AC SERVO MOTOR and SERVO AMPLIFIER Series S-FLAG

S-FLAG Ⅱ
Instruction Manual
- EtherCAT -

System Ver. 6.1.0.0

https://www.nidec.com/en/nidec-instruments/

NIDEC INSTRUMENTS CORPORATION

Specifications subject may change without notice.

AMO-NP-35475-42
APR. 2023
+A2

Thank you for your purchase of the S-FLAG Ⅱ 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 "Before Using".
- After reading this Instruction Manual, always keep it handy for easy access.
- The specifications or features of the product may change without notice because of further development of the product.
- We prepared the contents of this Instruction Manual with extreme care. Please do not hesitate to contact us if you have any questions.
- We always strive to have up-to-date information in the Instruction Manual; therefore, it is subject to change without prior notice.
- The illustrations and screenshot images of S-TUNE Ⅱ included in this document may be different from the actual S-TUNE Ⅱ views.
- No reproduction in any form of this Instruction Manual, in whole or in part, may be made without written authorization from Nidec Instruments Corporation.

APR. 2023

Trademarks and Patents

Inquiries

Inquiries

If you have any questions about this product, please contact our distributor.

Please ask our distributor for the latest exclusive software (S-TUNEII) and user's manual.

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Contents

A GENERAL

This chapter describes safety precautions.

B HARDWARE

This chapter describes the specifications and installation of the motor and amplifier, and wiring of the system and I/O connector.

C PARAMETERS

This chapter describes parameters and tuning methods.

D SOFTWARE

This chapter describes how to use "S-TUNE Ⅱ ".

E COMMUNICATIONS

This chapter describes EtherCAT communications.

F OPERATIONS

This chapter explains how to drive the motor by EtherCAT communication.

Z APPENDICES

This chapter describes troubleshooting and maintenance when an alarm occurs.

MEMO

A

GENERAL

1. Before Using

MEMO

1

Before Using

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 15 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.	✋ ⚡
	Do not run the dynamic brake frequently.	⚠
❗	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.	✋ ⚠
	After the dynamic brake works, it should be allowed to dissipate heat for about 10 minutes.	⚠

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 the S-FLAG Ⅱ 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. Compatibility Standards

Rating		Motor	Amplifier
EU/EC Directives	Low Voltage Directive (*1)	EN60034-1 EN60034-5	EN61800-5-1
	EMC Directive (*2)	–	EN61000-6-2 EN61000-6-4
	Machinery Directive	(N/A)	
UL Standards		UL1004-1 UL1004-6 (File No.E470950)	UL61800-5-1 (File No.E471456)
CSA Standards		C22.2 No.100	C22.2 No.274-17
South Korean EMC Standards		–	KS C 9610-6-2 KS C 9610-6-4
China Compulsory Product Certification System (CCC)		(N/A)	

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

- Overvoltage Category III
- 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 eighteen (18) 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 the S-FLAG Ⅱ instruction manual, we agrees to make repairs at free of charge. However, even during the warranty period, we 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. we shall not be liable for any indirect, incidental or consequential damage caused by the product failure or damage.

2. About Our Products

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 S-FLAG Ⅱ 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 the S-FLAG Ⅱ 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 us, 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. About Our Products

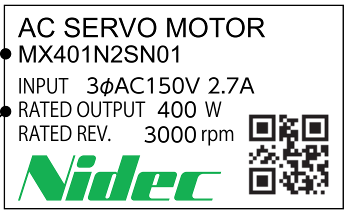
1. Product Label

Motor Label

Label 1

Motor Model

Specifications



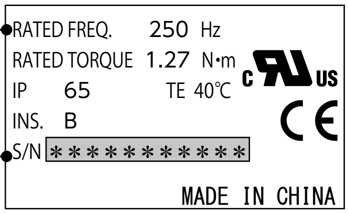
Label 2

Specifications

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

A product number is indicated by 11 digits.

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



Amplifier Label

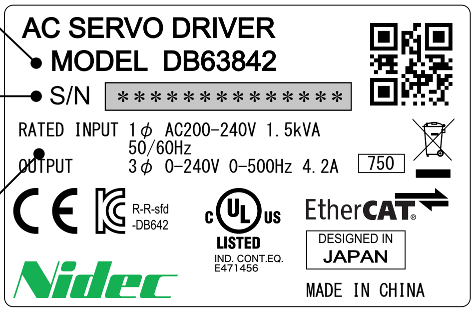
Amplifier Model

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

A product number is indicated by 14 digits.

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

Specifications



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

2. Danger Signs

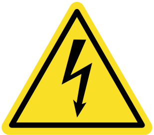
NO IMPACT/NO DISASSEMBLY LABEL

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

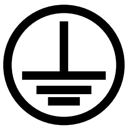


Do not touch the amplifier during operation and within 15 minutes after operation, or you may get injured.

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.

MEMO

S-FLAG Ⅱ　Instruction Manual
- EtherCAT -

B

HARDWARE

1. Specifications

2. Mounting and Wiring

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MEMO

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Specifications

1. Motors

1. Model Codes

Motors with a 23 bit Absolute Encoder

Models MX 201 B 2 S A * *

Series

Code	Specifications
MX	Low Inertia
MY	Middle Inertia
MG	
MM	
MJ	
MW	High Inertia
MH	

Rated Output

Code	Rated Output
500	50 W
101	100 W
201	200 W
401	400 W
751	750 W
851	850 W
951	1 kW
102	1 kW
132	1.3 kW
152	1.5 kW
202	2 kW

Brake

Code	Holding Brake
P	Without
B	With

The "Brake" code displays the specifications of the encoder resolution.

Voltage

Code	Specifications
2	AC200–240 V

Control Number

Code	Brake	Oil Seal	Shaft
11	Without	Without	Straight
12	With	Without	Straight
13	Without	Without	With Key
14	With	Without	With Key
15	Without	With	Straight
16	With	With	Straight
17	Without	With	With Key
18	With	With	With Key

Encoder

Code	Specifications
A	Absolute

The motor equipped with 23 bit encoder is a lineup only for absolute model.

Shaft end specifications/Oil Seal

Code	Shaft	Oil Seal
S (P)	Straight	Without
K (H)	With Key	Without
T (R)	Straight	With
L (J)	With Key	With

The straight shaft products are not tapped end.

( ) Shaft diameter = ⌀ 11

⌀ 11 shaft is exclusively for 200 W motor.

Please ask about this product to our distributor.

1. Motor

Motors with a 17 bit Absolute Encoder

Models MX 201 A 2 S A * *

Series

Code	Specifications
MX	Low Inertia
MY	Middle Inertia
MG	
MM	
MJ	
MW	High Inertia
MH	

Rated Output

Code	Rated Output
500	50 W
101	100 W
201	200 W
401	400 W
751	750 W
851	850 W
951	1 kW
102	1 kW
132	1.3 kW
152	1.5 kW
202	2 kW

Brake

Code	Holding Brake
N	Without
A	With

The "Brake" code displays the specifications of the encoder resolution.

Voltage

Code	Specifications
2	AC200-240 V

Control Number

Code	Brake	Oil Seal	Shaft
11	Without	Without	Straight
12	With	Without	Straight
13	Without	Without	With Key
14	With	Without	With Key
15	Without	With	Straight
16	With	With	Straight
17	Without	With	With Key
18	With	With	With Key

Encoder

Code	Specifications
A	Absolute

Shaft end specifications/Oil Seal

Code	Shaft	Oil Seal
S (P)	Straight	Without
K (H)	With Key	Without
T (R)	Straight	With
L (J)	With Key	With

The straight shaft products are not tapped end.

( ) Shaft diameter = ⌀ 11

⌀ 11 shaft is exclusively for 200 W motor.

Please ask about this product to our distributor.

Motors with a 17 bit Incremental Encoder

Models MX 201 A 2 S N * *

Series	
Code	Specifications
MX	Low Inertia
MY	Middle Inertia
MG	
MM	
MJ	
MW	High Inertia
MH	

Rated Output	
Code	Rated Output
500	50 W
101	100 W
201	200 W
401	400 W
751	750 W
851	850 W
951	1 kW
102	1 kW
132	1.3 kW
152	1.5 kW
202	2 kW

Brake	
Code	Holding Brake
N	Without
A	With

The "Brake" code displays the specifications of the encoder resolution.

Voltage	
Code	Specifications
2	AC200–240 V

Shaft end specifications/Oil Seal		
Code	Shaft	Oil Seal
S (P)	Straight	Without
K (H)	With Key	Without
T (R)	Straight	With
L (J)	With Key	With

The straight shaft products are not tapped end.
( ) Shaft diameter = ⌀ 11
⌀ 11 shaft is exclusively for 200 W motor.
Please ask about this product to our distributor.

Encoder	
Code	Specifications
N	Incremental

Control Number			
Code	Brake	Oil Seal	Shaft
01	Without	Without	Straight
02	With	Without	Straight
03	Without	Without	With Key
04	With	Without	With Key
05	Without	With	Straight
06	With	With	Straight
07	Without	With	With Key
08	With	With	With Key

1. Motor

Motor Rated Capacity	Motor Model Name Rotor Inertia & Series			Mounting Flange Size	Encoder Resolution	Rotational Speed	IP	Amplifier	Page
	L Low Inertia MX	M Middle Inertia MY MG MM MJ	H High Inertia MH MW						23bit / 17bit
50 W	–	MY500 MG500	–	40 SQUARE	23 bit / 17 bit	60 / 30	IP 65	DB6**YZ**42	p. 9- /p. 32-
100 W	–	MY101 MG101	–	40 SQUARE	23 bit / 17 bit	60 / 30	IP 65	DB6**Z1**42	p. 11- /p. 34-
200 W	MX201	MG201	MW201	60 SQUARE	23 bit / 17 bit	60 / 30	IP 65	DB6**12**42	P. 13- /p. 36-
400 W	MX401	MG401	MW401	60 SQUARE	23 bit / 17 bit	60 / 30	IP 65	DB6**24**42	p. 16- /p. 39-
750 W	MX751	–	MW751	80 SQUARE	23 bit / 17 bit	60 / 30	IP 65	DB6**38**42	p. 19- /p. 42-
850 W	–	MJ851	–	130 SQUARE	23 bit / 17 bit	30 / 15	IP 67	DB6**5B**42	p. 21 /p. 44
1 kW	MX951	–	–	80 SQUARE	23 bit / 17 bit	60 / 30	IP 65	DB6**4A**42	p. 22 /p. 45
	MX102	–	–	100 SQUARE	23 bit / 17 bit	50 / 30	IP 67	DB6**4A**42	p. 23 /p. 46
	–	MM102	MH102	130 SQUARE	23 bit / 17 bit	30 / 20	IP 67	DB6**4A**42	p. 24- /p. 47-
1.3 kW	–	MJ132	–	130 SQUARE	23 bit / 17 bit	30 / 15	IP 67	DB6**7C**42	p. 26 /p. 49
1.5 kW	MX152	–	–	100 SQUARE	23 bit / 17 bit	50 / 30	IP 67	DB6**6B**42	p. 27 /p. 50
	–	MM152	MH152	130 SQUARE	23 bit / 17 bit	30 / 20	IP 67	DB6**6B**42	p. 28- /p. 51-
2 kW	MX202	–	–	100 SQUARE	23 bit / 17 bit	50 / 30	IP 67	DB6**8C**42	p. 30 /p. 53
	–	MM202	–	130 SQUARE	23 bit / 17 bit	30 / 20	IP 67	DB6**8C**42	p. 31 /p. 54

Inertia

L	Low Inertia
M	Middle Inertia
H	High Inertia

Flange Size

40 SQUARE	40 mm × 40 mm
60 SQUARE	60 mm × 60 mm
80 SQUARE	80 mm × 80 mm
100 SQUARE	100 mm × 100 mm
130 SQUARE	130 mm × 130 mm

Rotational Speed

	Rated Motor Speed / Max.
30 / 15	1,500 r/min / 3,000 r/min
30 / 20	2,000 r/min / 3,000 r/min
50 / 30	3,000 r/min / 5,000 r/min
60 / 30	3,000 r/min / 6,000 r/min

Encoder Resolution

23 bit ENCODER	23 bit/rev
17 bit ENCODER	17 bit/rev

IP Code

IP 65	IP65
IP 67	IP67

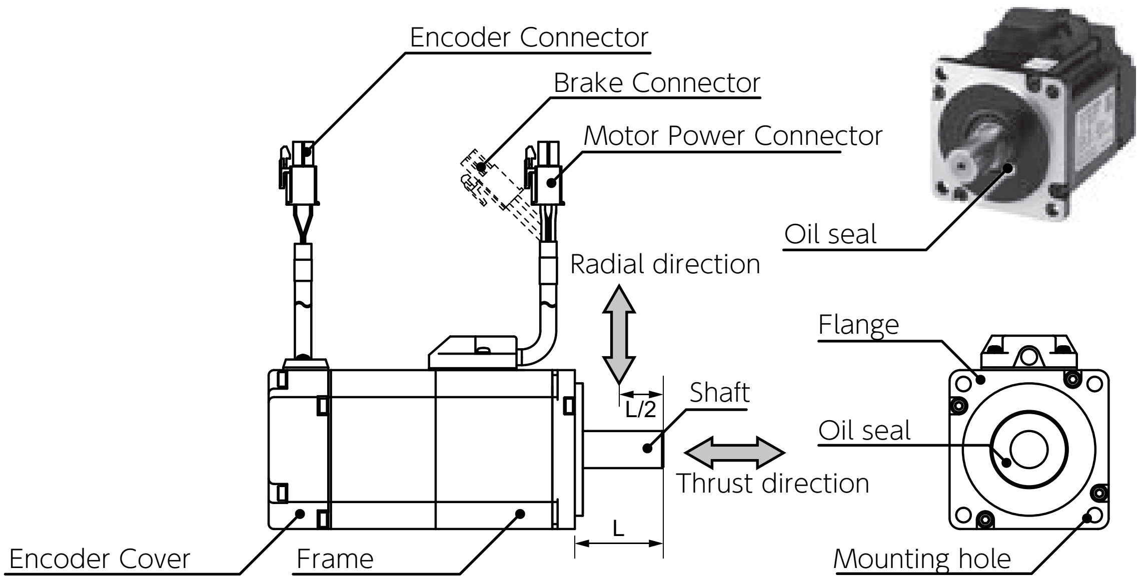
1. Motor

2. Names of parts

Figure 1

Motor rated output power: 50 W | 100 W | 200 W | 400 W | 750 W | 850 W | 1 kW | 1.3 kW | 1.5 kW | 2 kW

Motor Rated Capacity	Motor Model Name Rotor Inertia & Series			Mounting Flange Size
	L Low Inertia MX	M Middle Inertia MY MG MM	H High Inertia MW	
50 W	–	**MY500** **MG500**	–	40 mm × 40 mm
100 W	–	**MY101** **MG101**	–	40 mm × 40 mm
200 W	**MX201**	**MG201**	**MW201**	60 mm × 60 mm
400 W	**MX401**	**MG401**	**MW401**	60 mm × 60 mm
750 W	**MX751**	–	**MW751**	80 mm × 80 mm
1 kW	**MX951**	–	–	80 mm × 80 mm

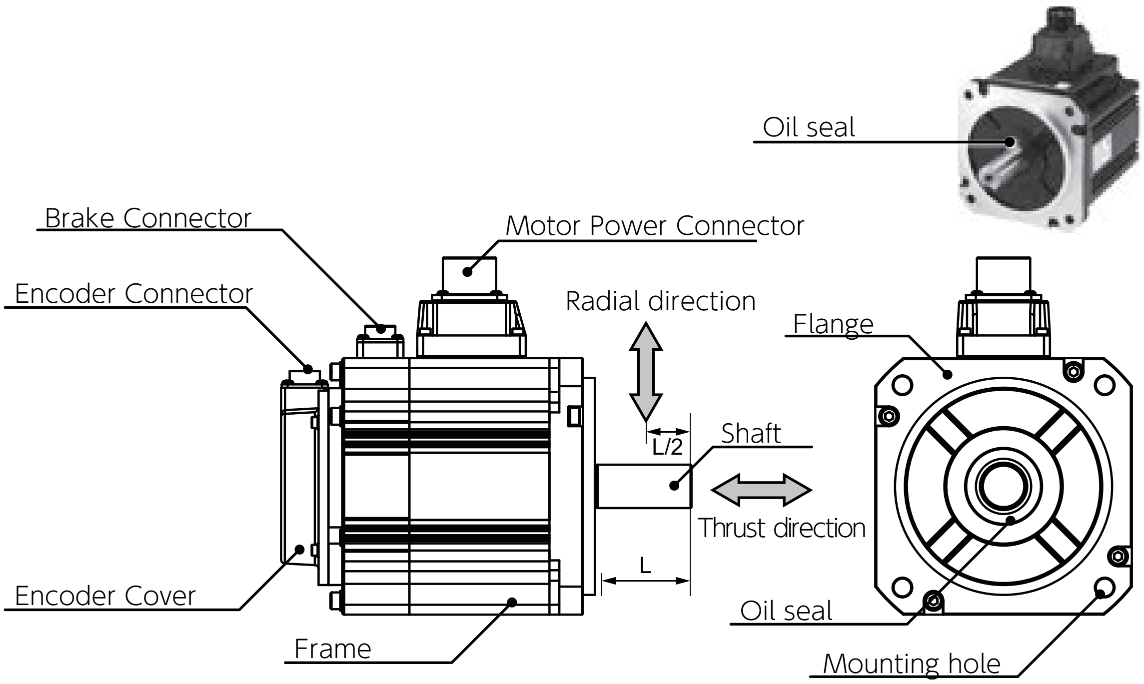


1. Specifications

1. Motor

Figure 2 Motor rated output power 50 W 100 W 200 W 400 W 750 W 850 W 1 kW 1.3 kW 1.5 kW 2 kW

Motor Rated Capacity	Motor Model Name Rotor Inertia & Series Low Inertia MX	 Middle Inertia MM MJ	 High Inertia MH	Mounting Flange Size
850 W	–	**MJ851**	–	130 mm × 130 mm
1 kW	**MX102**	–	–	100 mm × 100 mm
	–	**MM102**	**MH102**	130 mm × 130 mm
1.3 kW	–	**MJ132**	–	130 mm × 130 mm
1.5 kW	**MX152**	–	–	100 mm × 100 mm
	–	**MM152**	**MH152**	130 mm × 130 mm
2 kW	**MX202**	–	–	100 mm × 100 mm
	–	**MM202**	–	130 mm × 130 mm



1. Motor

3. Specifications

Item	Specifications
Ambient temperature for operation	0–40℃
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/s² (5 G)
Impact resistance	98 m/s² (10 G)
Protective structure	IP65 : 50 W to 750 W, 1kW (Only MX951) IP67 : 1 kW (Except for MX951) to 2 kW
Electric shock protection	Class I (Mandatory grounding)
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.

