable ・The equipment is installed firmly and properly. ・The gain parameters such as inertia ratio are properly set. ・The command smoothing filter 2 and 1 are set. ・The integral gain has been decreased and vibrations are unlikely to occur. Start the equipment operation and apply the vibration frequency (measured at the equipment end) to the notch frequency. To reduce the position deviation, gradually increase the high frequency gain setting. To reduce the position deviation during operation, increase the depth selection parameter with of a smaller vibration frequency. ☞ **5 Setting Parameters** List of Parameters



4. Torque Command Filter

PLS IN POS VEL IN VEL TRQ

Filter	Overview	Refer to
Notch	**Torque Command Filter: Notch Filter** This filter is effective in removing vibration elements from torque command and suppressing noise and vibration.	Page 42
Low-pass	**Torque Command Low-Pass Filter** This filter is effective in smoothing the position command and suppressing vibration at the time of positioning.	Page 43

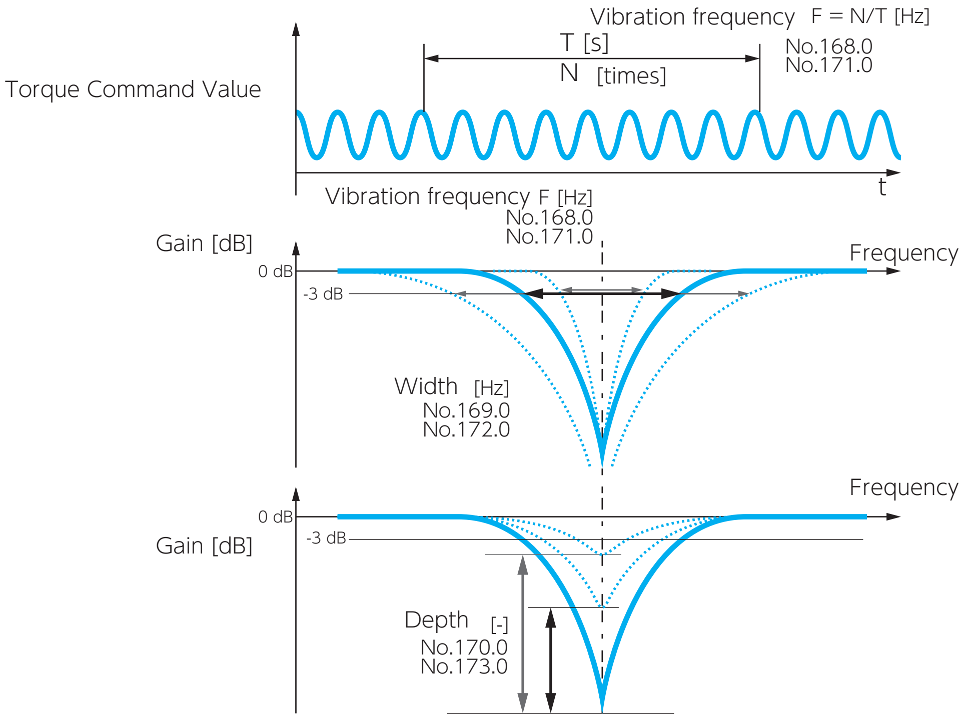


Block Diagram of Torque Command Filter with Details

Torque Command Filter: Notch Filter

PLS IN POS VEL IN VEL TRQ

Function	This filter is effective in suppressing noise and vibrations by removing vibration factors from the torque command.				
Parameter	Notch filter			Filter	Filter 2
	Switch	Default:	0	No.160.1	No.160.3
		Settings:	0, 1		
	Frequency	Default:	2,500 Hz	No.168.0	No.171.0
		Setting range:	0 to 2,500		
	Width	Default:	8	No.169.0	No.172.0
		Setting range:	1 to 16		
	Depth	Default:	0	No.170.0	No.173.0
		Setting range:	0 to 256		
Remark	Set this item only after the machinery is installed properly. Unless the equipment is installed correctly, the filter performance will be suboptimal.				
Tuning Tip	Set **Notch filter switch** (No.160.1) =1(enable) and set the value of **Notch filter frequency** (No.168.0) to be a vibration frequency. Calculate the vibration frequency using the waveform of, for example, the torque command when vibration is occurring. In the case of multiple vibration frequencies, set the second level notch filter. Alternatively, use this filter together with the **low-pass filter** (No.160.0, No.160.2, No.162.0) or increase **Notch filter - Width** (No.169.0). If applying the notch filter cannot stop resonant vibrations due to considerable machinery rattles, increase **Notch filter- Depth** (No.170.0) to 50,100,150 and so on, so that the actual notch depth will be shallower. ☞ 5 **Setting Parameters** List of Parameters				



Torque Command: Low-Pass Filter

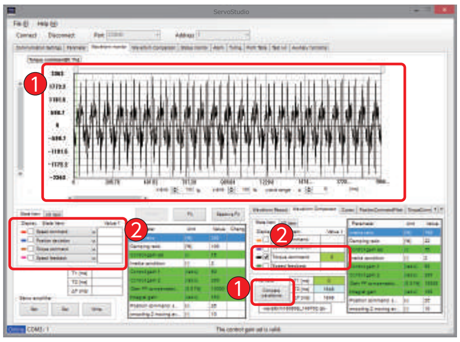
PLS IN POS VEL IN VEL TRQ

<table>
<tr><td>Function</td><td colspan="4">Setting relatively a large value may suppress vibrations.</td></tr>
<tr><td rowspan="7">Parameter</td><td colspan="4">Low-Pass Filter</td></tr>
<tr><td rowspan="2">Switch</td><td>Default:</td><td>1</td><td rowspan="2">No.160.0</td></tr>
<tr><td>Settings:</td><td>0, 1</td></tr>
<tr><td rowspan="2">Auto setting</td><td>Default:</td><td>0</td><td rowspan="2">No.160.2</td></tr>
<tr><td>Settings:</td><td>0, 1</td></tr>
<tr><td rowspan="2">Time constant</td><td>Default:</td><td>0 [0.01 ms/rad](less than 100 W)
10 [0.01 ms/rad](over 200 W)</td><td rowspan="2">No.162.0</td></tr>
<tr><td>Setting range:</td><td>0 to 65,535</td></tr>
<tr><td>Remark</td><td colspan="4">Setting a larger value means getting closer to the control range of the response model: another type of vibration will occur.</td></tr>
<tr><td>Tuning Tip</td><td colspan="4">Set Torque command filter: Notch filter switch (No.160.1) =1 (enable).
A rough estimate of possible max value for the filter can be obtained as follows.
$$\frac{(0.1 \text{ to } 0.2)}{\max((\omega 1+\omega 2), \omega_q)} \text{ [s] or below}$$
<table>
<tr><th></th><th colspan="2">Position Control Mode</th><th colspan="2">Velocity Control Mode</th></tr>
<tr><td>ω 1</td><td>Control Gain 1</td><td>No.115.0</td><td>Control Gain 1</td><td>No.131.0</td></tr>
<tr><td>ω 2</td><td>Control Gain 2</td><td>No.116.0</td><td>-</td><td>-</td></tr>
<tr><td>ω q</td><td>Integral Gain</td><td>No.119.0</td><td>Integral Gain</td><td>No.133.0</td></tr>
</table>
☞ 5 Setting Parameters List of Parameters</td></tr>
</table>

4. Using "Servo Studio" to Measure Vibration Frequency (FFT)

① Load the waveforms measured or waveform data saved to display.
(The example shown on the right is saved waveform data.)

② Select a parameter of which the vibration frequency is to be investigated.
Mark the check box to display the waveform.



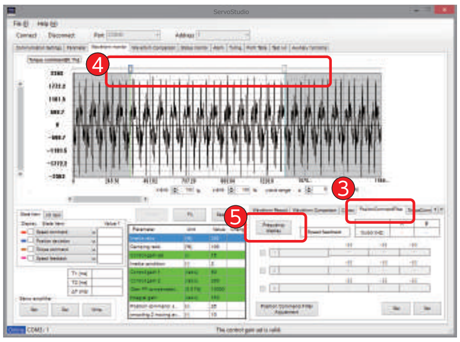
③ Select Position Command Filter or Torque Command Filter

④ Select a range to investigate vibration frequency.

If the position command filter or torque command filter is selected, the second cursor location of the chart will be determined based on the 1st cursor location such that the display range will contain 2^n sample points.

⑤ Click Frequency display .

The x-axis unit will be changed from time [ms] to frequency [Hz]. The display unit of the graph in the range between the 1st and 2nd cursors will be converted to frequency.

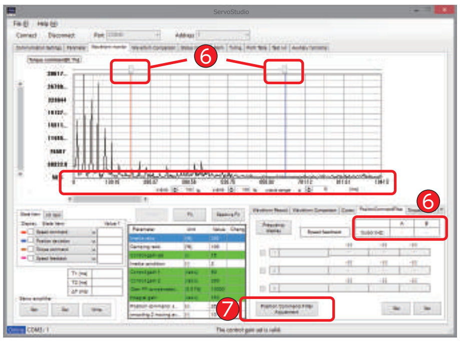


When the x-axis unit on the graph is switched to frequency, the cursor colors will change.
The table will show the frequency in red on column A and blue on column B.

⑥ Read the peak value by using the cursor.

⑦ Click on Position Command Filter Adjustment or Torque Command Filter Adjustment

This will take you to the filter setup window under the tuning tab where a filter can bet set.

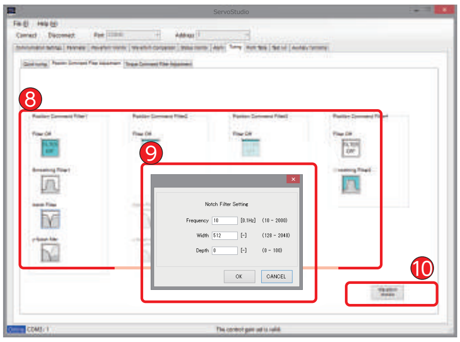


4. Using "Servo Studio" to Measure Vibration Frequency (FFT)

⑧ Click on the icon for the filter that you want to set.
Up to four levels of the position command filters are and three levels of torque command filters are available.

⑨ Set the filter parameters.
For the notch filer, enter the vibration frequency measured.

⑩ Click on Waveform monitor to return to the waveform monitor.



Notch Filter Setting

Frequency 10 [0.1Hz] (10 - 2000)
Width 512 [-] (128 - 2048)
Depth 0 [-] (0 - 100)

The filter that you just set will be shown on the list.

⑪ Unchecking the check box will switch ON/OFF of the filer.
Switch on to verify the filter effect. Switching off will not lose the filter parameter.

Tip for Notch Filter Setup

When you are setting a notch filter, use the initial value for the notch width and check the effect first.
After setting the notch filer, start the equipment, verify the filter effect, and lower the notch frequency gradually.
Measure the waveforms to find the best filter conditions such as frequency, width, and depth.
The notch frequency varies depending on the equipment.

MEMO

8 Troubleshooting

1. Checking Warnings and Alarms

Warnings and alarm numbers can be viewed on the Setup Panel or "Servo Studio".
When an alarm and a warning occur at the same time, the alarm will be displayed first.
For possible cause and remedy, verify on the warning or alarm list.
The alarm history keeps up to ten alarms including the current one. (*)

*) Alarm No.22 (control power supply error) and Warning numbers are not logged in the alarm history.

The alarm numbers and the cumulative run time (in hours) up to the time of alarm are logged.

Note: The amplifier version can be checked with "Servo Studio".

"Servo Studio" **User's Guide**

1. Using the Setup Panel

When a warning occurs, the amplifier STATUS LED blinks green. In addition, the Setup Panel will automatically display the corresponding warning No. Err.988 .

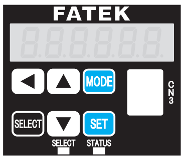
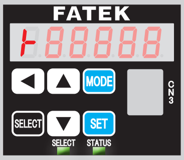
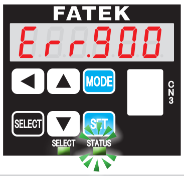
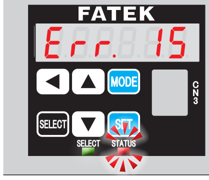
When an alarm occurs, the amplifier STATUS LED changes from solid green to solid red. In addition, the Setup Panel will automatically display the alarm No. Err. 88 .

Note that the above does not happen in the following modes: Parameter Setting Mode, Quick Tuning Mode, Auto Tuning Mode, Parameter Saving Mode, and Auxiliary Function Mode. In these cases, press MODE to switch to Alarm Display Mode.

Status Display Mode will be mute while an alarm or warning is occurring.

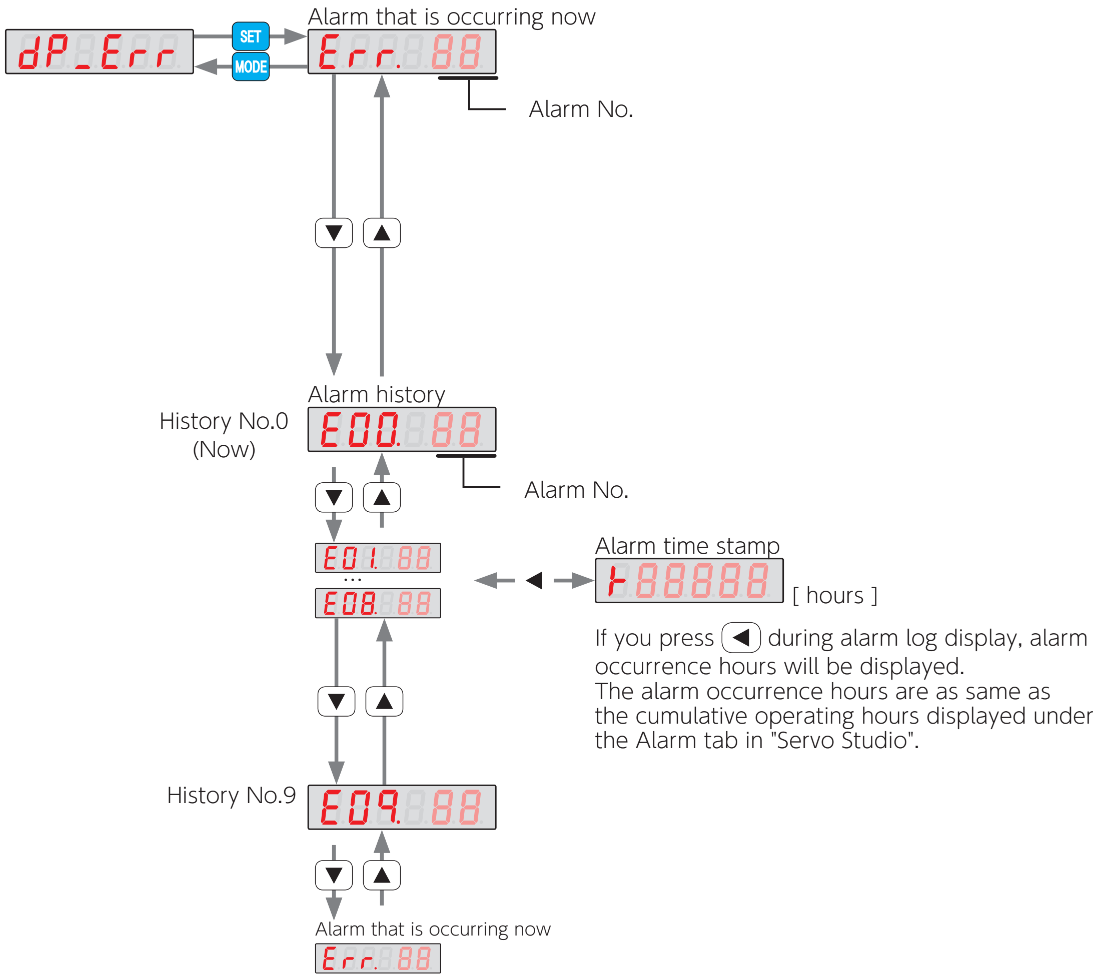
Press ▲▼ to check other warnings and alarms.