1. Motor

50 W

Motor Model : MY500P2 □□＊＊ (Without brake)
MY500B2 □□＊＊ (With brake)

Basic Specifications

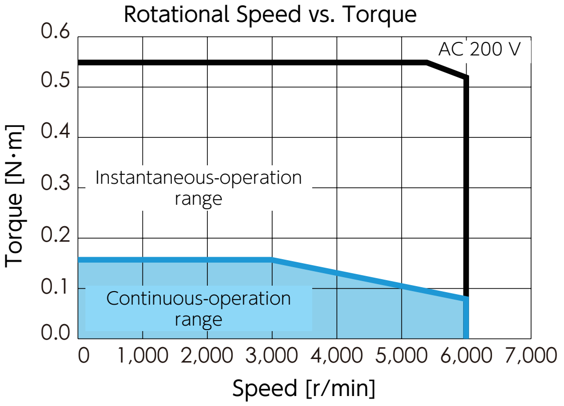
Item		Unit	Specifications
Rotor inertia		–	Middle
Fitting flange size		mm	40 sq.
Approximate mass	Without brake	kg	0.4
	With brake		0.6
Compatible amplifier model		–	DB6YZ42
Voltage		V	AC200–240 V
Rated output		W	50
Rated torque		N·m	0.16
Instantaneous maximum torque		N·m	0.56
Rated current (stall current)		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	7.1
	With brake		5.8
Mechanical time constant	Without brake	ms	1.76
	With brake		2.15
Electrical time constant		ms	0.74
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	0.036
	With brake		0.043

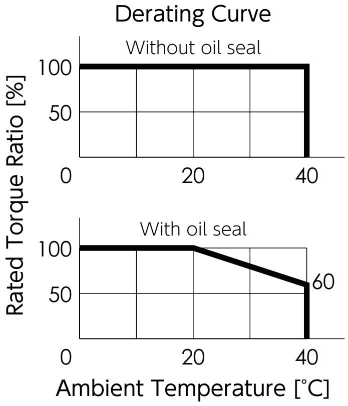
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.28
Static friction torque	N·m	≧0.16
Suction time	ms	≦35
Release time	ms	≦20
Release voltage	V	≧ DC1 V

Permissible Load

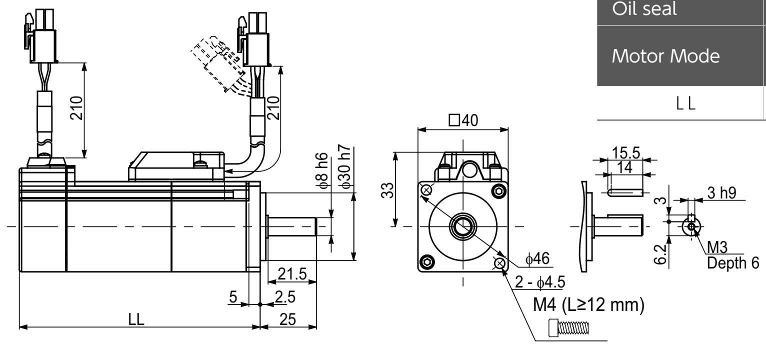
Item	Unit	Specifications
Radial	N	68
Thrust	N	58





(mm)

Brake	Without		With	
Oil seal	Without	With	Without	With
Motor Mode	MY500P2S MY500P2K	MY500P2T MY500P2L	MY500B2S MY500B2K	MY500B2T MY500B2L
LL	66.4	72.0	106.8	112.4



1. Motor

Motor Model : MG500P2□□** (Without brake)
MG500B2□□** (With brake)

Basic Specifications

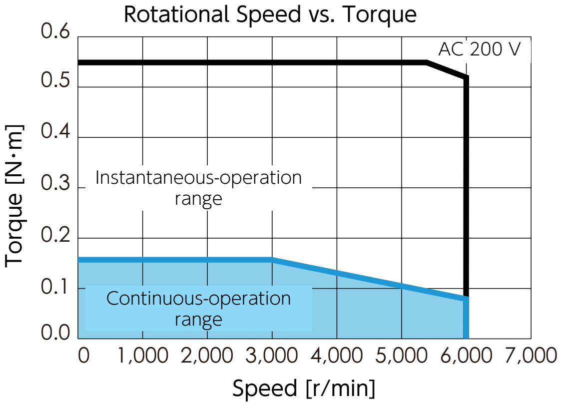
Item		Unit	Specifications
Rotor inertia		–	Middle
Fitting flange size		mm	40 sq.
Approximate mass	Without brake	kg	0.4
	With brake		0.6
Compatible amplifier model		–	DB6YZ42
Voltage		V	AC200–240 V
Rated output		W	50
Rated torque		N·m	0.16
Instantaneous maximum torque		N·m	0.56
Rated current (stall current)		A	0.71
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)	8.7
Rated power rate	Without brake	kW/s	6.4
	With brake		5.3
Mechanical time constant	Without brake	ms	2.14
	With brake		2.58
Electrical time constant		ms	0.65
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.040
	With brake		0.048

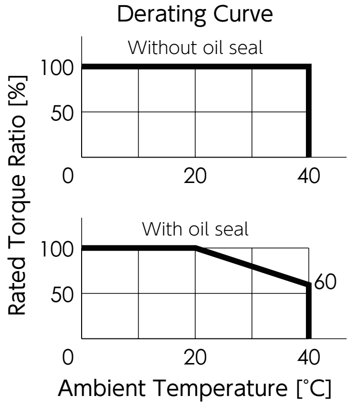
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.26
Static friction torque	N·m	≧ 0.16
Suction time	ms	≦ 35
Release time	ms	≦ 20
Release voltage	V	≧ DC1 V

Permissible Load

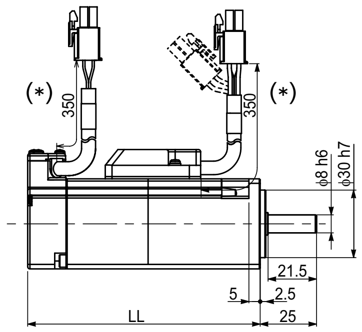
Item	Unit	Specifications
Radial	N	68
Thrust	N	58

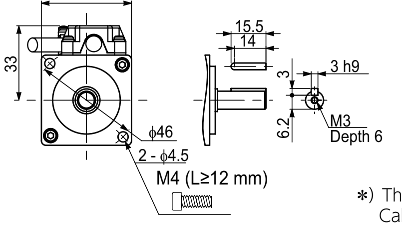




(mm)

Brake	Without		With	
Oil seal	Without	With	Without	With
Motor Mode	MG500P2S MG500P2K	MG500P2T MG500P2L	MG500B2S MG500B2K	MG500B2T MG500B2L
L L	57.1	64.7	89.5	97.1





*) The standard cable length is 350 mm.
Cable length 210mm is also available.

1. Specifications

1. Motor

100 W

Motor Model : MY101P2 □□** (Without brake)
MY101B2 □□** (With brake)

Basic Specifications

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		–	DB6Z142
Voltage		V	AC200–240 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	17.4
	With brake		15.4
Mechanical time constant	Without brake	ms	1.10
	With brake		1.25
Electrical time constant		ms	0.89
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.058
	With brake		0.066

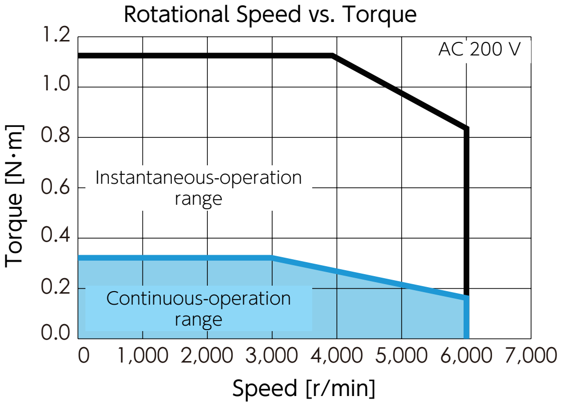
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.28
Static friction torque	N·m	≧ 0.32
Suction time	ms	≦ 35
Release time	ms	≦ 20
Release voltage	V	≧ DC1 V

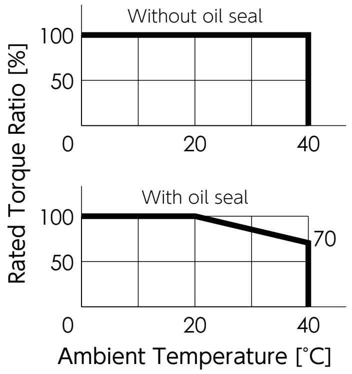
Permissible Load

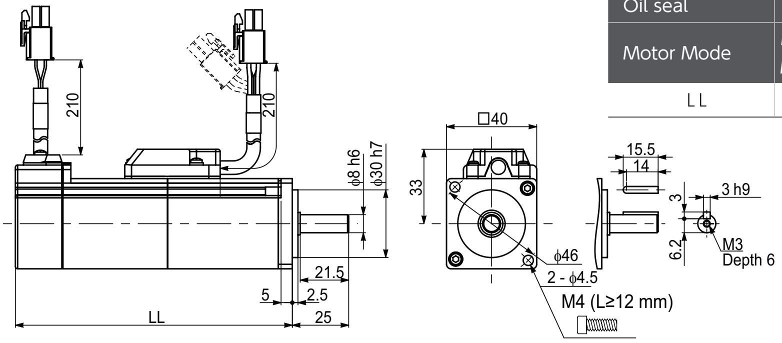
Item	Unit	Specifications
Radial	N	68
Thrust	N	58

Rotational Speed vs. Torque



Derating Curve





(mm)

Brake	Without		With	
Oil seal	Without	With	Without	With
Motor Mode	MY101P2S MY101P2K	MY101P2T MY101P2L	MY101B2S MY101B2K	MY101B2T MY101B2L
L L	82.4	88.0	122.8	128.4

1. Motor

Motor Model : MG101P2 □□** (Without brake)
MG101B2 □□** (With brake)

Basic Specifications

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		–	DB6Z142
Voltage		V	AC200–240 V
Rated output		W	100
Rated torque		N·m	0.32
Instantaneous maximum torque		N·m	1.12
Rated current (stall current)		A	0.99
Instantaneous maximum current		A	3.4
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.36
Induced voltage constant per phase		mV/(r/min)	12.7
Rated power rate	Without brake	kW/s	15.5
	With brake		13.8
Mechanical time constant	Without brake	ms	1.25
	With brake		1.41
Electrical time constant		ms	0.78
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	0.065
	With brake		0.073

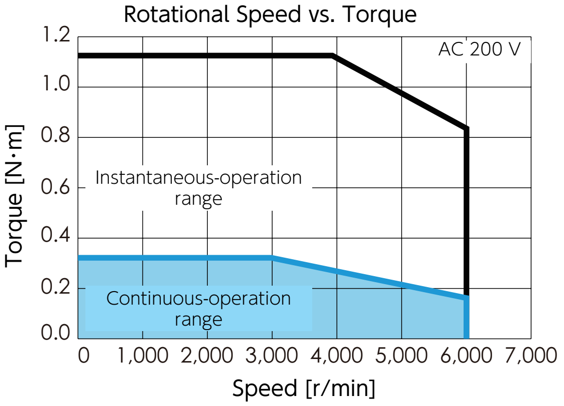
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.26
Static friction torque	N·m	≧ 0.32
Suction time	ms	≦ 35
Release time	ms	≦ 20
Release voltage	V	≧ DC1 V

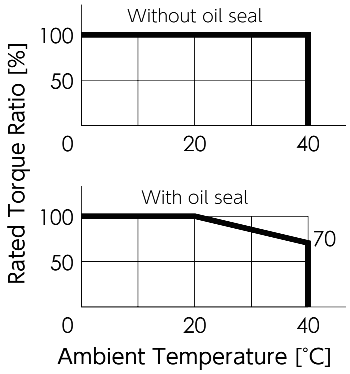
Permissible Load

Item	Unit	Specifications
Radial	N	68
Thrust	N	58

Rotational Speed vs. Torque

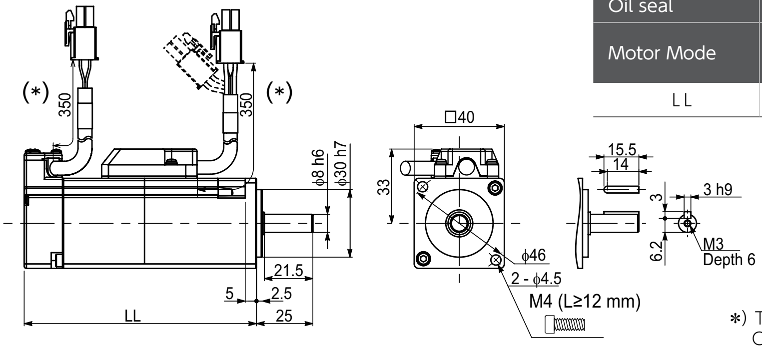


Derating Curve



(mm)

Brake	Without		With	
Oil seal	Without	With	Without	With
Motor Mode	MG101P2S MG101P2K	MG101P2T MG101P2L	MG101B2S MG101B2K	MG101B2T MG101B2L
L L	70.7	78.3	103.1	110.7



*) The standard cable length is 350 mm.
Cable length 210mm is also available.

1. Motor

200 W

Motor Model : MX201P2 □□** (Without brake)
MX201B2 □□** (With brake)

Basic Specifications

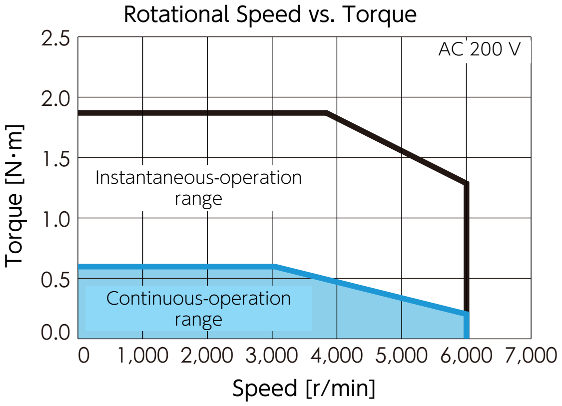
Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	0.8
	With brake		1.3
Compatible amplifier model		–	DB61242
Voltage		V	AC200–240 V
Rated output		W	200
Rated torque		N·m	0.64
Instantaneous maximum torque		N·m	1.91
Rated current (stall current)		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	29.9
	With brake		24.7
Mechanical time constant	Without brake	ms	0.68
	With brake		0.83
Electrical time constant		ms	2.53
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	0.14
	With brake		0.16

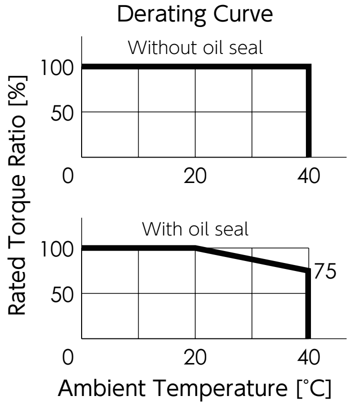
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

Permissible Load

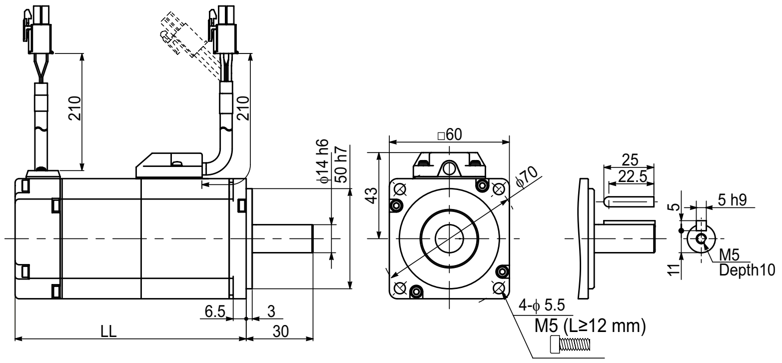
Item	Unit	Specifications
Radial	N	245
Thrust	N	98





(mm)

Brake	Without	With
Motor Model	MX201P	MX201B
LL	76.5	113.0



1. Motor

Motor Model : MG201P2 □□＊＊ (Without brake)
MG201B2 □□＊＊ (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	Middle
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	0.9
	With brake		1.3
Compatible amplifier model		–	DB61242
Voltage		V	AC200–240 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	15.9
	With brake		14.5
Mechanical time constant	Without brake	ms	1.29
	With brake		1.41
Electrical time constant		ms	2.53
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.26
	With brake		0.28

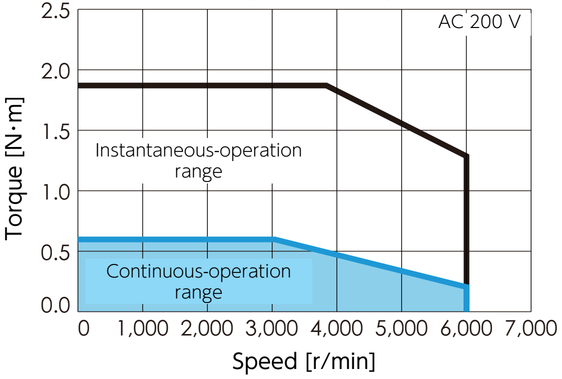
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.3
Static friction torque	N·m	≧ 1.27
Suction time	ms	≦ 50
Release time	ms	≦ 20
Release voltage	V	≧ DC1 V

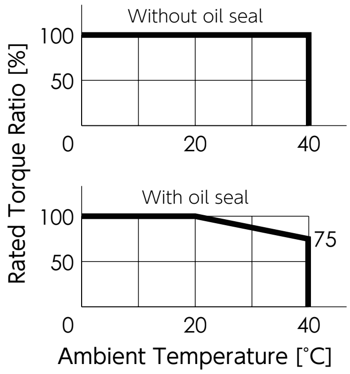
Permissible Load

Item	Unit	Specifications
Radial	N	245
Thrust	N	98

Rotational Speed vs. Torque

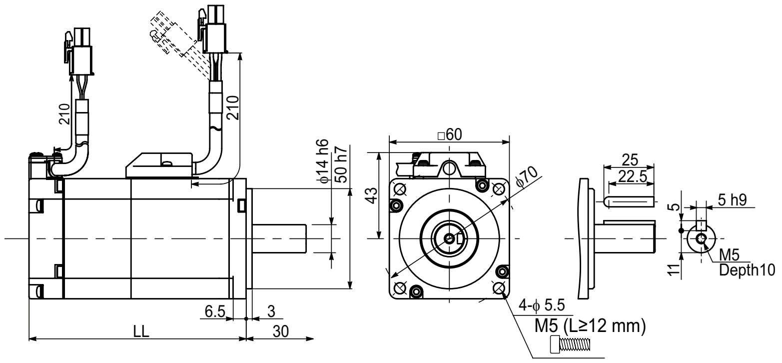


Derating Curve



(mm)

Brake	Without	With
Motor Model	MG201P	MG201B
LL	78.0	108.5



1. Motor

Motor Model : MW201P2 □□✻✻ (Without brake)
MW201B2 □□✻✻ (With brake)

Basic Specifications

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		–	DB61242
Voltage		V	AC200–240 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	9.3
	With brake		8.7
Mechanical time constant	Without brake	ms	2.19
	With brake		2.34
Electrical time constant		ms	2.53
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.44
	With brake		0.46

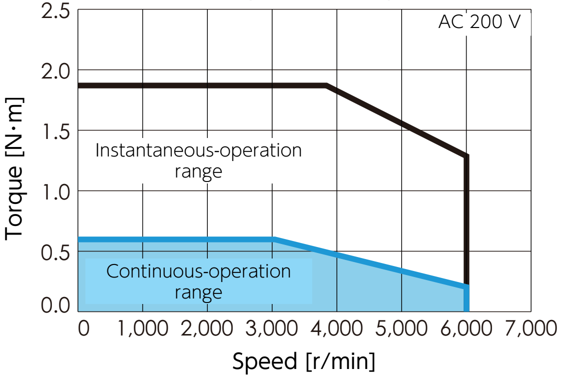
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	245
Thrust	N	98

Rotational Speed vs. Torque



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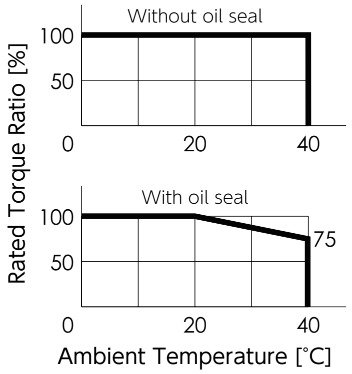
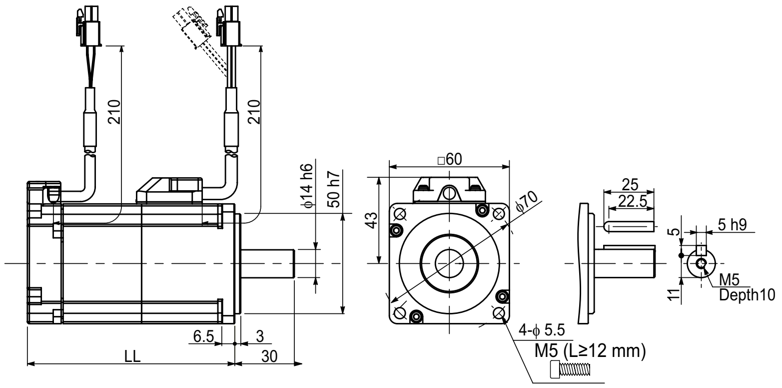




(mm)

Brake	Without	With
Motor Model	MW201P	MW201B
LL	67.9	104.4

1. Motor

400 W

Motor Model : MX401P2 □□** (Without brake)
MX401B2 □□** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	1.1
	With brake		1.6
Compatible amplifier model		–	DB62442
Voltage		V	AC200–240 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	71.8
	With brake		63.8
Mechanical time constant	Without brake	ms	0.45
	With brake		0.51
Electrical time constant		ms	2.92
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.23
	With brake		0.25

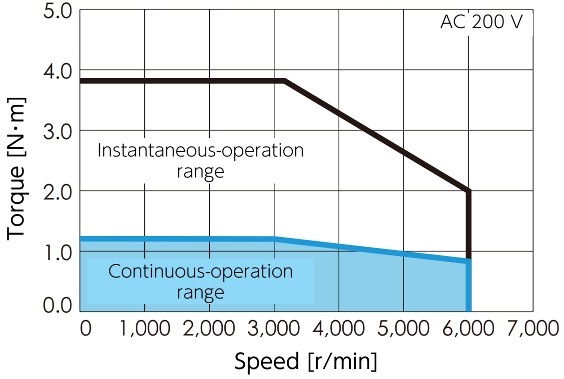
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	245
Thrust	N	98

Rotational Speed vs. Torque



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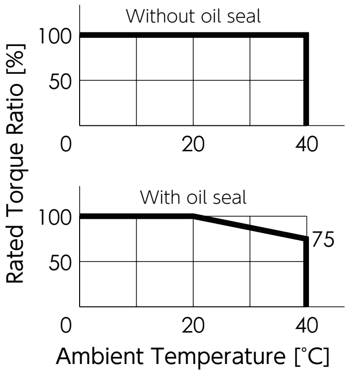
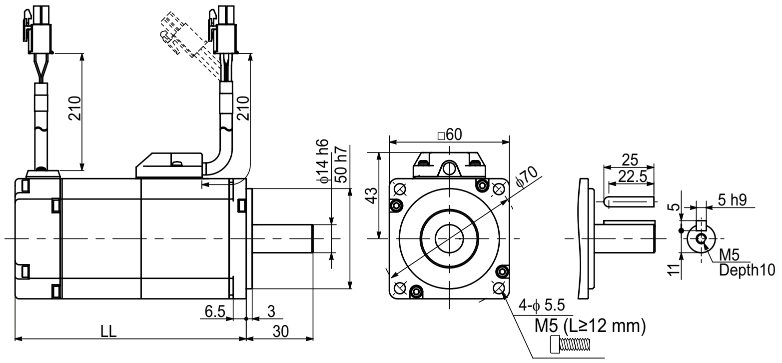




(mm)

Brake	Without	With
Motor Model	MX401P	MX401B
LL	93.5	130.0

1. Motor

Motor Model : MG401P2 □□** (Without brake)
MG401B2 □□** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	Middle
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	1.2
	With brake		1.6
Compatible amplifier model		–	DB62442
Voltage		V	AC200–240 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	33.7
	With brake		32.1
Mechanical time constant	Without brake	ms	0.96
	With brake		1.01
Electrical time constant		ms	2.92
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.48
	With brake		0.51

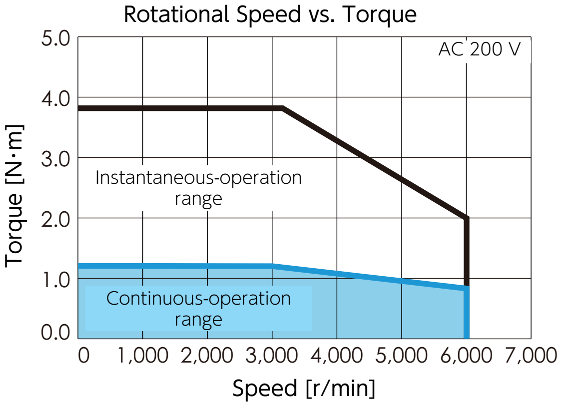
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.3
Static friction torque	N·m	≧ 1.27
Suction time	ms	≦ 50
Release time	ms	≦ 20
Release voltage	V	≧ DC1 V

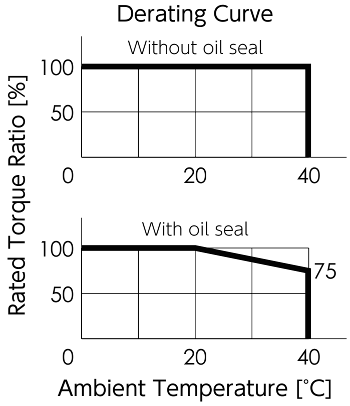
Permissible Load

Item	Unit	Specifications
Radial	N	245
Thrust	N	98

Rotational Speed vs. Torque

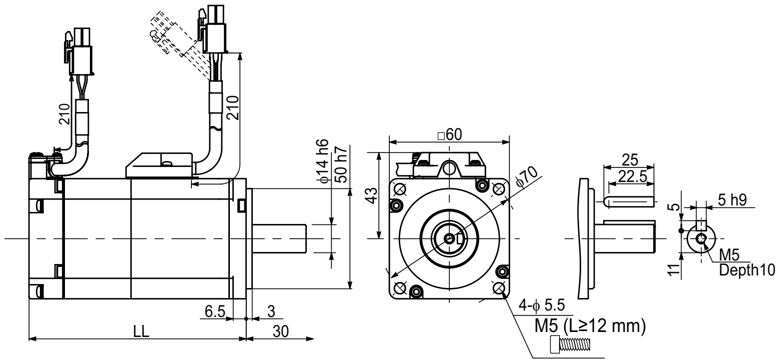


Derating Curve



(mm)

Brake	Without	With
Motor Model	MG401P	MG401B
L L	98.0	128.5



1. Motor

Motor Model : MW401P2 □□✻✻ (Without brake)
MW401B2 □□✻✻ (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	1.3
	With brake		1.8
Compatible amplifier model		–	DB62442
Voltage		V	AC200–240 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	23.2
	With brake		22.3
Mechanical time constant	Without brake	ms	1.40
	With brake		1.46
Electrical time constant		ms	2.92
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.70
	With brake		0.73

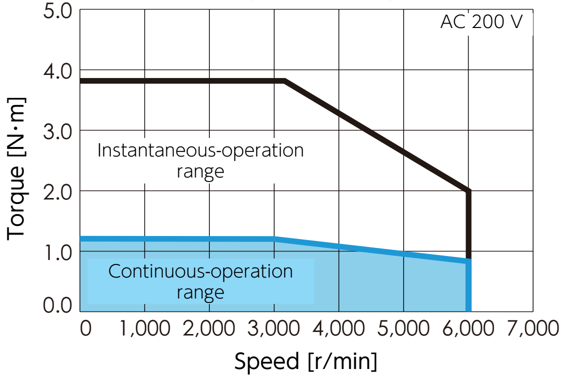
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	245
Thrust	N	98

Rotational Speed vs. Torque



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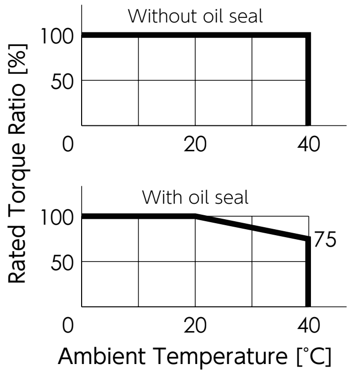
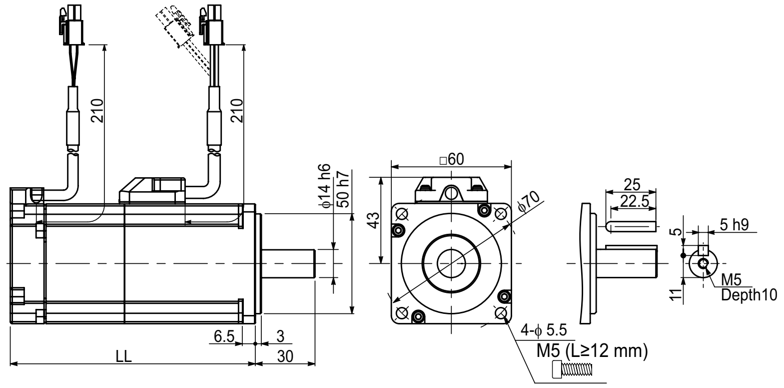




(mm)

Brake	Without	With
Motor Model	MW401P	MW401B
L L	86.9	123.4

1. Motor

750 W

Motor Model : MX751P2 ☐☐ ✻✻ (Without brake)
MX751B2 ☐☐ ✻✻ (With brake)

Basic Specifications

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		–	DB63842
Voltage		V	AC200–240 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	77.5
	With brake		61.3
Mechanical time constant	Without brake	ms	0.39
	With brake		0.50
Electrical time constant		ms	4.63
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.74
	With brake		0.93

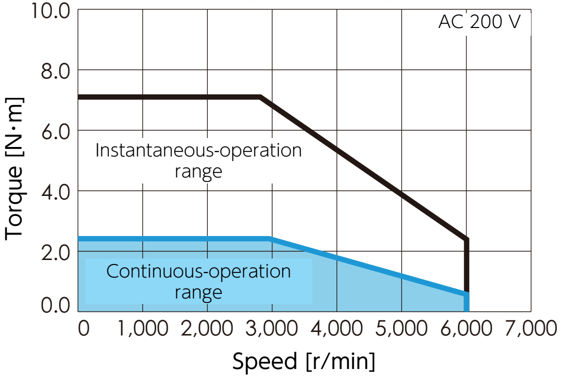
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	392
Thrust	N	147

Rotational Speed vs. Torque



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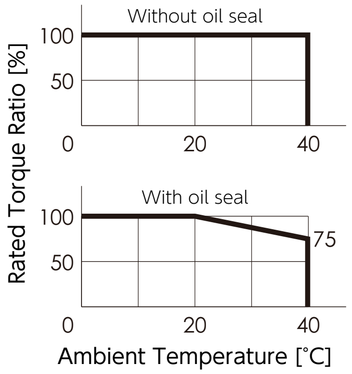
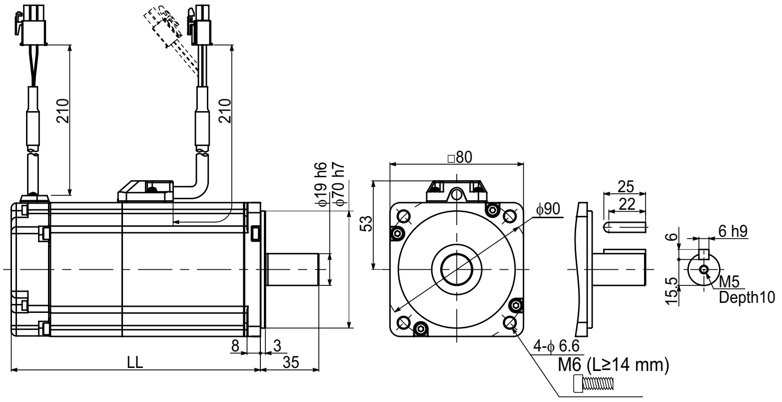




(mm)

Brake	Without	With
Motor Model	MX751P	MX751B
LL	107.3	144.3

1. Motor

Motor Model : MW751P2□□** (Without brake)
MW751B2□□** (With brake)

Basic Specifications

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		–	DB63842
Voltage		V	AC200–240 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	35.5
	With brake		31.7
Mechanical time constant	Without brake	ms	0.85
	With brake		0.96
Electrical time constant		ms	4.63
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	1.60
	With brake		1.80

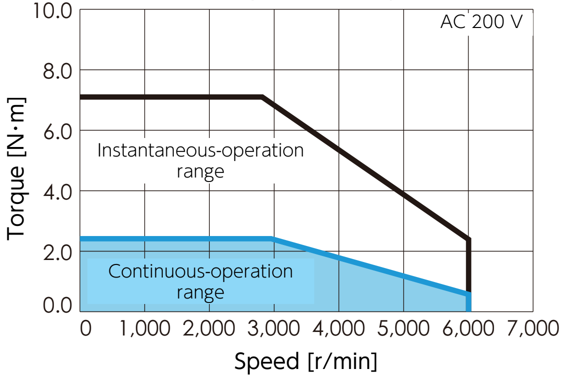
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	392
Thrust	N	147

Rotational Speed vs. Torque



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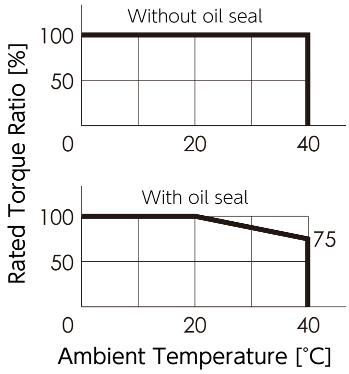
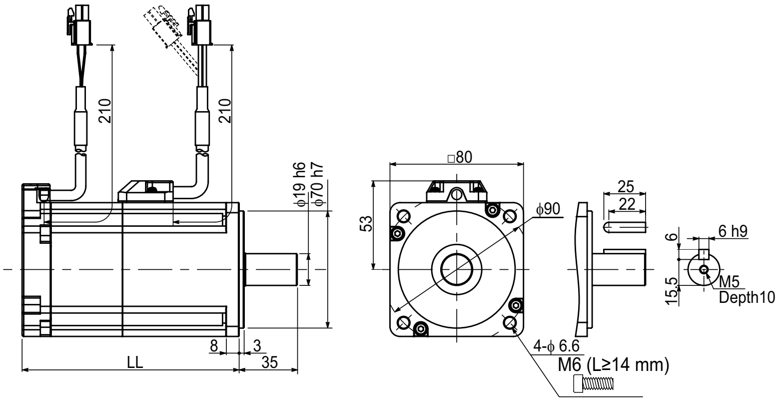




(mm)

Brake	Without	With
Motor Model	MW751P	MW751B
L L	93.8	130.8

1. Motor

850 W

Motor Model : MJ851P2 □□** (Without brake)
MJ851B2 □□** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	130 sq.
Approximate mass	Without brake	kg	6.2
	With brake		7.9
Compatible amplifier model		–	DB65B42
Voltage		V	AC200–240 V
Rated output		W	850
Rated torque		N·m	5.39
Instantaneous maximum torque		N·m	14.2
Rated current (stall current)		A	6.9
Instantaneous maximum current		A	17.0
Rated revolving speed		r/min	1,500
Maximum revolving speed		r/min	3,000
Torque constant		N·m/A	0.83
Induced voltage constant per phase		mV/(r/min)	28.9
Rated power rate	Without brake	kW/s	21.1
	With brake		18.3
Mechanical time constant	Without brake	ms	2.70
	With brake		3.12
Electrical time constant		ms	8.45
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	13.9
	With brake		16.0

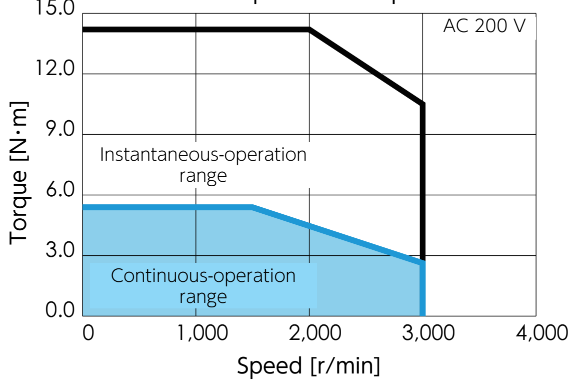
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.41
Static friction torque	N·m	≧ 12.7
Suction time	ms	≦ 100
Release time	ms	≦ 60
Release voltage	V	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	98

Rotational Speed vs. Torque



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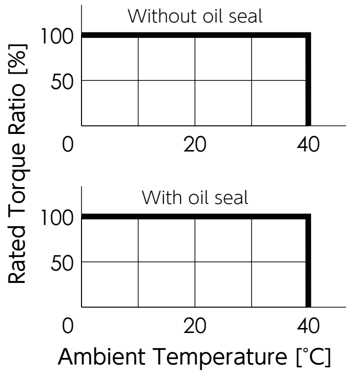
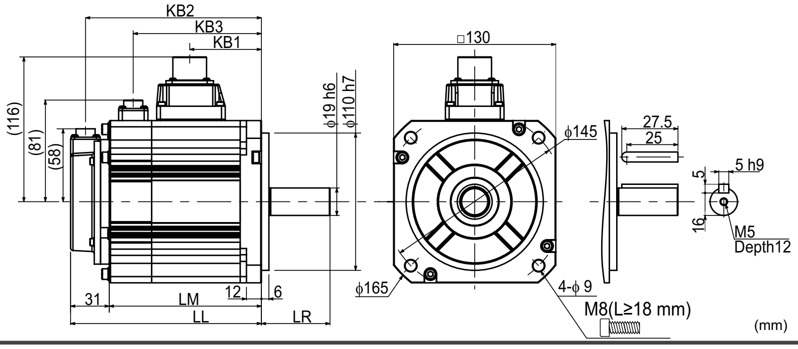


(mm)

Brake	Without	With
Motor Model	MJ851P	MJ851B
LL	128.0	162.0
LM	97.0	131.0
LR	58.0	
KB1	70.0	
KB2	116.0	150.0
KB3	–	109.0



1. Motor

1 kW

Motor Model : MX951P2 □□ ** (Without brake)
MX951B2 □□ ** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	80 sq.
Approximate mass	Without brake	kg	2.8
	With brake		3.6
Compatible amplifier model		–	DB64A42
Voltage		V	AC200–240 V
Rated output		W	1,000
Rated torque		N·m	3.18
Instantaneous maximum torque		N·m	9.55
Rated current (stall current)		A	5.2
Instantaneous maximum current		A	15.2
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.66
Induced voltage constant per phase		mV/(r/min)	22.9
Rated power rate	Without brake	kW/s	91.4
	With brake		79.0
Mechanical time constant	Without brake	ms	0.34
	With brake		0.39
Electrical time constant		ms	4.00
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	1.11
	With brake		1.28

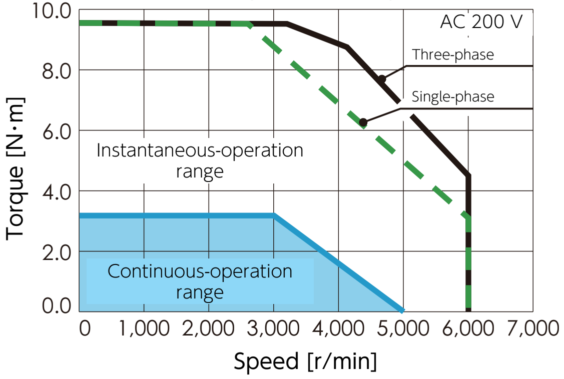
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.47
Static friction torque	N·m	≧ 3.18
Suction time	ms	≦ 70
Release time	ms	≦ 20
Release voltage	V	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	392
Thrust	N	147