5 Setting Parameters Setup Panel

STATUS LED	Meaning	Symptom
Off 	The amplifier is not ON.	The control power (24 VDC) is not supplied. Or the amplifier has not been started.
Solid Green 	Normal no warnings/alarms	Amplifier is operating normally.
Blinking Green 	Abnormal warning occurring	Warning is occurring
Solid Red 	Abnormal alarm occurring	Alarm is occurring

1. Checking Warnings and Alarms

Checking the Alarm History on the Setup Panel



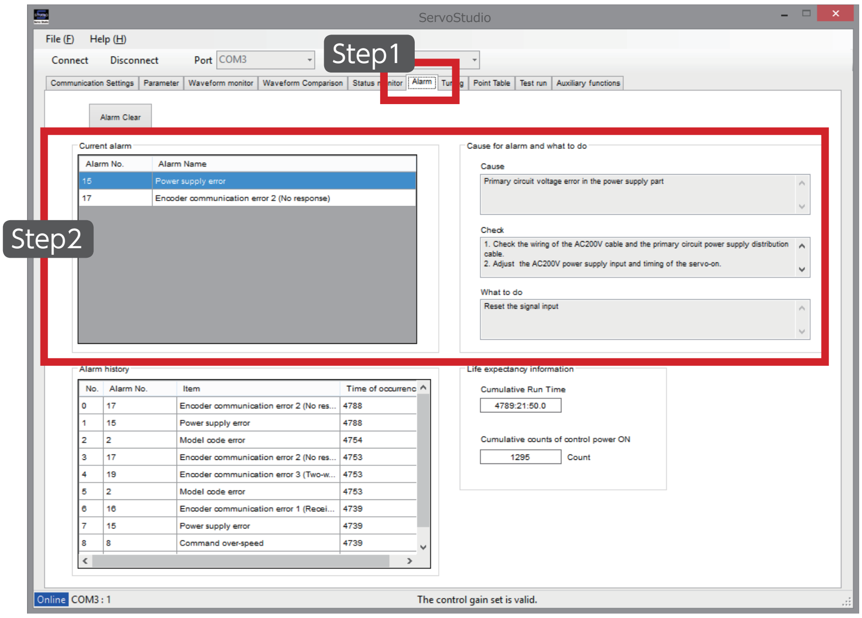
If you press ◀ during alarm log display, alarm occurrence hours will be displayed.
The alarm occurrence hours are as same as the cumulative operating hours displayed under the Alarm tab in "Servo Studio".

1. Checking Warnings and Alarms

2. Using "Servo Studio"

Turn on the 24 VDC control power to the amplifier and start "Servo Studio".
For information on the warning/alarm, check "Alarm currently occurring" under the [Alarm] tab.
If you are not sure what to do, contact us with the alarm number and its description.

☞ "Servo Studio" User's Guide



Port: COM3

Current alarm

Alarm No.	Alarm Name
15	Power supply error
17	Encoder communication error 2 (No response)

Cause for alarm and what to do

Cause: Primary circuit voltage error in the power supply part

Check:
1. Check the wiring of the AC200V cable and the primary circuit power supply distribution cable.
2. Adjust the AC200V power supply input and timing of the servo-on.

What to do: Reset the signal input

Alarm history

No.	Alarm No.	Item	Time of occurrenc
0	17	Encoder communication error 2 (No res...	4788
1	15	Power supply error	4788
2	2	Model code error	4754
3	17	Encoder communication error 2 (No res...	4753
4	19	Encoder communication error 3 (Two-w...	4753
5	2	Model code error	4753
6	16	Encoder communication error 1 (Recei...	4739
7	15	Power supply error	4739
8	8	Command over-speed	4739

Life expectancy information

Cumulative Run Time: 4789:21:50.0

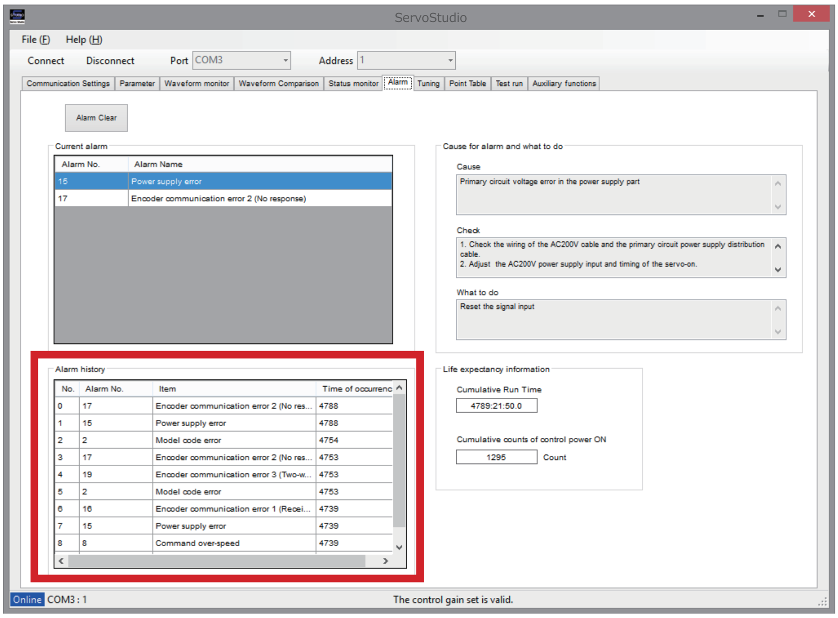
Cumulative counts of control power ON: 1295 Count

COM3 : 1

The control gain set is valid.

Step1 Select the Alarm tab in "Servo Studio".
Step2 See [Current alarm] and [Cause for the alarm] and [What to do] windows for details.

Checking the Alarm History in "Servo Studio"



Port: COM3

Address: 1

Current alarm

Alarm No.	Alarm Name
15	Power supply error
17	Encoder communication error 2 (No response)

Cause for alarm and what to do

Cause: Primary circuit voltage error in the power supply part

Check:
1. Check the wiring of the AC200V cable and the primary circuit power supply distribution cable.
2. Adjust the AC200V power supply input and timing of the servo-on.

What to do: Reset the signal input

Alarm history

No.	Alarm No.	Item	Time of occurrenc
0	17	Encoder communication error 2 (No res...	4788
1	15	Power supply error	4788
2	2	Model code error	4754
3	17	Encoder communication error 2 (No res...	4753
4	19	Encoder communication error 3 (Two-w...	4753
5	2	Model code error	4753
6	16	Encoder communication error 1 (Recei...	4739
7	15	Power supply error	4739
8	8	Command over-speed	4739

Life expectancy information

Cumulative Run Time: 4789:21:50.0

Cumulative counts of control power ON: 1295 Count

COM3 : 1

The control gain set is valid.

The alarm history area shows a list of the alarms.

2. Warnings and Remedies

1. Warning Output

There are 4 ways to output warnings.

1. I/O

While a warning is being output, the user I/O WARN1 (warning) becomes closed.

☞ 4 **Connections** Descriptions CN1 connector signals

2. Setup Panel Output

During waring output, the warning number will appear on the Setup Panel.

Warning No.	Display	Warning Description	Refer to
900	Err.900	Encoder overheat detection	Page 6
901	Err.901	Encoder battery voltage drop error detection	Page 6
902	Err.902	Emergency stop	Page 6
903	Err.903	Encoder communication warning	Page 7
904	Err.904	Excessive position deviation	Page 7

3. RS-485 Communication

Warning status output with the RS-485 communication.

☞ 9 **Appendices** Status Display

4. "Servo Studio"

Select the Alarm tab in "Servo Studio".
See [Current alarm] and [Alarm history] windows for details.

☞ **"Servo Studio" User's Guide**

2. Warnings and Remedies

2. Warning Details

Warning No.	900	Encoder overheat detection
Symptom and Possible Cause	**The temperature inside the absolute encoder has exceeded the temperature value specified by Encoder: Overheat detection - Value (No.267.0).** An alarm can be output in place of the warning.	
Remedy	Lower ambient temperatures and improve thermal radiation conditions. Check the setting of **Encoder: Overheat detection - Value** (No.267.0).	
Reset Method	After eliminating the cause, then input RESET signal to the RESET terminal on the connector CN1.	

Warning No.	901	Encoder battery voltage drop error detection
Symptom and Possible Cause	**The battery voltage of the absolute encoder dropped below the voltage set by Encoder: Battery voltage drop detection - Value (No.268.0).**	
Remedy	Replace the battery in the absolute encoder. Check the **Encoder: Battery voltage drop detection - Value** (No.268.0).	
Reset Method	After eliminating the cause, then input RESET signal to the RESET terminal on the connector CN1.	

Warning No.	902	Emergency stop
Symptom and Possible Cause	**E-STOP by I/O is open.**	
Remedy	Close E-STOP of the I/O. Check for proper I/O connections.	
Reset Method	After eliminating the cause, then input RESET signal to the RESET terminal on the connector CN1.	
Related To	9 **Appendices** Functions	

2. Warnings and Remedies

Warning No.	903	Encoder communication warning
Symptom and Possible Cause	**Failed to obtain ABS encoder temperature and battery voltage data.**	
Remedy	Check for wire disconnection or loose connection of pins. Keep the cable length no longer than 20 meters. Check for noise interference. → Use a shielded twist-pair cable. → Keep the encoder cable away from the motor power cable. → Connect FG firmly. → Use ferrite core for the motor power cable and encoder cable. If any of the above didn't resolve the issue, please contact our distributor.	
Reset Method	After eliminating the cause, then input RESET signal to the RESET terminal on the connector CN1.	

Warning No.	904	Excessive position deviation
Symptom and Possible Cause	**The position deviation consecutively exceeded the setting of Position deviation warning detection: Value (No.363.0) and the setting of Position deviation warning detection: Delay time (No.365.0).**	
Remedy	Adjust the tuning parameters. Check the command from the host controller. Check the wiring. Verify that the brake is released. Verify that the motor is not in a torque limit state per torque command limit. Check the settings of **Position deviation warning detection: Value** (No.363.0) and **Position deviation warning detection: Delay time** (No.365.0).	
Reset Method	After eliminating the cause, then input RESET signal to the RESET terminal on the connector CN1.	

3. Alarms and Remedies

1. List of Alarms

Alarm No.	Display	Alarm Name	Refer to
0	Err. 00	System error	Page 9
1	Err. 01	EEPROM data error	Page 9
2	Err. 02	Product code error	Page 9
4	Err. 04	Overspeed error	Page 9
5	Err. 05	Speed deviation error	Page 10
6	Err. 06	Position deviation error	Page 10
7	Err. 07	Overload error	Page 11
8	Err. 08	Command overspeed error	Page 11
9	Err. 09	Encoder pulse Output frequency error	Page 12
10	Err. 10	Positioning command overflow error/Homing failure	Page 12
11	Err. 11	Encoder error (multi-turn counter overflow)	Page 12
12	Err. 12	Overheat error	Page 12
14	Err. 14	Overvoltage error	Page 13
15	Err. 15	Power supply error (primary circuit power)	Page 13
16	Err. 16	Encoder error (received data)	Page 14
17	Err. 17	Encoder error (no response)	Page 14
18	Err. 18	Encoder error (circuit)	Page 14
19	Err. 19	Encoder error (communication)	Page 14
20	Err. 20	Encoder error (multi-turn data)	Page 14
21	Err. 21	Encoder error (voltage drop)	Page 15
22	Err. 22	Voltage error (control power)	Page 15
23	Err. 23	Switch circuit error	Page 15
24	Err. 24	Overcurrent error	Page 15
25	Err. 25	Inverter error 1	Page 16
26	Err. 26	Inverter error 2	Page 16
27	Err. 27	Current sensor error	Page 16
28	Err. 28	Encoder error (overheat)	Page 16
29	Err. 29	Voltage drop (inside the amplifier)	Page 16

2. Alarm Details

Alarm No.	0	System error
Symptom and Possible Cause	Error in the control circuit The control circuit CPU is not operating normally.	
Remedy	Please contact our distributor.	
Reset Method	⏻	

Alarm No.	1	EEPROM data error
Symptom and Possible Cause	Error at Write Parameters	
Remedy	Check the interface cable and re-write the parameters.	
Reset Method	RST	

Alarm No.	2	Product code error
Symptom and Possible Cause	Unable to read the product code The amplifier-motor pairing was wrong. The encoder cable was not connected to the amplifier correctly. (This includes wiring disconnection)	
Remedy	Check the motor-amplifier pairing. Check the encoder cable connections.	
Reset Method	⏻	

Alarm No.	4	Overspeed error
Symptom and Possible Cause	The motor rotational speed exceeded the rated maximum rotational speed. The command from the host controller was not appropriate. There were residual pulses due to drive restriction or other reasons.	
Remedy	Adjust the Tuning parameters. Check the command. Verify that the location of the limit sensor hasn't shifted.	
Reset Method	RST	

Alarm No.	5	Speed deviation error
Symptom and Possible Cause	Position control/Speed control error The command was not appropriate. The load was too heavy and could not keep up with the command speed. **Speed deviation error detection: Value** (No.90.0) was not appropriate.	
Remedy	Check the command from the host controller. Adjust the tuning parameters. Check the setting of **Speed deviation error detection: Value** (No.90.0). Verify that the brake is released. Verify that the motor is not in a torque limit state per torque command limit.	
Reset Method	RST	

Alarm No.	6	Position deviation error
Symptom and Possible Cause	Position Control Error The acceleration time was too short There was wrong connection or disconnection of the motor power cable or encoder cable. **Position deviation error detection: Value** (No.87.0) was not appropriate.	
Remedy	Adjust the tuning parameters. Check the command from the host controller. Check the wiring. Check the setting of **Position deviation error detection: Value** (No.87.0). Verify that the brake is disengaged. Verify that the motor is not in a torque limit state per torque command limit.	
Reset Method	RST	

RST RESET Signal	Control-power cycle	CLR CLEAR Encoder
① Eliminate the cause. ② input RESET signal to the RESET terminal on the connector CN1.	① Eliminate the cause. ② Cycle control-power.	① Eliminate the cause. ② Execute CLEAR Encoder ③ Cycle control-power. After power cycle, perform Homing.

3. Alarms and Remedies

Alarm No.	7	Overload error
Symptom and Possible Cause	Position Control Error Immediately after the operation started 1. The motor did not move at all. 2. The motor moved a little. 3. An alarm occurred after the motor started moving. During operation 4. An alarm occurred at the same timings during of motions. The acceleration time was too short. The motor was not accelerating when the alarm occurred. (The machine collided with some object.) 5. The motor capacity was too small (i.e. the load was too large) 6. The vibration was significant upon alarm occurrence. 7. Tuning parameters or command(s) were not appropriate. (The motor changed its rotational direction abruptly) 8. Noise was generated.	
Remedy	**Executing overloaded motions continuously may burnout the motor.** 1.2 Check the motor power cable connections. 3. Verify that the user-selected motor capacity is appropriate. Verify that the brake is disengaged. Verify that the deceleration ratio is appropriate. 4. During Acceleration - Check the acceleration time, torque wave form and load ratio. Not During Acceleration - Verify that there are no obstacles inside the work area of the equipment. 5. Check the torque waveforms and load ratio. Check the inertia ratio. Increase the motor capacity. Install a decelerator 6.7 Adjust the Tuning parameters. Verify that there are no commands to cause a sudden change in the motor rotational direction. Configure moderate commands, for example, use command smoothing filer. 8. Configure countermeasures for noise such as a notch filter or low-pass filter.	
Reset Method	RST	

Alarm No.	8	Command overspeed error
Symptom and Possible Cause	Position Control Error The position control input exceeded the max rotational speed. The command from the host controller was not appropriate.	
Remedy	Check the **Pulse train command: Ratio** (No.34.0 and No.36.0). Check the commands from the host controller.	
Reset Method	RST	

3. Alarms and Remedies

Alarm No.	9	Encoder pulse - Output frequency error
Symptom and Possible Cause	The frequency of encoder pulse output exceeded 4 Mpps.	
Remedy	Check the numerator and denominator settings in the **Encoder pulse output: Pulse ratio** (No.276.0 and No.278.0). Check the settings of **Encoder pulse output: Error detection - Frequency upper bound** (No.285.0) and **Encoder pulse output: Error detection - Delay time** (No.286.0).	
Reset Method	⏻	

Alarm No.	10	Positioning command overflow error/Homing failure
Symptom and Possible Cause	External position command exceeded the absolute value range of ± 1,073,741,823. The shift amount per one of commands exceeded the ± 2,147,483,647 range. Homing failed and timed out.	
Remedy	Select a value different from the current setting of **Internal Position: Overflow detection** (No.643.0). Adjust the parameters such that the shift amount will be within the ± 1,073,741,823 range. Adjust the shift amount of Positioner motion, inching and testing each. Adjust the Homing related parameters.	
Reset Method	RST	

Alarm No.	11	Encoder error (multi-turn counter overflow)
Symptom and Possible Cause	Multi-turn data of the encoder has exceeded the ± 32,767 range.	
Remedy	Check the setting of **Absolute system** (No.257.0). Verify that the multi-turn motion amount is within the ± 32,767 range.	
Reset Method	⏻	

Alarm No.	12	Overheat error
Symptom and Possible Cause	The control circuit temperature has exceeded the upper limit.	
Remedy	Check the amplifier's installation method and environment. Lower the ambient temperature to below the rating.	
Reset Method	RST	

Alarm No.	14	Overvoltage error
Symptom and Possible Cause	The primary circuit voltage of the control component has exceeded the amplifier circuit limits.	
Remedy	If the alarm occurs only during deceleration By using the Setup Panel or "Servo Studio", check the regeneration status, which tells you if a regenerative resistor is necessary. If necessary, install a regenerative resistor. Check the motion patterns of commands. Use a command filter and gradually decrease the speed. If the alarm occurs regardless of deceleration Verify that the primary circuit power voltage is within specification. Check for voltage changes while the whole system is operating.	
Reset Method	RST	

Alarm No.	15	Power supply error (primary circuit power)
Symptom and Possible Cause	The primary circuit voltage is abnormally high or low. The primary circuit power was not supplied. The primary circuit power was not within the input range. The primary power voltage fluctuated and exceeded the rated range. SVON signal was input without primary circuit power supply. Anomaly of the regenerative control circuit operating time lasted longer than a specific amount of time. Regeneration ON status lasted.	
Remedy	If the alarm occurred between servo on and operation startup Verify that the primary circuit power is connected to the amplifier. Check the primary circuit power voltage. Check the timing of primary circuit power input and SVON signal input. If the alarm occurred during motor operation Check for no voltage fluctuations due to the whole system operation. Provide enough power supply so that the system experiences no voltage fluctuations. If the alarm occurs during deceleration Check the regenerative voltage warning spinal on the Setup Panel or "Servo Studio". If a regenerative voltage warning occurs, install a regenerative resistor. Check the motion patterns directed by commands. Gradually decrease speeds by using a command smoothing filter.	
Reset Method	RST	

RST RESET Signal	⏻ Control-power cycle	CLR CLEAR Encoder
① Eliminate the cause. ② input RESET signal to the RESET terminal on the connector CN1.	① Eliminate the cause. ② Cycle control-power.	① Eliminate the cause. ② Execute CLEAR Encoder ③ Cycle control-power. After power cycle, perform Homing.

3. Alarms and Remedies

Alarm No.	16	Encoder error (received data)
Symptom and Possible Cause	Encoder data changed rapidly for a short period of time.	
Alarm No.	17	Encoder error (no response)
Symptom and Possible Cause	Encoder communications were disconnected.	
Alarm No.	19	Encoder error (communication)
Symptom and Possible Cause	The initial communication with the encoder failed.	
Alarm No.	20	Encoder error (multi-turn data)
Symptom and Possible Cause	Absolute encoder data changed rapidly for a short period of time. At the time of starting, the encoder failed to receive multi-turn data internally.	
Remedy	Check for wire disconnection or loose connection of pins. Keep the cable length no longer than 20 meters. Check for noise interference. → Use a shielded twist-pair cable. → Keep the encoder cable away from the motor power cable. → Connect FG firmly. → Use ferrite core for motor power cable and encoder cable. If any of the above didn't resolve the issue, please contact our distributor.	
Reset Method	⏻	

Alarm No.	18	Encoder error (circuit)
Symptom and Possible Cause	The battery voltage of the absolute encoder dropped or the battery became disconnected. (Alarm No.21 is output in this case) The encoder temperature has exceeded the specification and output data has become abnormal. Anomaly of the encoder itself has been detected.	
Remedy	If you are using an absolute system Replace the battery, connect it, and initialize the encoder. If you are not using an absolute system Check whether the encoder temperature is within specification. If any of the above didn't resolve the issue, please contact our distributor.	
Reset Method	✎ ⏻	

3. Alarms and Remedies

Alarm No.	21	Encoder error (voltage drop)
Symptom and Possible Cause	The battery voltage dropped. The batter became disconnected. It was the first start-up after the battery was connected.	
Remedy	Check for low battery voltage. Check for loose battery cable. Initialize the encoder.	
Reset Method	✎ ⏻	

Alarm No.	22	Voltage error (control power)
Symptom and Possible Cause	The control power voltage dropped.	
Remedy	Check the control power voltage. Check for insufficient control power capacity. Check the wiring of user I/O connector 24 V (Pin 1 and Pin 2). This alarm may be output at the same time as other alarms such as Alarm No.15 (Power error). Check all the alarms that are occurring. This alarm will not remain in the alarm history.	
Reset Method	RST	

Alarm No.	23	Switch circuit error
Symptom and Possible Cause	Control circuit is faulty.	
Remedy	Please contact our distributor.	
Reset Method	RST	

Alarm No.	24	Overcurrent error
Symptom and Possible Cause	Anomaly of motor control current inside of the amplifier has been detected.	
Remedy	Check the motor power cable. → Grounding fault → Wiring mistake in the motor power cable connection Check the Tuning parameters and motor motion patterns. → Increase the acceleration/deceleration time of command. → Enable/Disable Position command filter 1 and 4 (No.66.0, No.66.1, No.80.0, and No.81.0). Allow motor motion by disengaging the brake or removing from the stopper. Check the encoder cable. → Connection (bad connection) → Use a twist-pair cable If any of the above didn't resolve the issue, please contact our distributor.	
Reset Method	RST	

3. Alarms and Remedies

Alarm No.	25	Inverter error 1
Symptom and Possible Cause	Anomaly in the control circuit has been detected.	
Alarm No.	26	Inverter error 2
Symptom and Possible Cause	Anomaly in the control circuit has been detected. SERVO ON timed out.	
Remedy	Check the motor power cable. → Grounding fault → Wiring mistake in motor power cable connections If any of the above didn't resolve the issue, please contact our distributor.	
Reset Method	RST	

Alarm No.	27	Current sensor error
Symptom and Possible Cause	The ambient temperature of the current sensor was high. Anomaly of the current sensor has been detected.	
Remedy	Check the installation method and environment. If any of the above didn't resolve the issue, please contact our distributor.	
Reset Method	RST	

Alarm No.	28	Encoder error (overheat)
Symptom and Possible Cause	The encoder board temperature has reached the upper limit.	
Remedy	Check the installation method and environment of the motor. Decrease the ambient temperature of the motor below the specification.	
Reset Method	RST	

Alarm No.	29	Voltage drop (inside the amplifier)
Symptom and Possible Cause	The control power voltage (5 VDC) inside of the amplifier has dropped.	
Remedy	Verify that there is no short-circuit in encoder cable connections. If any of the above didn't resolve the issue, please contact our distributor.	
Reset Method	RST	

4. Troubleshooting

Check the following if the amplifier does not start and the motor does not rotate although no alarm is output.

Problem	Symptom	Refer to
Problem 1 No display on the Setup Panel	Control power (24 VDC) is being supplied, but the Setup Panel does not show.	Page.18

Problem	Symptom	Refer to
Problem 2 Servomotor not turning ON	The Setup Panel shows, but the servo cannot be turned on.	Page.19

Problem	Symptom	Refer to
Problem 3 No motor rotation	The motor does not rotate although the servo is on.	Page.20

Problem	Symptom	Refer to
Problem 4 Unstable motor motions	The motor motions are unstable.	Page.21

Problem	Symptom	Refer to
Problem 5 Positional aberration	Positional aberration occurs.	Page.22

Problem	Symptom	Refer to
Problem 6 Vibration and abnormal noise	The motor causes vibration or abnormal noise.	Page.23

4. Troubleshooting

Problem 1. No display on the Setup Panel

Control power (24 VDC) is being supplied, but the Setup Panel does not show.

Cause	Remedy
The controller power 24 VDC is not connected to the user I/O connector.	Connect the 24 VDC to the user I/O connector. Connect the 24 VDC to Pin 1 and Pin 3 and GND to Pin 2 and Pin 12 respectively.
Loose user I/O connector	Connect the user I/O connector firmly.
The control power voltage is low.	Check the control power voltage capacity.
The amplifier is faulty.	Please contact our distributor.

4. Troubleshooting

Problem 2. Servomotor not turning ON

The Setup Panel shows, but the servo cannot be turned on.

Cause	Remedy
The servo on signal (SVON) is not being input.	Input the SVON signal of the host connector to the user I/O connector.
The primary circuit power is not supplied. (Alarm No.15 is displayed)	Verify that CHARGE LED is on. If it is off, verify that the primary circuit power is not loose, and the primary circuit power is output.
The motor power connector is loose.	Connect the user I/O connector firmly.
The amplifier is faulty.	Please contact our distributor.

4. Troubleshooting

Problem 3. No motor rotation

The servo is on, but the motor does not rotate.

Cause	Remedy
The parameters are not set right.	Correctly set the parameters required for the control mode that you are using. ☞ **6 Operations**
Command from the host controller is not correctly input.	Check the command from the host controller. Use "Servo Studio" to measure the waveforms of Pulse Train Command Input (position) or Analog Velocity Command Input and verify that normal commands are input. Check the parameters such as pulse ratio. It is possible that the motor is rotating very slowly.
The command input pins of user I/O connector are not connected correctly.	Check for proper connections. ☞ **4 Connections**
No command input is allowed.	Open HOLD and COM− pins of the user I/O.
Torque command limit is not set right.	Verify that **Torque command limit: Value 1 and Value 2** (No.147.0, No.148.0) are set correctly.
CCW/CW drive restriction is enabled.	If CCW/CW drive restriction input is disabled, set **Drive restriction input: Setup** (No.67.0) to 0 (disable). If it is enabled, connect both CCWL and CWL pins of the user I/O connector with either "COM−" or "closed" each.

4. Troubleshooting

Problem 4. Unstable motor motions

The motor does rotate, but its motions are unstable.

Cause	Remedy
FG and GND are not connected correctly.	Connect FG and GND correctly.
Speed/Position commands are unstable.	On the waveform monitor in "Servo Studio", check the command from the host controller. Check for proper connection of the I/O connector.
Tuning is incomplete.	Adjust the parameters.
The motor rotates with no host command input.	In Position Control Mode Set **Pulse train command: Input filter** (No.33.0) to an appropriate value. In Velocity Control Mode Adjust **Analog velocity: Offset value** (No.60.0). In Torque Control Mode Adjust **Analog torque: Offset value** (No.300.0)

4. Troubleshooting

Problem 5. Positional aberration

The motor does rotate, but position aberration occurs.

Cause	Remedy
The command signal is interfered with noise.	In Position Control/Pulse Train Command Set **Pulse train command Input filter** (No.33.0) to an appropriate value. Check the following three items. 1. Status No.33 (Pulse Train Command Input (position) agrees with the host controller output. 2. Status No.65 "Position command" and Status No.67 "Position feedback" agree. 3. (Status No.67) x (**Encoder pulse ratio** (No.276.0/No.278.0) = (Position feedback from the host control device) If any of the above conditions fails, take countermeasures for noise. Connect FG correctly. Adjust **Pulse train command: Input filter** (No.33.0) Select a shielded twist-pair wire for the I/O cable. For the encoder cable, select a shielded twist-pair wire of no longer than 20 m.
The position deviation is not converging.	Verify that Status No.65 (Position command value) and Status No.67 (Position feedback) agree. If not, adjust the tuning parameters.
The host controller is not obtaining encoder Z-phase correctly.	Check the command from the host controller. Use "Servo Studio" to measure the waveforms of Status No.33 "Pulse Train Command Input (position)" or Status No.49 "Analog Velocity Command Input" to verify that a normal command is input. Verify that the host controller is obtaining Z-phase correctly. If the Z-phase pulse width is too small, increase the pulse width by using the **Encoder pulse ratio** (No.276.0/No.278.0) As a rule of thumb, the pulse width of 1 ms or above is required for PLC.
Output pulse frequency of the host controller is above the upper limit.	Verify that the output pulse frequency of the host controller such as PLC is not above the upper limit.
A resistor is installed in the pulse output circuit of the host controller (PLC).	Verify that there is no built-in resistor in pulse output terminal. The output resistor of the host controller and the input resistor of servo amplifier being connected in series prevents correct command signal from being input to the amplifier.