Rotational Speed vs. Torque



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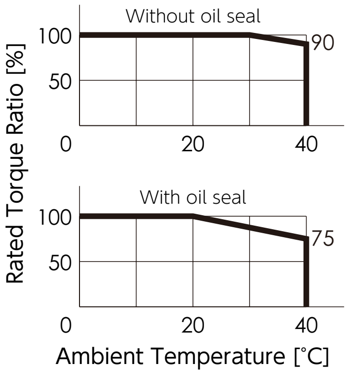
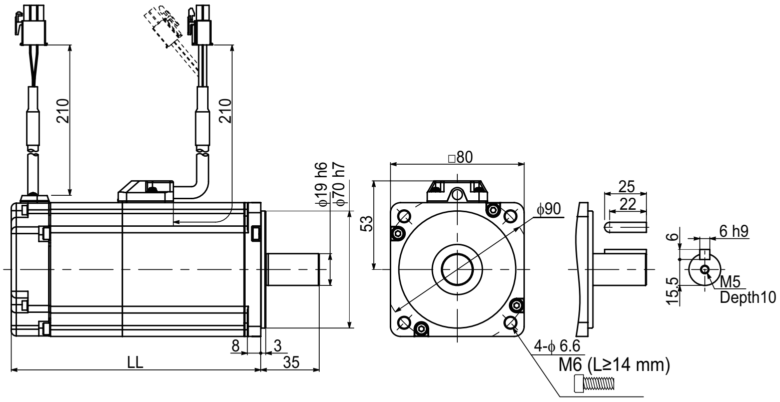




(mm)

Brake	Without	With
Motor Model	MX951P	MX951B
LL	127.3	164.3

1. Specifications

1. Motor

Motor Model : MX102P2 □□** (Without brake)
MX102B2 □□** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	100 sq.
Approximate mass	Without brake	kg	3.9
	With brake		5.2
Compatible amplifier model		–	DB64A42
Voltage		V	AC200–240 V
Rated output		W	1,000
Rated torque		N·m	3.18
Instantaneous maximum torque		N·m	9.55
Rated current (stall current)		A	6.1
Instantaneous maximum current		A	19.9
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	5,000
Torque constant		N·m/A	0.52
Induced voltage constant per phase		mV/(r/min)	18.2
Rated power rate	Without brake	kW/s	52.3
	With brake		43.2
Mechanical time constant	Without brake	ms	0.59
	With brake		0.72
Electrical time constant		ms	5.19
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	1.94
	With brake		2.35

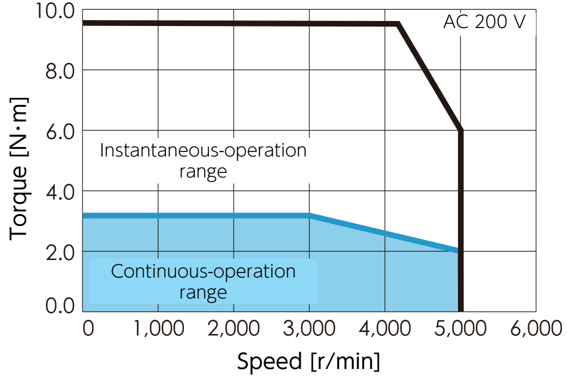
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	1.0
Static friction torque	N·m	≧ 8.0
Suction time	ms	≦ 120
Release time	ms	≦ 30
Release voltage	V	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque



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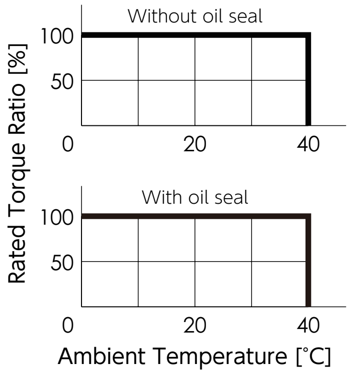
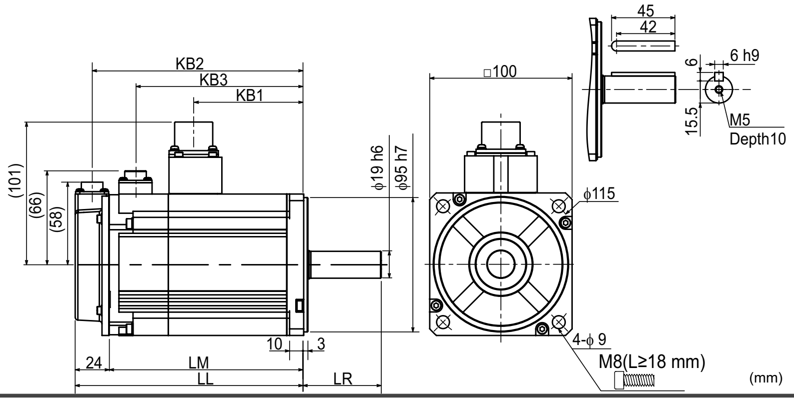




(mm)

Brake	Without	With
Motor Model	MX102P	MX102B
LL	132.0	162.0
LM	108.0	138.0
LR	55.0	
KB1	78.0	
KB2	120.0	150.0
KB3	–	119.3

1. Motor

Motor Model : MM102P2 □□** (Without brake)
MM102B2 □□** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	130 sq.
Approximate mass	Without brake	kg	5.6
	With brake		7.0
Compatible amplifier model		–	DB64A42
Voltage		V	AC200–240 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	50.2
	With brake		36.6
Mechanical time constant	Without brake	ms	0.77
	With brake		1.05
Electrical time constant		ms	10.8
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	4.54
	With brake		6.23

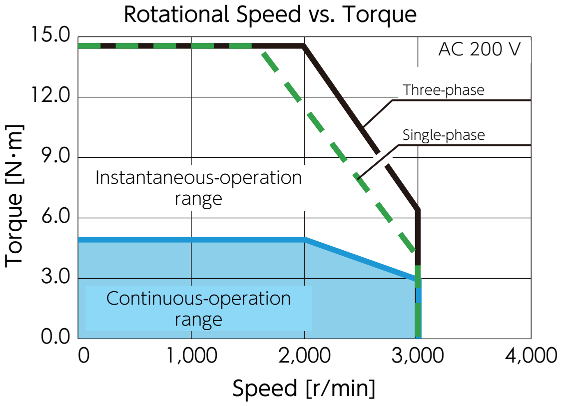
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque



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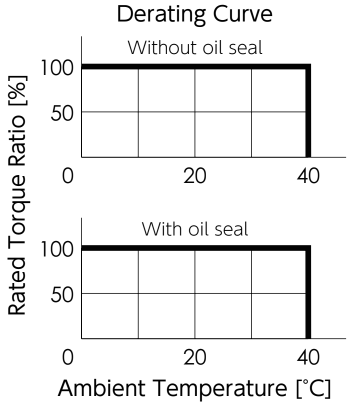
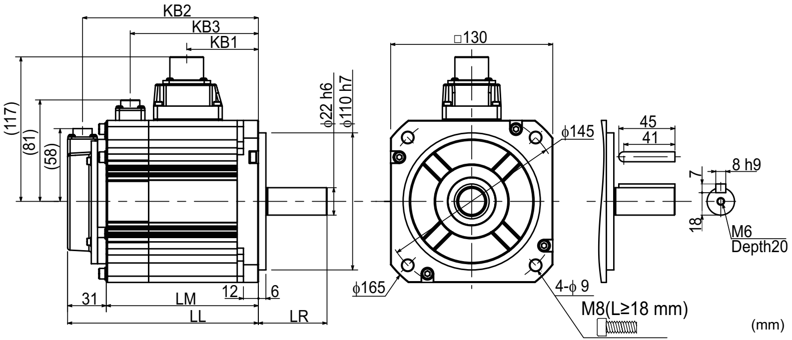


(mm)

Brake	Without	With
Motor Model	MM102P	MM102B
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. Specifications

1. Motor

Motor Model : MH102P2 □□** (Without brake)
MH102B2 □□** (With brake)

Basic Specifications

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		–	DB64A42
Voltage		V	AC200–240 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	4.20
	With brake		4.45
Electrical time constant		ms	10.8
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	24.9
	With brake		26.4

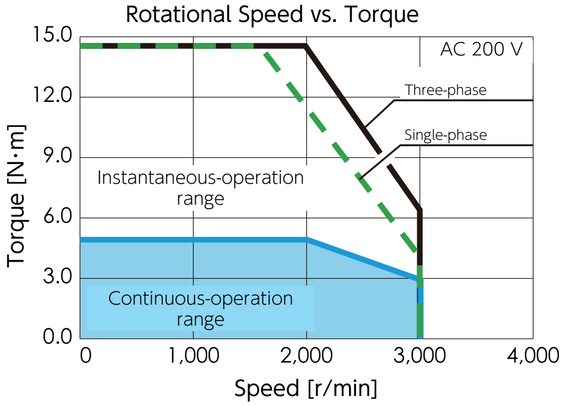
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque



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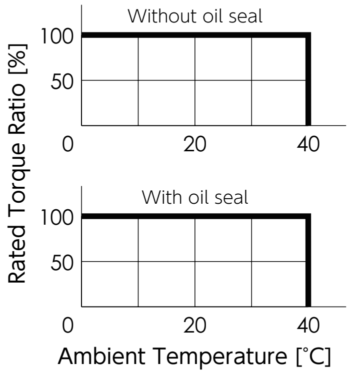
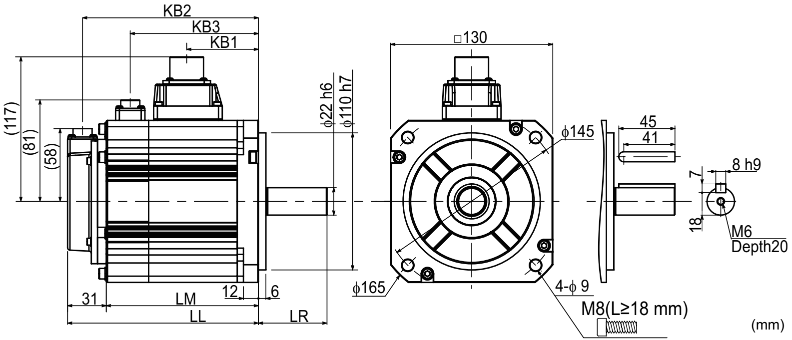




(mm)

Brake	Without	With
Motor Model	MH102P	MH102B
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. Motor

1.3 kW

Motor Model : MJ132P2□□** (Without brake)
MJ132B2□□** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	130 sq.
Approximate mass	Without brake	kg	7.7
	With brake		9.8
Compatible amplifier model		–	DB67C42
Voltage		V	AC200–240 V
Rated output		W	1,300
Rated torque		N·m	8.34
Instantaneous maximum torque		N·m	23.3
Rated current (stall current)		A	10.7
Instantaneous maximum current		A	28.0
Rated revolving speed		r/min	1,500
Maximum revolving speed		r/min	3,000
Torque constant		N·m/A	0.85
Induced voltage constant per phase		mV/(r/min)	29.8
Rated power rate	Without brake	kW/s	34.7
	With brake		31.3
Mechanical time constant	Without brake	ms	2.12
	With brake		2.34
Electrical time constant		ms	8.42
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	19.8
	With brake		21.9

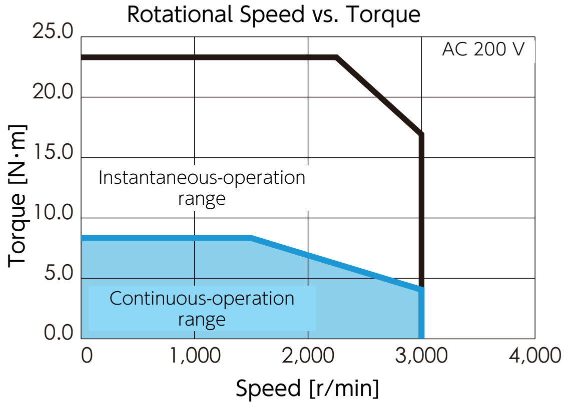
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.41
Static friction torque	N·m	≧ 19.6
Suction time	ms	≦ 100
Release time	ms	≦ 60
Release voltage	V	≧ DC1 V

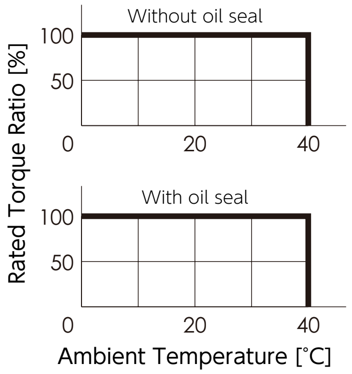
Permissible Load

Item	Unit	Specifications
Radial	N	686
Thrust	N	343

Rotational Speed vs. Torque

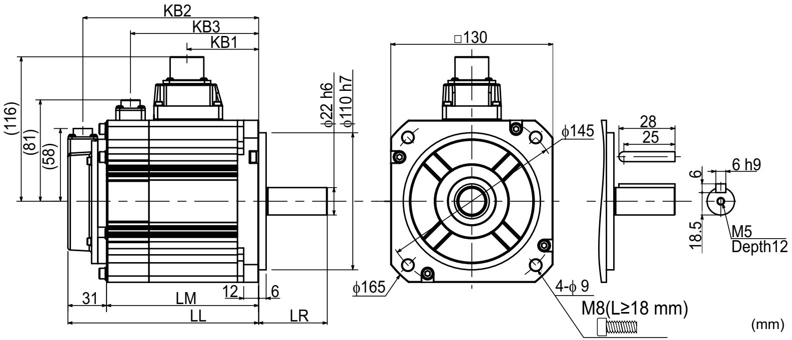


Derating Curve



(mm)

Brake	Without	With
Motor Model	MJ132P	MJ132B
LL	145.5	179.5
LM	114.5	148.5
LR	58.0	
KB1	87.5	
KB2	133.5	167.5
KB3	–	126.0



1.5 kW

Motor Model : MX152P2 □□ ** (Without brake)
MX152B2 □□ ** (With brake)

Basic Specifications

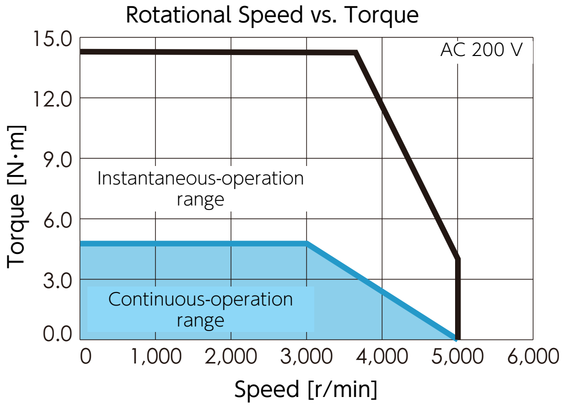
Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	100 sq.
Approximate mass	Without brake	kg	4.9
	With brake		6.2
Compatible amplifier model		–	DB66B42
Voltage		V	AC200–240 V
Rated output		W	1,500
Rated torque		N·m	4.77
Instantaneous maximum torque		N·m	14.3
Rated current (stall current)		A	8.0
Instantaneous maximum current		A	24.9
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	5,000
Torque constant		N·m/A	0.64
Induced voltage constant per phase		mV/(r/min)	22.3
Rated power rate	Without brake	kW/s	81.4
	With brake		70.2
Mechanical time constant	Without brake	ms	0.50
	With brake		0.57
Electrical time constant		ms	5.95
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	2.80
	With brake		3.25

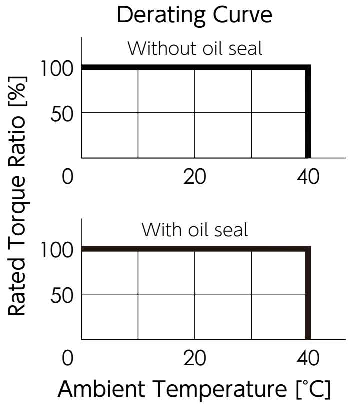
Brake Specifications

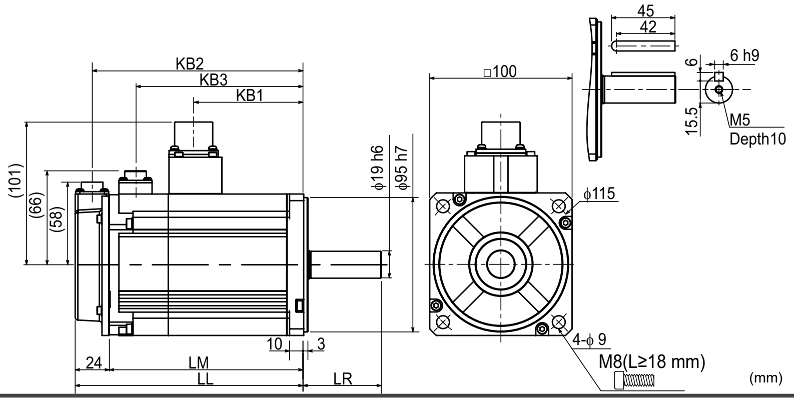
Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	1.0
Static friction torque	N·m	≧ 8.0
Suction time	ms	≦ 120
Release time	ms	≦ 30
Release voltage	V	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	196







(mm)

Brake	Without	With
Motor Model	MX152P	MX152B
LL	151.0	181.0
LM	127.0	157.0
LR	55.0	
KB1	97.0	
KB2	139.0	169.0
KB3	-	138.3

1. Motor

Motor Model : MM152P2 □□ ＊＊ (Without brake)
MM152B2 □□ ＊＊ (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	130 sq.
Approximate mass	Without brake	kg	7.0
	With brake		8.4
Compatible amplifier model		–	DB66B42
Voltage		V	AC200–240 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	77.1
	With brake		61.5
Mechanical time constant	Without brake	ms	0.60
	With brake		0.76
Electrical time constant		ms	11.9
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	6.65
	With brake		8.34

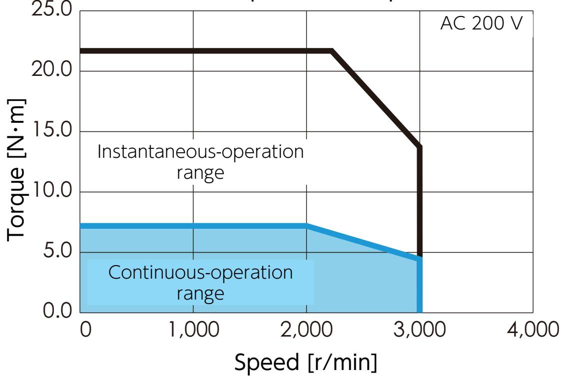
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

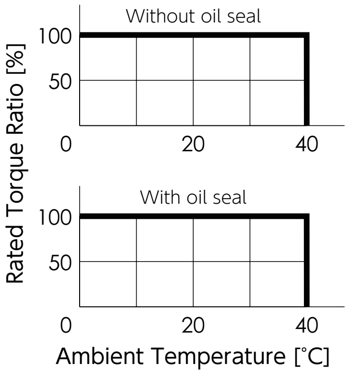
Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque

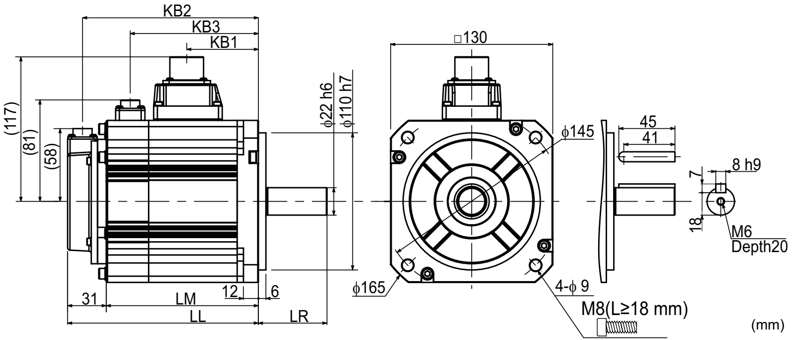


Derating Curve



(mm)

Brake	Without	With
Motor Model	MM152P	MM152B
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. Specifications

1. Motor

Motor Model : MH152P2 □□** (Without brake)
MH152B2 □□** (With brake)

Basic Specifications

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		–	DB66B42
Voltage		V	AC200–240 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	3.36
	With brake		3.50
Electrical time constant		ms	11.9
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	37.1
	With brake		38.6

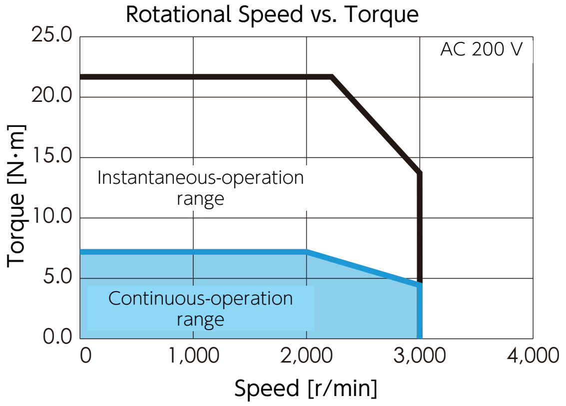
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

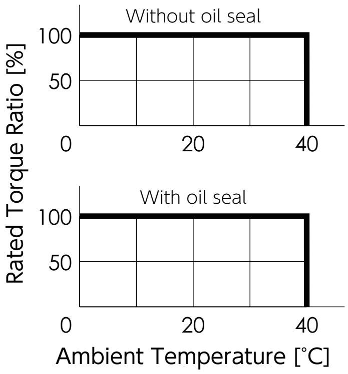
Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque

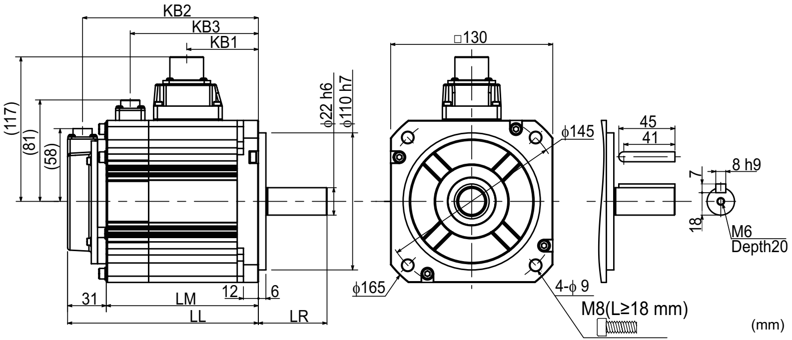


Derating Curve



(mm)

Brake	Without	With
Motor Model	MH152P	MH152B
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 : MX202P2 □□** (Without brake)
MX202B2 □□** (With brake)

Basic Specifications

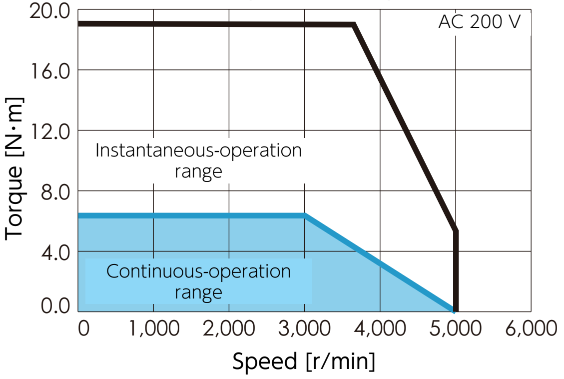
Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	100 sq.
Approximate mass	Without brake	kg	6.0
	With brake		7.3
Compatible amplifier model		–	DB68C42
Voltage		V	AC200–240 V
Rated output		W	2,000
Rated torque		N·m	6.37
Instantaneous maximum torque		N·m	19.1
Rated current (stall current)		A	10.6
Instantaneous maximum current		A	33.9
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	5,000
Torque constant		N·m/A	0.62
Induced voltage constant per phase		mV/(r/min)	21.7
Rated power rate	Without brake	kW/s	110.3
	With brake		99.2
Mechanical time constant	Without brake	ms	0.50
	With brake		0.56
Electrical time constant		ms	5.44
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	3.68
	With brake		4.09

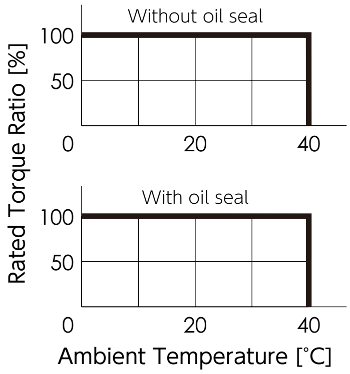
Brake Specifications

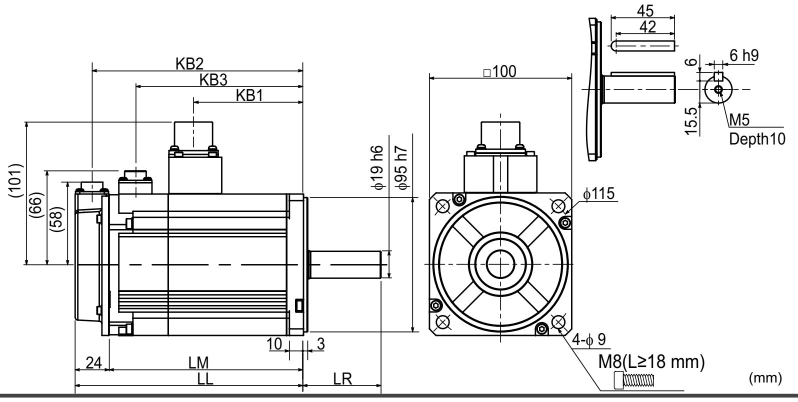
Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	1.0
Static friction torque	N·m	≧ 8.0
Suction time	ms	≦ 120
Release time	ms	≦ 30
Release voltage	V	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	196


Rotational Speed vs. Torque


Derating Curve



(mm)

Brake	Without	With
Motor Model	MX202P	MX202B
LL	170.0	200.0
LM	146.0	176.0
LR	55.0	
KB1	116.0	
KB2	158.0	188.0
KB3	-	157.3

1. Motor

Motor Model : MM202P2 □□** (Without brake)
MM202B2 □□** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	130 sq.
Approximate mass	Without brake	kg	8.4
	With brake		9.8
Compatible amplifier model		–	DB68C42
Voltage		V	AC200–240 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	105.0
	With brake		88.0
Mechanical time constant	Without brake	ms	0.58
	With brake		0.69
Electrical time constant		ms	11.9
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	8.68
	With brake		10.4

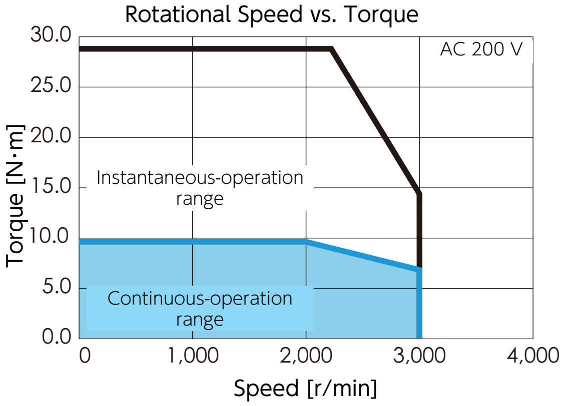
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

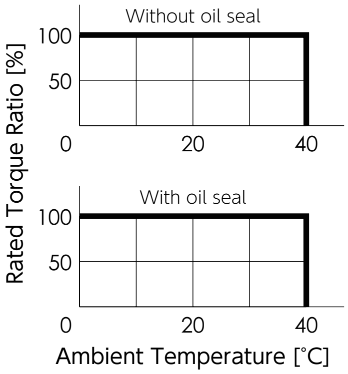
Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque

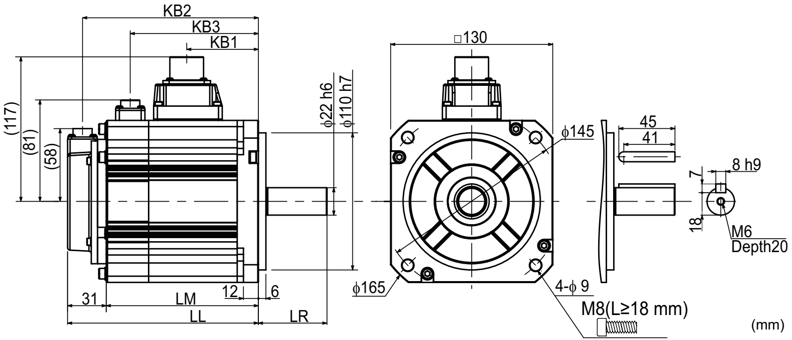


Derating Curve



(mm)

Brake	Without	With
Motor Model	MM202P	MM202B
LL	163.0	188.0
LM	132.0	157.0
LR	55.0	
KB1	92.5	
KB2	151.0	176.0
KB3	–	137.8



1. Motor

50 W

Motor Model : MY500N2□□** (Without brake)
MY500A2□□** (With brake)

Basic Specifications

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		–	DB6YZ42
Voltage		V	AC200–240 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	$\times10^{-4}$ kg·m^2	0.039
	With brake		0.047

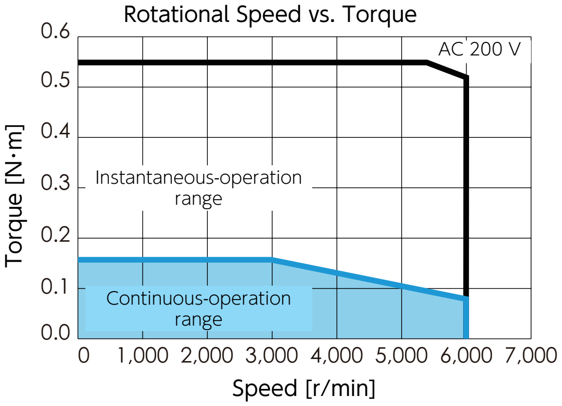
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.28
Static friction torque	N·m	≧ 0.16
Suction time	ms	≦ 35
Release time	ms	≦ 20
Release voltage	V	≧ DC1 V

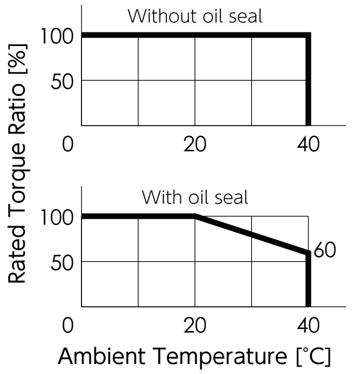
Permissible Load

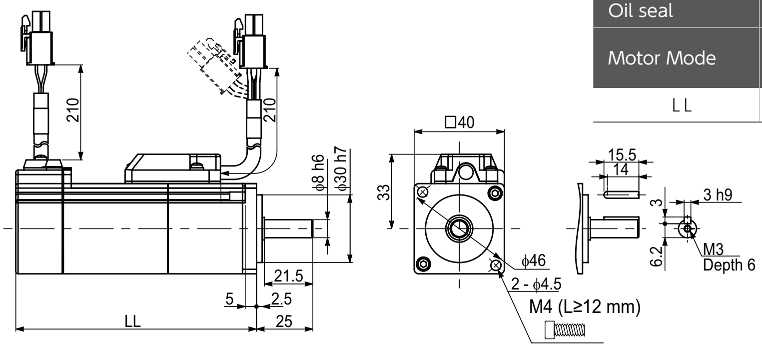
Item	Unit	Specifications
Radial	N	68
Thrust	N	58

Rotational Speed vs. Torque



Derating Curve





(mm)

Brake	Without		With	
Oil seal	Without	With	Without	With
Motor Mode	MY500N2S MY500N2K	MY500N2T MY500N2L	MY500A2S MY500A2K	MY500A2T MY500A2L
LL	66.4	72.0	106.8	112.4

1. Motor

Motor Model : MG500N2 □□✱✱ (Without brake)
MG500A2 □□✱✱ (With brake)

Basic Specifications

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		–	DB6YZ42
Voltage		V	AC200–240 V
Rated output		W	50
Rated torque		N·m	0.16
Instantaneous maximum torque		N·m	0.56
Rated current (stall current)		A	0.71
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)	8.7
Rated power rate	Without brake	kW/s	6.6
	With brake		5.4
Mechanical time constant	Without brake	ms	2.08
	With brake		2.51
Electrical time constant		ms	0.65
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	0.039
	With brake		0.047

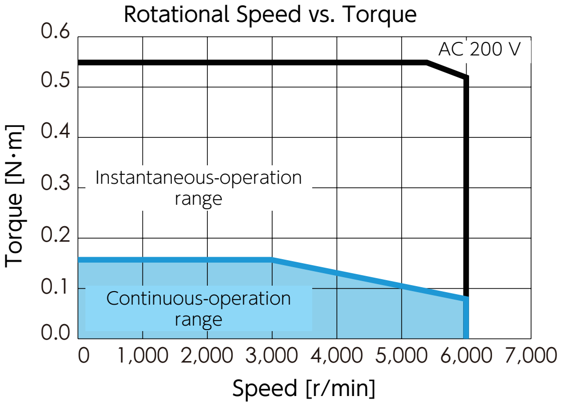
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.26
Static friction torque	N·m	≧ 0.16
Suction time	ms	≦ 35
Release time	ms	≦ 20
Release voltage	V	≧ DC1 V

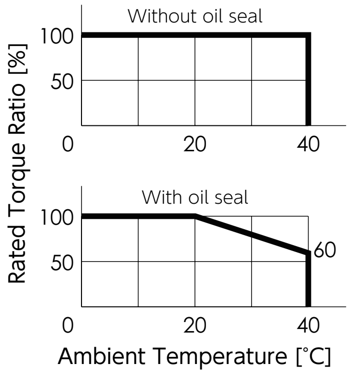
Permissible Load

Item	Unit	Specifications
Radial	N	68
Thrust	N	58

Rotational Speed vs. Torque

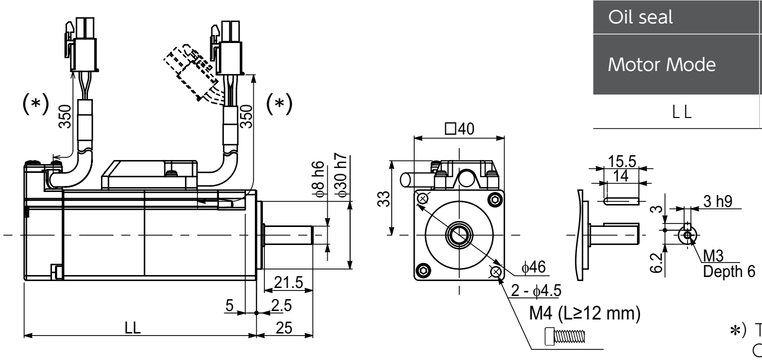


Derating Curve



(mm)

Brake	Without		With	
Oil seal	Without	With	Without	With
Motor Mode	MG500N2S MG500N2K	MG500N2T MG500N2L	MG500A2S MG500A2K	MG500A2T MG500A2L
L L	57.1	64.7	89.5	97.1



∗) The standard cable length is 350 mm.
Cable length 210mm is also available.

1. Motor

100 W

Motor Model : MY101N2 □□** (Without brake)
MY101A2 □□** (With brake)

Basic Specifications

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		–	DB6Z142
Voltage		V	AC200–240 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

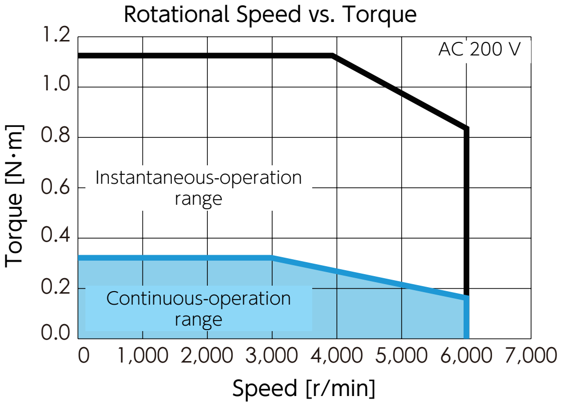
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.28
Static friction torque	N·m	≧ 0.32
Suction time	ms	≦ 35
Release time	ms	≦ 20
Release voltage	V	≧ DC1 V

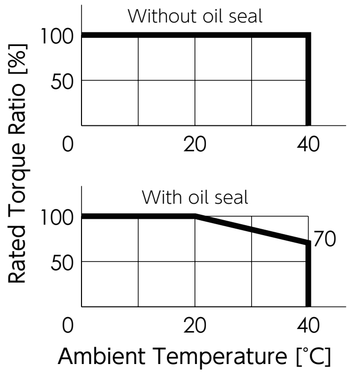
Permissible Load

Item	Unit	Specifications
Radial	N	68
Thrust	N	58

Rotational Speed vs. Torque

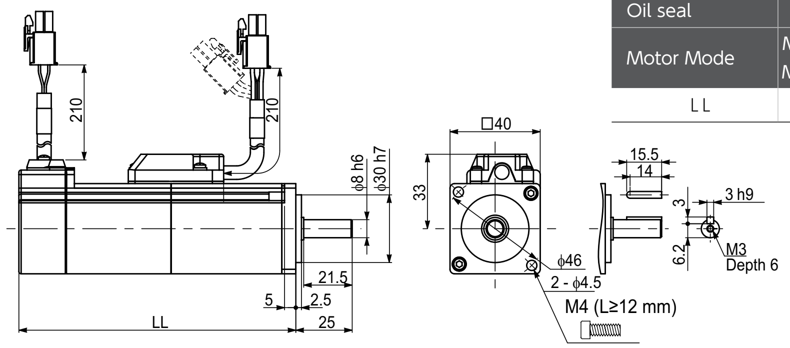


Derating Curve



(mm)

Brake	Without		With	
Oil seal	Without	With	Without	With
Motor Mode	MY101N2S MY101N2K	MY101N2T MY101N2L	MY101A2S MY101A2K	MY101A2T MY101A2L
L L	82.4	88.0	122.8	128.4



1. Specifications

1. Motor

Motor Model : MG101N2 □□** (Without brake)
MG101A2 □□** (With brake)

Basic Specifications

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		–	DB6Z142
Voltage		V	AC200–240 V
Rated output		W	100
Rated torque		N·m	0.32
Instantaneous maximum torque		N·m	1.12
Rated current (stall current)		A	0.99
Instantaneous maximum current		A	3.4
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.36
Induced voltage constant per phase		mV/(r/min)	12.7
Rated power rate	Without brake	kW/s	15.8
	With brake		14.1
Mechanical time constant	Without brake	ms	1.23
	With brake		1.38
Electrical time constant		ms	0.78
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.064
	With brake		0.072

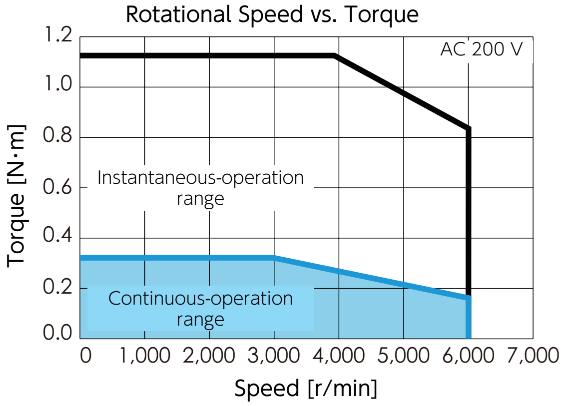
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.26
Static friction torque	N·m	≧ 0.32
Suction time	ms	≦ 35
Release time	ms	≦ 20
Release voltage	V	≧ DC1 V

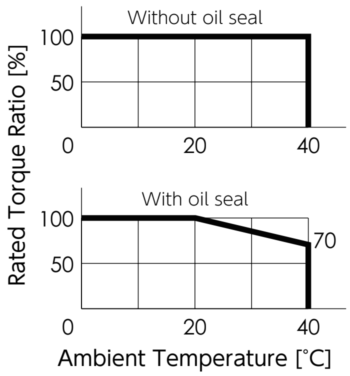
Permissible Load

Item	Unit	Specifications
Radial	N	68
Thrust	N	58

Rotational Speed vs. Torque

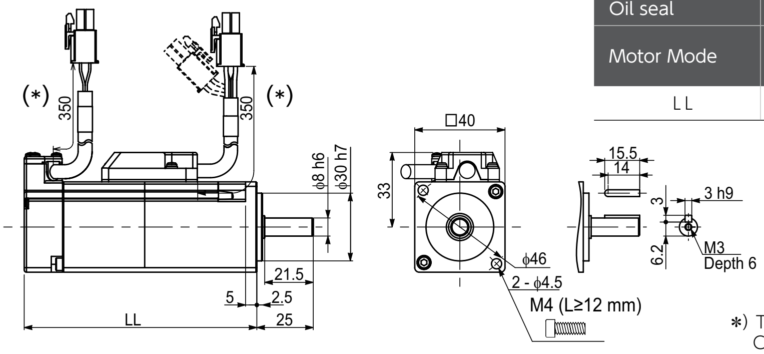


Derating Curve



(mm)

Brake	Without		With	
Oil seal	Without	With	Without	With
Motor Mode	MG101N2S MG101N2K	MG101N2T MG101N2L	MG101A2S MG101A2K	MG101A2T MG101A2L
L L	70.7	78.3	103.1	110.7



*) The standard cable length is 350 mm.
Cable length 210mm is also available.