4. Troubleshooting

Problem 6. Vibration and abnormal noise

The motor is experiencing vibration or abnormal noise.

Cause	Remedy
Tuning parameter settings are not appropriate.	Set the Control Gain 1, Control Gain 2, Integral Gain to lower values. Especially for highly rigid equipment such as ball screws, set the **Current control gain** (No.193.0) to "1" if noise occurs at servo-on stop. ☞ 7 **Tunings**
Cranky or loose machines and equipment	Check the installation of the motor, decelerator, couplers, and so on.
Noise interference is occurring.	Check the length or shield of each cable. Isolate the high voltage cable such as motor power cable from the signal cable such as encoder cables.
The equipment and the motor are resonating.	For low-frequency vibration, adjust the position command smoothing filter. For high-frequency vibration, adjust the low-pass filter or notch filter.
Motor load is substantially large (*) (Alarm No.7 is displayed)	Set the inertia condition parameter to "Heavy" Keep adjusting the Position Command Smoothing Filter to smooth command until the vibration at the time of acceleration becomes eliminated. Set the **Inertia ratio** (No.102.0) to 3,000. To stabilize the motions, increase Integral gain value according to Control Gain 1 and Control Gain 2.
The current pairing of amplifier and motor is not right.	Check the motor model code under "Communication Settings" tab in "Servo Studio". In case of wrong pairing, clear the parameters saved in EEPROM and change the motor model code.

*) This problem may occur in a low-rigidity case such as belt drive whose load inertia ratio is over 30 times.

MEMO

9 Appendices

1. Absolute System

1. Overview

By using the absolute system, you do not have to perform Homing after cycling power.

Preparations

To configure an absolute system, prepare the following items.

① A motor equipped with absolute-encode and an amplifier that supports absolute system.

② A backup battery

③ An absolute encoder Cable

☞ Page 4 Backup Batteries

☞ Page 6 Absolute Encoder Cable

Checking the model code

Use the modes that supports absolute systems.

Motor Product Code:

M 5 G 005 C S N N A ＊＊

Encoder	
Code	Specifications
C	17 bit (Incremental)
A	17 bit (Absolute)

2. System Configuration

Connection Method

1. To ensure safety, power off the primary power and the control power first, and then connect the absolute encoder cable.

   ☞ Refer to the figure below.

2. Be sure of the right connecting direction, and connect the backup battery correctly.

   ☞ Page 4 Backup Battery

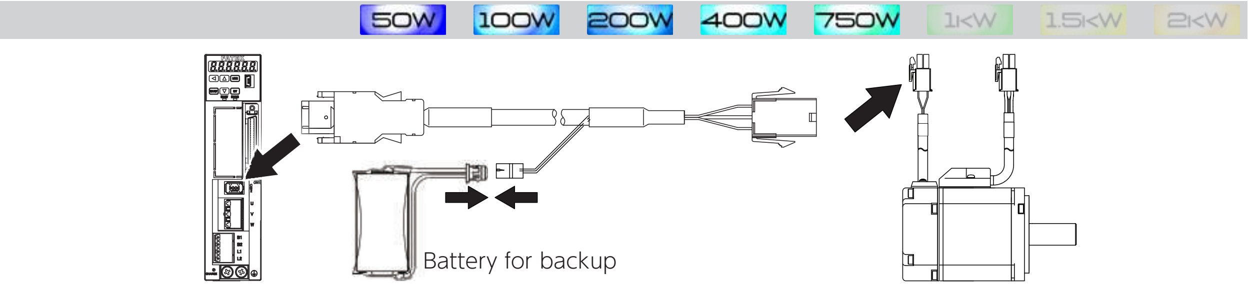
3. After connecting the battery, secure the battery to the absolute encoder cable by using a cable tie.

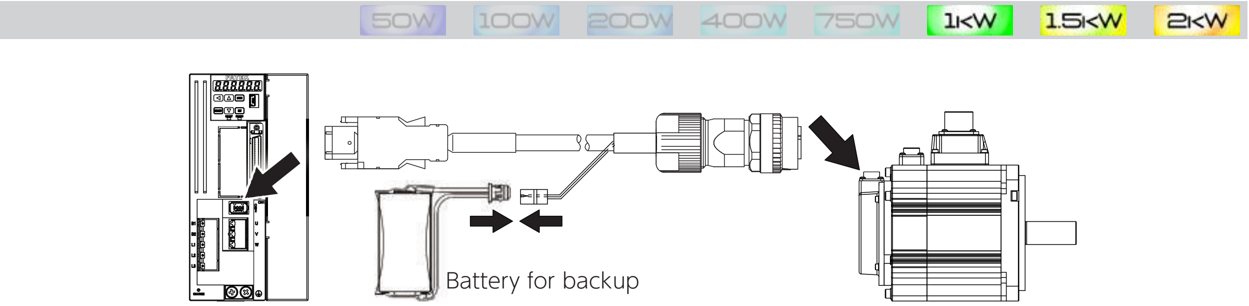
   ☞ Page 5 Securing the Battery

4. Initialize the absolute encoder.

   ☞ Page 7 Initializing Absolute Encoder

Cable and Battery Connections





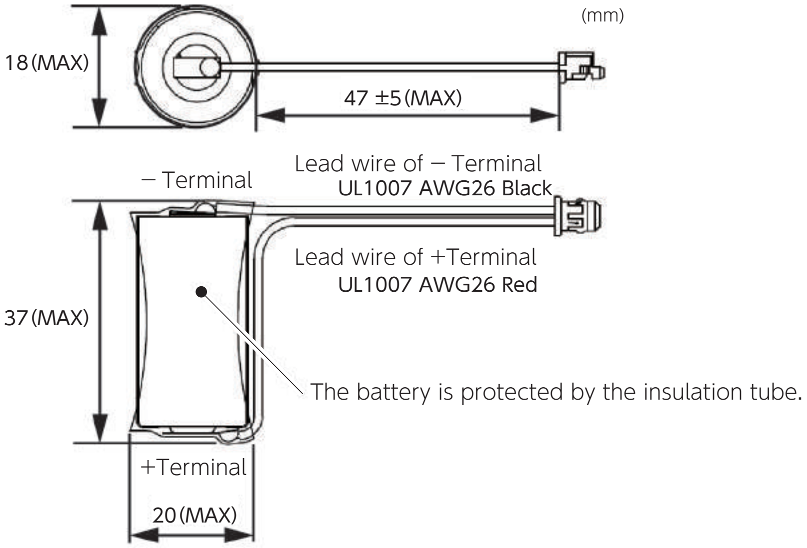
3. Backup Battery

Recommended Specifications

Item	Specifications	Remark
Model Code	CR17335E-R-CH3	Manufactured by FDK (*) Series battery: CR17335E-R
Nominal Voltage	3.0 V	–
Nominal Capacity	1,600 mAh	Nominal capacity is determined at the voltage of 2.0 V when the battery was discharged at a standard current level under the 23℃ environment.
Maximum Continuous Discharge Current	500 mA	Under the 23℃ environment
Dimensions	See the figure below.	No obvious deformation or damage Clear label print
Exterior	Insulation tubing	–
Terminal	Housing: DF3-2S-2C Contact: DF3E-2428SCFC Lead wire: UL 1007 AWG26 Red (+)., Black (－)	Connector: Hirose Electric
Mass	17 g	reference value
Temperature Range	Operating temperature: －40℃ to +70℃	No dew condensation
Recommended Storage Conditions	Temperature: 10℃ to 30℃ Humidity : 60% RH or less	–

*) This is a primary lithium battery. Do not try to charge it, or it may explode.

Dimensions



1. Absolute System

Precautions for Battery Storage and Installation

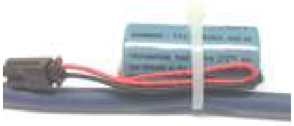
Avoid places subjected to any of the following:

- Direct sunlight, rain drops
- Corrosive atmosphere, oil mist, or iron powder
- Poor ventilation or high humidity
- Dirt or dust
- Vibrations
- Impact to the installed battery

Securing the Battery

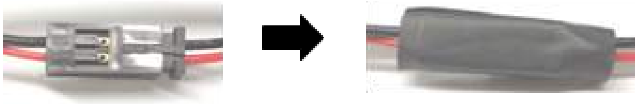
1. Securing the Battery

Secure the battery to the cable, for example, using a cable tie.
We recommend using a cable tie tensioning tool.
Holding strength of the cable tie should be 11.6 to 44.2 N.



2. Protecting the Battery Connector Part

Protect the exposed part of the battery connector terminal with a heat shrink tube.



Replacing the Battery

When the battery voltage drops, Alarm No.21 (Encoder voltage drop) occurs. In this case, you need to replace the battery to a new one.
When replacing the battery, be sure to keep the control power (24 V) of the amplifier ON. Otherwise, you will lose the multi-turn data and need to perform homing again.

⚠ CAUTION

- Be careful not to connect the battery in the wrong way.
- Do not attempt to disassemble the battery.
- Do not short circuit the battery.
- Never attempt to charge the recommended battery.

Disposal of Batteries

Dispose of used batteries according to local government regulations.

4. Absolute Encoder Cable

Recommended Products

Please contact our distributor.

Making Your Own Cable

⚠ CAUTION		
🚫	Ensure correct wiring.	⚠ ⚠ ⚠
❗	Select a battery that meets the specifications of the recommended one. Replace the battery at a reasonable interval, taking the batter life into consideration.	⚠

The connectors and cables needed to make your own cable are user-supplied.

☞ 3 Preparation

5. Initializing Absolute Encoder

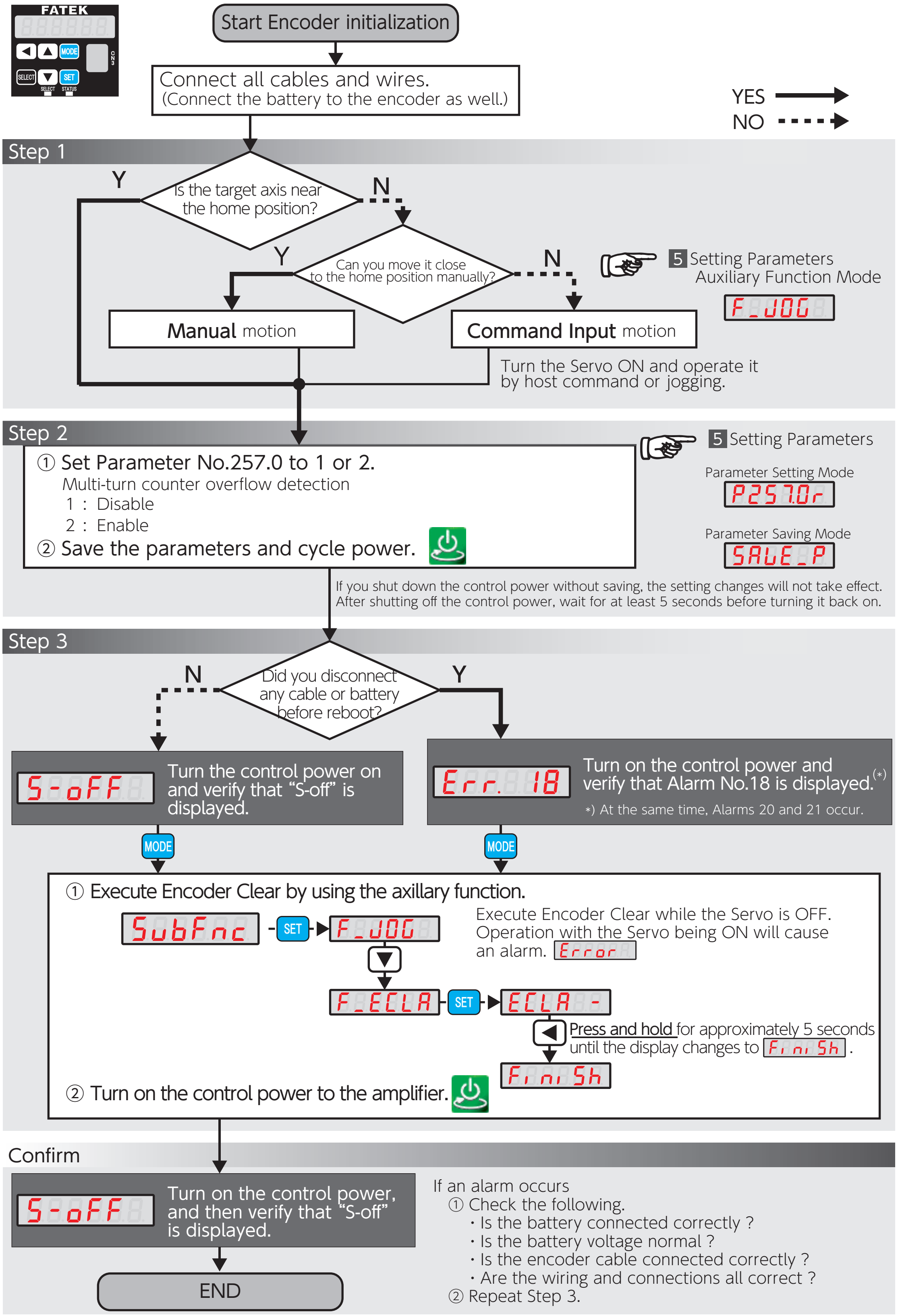
When using an absolute system for the first time or using it after replacing the motor, you need to initialize the encoder.
Use the Encoder Clear function by using the Setup Panel or "Servo Studio" to initialize the encoder. And then restart your amplifier.

Only multi-turn data will be initialized and single-turn absolute data will not.

❗	Initialize the absolute encoder before performing homing.	⚠ ⚠

1. Absolute System

Initializing Encoder with Setup Panel



Start Encoder initialization

Connect all cables and wires.
(Connect the battery to the encoder as well.)

Step 1

Is the target axis near the home position?

Can you move it close to the home position manually?

Manual motion

Command Input motion

Turn the Servo ON and operate it by host command or jogging.

5 Setting Parameters
Auxiliary Function Mode

Step 2

① Set Parameter No.257.0 to 1 or 2.
Multi-turn counter overflow detection
1 : Disable
2 : Enable

② Save the parameters and cycle power.

5 Setting Parameters
Parameter Setting Mode
Parameter Saving Mode

If you shut down the control power without saving, the setting changes will not take effect.
After shutting off the control power, wait for at least 5 seconds before turning it back on.

Step 3

Did you disconnect any cable or battery before reboot?

Turn the control power on and verify that "S-off" is displayed.

Turn on the control power and verify that Alarm No.18 is displayed.(*)

*) At the same time, Alarms 20 and 21 occur.

① Execute Encoder Clear by using the axillary function.

Execute Encoder Clear while the Servo is OFF. Operation with the Servo being ON will cause an alarm.

Press and hold for approximately 5 seconds until the display changes to FinISh.