1. Motor

200 W

Motor Model : MX201N2 □□** (Without brake)
MX201A2 □□** (With brake)

Basic Specifications

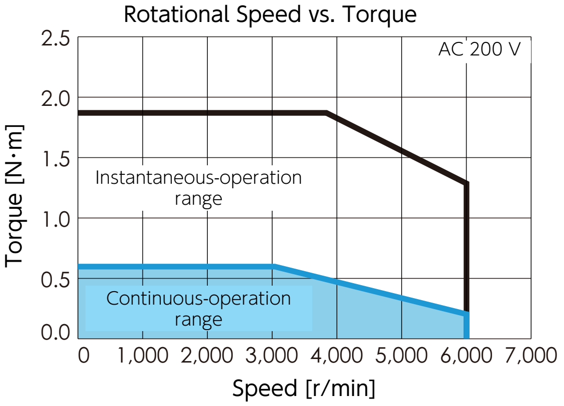
Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	0.8
	With brake		1.3
Compatible amplifier model		–	DB61242
Voltage		V	AC200–240 V
Rated output		W	200
Rated torque		N·m	0.64
Instantaneous maximum torque		N·m	1.91
Rated current (stall current)		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	$\times10^{-4}$ kg·m^2	0.14
	With brake		0.17

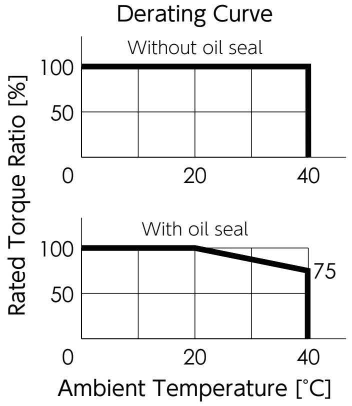
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

Permissible Load

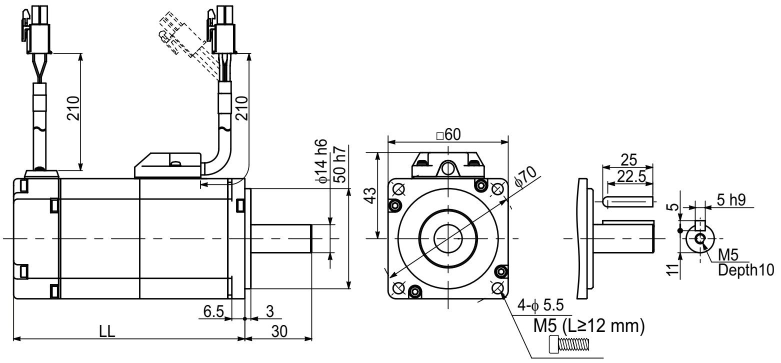
Item	Unit	Specifications
Radial	N	245
Thrust	N	98


Rotational Speed vs. Torque


Derating Curve

(mm)

Brake	Without	With
Motor Model	MX201N	MX201A
LL	76.5	113.0



1. Specifications

1. Motor

Motor Model : MG201N2 □□** (Without brake)
MG201A2 □□** (With brake)

Basic Specifications

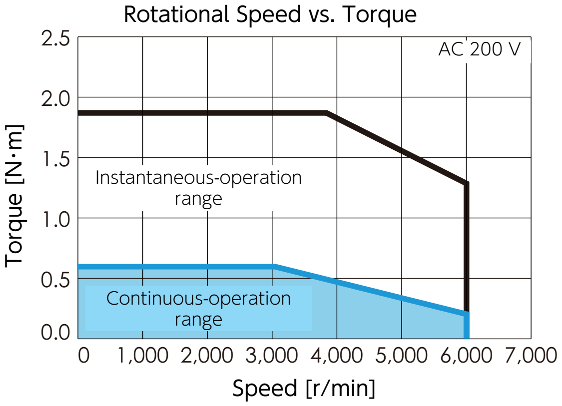
Item		Unit	Specifications
Rotor inertia		–	Middle
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	0.9
	With brake		1.3
Compatible amplifier model		–	DB61242
Voltage		V	AC200–240 V
Rated output		W	200
Rated torque		N·m	0.64
Instantaneous maximum torque		N·m	1.91
Rated current (stall current)		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	15.9
	With brake		14.5
Mechanical time constant	Without brake	ms	1.28
	With brake		1.41
Electrical time constant		ms	2.53
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.26
	With brake		0.28

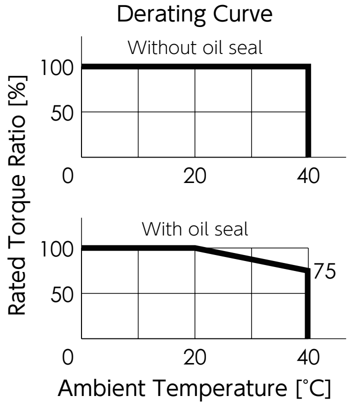
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.3
Static friction torque	N·m	≧ 1.27
Suction time	ms	≦ 50
Release time	ms	≦ 20
Release voltage	V	≧ DC1 V

Permissible Load

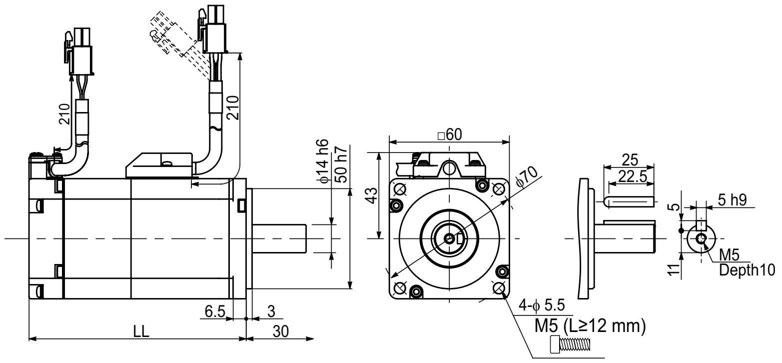
Item	Unit	Specifications
Radial	N	245
Thrust	N	98


Rotational Speed vs. Torque


Derating Curve

(mm)

Brake	Without	With
Motor Model	MG201N	MG201A
LL	78.0	108.5



1. Motor

Motor Model : MW201N2 □□** (Without brake) MW201A2 □□** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	0.8
	With brake		1.2
Compatible amplifier model		–	DB61242
Voltage		V	AC200–240 V
Rated output		W	200
Rated torque		N·m	0.64
Instantaneous maximum torque		N·m	1.91
Rated current (stall current)		A	1.8
Instantaneous maximum current		A	5.4
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.40
Induced voltage constant per phase		mV/(r/min)	14.0
Rated power rate	Without brake	kW/s	11.0
	With brake		10.2
Mechanical time constant	Without brake	ms	2.29
	With brake		2.48
Electrical time constant		ms	1.01
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	0.37
	With brake		0.40

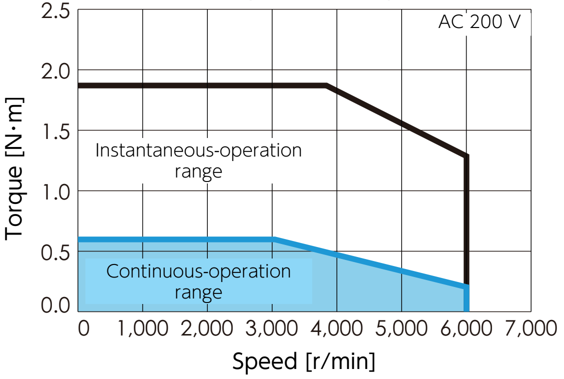
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

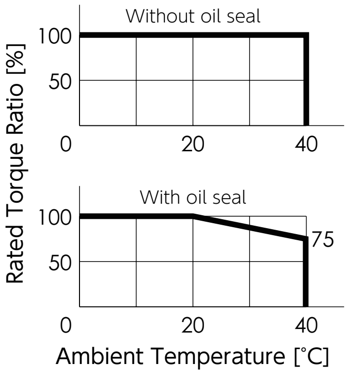
Permissible Load

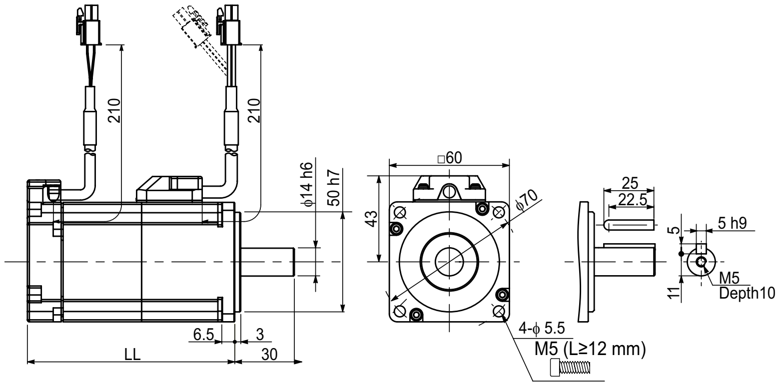
Item	Unit	Specifications
Radial	N	245
Thrust	N	98

Rotational Speed vs. Torque



Derating Curve





(mm)

Brake	Without	With
Motor Model	MW201N	MW201A
L L	67.9	104.4

1. Motor

400 W

Motor Model : MX401N2 □□✽✽ (Without brake)
MX401A2 □□✽✽ (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	1.1
	With brake		1.6
Compatible amplifier model		–	DB62442
Voltage		V	AC200–240 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

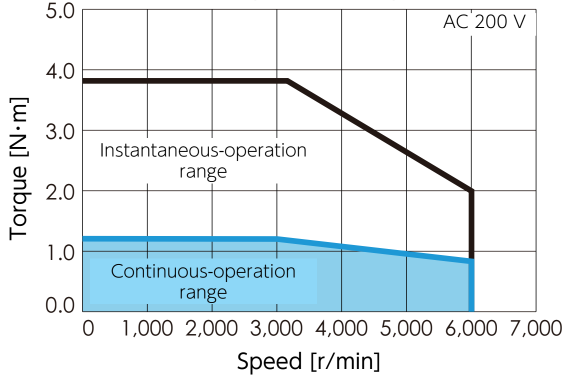
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

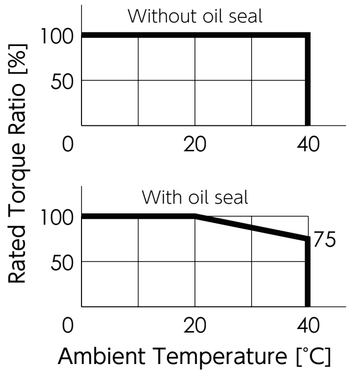
Permissible Load

Item	Unit	Specifications
Radial	N	245
Thrust	N	98

Rotational Speed vs. Torque

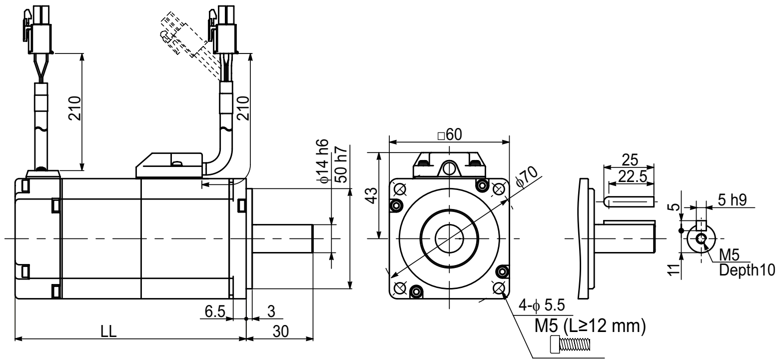


Derating Curve



(mm)

Brake	Without	With
Motor Model	MX401N	MX401A
LL	93.5	130.0



1. Motor

Motor Model : MG401N2 □□** (Without brake)
MG401A2 □□** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	Middle
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	1.2
	With brake		1.6
Compatible amplifier model		–	DB62442
Voltage		V	AC200–240 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	33.7
	With brake		32.1
Mechanical time constant	Without brake	ms	0.96
	With brake		1.01
Electrical time constant		ms	2.92
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.48
	With brake		0.51

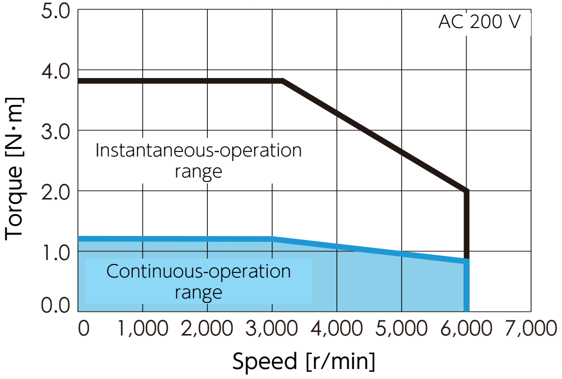
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.3
Static friction torque	N·m	≧ 1.27
Suction time	ms	≦ 50
Release time	ms	≦ 20
Release voltage	V	≧ DC1 V

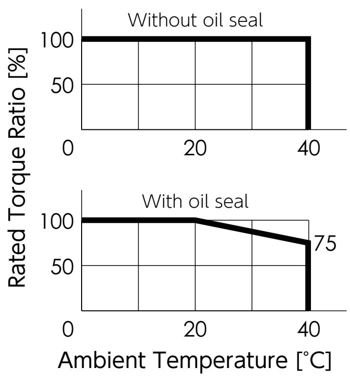
Permissible Load

Item	Unit	Specifications
Radial	N	245
Thrust	N	98

Rotational Speed vs. Torque

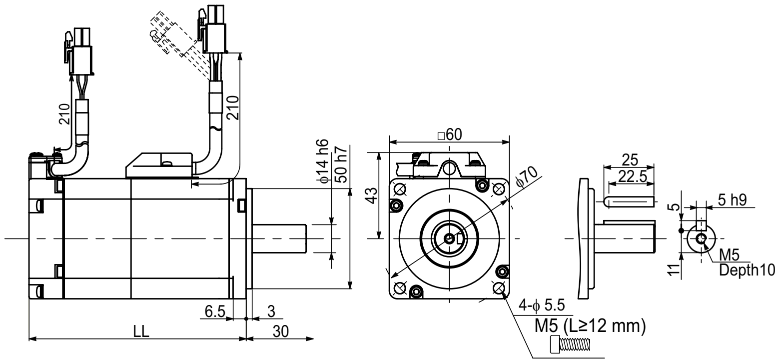


Derating Curve



(mm)

Brake	Without	With
Motor Model	MG401N	MG401A
LL	98.0	128.5



1. Motor

Motor Model : MW401N2□□** (Without brake) MW401A2□□** (With brake)

Basic Specifications

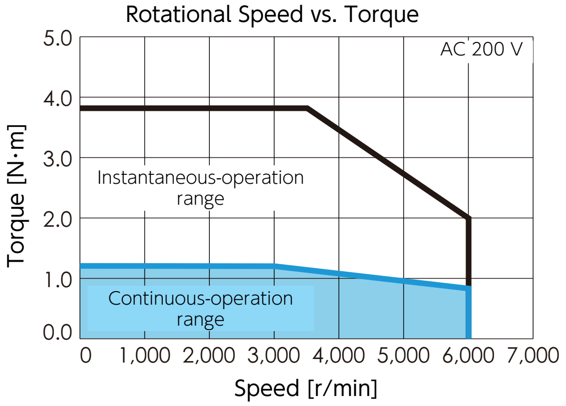
Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	60 sq.
Approximate mass	Without brake	kg	1.2
	With brake		1.6
Compatible amplifier model		–	DB62442
Voltage		V	AC200–240 V
Rated output		W	400
Rated torque		N·m	1.27
Instantaneous maximum torque		N·m	3.82
Rated current (stall current)		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	0.51
Induced voltage constant per phase		mV/(r/min)	17.9
Rated power rate	Without brake	kW/s	23.1
	With brake		22.2
Mechanical time constant	Without brake	ms	1.48
	With brake		1.54
Electrical time constant		ms	0.98
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	0.70
	With brake		0.73

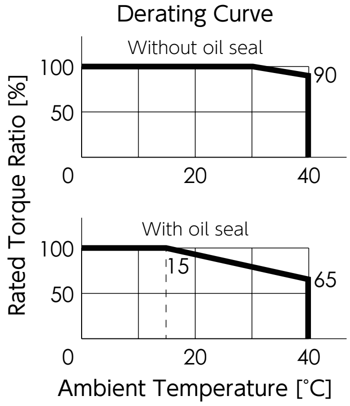
Brake Specifications

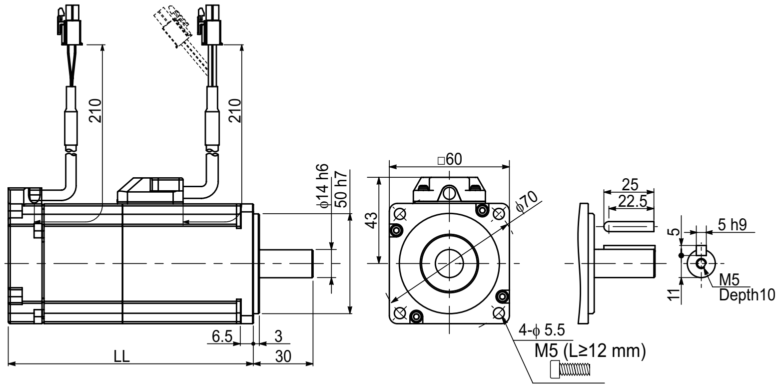
Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.3
Static friction torque	N·m	≧ 1.27
Suction time	ms	≦ 50
Release time	ms	≦ 15
Release voltage	V	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	245
Thrust	N	98







(mm)

Brake	Without	With
Motor Model	MW401N	MW401A
LL	86.9	123.4

1. Motor

750 W

Motor Model : MX751N2 □□** (Without brake)
MX751A2 □□** (With brake)

Basic Specifications

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		–	DB63842
Voltage		V	AC200–240 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	4.20
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	0.74
	With brake		0.94

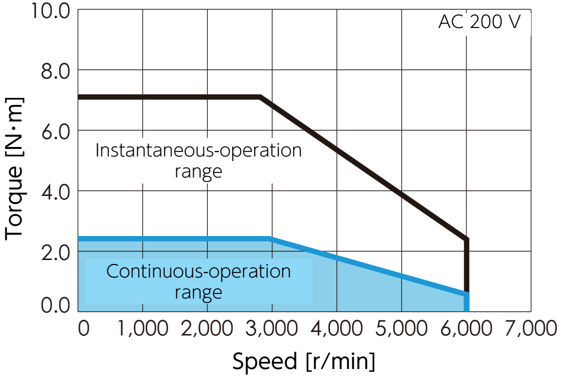
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

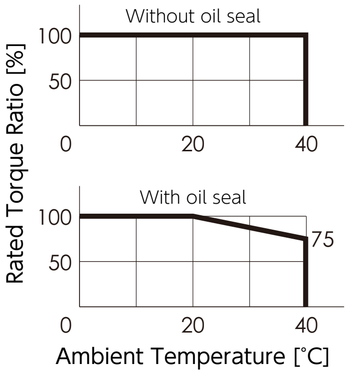
Permissible Load

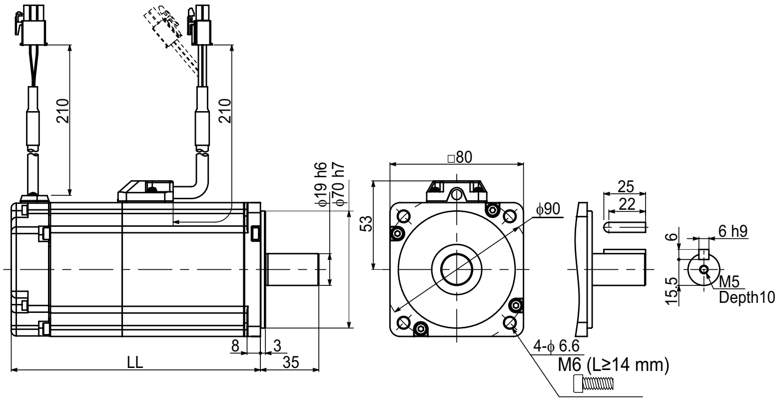
Item	Unit	Specifications
Radial	N	392
Thrust	N	147

Rotational Speed vs. Torque



Derating Curve





(mm)

Brake	Without	With
Motor Model	MX751N	MX751A
LL	107.3	144.3

1. Motor

Motor Model : MW751N2 □□** (Without brake)
MW751A2 □□** (With brake)

Basic Specifications

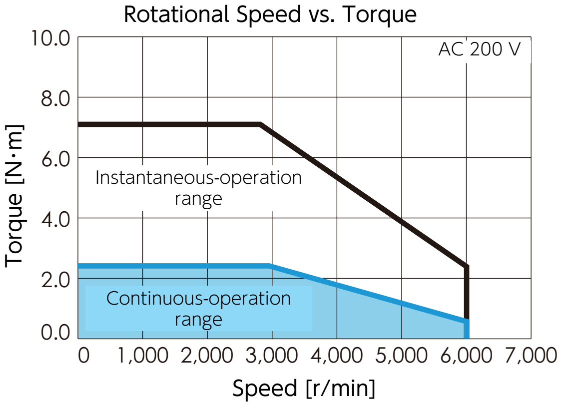
Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	80 sq.
Approximate mass	Without brake	kg	2.1
	With brake		2.9
Compatible amplifier model		–	DB63842
Voltage		V	AC200–240 V
Rated output		W	750
Rated torque		N·m	2.39
Instantaneous maximum torque		N·m	7.1
Rated current (stall current)		A	4.2
Instantaneous maximum current		A	12.6
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.64
Induced voltage constant per phase		mV/(r/min)	22.3
Rated power rate	Without brake	kW/s	35.6
	With brake		34.3
Mechanical time constant	Without brake	ms	0.93
	With brake		0.96
Electrical time constant		ms	4.20
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	1.60
	With brake		1.66

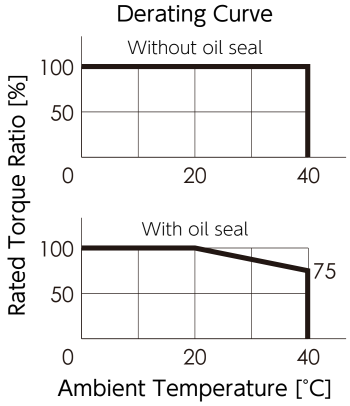
Brake Specifications

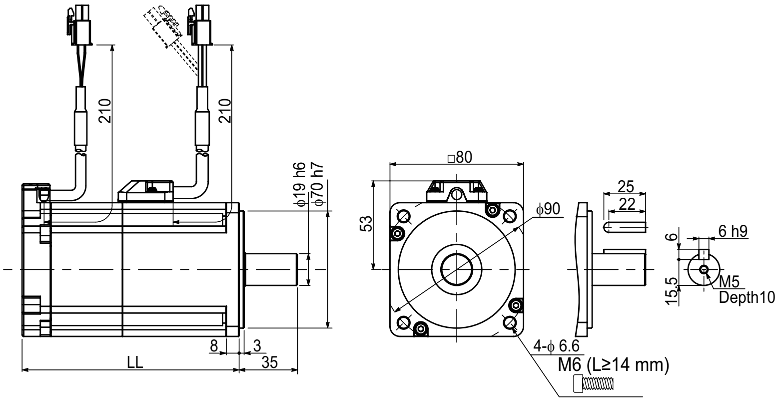
Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.4
Static friction torque	N·m	≧ 2.39
Suction time	ms	≦ 70
Release time	ms	≦ 20
Release voltage	V	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	392
Thrust	N	147







(mm)

Brake	Without	With
Motor Model	MW751N	MW751A
LL	93.8	130.8

1. Motor

850 W

Motor Model : MJ851N2 □□** (Without brake)
MJ851A2 □□** (With brake)

Basic Specifications

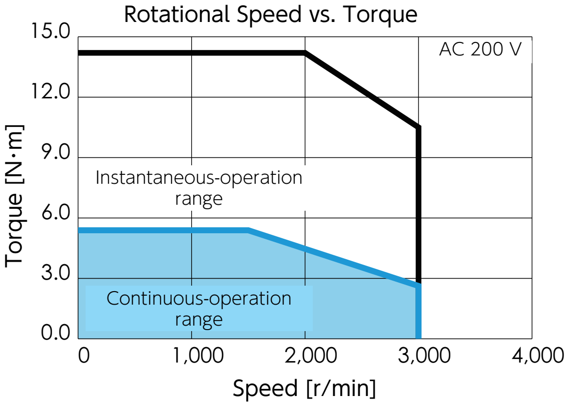
Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	130 sq.
Approximate mass	Without brake	kg	6.2
	With brake		7.9
Compatible amplifier model		–	DB65B42
Voltage		V	AC200–240 V
Rated output		W	850
Rated torque		N·m	5.39
Instantaneous maximum torque		N·m	14.2
Rated current (stall current)		A	6.9
Instantaneous maximum current		A	17.0
Rated revolving speed		r/min	1,500
Maximum revolving speed		r/min	3,000
Torque constant		N·m/A	0.83
Induced voltage constant per phase		mV/(r/min)	28.9
Rated power rate	Without brake	kW/s	21.1
	With brake		18.3
Mechanical time constant	Without brake	ms	2.71
	With brake		3.12
Electrical time constant		ms	8.45
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	13.9
	With brake		16.0

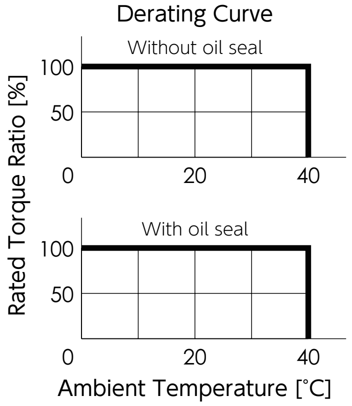
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.41
Static friction torque	N·m	≧ 12.7
Suction time	ms	≦ 100
Release time	ms	≦ 60
Release voltage	V	≧ DC1 V

Permissible Load

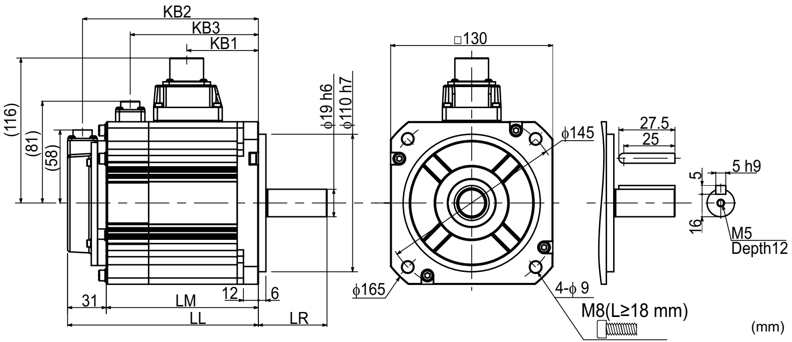
Item	Unit	Specifications
Radial	N	490
Thrust	N	98





(mm)

Brake	Without	With
Motor Model	MJ851N	MJ851A
LL	128.0	162.0
LM	97.0	131.0
LR	58.0	
KB1	70.0	
KB2	116.0	150.0
KB3	–	109.0



1. Motor

1 kW

Motor Model : MX951N2 □□** (Without brake)
MX951A2 □□** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	80 sq.
Approximate mass	Without brake	kg	2.8
	With brake		3.6
Compatible amplifier model		–	DB64A42
Voltage		V	AC200–240 V
Rated output		W	1,000
Rated torque		N·m	3.18
Instantaneous maximum torque		N·m	9.55
Rated current (stall current)		A	5.2
Instantaneous maximum current		A	15.2
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	6,000
Torque constant		N·m/A	0.66
Induced voltage constant per phase		mV/(r/min)	22.9
Rated power rate	Without brake	kW/s	90.8
	With brake		78.6
Mechanical time constant	Without brake	ms	0.34
	With brake		0.40
Electrical time constant		ms	3.95
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	1.12
	With brake		1.29

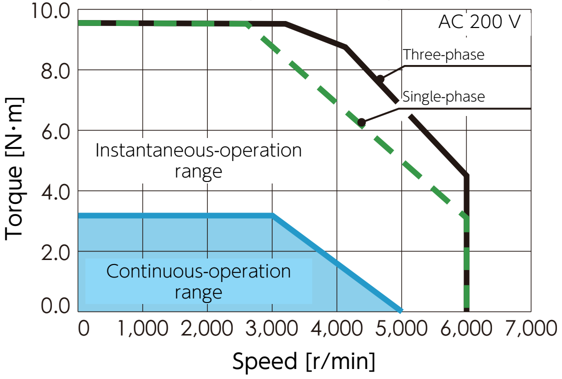
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.47
Static friction torque	N·m	≧ 3.18
Suction time	ms	≦ 70
Release time	ms	≦ 20
Release voltage	V	≧ DC1 V

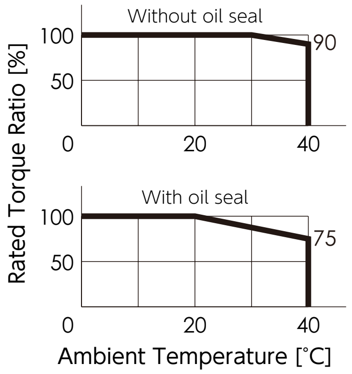
Permissible Load

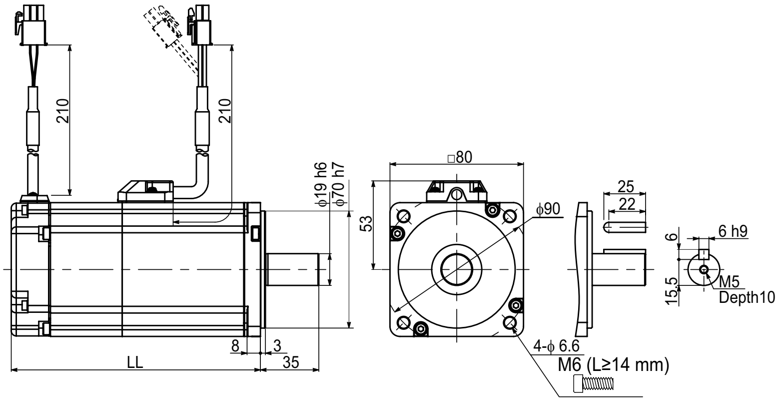
Item	Unit	Specifications
Radial	N	392
Thrust	N	147

Rotational Speed vs. Torque



Derating Curve





(mm)

Brake	Without	With
Motor Model	MX951N	MX951A
L L	127.3	164.3

1. Motor

Motor Model : MX102N2 □□** (Without brake)
MX102A2 □□** (With brake)

Basic Specifications

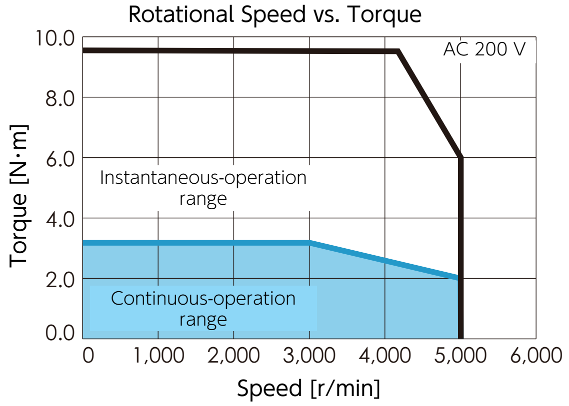
Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	100 sq.
Approximate mass	Without brake	kg	3.9
	With brake		5.2
Compatible amplifier model		–	DB64A42
Voltage		V	AC200–240 V
Rated output		W	1,000
Rated torque		N·m	3.18
Instantaneous maximum torque		N·m	9.55
Rated current (stall current)		A	6.8
Instantaneous maximum current		A	19.9
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	5,000
Torque constant		N·m/A	0.52
Induced voltage constant per phase		mV/(r/min)	18.2
Rated power rate	Without brake	kW/s	52.1
	With brake		43.0
Mechanical time constant	Without brake	ms	0.59
	With brake		0.72
Electrical time constant		ms	5.19
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	1.94
	With brake		2.35

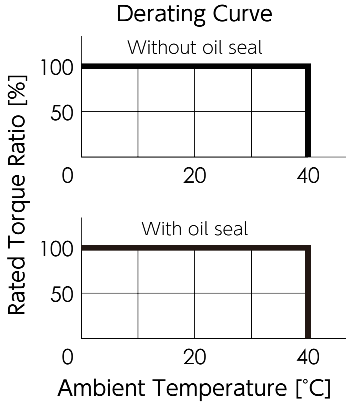
Brake Specifications

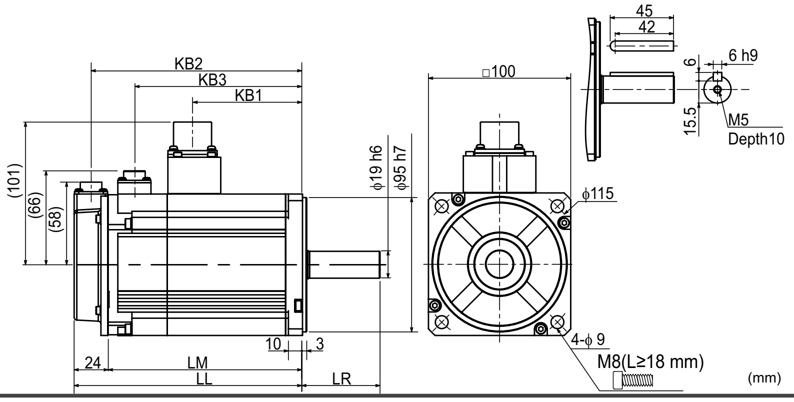
Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	1.0
Static friction torque	N·m	≧ 8.0
Suction time	ms	≦ 120
Release time	ms	≦ 30
Release voltage	V	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	196







(mm)

Brake	Without	With
Motor Model	MX102N	MX102A
LL	132.0	162.0
LM	108.0	138.0
LR	55.0	
KB1	78.0	
KB2	120.0	150.0
KB3	–	119.3

1. Motor

Motor Model : MM102N2 □□** (Without brake)
MM102A2 □□** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	130 sq.
Approximate mass	Without brake	kg	5.6
	With brake		7.0
Compatible amplifier model		–	DB64A42
Voltage		V	AC200–240 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	10.8
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	4.56
	With brake		6.24

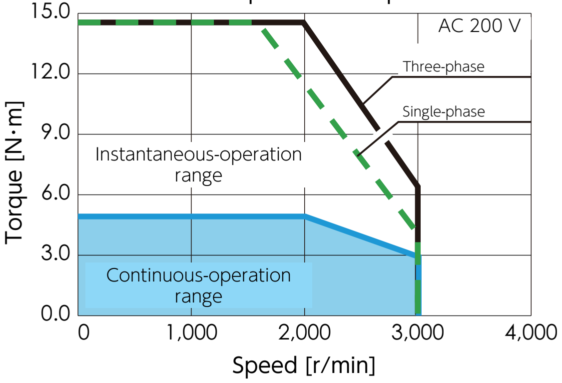
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

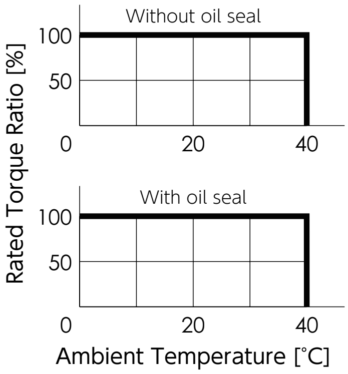
Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque

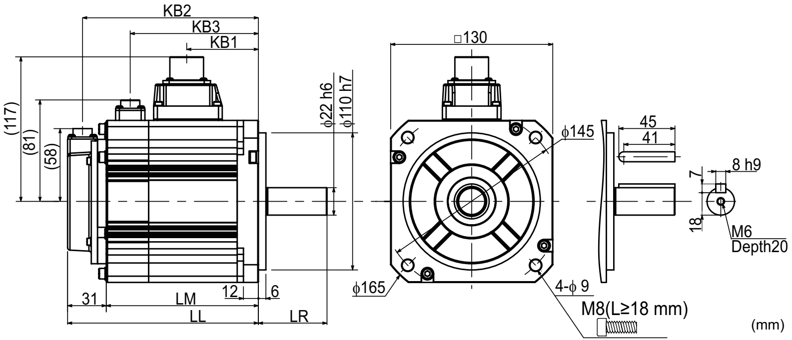


Derating Curve



(mm)

Brake	Without	With
Motor Model	MM102N	MM102A
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 : MH102N2 □□** (Without brake)
MH102A2 □□** (With brake)