② Turn on the control power to the amplifier.

Confirm

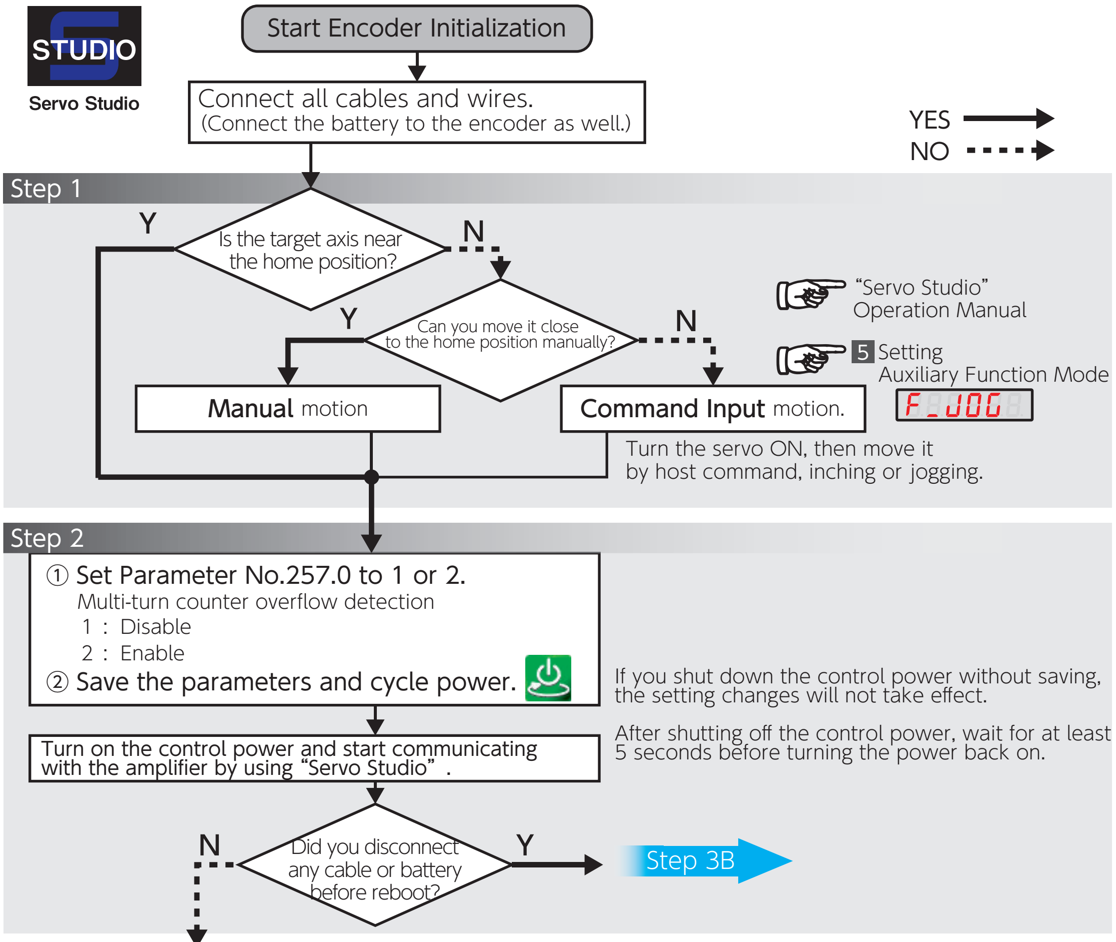
Turn on the control power, and then verify that "S-off" is displayed.

END

If an alarm occurs
① Check the following.
- Is the battery connected correctly ?
- Is the battery voltage normal ?
- Is the encoder cable connected correctly ?
- Are the wiring and connections all correct ?

② Repeat Step 3.

Initializing Encoder with "Servo Studio"



Servo Studio

Start Encoder Initialization

Connect all cables and wires.
(Connect the battery to the encoder as well.)

Step 1

Is the target axis near the home position?

Can you move it close to the home position manually?

Manual motion

Command Input motion.

Turn the servo ON, then move it by host command, inching or jogging.

☞ "Servo Studio" Operation Manual

☞ 5 Setting Auxiliary Function Mode

Step 2

① Set Parameter No.257.0 to 1 or 2.
Multi-turn counter overflow detection
1 : Disable
2 : Enable

② Save the parameters and cycle power.

If you shut down the control power without saving, the setting changes will not take effect.

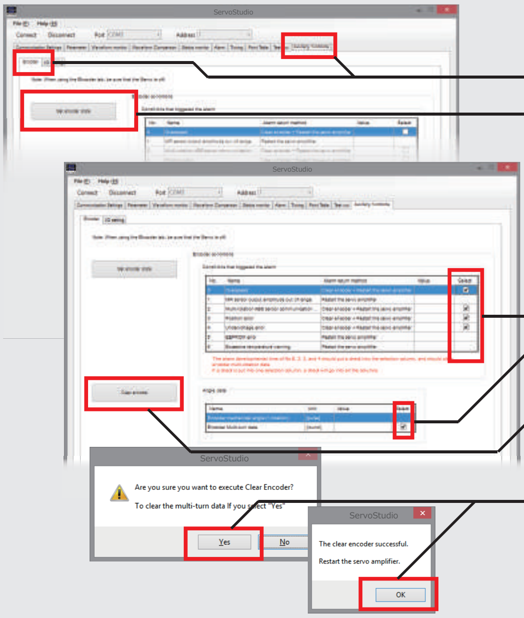
After shutting off the control power, wait for at least 5 seconds before turning the power back on.

Turn on the control power and start communicating with the amplifier by using "Servo Studio" .

Did you disconnect any cable or battery before reboot?

Step 3B

Step 3A



Are you sure you want to execute Clear Encoder?

To clear the multi-turn data If you select "Yes"

The clear encoder successful.

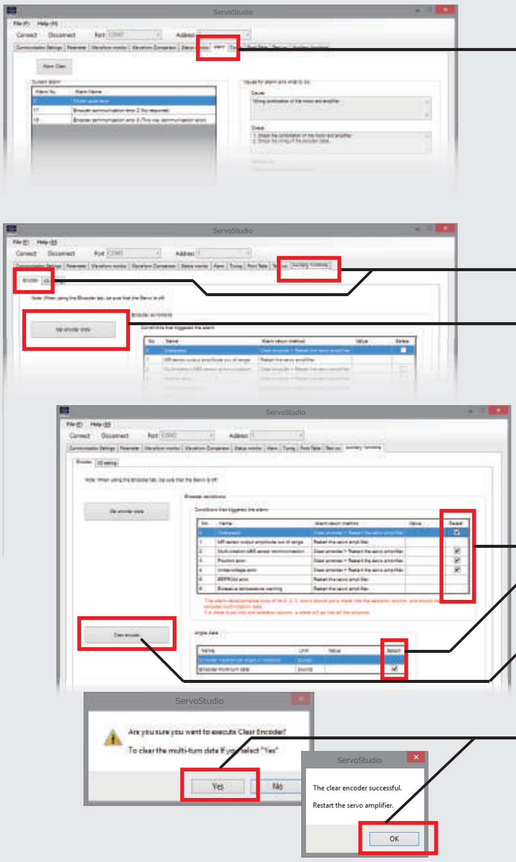
Restart the servo amplifier.

1. Under the Auxiliary function tab, click Encoder
2. Click on Get Encoder Status.
3. Check one of the boxes.
4. Click Clear encoder .
   Until checking the boxes, the Clear encoder button does not work.
5. Click Yes .
6. Cycle the control power.

Confirm

Initializing Encoder with "Servo Studio" (continued)

Step 3B



Are you sure you want to execute Clear Encoder?
To clear the multi-turn data if you select "Yes"

The clear encoder successful.
Restart the servo amplifier.

1. Under the Alarms tab, check the following alarms that are occurring.

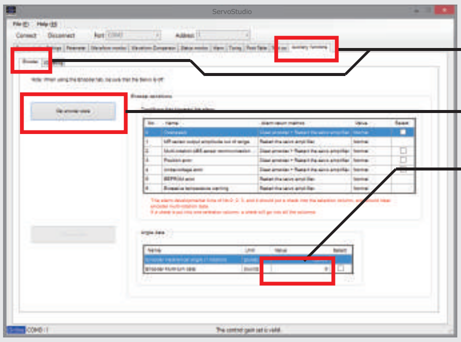
No. 18	Encoder error (circuit)
No. 20	Encoder error (multi-turn data)
No. 21	Encoder error (voltage drop)

The Setup Panel on the amplifier displays Err. 18.

2. Under the Auxiliary functions tab, select Encoder.
3. Click on Get Encoder Status.
4. Check one of the boxes.
5. Click Clear encoder.
   Until checking the boxes, the encoder clear button does not work.
6. Click Yes.
7. Cycle the control power.

Confirm

Turn on the control power and start communicating with the amplifier by using "Servo Studio".



1. Under the Auxiliary functions tab, select Encoder.
2. Click on Show Encoder Status.
3. Verify that this value is 0.

If an alarm occurs
① Check the following.
- Is the battery connected correctly ?
- Is the battery voltage normal ?
- Is the encoder cable connected correctly ?
- Are the wiring and connections all correct ?

② Repeat Step 3.

END

1. Absolute System

6. Obtaining Absolute Data

You can check the encoder absolute data using RS-485 Communications or "Servo Studio".

Checking Absolute Data using RS-485 Communication

The RS-485 communications enable the host controller to obtain absolute data from the amplifier. To use RS-485 communications, set the following parameters.
Use the Setup Panel or "Servo Studio" for the parameter setup.

Communications Manual: RS-485

RS-485 Communications	Setting	Parameter No.
Communication Address	Set the address for RS-485 Communication. Default: 1 Setting: 1 to 32	4.0
Communication Switch	Enable or disable RS-485 Communication. Select "1".	8.0
Minimum response time	Adjust response timing from the amplifier. Adjust it to satisfy the communication specification of the host controller. Default: 3 ms Range: 0 to 255 ms	11.0

Example of communication commands to obtain absolute data

Transmit data (*): 24 01 00 11 00 C3 0A 94
Response data : 26 01 80 11 □□ □□ □□ □□ ○○ ○○

absolute data
unit: encoder pulse
the number of bytes in data: 4 bytes (unsigned)

an error detection segment.

*) This example is a command sent to the amplifier at Address 1.
If the command is sent to another amplifier at an address other than Address 1, the error detection segment in the command is different from this example.

Communications Manual: RS-485

Page 26 Encoder/Rotor mechanical angle (integrated value) in List of Status Variables

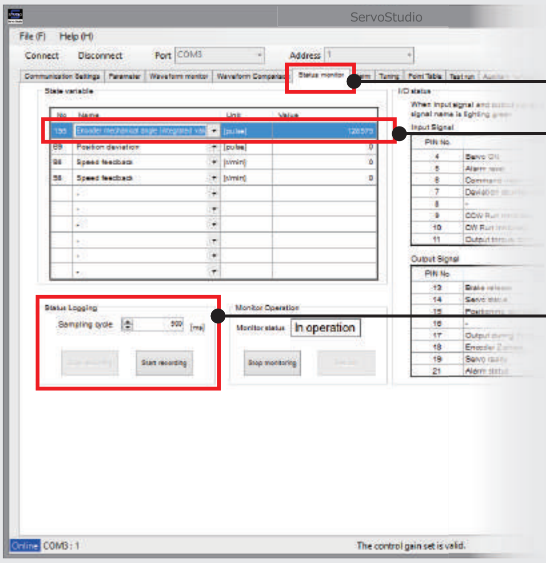
1. Absolute System

Get Absolute Data by Using "Servo Studio"

Servo Studio

Start "Servo Studio" and start communicating with the amplifier.

Use the【Status monitor】tab.



1. Display the Status monitor view.

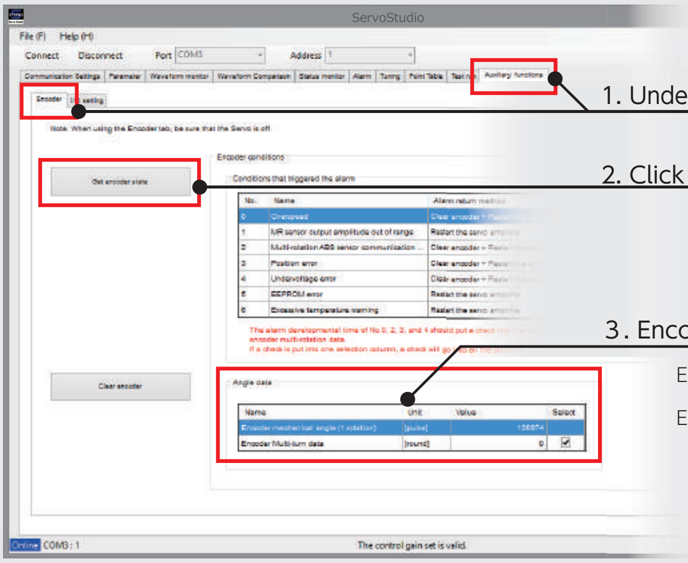
2. Select Encoder/Rotor mechanical angle (integrated value)

Encoder mechanical angle (integrated value) … Ⓐ
(=Absolute data)

3. Set the sampling cycle, and then click Start recording .

Data capture continues until you click Stop recording .

Use the【Auxiliary functions】tab.



1. Under the Auxiliary functions tab, select Encoder.

2. Click on Get encoder state .

3. Encoder data is displayed.

Encoder mechanical angle (1 rotation) … Ⓑ

Encoder Multi-turn data … Ⓒ

The formula to calculate the absolute data

Below is the formula to derive absolute data (Encoder mechanical angle (integrated value)).

$$\text{Ⓐ} = \text{Ⓑ} + \text{Ⓒ} \times 2^{17}$$

Ⓐ : Encoder mechanical angle (integrated value)
(=Absolute data)

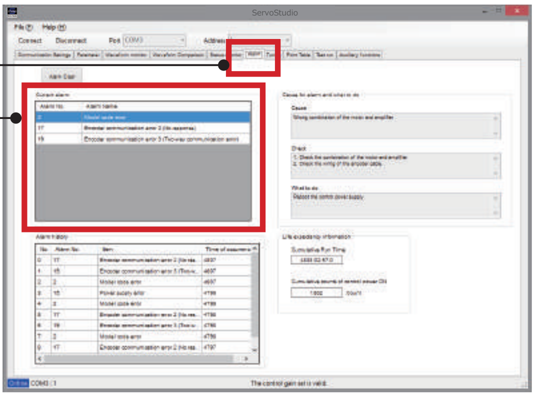
Ⓑ : Encoder mechanical angle (1 rotation)

Ⓒ : Encoder Multi-turn data

7. Alarm

By using "Servo Studio", you can check alarms that has occurred when using an absolute system.
These alarms cannot be cleared by Alarm Reset or cycling the control power. To reset alarms, execute ENCODER CLEAR at the Auxiliary functions tab, and then cycle the control power.

1. Click on the Alarms tab.
2. Check the alarms that are occurring.



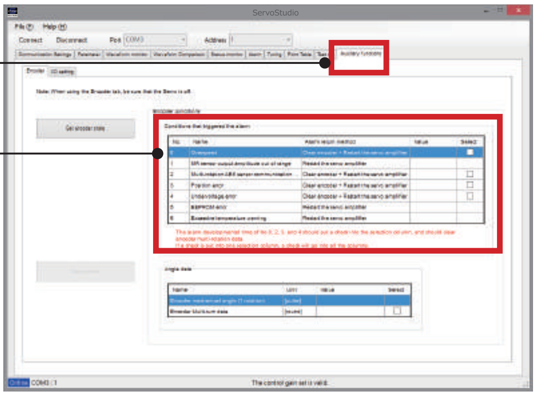
Alarm No.	Alarm Description	Symptoms and Remedy
11	Encoder error (multi-turn counter overflow)	· Multi-turn data of the encoder has exceeded the specification. · Check the setting of **Absolute system** (No.257.0). · Verify that rotational data is no higher than 32,767 rotations.
18	Encoder error (circuit)	· Anomaly of the encoder itself. · Check the alarm details. ☞ Page 14 Encoder Alarms
20	Encoder error (multi-turn data)	· Multi-turn data being reset. · Check for the encoder cable connection problems such as poor pin contact. · Take noise countermeasures. For example, separate the motor power cable from the encoder cable.
21	Encoder error (voltage drop)	· Multi-turn data being reset due to low battery voltage. · Check for low battery voltage and loose connection of the battery cable. · Initialize the encoder.

Encoder Alarms

Use "Servo Studio" to check alarms from the encoder. In case of Alarm No.18, No.20, or No.21, you can check the details under the Auxiliary Functions tab in "Servo Studio".
These alarms cannot be cleared by Alarm Reset or cycle the control power. To reset alarms, execute ENCODER CLEAR, and then cycle the control power.
If cycling power does not solve the problem, please contact our distributor.

1. Click on the Auxiliary Functions Tab.

2.Check alarms that are occurring.



No.	Name	Description of Symptom
0	Speed error	Multi-turn sensor error occurred during backup, or speed error occurred upon the control power on.
1	Angle sensor output Amplitude error	Abnormal amplitude of Angle sensor output amplitude.
2	Multi-turn ABS sensor communication error	Could not obtain multi-turn data during upon the control power on.
3	Position error	The single-turn sensor value and multi-turn sensor value do not agree because of faulty sensor; the encoder position data is unreliable.
4	Voltage drop error	Relevant only to absolute encoders. The supply voltage fell below the rated voltage range upon the control power OFF.
5	EEPROM error	The saved data in EEPROM is unreliable.
6	Overheat warning	The temperature of the encoder board exceeded the user-specified temperature.

Encoder battery voltage drop warning (Warning No.901 Err.901)

The Setup panel displays a warning when the battery voltage falls below the parameter No.268.0 setting value.

This warning isn't show to【Auxiliary functions】tab but is shown to【Alarm】tab of "Servo Studio".

The battery voltage is checked at the time of power turning on and every hour afterwards.

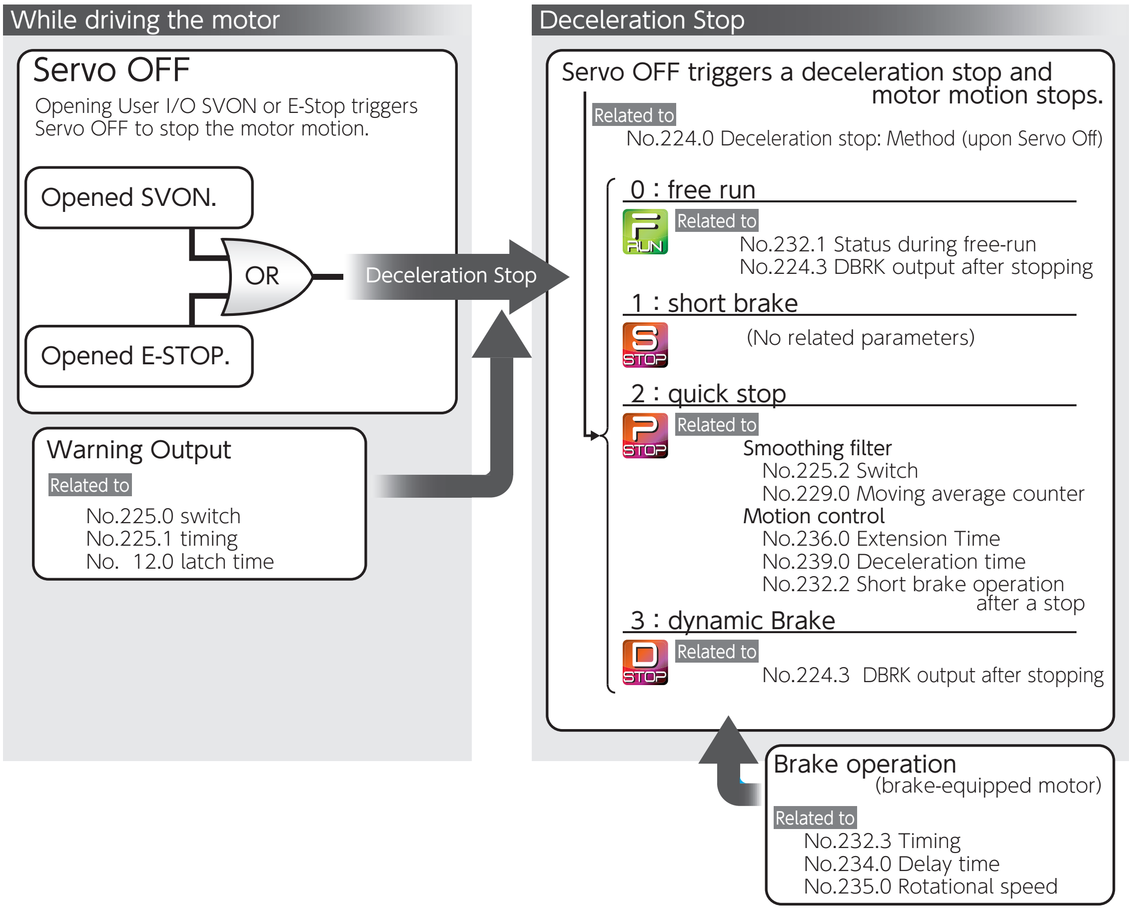
1. Emergency Stop

When you open User I/O E-STOP, Emergency Stop Status becomes ON.
Servo-OFF triggers deceleration stop and motor motion stops.
No alarm is output. A warning is output by parameter settings. Close E-STOP to cancel Emergency Stop Status to resume motor operation.
The emergency stop function is always enabled regardless parameter settings; however, you need to set related parameters so that a warning is output upon Emergency Stop Status ON.

If you close E-STOP to turn Emergency Stop Status off while SVON is being input, any command input immediately starts motor motion.

Deceleration Stop Setup

When you open User I/O SVON or E-STOP while operating the motor, the motor makes a deceleration stop according to the method predetermined by parameters.



While driving the motor

Servo OFF
Opening User I/O SVON or E-Stop triggers Servo OFF to stop the motor motion.

Opened SVON.
Opened E-STOP.

Warning Output
Related to
No.225.0 switch
No.225.1 timing
No. 12.0 latch time

Deceleration Stop

Servo OFF triggers a deceleration stop and motor motion stops.
Related to
No.224.0 Deceleration stop: Method (upon Servo Off)

0 : free run
Related to
No.232.1 Status during free-run
No.224.3 DBRK output after stopping

1 : short brake
(No related parameters)

2 : quick stop
Related to
Smoothing filter
No.225.2 Switch
No.229.0 Moving average counter
Motion control
No.236.0 Extension Time
No.239.0 Deceleration time
No.232.2 Short brake operation after a stop

3 : dynamic Brake
Related to
No.224.3 DBRK output after stopping

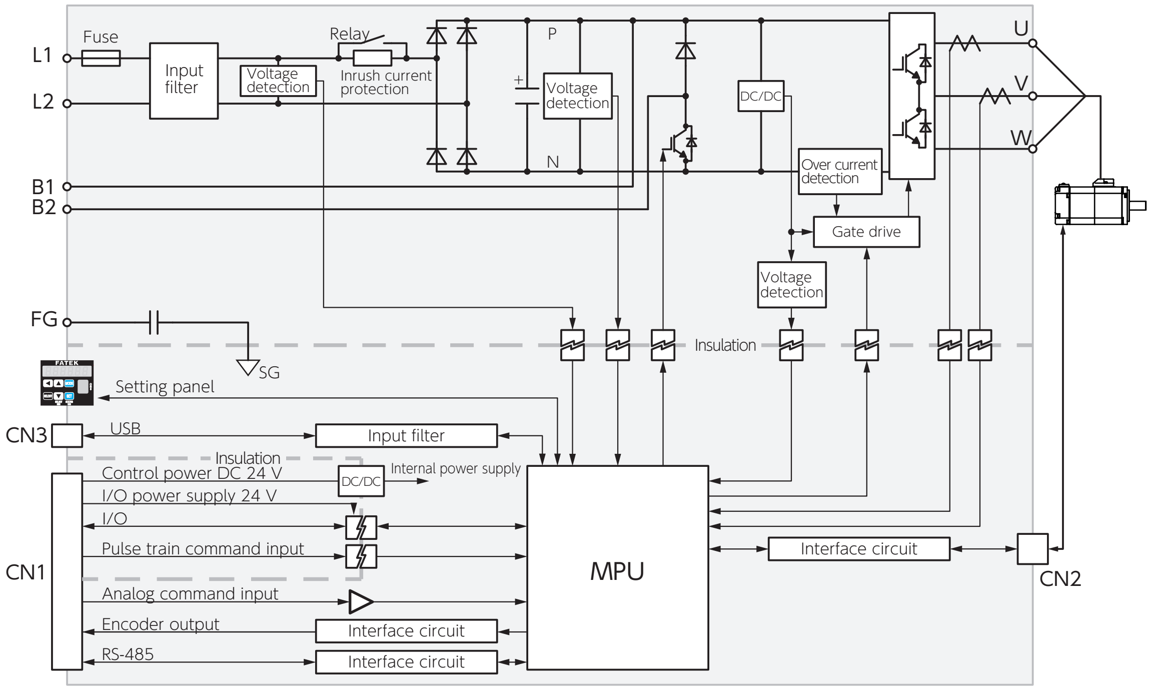
Brake operation (brake-equipped motor)
Related to
No.232.3 Timing
No.234.0 Delay time
No.235.0 Rotational speed

3. Technical Data

1. Amplifier Circuit System Block Diagram

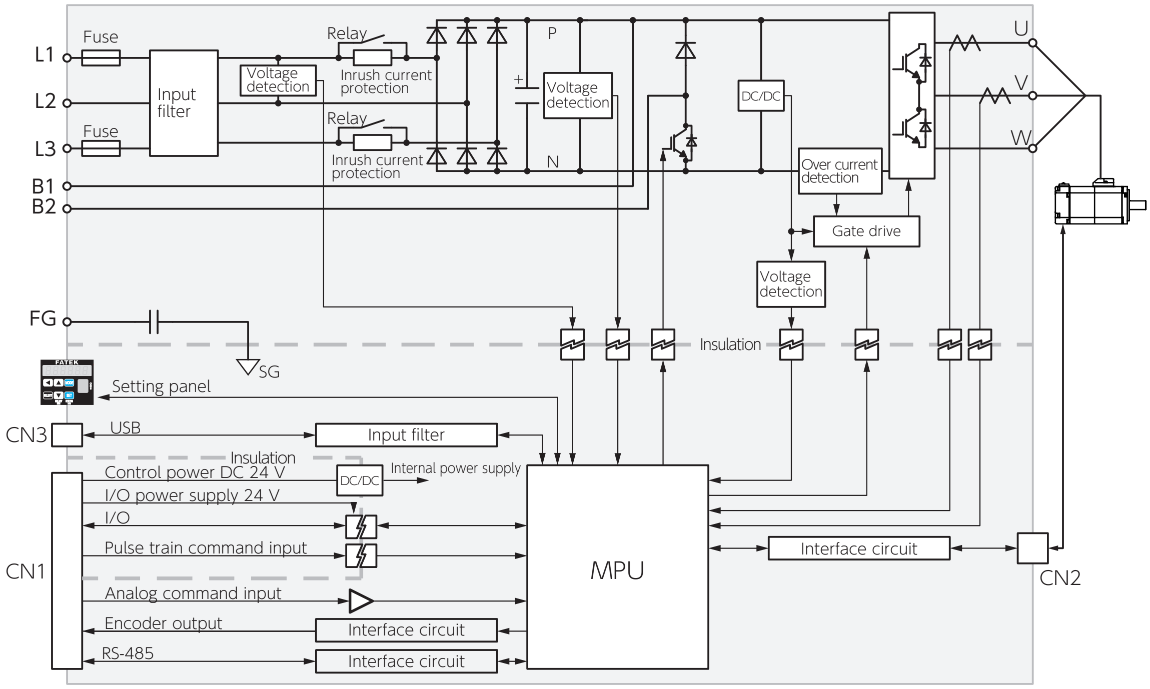
Amplifier

50W 100W 200W 400W 750W 1kW 1.5kW 2kW



Amplifier

50W 100W 200W 400W 750W 1kW 1.5kW 2kW



4. Status Display

1. Introduction

You can see status data by using the Setup Panel, "Servo Studio" or RS-485 communication.

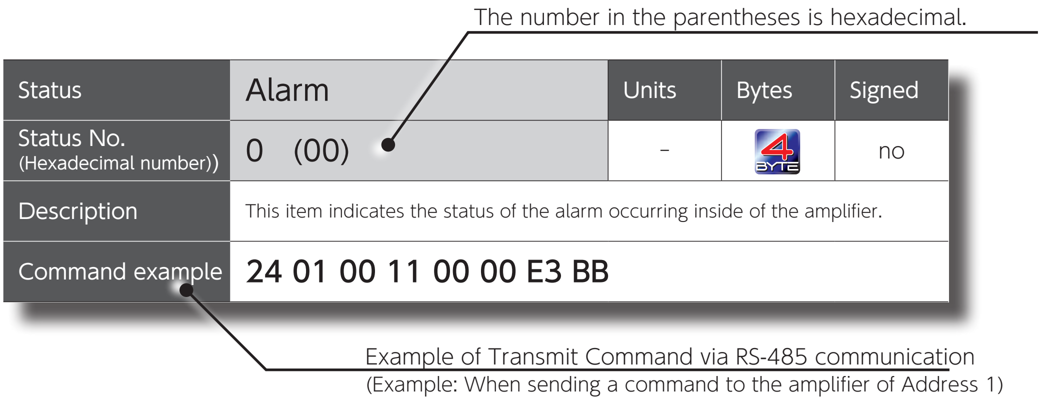
- For information on how to display status information using the Setup Panel or "Servo Studio", refer to 5 **Setting Parameters**

- The following communication commands are available for RS-485 communication.

Command Name	Command Code (*)	Description
GET_STATE_VALUE_2	10	The status value specified by a status number is displayed in the 2-byte unit.
GET_STATE_VALUE_4	11	The status value specified by a status number is displayed in the 4-byte unit.

*) Command code is a hexadecimal number.

☞ **Communications Manual:** RS-485



The number in the parentheses is hexadecimal.

Status	Alarm	Units	Bytes	Signed
Status No. (Hexadecimal number))	0 (00)	-	4 BYTE	no
Description	This item indicates the status of the alarm occurring inside of the amplifier.			
Command example	24 01 00 11 00 00 E3 BB			

Example of Transmit Command via RS-485 communication
(Example: When sending a command to the amplifier of Address 1)

The command example is for reference only.

- Be sure to carefully review 5 **Setting Parameters** and the **Communication Manual: RS-485** communication to become familiar with how to use communications commands.
- Be sure that the data to be written is within the range between the predetermined upper bound and lower bound.

Note

This manual uses the following two types of pulse units to explain status variables.

Unit of Encoder pulse
This unit is pulse count of the amplifier control block, based on the pulses equivalent to single turn of the motor which is 17-bit. It is a pulse value resulting from division/ multiplication in the amplifier.

Unit of Command pulse
This unit is based on pulse count corresponding to single turn of the motor in the host controller's perspective. This is a pre-division/multiplication value.

2. List of Status Variables

Status No.	Status Variable	Units	Refer to
0	Alarm	-	Page 19
16	I/O Status	-	Page 20
22	Warning Output	-	Page 21
24	Control Component Temperature	℃	Page 21
33	Pulse Train Command Input (position)	command pulse	Page 21
35	Pulse Train Command Input (speed)	pulse/160 μs (50 W to 750 W) pulse/200 μs (1 kW to 2 kW)	Page 21
49	Analog Velocity Command	r/min	Page 22
64	Positioning Status	-	Page 22
65	Internal Command Value	encoder pulse	Page 22
67	Position Feedback	encoder pulse	Page 22
69	Position Deviation	encoder pulse	Page 23
74	ABS Position Command	command pulse	Page 23
76	Absolute Position Feedback	command pulse	Page 24
78	Command Position Deviation	command pulse	Page 24
80	ABS Position Deviation	command pulse	Page 24
97	Speed Command Value	r/min	Page 24
98	Speed Feedback	r/min	Page 25
99	Speed Deviation	r/min	Page 25
113	Torque Command Value	0.1%	Page 25
131	Load Factor	digit	Page 26
132	Load Factor(%) (*1)	%	Page 26
194	Encoder/Rotor mechanical angle (single-turn value)	encoder pulse	Page 26
195	Encoder/Rotor mechanical angle (integrated value)	encoder pulse	Page 26
205	Encoder Temperature	℃	Page 26
206	Encoder Battery Voltage	0.1 V	Page 27
216	Encoder Communication Retry Count	times	Page 27
218	Encoder Data Error Count	times	Page 27
228	Regeneration Status	-	Page 28
232	Primary Circuit Power Supply Voltage	0.1 V	Page 28
288	Logical I/O Input (*2)	-	Page 29
296	Logical I/O Output (*2)	-	Page 30
371	Inertia Ratio Estimate	%	Page 31

*1) "Servo Studio" only
*2) RS-485 communication only

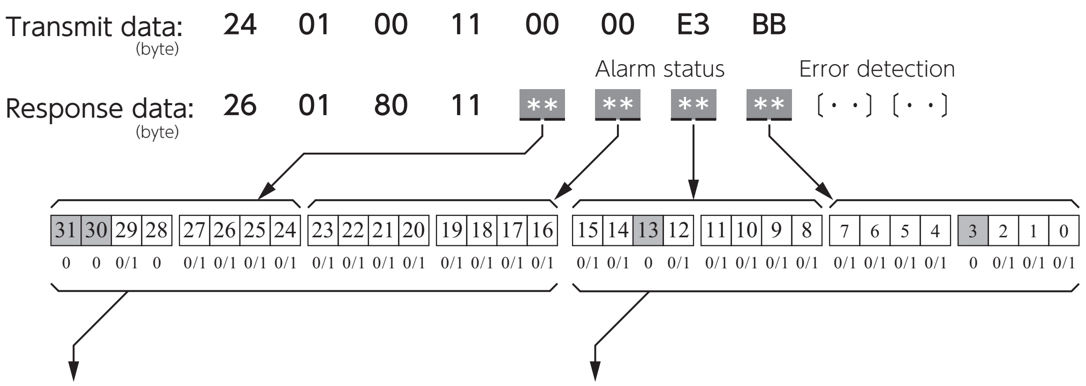
Note: The amplifier version can be checked in "Servo Studio".

☞ "Servo Studio" Operation Manual

3. Details of Each Status Variable

Status	Alarm	Units	Bytes	Signed
Status No. (Hexadecimal number)	0 (00)	-	4 BYTE	no
Description	This item indicates the status of the alarm occurring inside of the amplifier.			
Command example	24 01 00 11 00 00 E3 BB			

Relations between RS-485 Communication Command and Bit Tables



16	Encoder error (Received data)
17	Encoder error (no response)
18	Encoder error (circuitry)
19	Encoder error (communication)
20	Encoder error (multi-turn data)
21	Encoder error (voltage drop)
22	Voltage error (control power)
23	Switch circuitry error
24	Overcurrent error
25	Inverter error 1
26	Inverter error 2
27	Current sensor error
28	Encoder error (overheat)
29	Voltage drop (inside the amplifier)
30	(Reserved)
31	(Reserved)

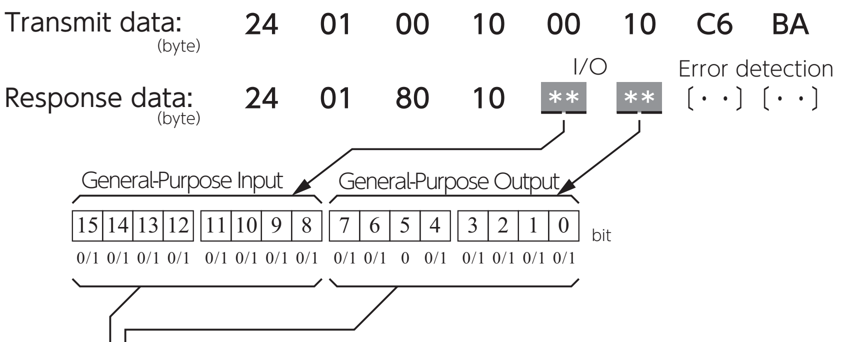
0	System error
1	EEPROM data error
2	Product code error
3	(Reserved)
4	Overspeed error
5	Speed deviation error
6	Position deviation error
7	Overload error
8	Command overspeed error
9	Encoder pulse Output frequency error
10	Internal Position Command overflow error Homing failure
11	Encoder error (multi-turn counter overflow)
12	Overheat error
13	(Reserved)
14	Overvoltage error
15	Power supply error (primary circuit power)

☞ 8 Troubleshooting

4. Status Display

Status	I/O Status	Units	Bytes	Signed
Status No. (Hexadecimal number)	16 (10)	-	2 BYTE	no
Description	This item indicated the I/O Status of the CN1 connector. You can check the I/O Status under【waveform monitor】and【status monitor】in "Servo Studio". 【waveform monitor】displays total value of I/O bits in decimal. 【status monitor】 displays I/O bits in binary. Encoder z-phase output (OCZ) is always fixed to 0.			
Command example	24 01 00 10 00 10 C6 BA			

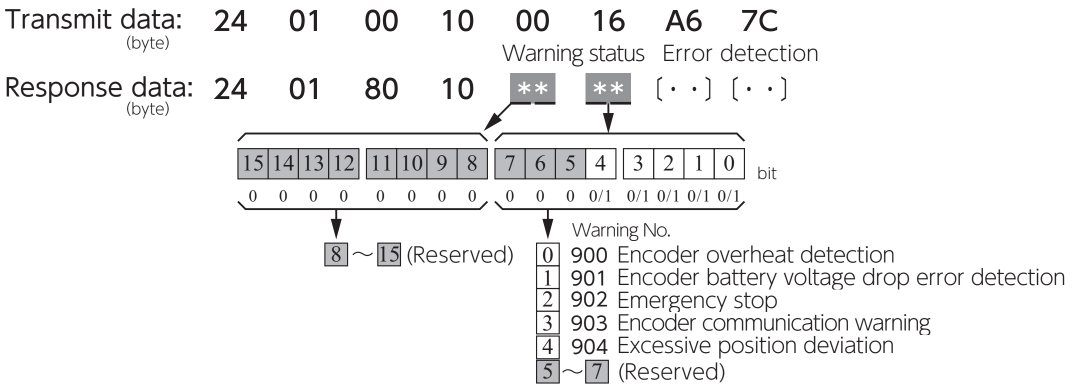
Relations between RS-485 Communication Command and Bit Tables



Control/ Command Mode		Position					Velocity		Torque
		Pulse Train			Internal		Analog	Internal	Analog
Preset		Standard	Option 1	Option 2	Standard	Option	Standard	Standard	Standard
General-Purpose Output	0	MRBK				PM1	MRBK		
	1	SERVO				PM2	SERVO		
	2	POSIN			MEND	PM3	(Reserved)		
	3	(Reserved)	HEND	WARN1	HEND		(Reserved)		
	4	T-LIMIT	MEND/ T-LIMIT	T-LIMIT		MEND/ T-LIMIT	T-LIMIT		
	5	OCZ (always fixed to 0)							
	6	SRDY		DBRK	SRDY	SERVO	SRDY		
	7	ALM							
General-Purpose Input	8	SVON							
	9	RESET			RESET/PCLR		RESET		
	10	HOLD			RCSTART1		HOLD	VCRUN1	HOLD
	11	PCLR			PCSEL1		(Reserved)	VCRUN2	(Reserved)
	12	(Reserved)	HOME	E-STOP	PCSEL2		(Reserved)	VCSEL1	(Reserved)
	13	CCWL			PCSEL3		CCWL	VCSEL2	CCWL
	14	CWL			PCSEL4	HOME	CWL	VCSEL3	CWL
	15	TLSEL1			ORG	TLSEL1			

Status	Warning Output	Units	Bytes	Signed
Status No. (Hexadecimal number)	22 (16)	-	2 BYTE	no
Description	The warning detail is returned in a bit field format.			
Command example	24 01 00 10 00 16 A6 7C			

Relations between Warning Output and Bit Tables



Status	Control Component Temperature	Units	Bytes	Signed
Status No. (Hexadecimal number)	24 (18)	℃	2 BYTE	yes
Description	Indicates the temperature at the amplifier control block. Install the amplifier in a place where the temperature at the control block will not exceed 85℃.			
Command example	24 01 00 10 00 18 47 B2			

Status	Pulse Train Command Input (position)	Units	Bytes	Signed
Status No. (Hexadecimal number)	33 (21)	command pulse	4 BYTE	yes
Description	The pulse count being output from the host controller is returned.			
Command example	24 01 00 11 00 21 D7 F8			

Status	Pulse Train Command Input (speed)	Units	Bytes	Signed
Status No. (Hexadecimal number)	35 (23)	command pulse/160 μs (750 W or less) command pulse/200 μs (1 kW to 2 kW)	2 BYTE	yes
Description	The speed value derived from using differentials of Pulse train command (position) at each 160 or 200 μs is returned.			
Command example	24 01 00 10 00 23 C0 8A			

Status	Analog Velocity Command	Units	Bytes	Signed
Status No. (Hexadecimal number)	49 (31)	r/min	2 BYTE	yes
Description	Indicates the value of the analog speed command being input to the amplifier. In Analog Velocity Command mode, by measuring this value (in the waveform data displayed in "Servo Studio") and the value of speed deviation at the same time, you can check the command response and vibration.			
Command example	24 01 00 10 00 31 F2 F9			

Status	Positioning Status	Units	Bytes	Signed
Status No. (Hexadecimal number)	64 (40)	-	2 BYTE	no
Description	Indicates whether positioning is completed or not 0: Not completed 1: Completed			
Command example	24 01 00 10 00 40 9C 4F			

Status	Internal Command Value	Units	Bytes	Signed
Status No. (Hexadecimal number)	65 (41)	encoder pulse	4 BYTE	yes
Description	Indicates the command value being input to the positioning loop. This is a value of the pulse command input (position) or a value of internal position command divided/multiplied and smoothed.			
Command example	24 01 00 11 00 41 BB 5E			

Status	Position Feedback	Units	Bytes	Signed
Status No. (Hexadecimal number)	67 (43)	encoder pulse	4 BYTE	yes
Description	Indicates the position data of the motor returned from the encoder to the amplifier.			
Command example	24 01 00 11 00 43 9B 1C			

4. Status Display

Status	Position Deviation	Units	Bytes	Signed
Status No. (Hexadecimal number)	69 (45)	encoder pulse	4 BYTE	yes
Description	Indicates deviation between the position command and position feedback. This value is important for tuning in position control mode, enabling you to do the following: To check the positioning time—for the position deviation to settle into your desired range after the pulse train command became 0—and vibration. To adjust gains such that the positioning time will be shorter and vibration will be suppressed, so the specifications for the equipment will be satisfied To check resonant frequency, in case of equipment vibration, by using waveforms of position deviation or torque limit value. To see whether vibration was suppressed by checking waveforms after specifying the vibration frequency for the following position command filters. · Filter 1 (Smoothing filter 1) Moving average counter (No.80.0) · Filter 4 (Smoothing filter 2) Moving average counter (No.81.0)			
Command example	24 01 00 11 00 45 FB DA			

Status	ABS Position Command	Units	Bytes	Signed
Status No. (Hexadecimal number)	74 (4A)	command pulse	4 BYTE	yes
Description	This indicates a position command value based on the home-position offset.			
Command example	24 01 00 11 00 4A 0A 35			

Status	Absolute Position Feedback	Units	Bytes	Signed
Status No. (Hexadecimal number)	76 (4C)	command pulse	4 BYTE	yes
Description	Indicates the absolute position data returned from the encoder to the amplifier.			
Command example	24 01 00 11 00 4C 6A F3			

Status	Command Position Deviation	Units	Bytes	Signed
Status No. (Hexadecimal number)	78 (4E)	command pulse	4 BYTE	yes
Description	Indicates the deviation between a position command value and the feedbacked position value.			
Command example	24 01 00 11 00 4E 4A B1			

Status	ABS Position Deviation	Units	Bytes	Signed
Status No. (Hexadecimal number)	80 (50)	command pulse	4 BYTE	yes
Description	Indicates the deviation between a value of ABS Position Command (Status No.74) and the value of ABS Positioning Feedback (Status No.76).			
Command example	24 01 00 10 00 50 B9 4E			

Status	Speed Command Value	Units	Bytes	Signed
Status No. (Hexadecimal number)	97 (61)	r/min	2 BYTE	yes
Description	Indicates the command value being input from the position loop (in Position Control mode) or analog speed command (in Analog Speed Control mode) to the speed loop. While tuning, by measuring this value (waveform data displayed in "Servo Studio") and position deviation (or speed deviation) at the same time, you can check command response with positioning time and vibration. Verify that no commands with extremely short acceleration/deceleration time are input from the host controller. If a command's acceleration/deceleration time is too short, the motor will be unable to keep up and vibration will easily occur. If you want to set a short acceleration/deceleration time, use a position command smoothing filter.			
Command example	24 01 00 10 00 61 A8 0C			

Status	Speed Feedback	Units	Bytes	Signed
Status No. (Hexadecimal number)	98 (62)	r/min	2 BYTE	yes
Description	Indicates the speed value returned from the encoder to the amplifier. With this, you can check command response and motor rotational speed.			
Command example	24 01 00 10 00 62 98 6F			

Status	Speed Deviation	Units	Bytes	Signed
Status No. (Hexadecimal number)	99 (63)	r/min	2 BYTE	yes
Description	Deviation between the speed command and the speed feedback. This item is used in Velocity Control Mode. With this, you can check the deviation during acceleration/deceleration, and adjust gains so that the value becomes within the desired range for the equipment. If the speed deviation is too large, make the adjustment with Control Gain 1 first, then Integral Gain next. This item is a reference value In Position Control Mode			
Command example	24 01 00 10 00 63 88 4E			

Status	Torque Command Value	Units	Bytes	Signed
Status No. (Hexadecimal number)	113 (71)	0.1%	2 BYTE	yes
Description	Indicates the value of torque command. The value of 1,000 equals to the rated torque. You can check the torque range during acceleration time and compare to the rated torque and the instantaneous maximum torque. ・RMS torque: Keep this below the rated torque. ・Instantaneous torque: Use the motor such that this will be approximately 80% of instantaneous peak torque. When the RMS torque command value reaches the instantaneous max torque value (that is, toque saturation), the torque output will be limited and an alarm will occur after the predetermined time will have elapses. Torque saturation causes slow response. Take countermeasures. For example, ① Set Position command filter. ・**Filter 1 (Smoothing filter 1) Moving average counter** (No.80.0) ・**Filter 4 (Smoothing filter 2) Moving average counter** (No.81.0) ② Smooth acceleration/deceleration of the command output from the host controller. ③ Install a speed reducer to decrease the inertia ratio. ④ Select a new motor to increase the rotor inertia or increase the capacity to decrease the inertia ratio.			
Command example	24 01 00 10 00 71 BA 3D			

Status	Load Factor	Units	Bytes	Signed
Status No. (Hexadecimal number)	131 (83)	digit	2 BYTE	no
Description	Indicates the motor load factor. The value of 1,000 is equivalent to 100% of the rated load. This item becoming 1,440 (120%) is an indicator of overload. Adjust the operating conditions such that this value remains under 1,000. Calculation formula: Motor load factor% = √ (Load factor digit × 10)			
Command example	24 01 00 10 00 71 BA 3D			

Status	Load Factor (%)	Units	Bytes	Signed
Status No. (Hexadecimal number)	132 (-)	%	-	no
Description	The motor load factor is presented in%. ("Servo Studio" only)			
Command example	-			

Status	Encoder/rotor mechanical angle (single-turn value)	Units	Bytes	Signed
Status No. (Hexadecimal number)	194 (C2)	encoder pulse	4 BYTE	no
Description	Indicates single-turn data of the motor. It is presented in 0 – 131,072 (17bit). This value is an absolute value.			
Command example	24 01 00 11 00 C2 1A B5			

Status	Encoder/rotor mechanical angle (integrated value)	Units	Bytes	Signed
Status No. (Hexadecimal number)	195 (C3)	encoder pulse	4 BYTE	yes
Description	This indicates multi-turn data of the motor. It is presented as a total of encoder feedback pulses. (Single-turn value)+(2^{17} × Encoder Multi-turn data) This item is the absolute data if you are using an absolute encoder.			
Command example	24 01 00 11 00 C3 0A 94			

Status	Encoder temperature	Units	Bytes	Signed
Status No. (Hexadecimal number)	205 (CD)	℃	2 BYTE	yes
Description	Indicates the encoder internal temperature. (for reference only)			
Command example	24 01 00 10 00 CD DC 6A			

Status	Encoder battery voltage	Units	Bytes	Signed
Status No. (Hexadecimal number)	206 (CE)	0.1 V	2 BYTE	yes
Description	Indicates the voltage of the encoder backup battery.			
Command example	24 01 00 10 00 CE EC 09			

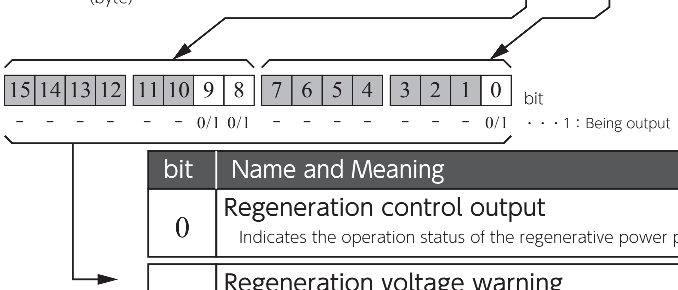
Status	Encoder communication retry times	Units	Bytes	Signed
Status No. (Hexadecimal number)	216 (D8)	times	2 BYTE	no
Description	Indicates the communication retry count upon encoder communication error.			
Command example	24 01 00 10 00 D8 9E FE			

Status	Encoder Data Error Counter	Units	Bytes	Signed
Status No. (Hexadecimal number)	218 (DA)	times	2 BYTE	no
Description	Indicates the cumulative count of errors in receiving encoder data.			
Command example	24 01 00 10 00 DA BE BC			

Status	Regeneration Status	Units	Bytes	Signed
Status No. (Hexadecimal number)	228 (E4)	-	2 BYTE	no
Description	This item indicates the regeneration status of the amplifier power circuit. Setup Panel ☞ 5 **Setting Parameters** Setup Panel "Servo Studio" 【waveform monitor】 displays total value of I/O bits in decimal. 【status monitor】 displays I/O bits in binary.			
Command example	24 01 00 10 00 E4 69 21			

Relations between RS-485 Communication Command and Bit Tables

Transmit data : (byte)	24	01	00	10	00	E4	69	21
					Regeneration Status		Error detection	
Response data : (byte)	24	01	80	10	**	**	〔··〕	〔··〕

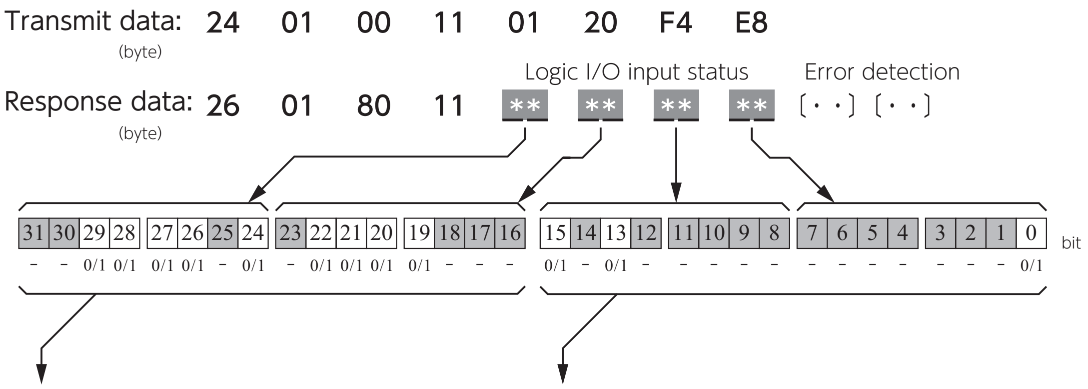


bit	Name and Meaning	Decimal
0	Regeneration control output Indicates the operation status of the regenerative power processing circuit.	0
8	Regeneration voltage warning Indicates the primary circuit power voltage has reached the warning level. You need to connect a regenerative resistor to the amplifier.	256
9	Regeneration voltage threshold Indicates the primary circuit power voltage has reached the threshold. A power error, Err. 14 or Err. 15, will occur if the regenerative resistor is not connected.	512

Status	Primary Circuit Power Voltage	Units	Bytes	Signed
Status No. (Hexadecimal number)	232 (E8)	0.1 V	2 BYTE	no
Description	Indicates the primary circuit power voltage (for reference only).			
Command example	24 01 00 10 00 E8 A8 AD			

Status	Logic I/O input	Units	Bytes	Signed
Status No. (Hexadecimal number)	288 (120)	-	4 BYTE	no
Description	Indicates the logic I/O input status inside the amplifier. (RS-485 Communication only) Use this item while operating the motor with the point table in Internal Position Command mode using RS-485 communication with the host controller. ☞ **Communications Manual:** RS-485			
Command example	24 01 00 11 01 20 F4 E8			

Relations between Logic I/O input command and Bit Tables



31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
-	-	0/1	0/1	0/1	0/1	-	0/1	-	0/1	0/1	0/1	0/1	-	-	-	0/1	-	0/1	-	-	-	-	-	-	-	-	-	-	-	-	0/1

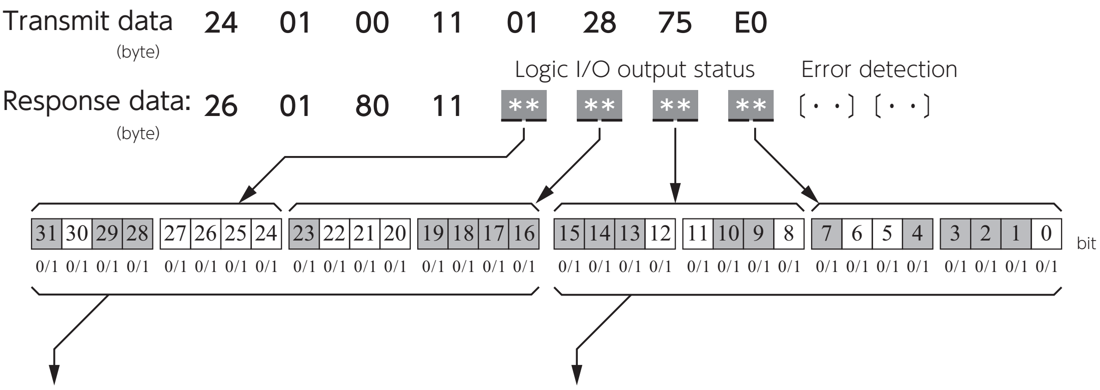
16	(Reserved)	
17		
18		
19	HOME	Homing start
20	ORG	Home position sensor
21	PCPAUSE	Pause
22	PCCANCEL	Cancel
23	(Reserved)	
24	PCSTART1	Start Forward Rotation
25	(Reserved)	
26	PCSEL1	Point No. Select 1
27	PCSEL2	Point No. Select 2
28	PCSEL3	Point No. Select 3
29	PCSEL4	Point No. Select 4
30	(Reserved)	
31		

0	SVON	Servo ON
1	(Reserved)	
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13	TLSEL1	Torque Limit
14	(Reserved)	
15	RESET/PCLR	Alarm Reset/ Deviation Counter Clear

4. Status Display

Status	Logic I/O output	Units	Bytes	Signed
Status No. (Hexadecimal number)	296 (128)	-	4 BYTE	no
Description	Indicates the logic I/O output status of the amplifier. (RS-485 Communication only) Us this during the point table operation in Internal Position Command mode by using RS-485 communication from the host controller. ☞ **Communications Manual:** RS-485			
Command example	24 01 00 11 01 28 75 E0			

Relations between Logic I/O output command and Bit Tables



16	(Reserved)	
17		
18		
19		
20	MEND	Motion complete
21	PAUSED	Pause
22	HEND	Homing complete
23	(Reserved)	
24	PM1	Point No. Select 1
25	PM2	Point No. Select 2
26	PM3	Point No. Select 3
27	PM4	Point No. Select 4
28	(Reserved)	
29		
30	MEND/T-LIMIT	Motion complete/ Torque limiting
31	(Reserved)	

0	POSIN	Positioning complete
1	(Reserved)	
2		
3		
4		
5	SREDY	Servo ready
6	T-LIMIT	Torque Limiting
7	(Reserved)	
8	MBRK	Brake release
9	(Reserved)	
10		
11	SERVO	Servo status
12	ALM	Alarm OUTPUT
13	(Reserved)	
14		
15		

Status	Inertia Ratio Estimate	Units	Bytes	Signed
Status No. (Hexadecimal number)	371 (173)	-	2BYTE	no
Description	This item indicates the inertia ratio value estimated in auto turning.			
Command example	24 01 00 10 01 73 A9 4E			

5. How to set Pulse train command: Input filter (No.33.0)

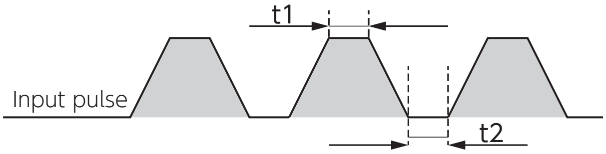
Pulse Train Command Input Filter (No.33.0) is a function to reduce malfunction caused by noise.
Select a value for the pulse width that you want the filter to pass Pulse Train Command input signal.
Pulse Train Command input is open collector, be sure to select the best filter.

( ) recommended when input

Setting	Passing pulse width [ns]	Setting	Passing pulse width [ns]
0	No filter	8	600 (500 kHz)
1	25	9	800
2	50 (4 MHz)	10	1,000
3	100	11	1,200
4	150 (2 MHz)	12	1,600 (250 kHz)
5	200	13	2,000
6	300 (1 MHz)	14	2,300
7	400	15	3,100

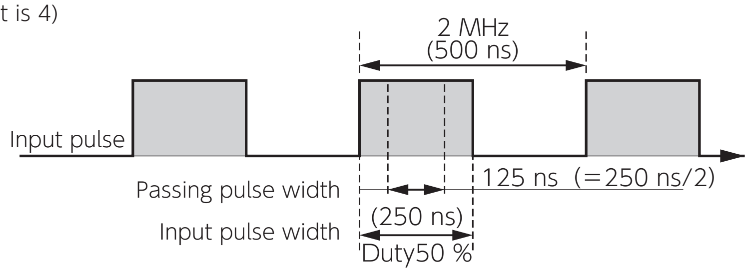
Tip for Filter Setup

- When the input frequency is high, select a small passing pulse width.
- To improve noise resistance, select a larger passing pulse width.



The minimum value of t1 or t2 is the passing pulse width.

- Set the passing pulse width to be 1/3 to 1/2 of the input pulse width.
  Example: Input pulse of 2 MHz with 50% duty cycle
  Because the input pulse width is 250 ns, set No.33.0 to 3 or 4 so that pulses to pass the filter will be 125 ns or less. (The default is 4)



Selecting the best filter value using the pulse frequency by pulse duty cycle matrix

Duty [%] / Pulse Frequency	50	40	30	20	10
100 kHz	12	11	10	8	6
200 kHz	9	8	7	6	4

MEMO

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