Basic Specifications

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		–	DB64A42
Voltage		V	AC200–240 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	10.8
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	24.9
	With brake		26.4

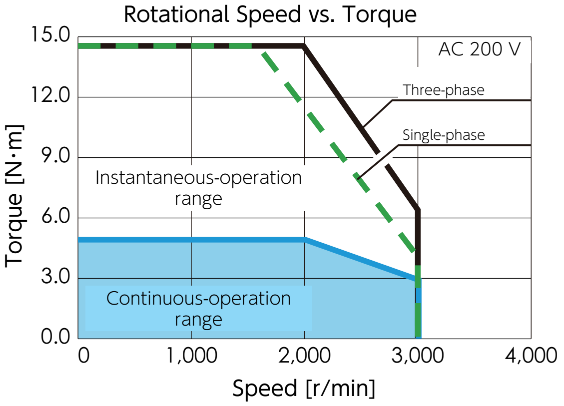
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque



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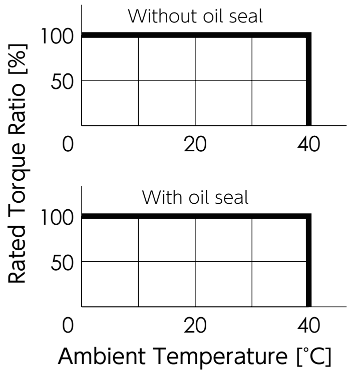
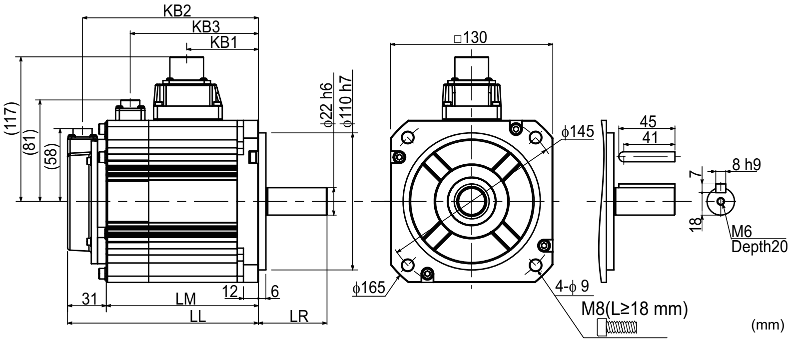


(mm)

Brake	Without	With
Motor Model	MH102N	MH102A
LL	163.0	188.0
LM	132.0	157.0
LR	70.0	
KB1	92.5	
KB2	151.0	176.0
KB3	–	137.8



1.3 kW

Motor Model : MJ132N2 □□** (Without brake)
MJ132A2 □□** (With brake)

1.3 kW | 17 bit ENCODER | 180 SQUARE | M | 30 15 | IP67

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	130 sq.
Approximate mass	Without brake	kg	7.7
	With brake		9.8
Compatible amplifier model		–	DB67C42
Voltage		V	AC200–240 V
Rated output		W	1,300
Rated torque		N·m	8.34
Instantaneous maximum torque		N·m	23.3
Rated current (stall current)		A	10.7
Instantaneous maximum current		A	28.0
Rated revolving speed		r/min	1,500
Maximum revolving speed		r/min	3,000
Torque constant		N·m/A	0.85
Induced voltage constant per phase		mV/(r/min)	29.8
Rated power rate	Without brake	kW/s	34.6
	With brake		31.3
Mechanical time constant	Without brake	ms	2.12
	With brake		2.34
Electrical time constant		ms	8.42
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	19.8
	With brake		21.9

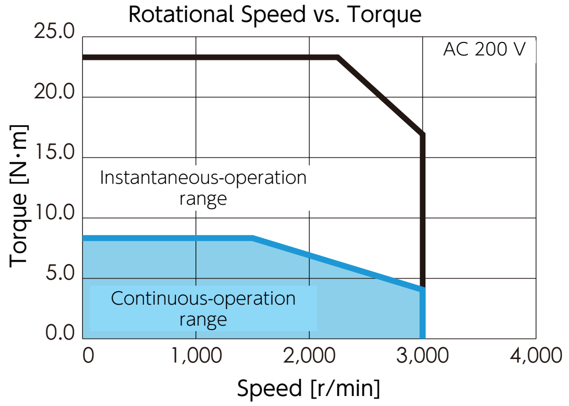
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	0.41
Static friction torque	N·m	≧ 19.6
Suction time	ms	≦ 100
Release time	ms	≦ 60
Release voltage	V	≧ DC1 V

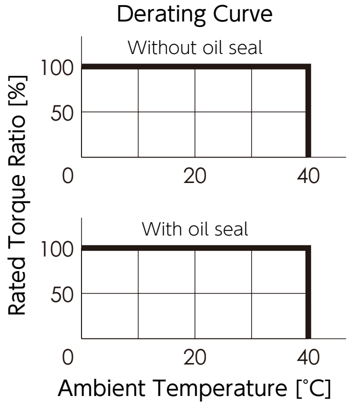
Permissible Load

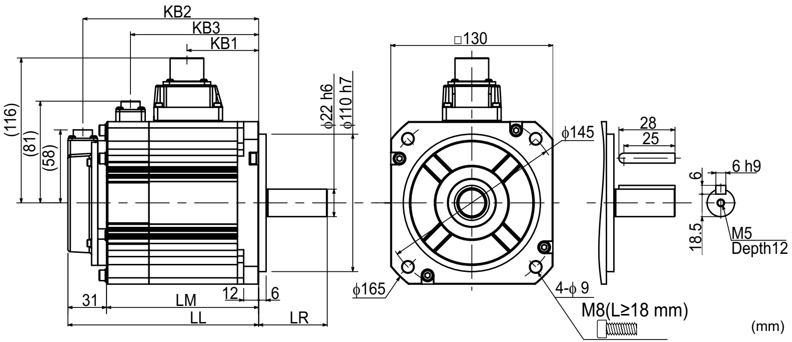
Item	Unit	Specifications
Radial	N	686
Thrust	N	343

Rotational Speed vs. Torque



Derating Curve





(mm)

Brake	Without	With
Motor Model	MJ132N	MJ132A
LL	145.5	179.5
LM	114.5	148.5
LR	58.0	
KB1	87.5	
KB2	133.5	167.5
KB3	–	126.0

1. Motor

1.5 kW

Motor Model : MX152N2 □□** (Without brake)
MX152A2 □□** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	100 sq.
Approximate mass	Without brake	kg	4.9
	With brake		6.2
Compatible amplifier model		–	DB66B42
Voltage		V	AC200–240 V
Rated output		W	1,500
Rated torque		N·m	4.77
Instantaneous maximum torque		N·m	14.3
Rated current (stall current)		A	7.6
Instantaneous maximum current		A	24.9
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	5,000
Torque constant		N·m/A	0.64
Induced voltage constant per phase		mV/(r/min)	22.3
Rated power rate	Without brake	kW/s	81.1
	With brake		70.1
Mechanical time constant	Without brake	ms	0.50
	With brake		0.58
Electrical time constant		ms	5.95
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	2.81
	With brake		3.25

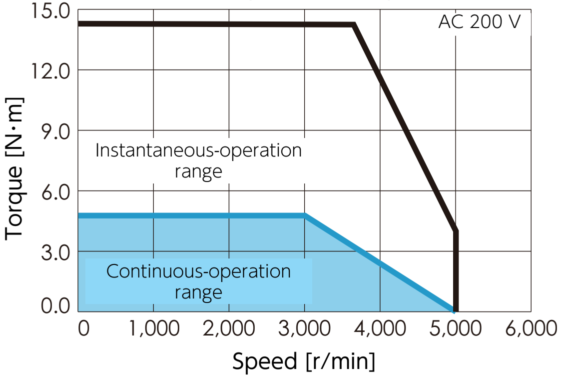
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	1.0
Static friction torque	N·m	≧ 8.0
Suction time	ms	≦ 120
Release time	ms	≦ 30
Release voltage	V	≧ DC1 V

Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque



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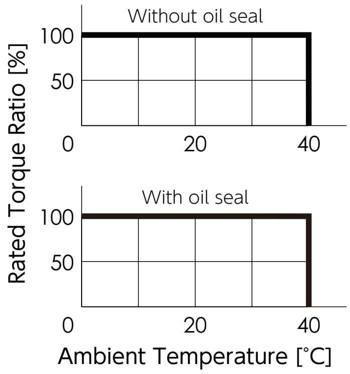
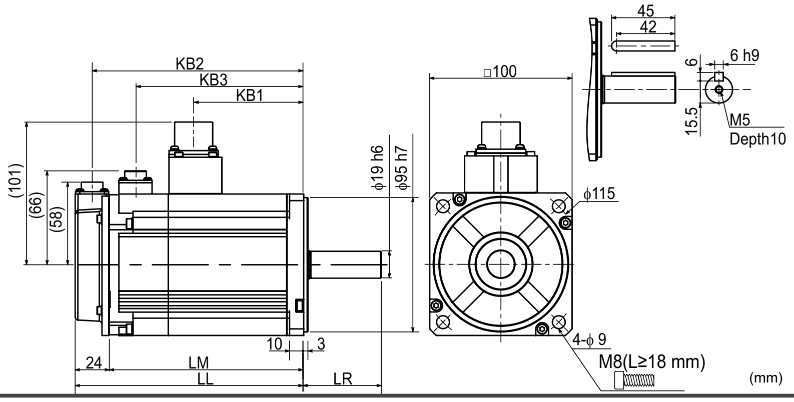




(mm)

Brake	Without	With
Motor Model	MX152N	MX152A
LL	151.0	181.0
LM	127.0	157.0
LR	55.0	
KB1	97.0	
KB2	139.0	169.0
KB3	–	138.3

1. Motor

Motor Model : MM152N2 □□** (Without brake)
MM152A2 □□** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	High
Fitting flange size		mm	130 sq.
Approximate mass	Without brake	kg	7.0
	With brake		8.4
Compatible amplifier model		–	DB66B42
Voltage		V	AC200–240 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	11.9
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	6.67
	With brake		8.35

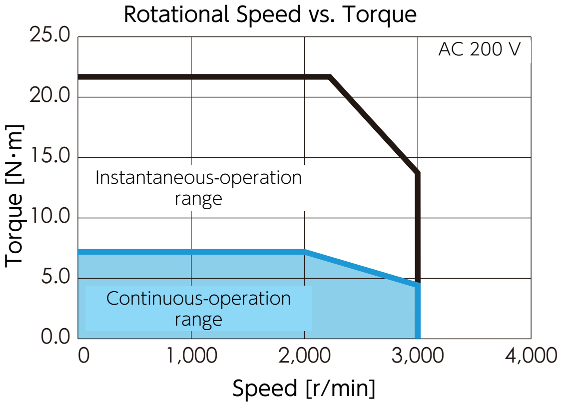
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

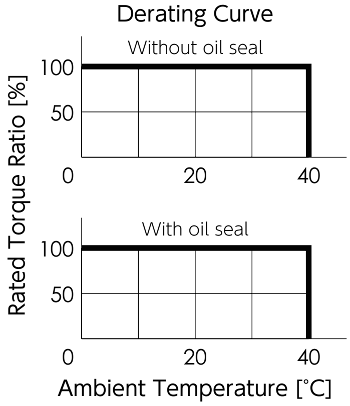
Permissible Load

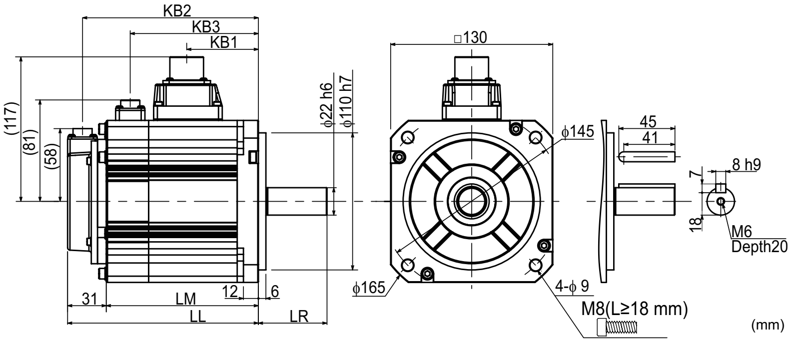
Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque



Derating Curve





(mm)

Brake	Without	With
Motor Model	MM152N	MM152A
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

Motor Model : MH152N2 □□** (Without brake) MH152A2 □□** (With brake)

Basic Specifications

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		–	DB66B42
Voltage		V	AC200–240 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	11.9
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	37.1
	With brake		38.7

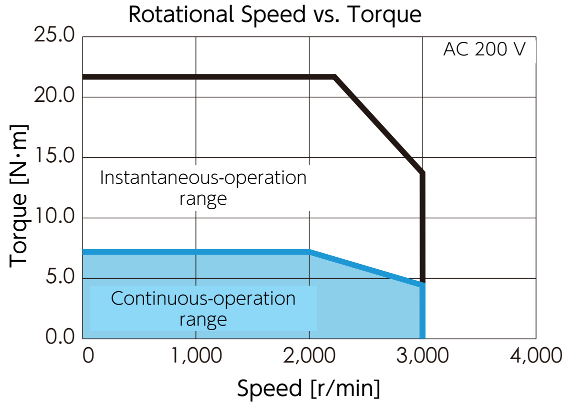
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

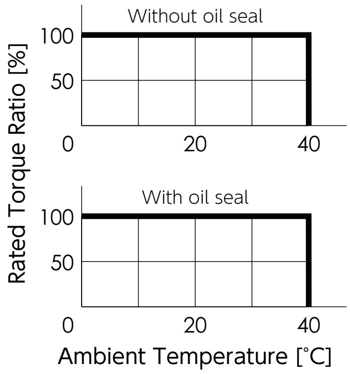
Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque

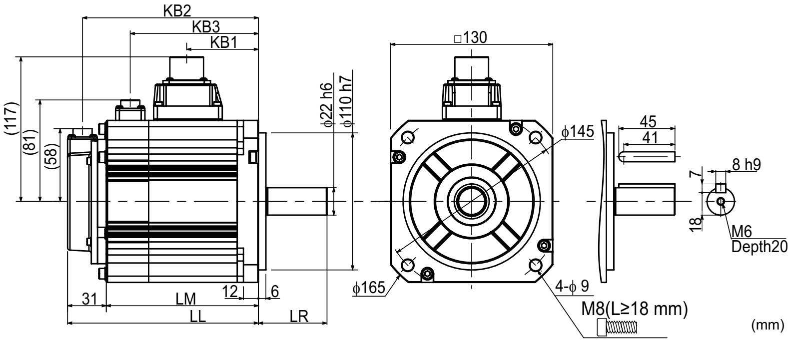


Derating Curve



(mm)

Brake	Without	With
Motor Model	MH152N	MH152A
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 : MX202N2 □□** (Without brake)
MX202A2 □□** (With brake)

Basic Specifications

Item		Unit	Specifications
Rotor inertia		–	Low
Fitting flange size		mm	100 sq.
Approximate mass	Without brake	kg	6.0
	With brake		7.3
Compatible amplifier model		–	DB68C42
Voltage		V	AC200–240 V
Rated output		W	2,000
Rated torque		N·m	6.37
Instantaneous maximum torque		N·m	19.1
Rated current (stall current)		A	10.6
Instantaneous maximum current		A	33.9
Rated revolving speed		r/min	3,000
Maximum revolving speed		r/min	5,000
Torque constant		N·m/A	0.62
Induced voltage constant per phase		mV/(r/min)	21.7
Rated power rate	Without brake	kW/s	110.0
	With brake		99.0
Mechanical time constant	Without brake	ms	0.50
	With brake		0.56
Electrical time constant		ms	5.44
Rotor moment of inertia	Without brake	$\times 10^{-4}$ kg·m^2	3.68
	With brake		4.09

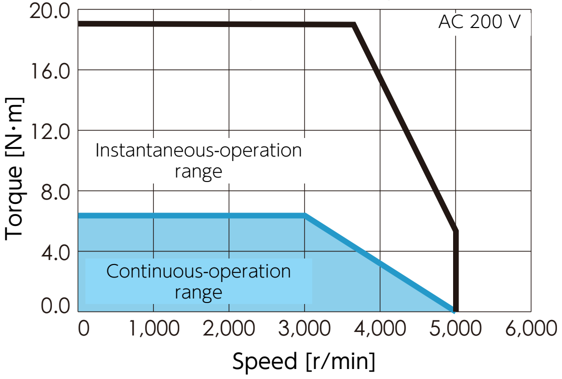
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 V±10%
Rated current	A	1.0
Static friction torque	N·m	≧ 8.0
Suction time	ms	≦ 120
Release time	ms	≦ 30
Release voltage	V	≧ DC1 V

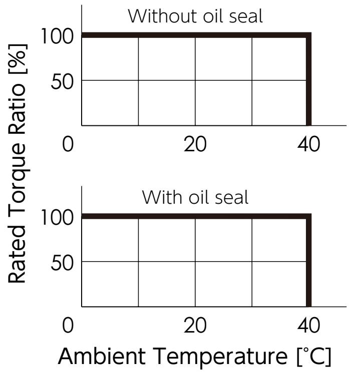
Permissible Load

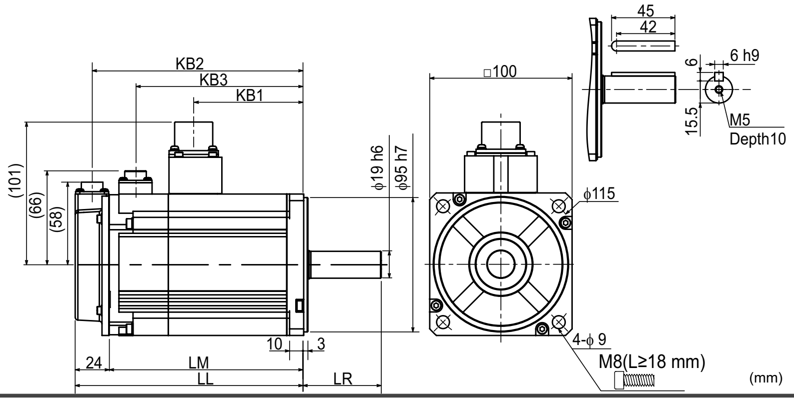
Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque



Derating Curve





(mm)

Brake	Without	With
Motor Model	MX202N	MX202A
LL	170.0	200.0
LM	146.0	176.0
LR	55.0	
KB1	116.0	
KB2	158.0	188.0
KB3	–	157.3

1. Motor

Motor Model : MM202N2 □□** (Without brake)
MM202A2 □□** (With brake)

Basic Specifications

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		–	DB68C42
Voltage		V	AC200–240 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	11.9
Rotor moment of inertia	Without brake	$\times10^{-4}$ kg·m^2	8.70
	With brake		10.4

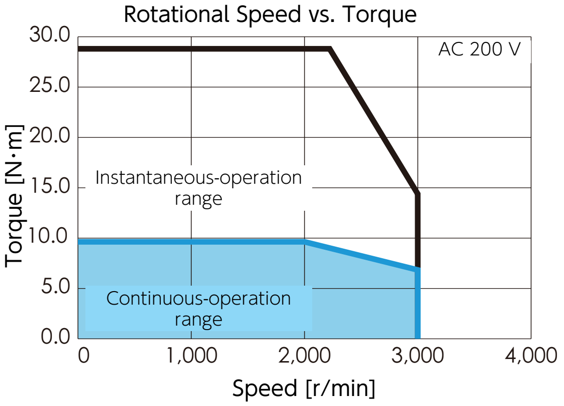
Brake Specifications

Item	Unit	Specifications
Usage	–	Holding
Rated voltage	V	DC24 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	≧ DC1 V

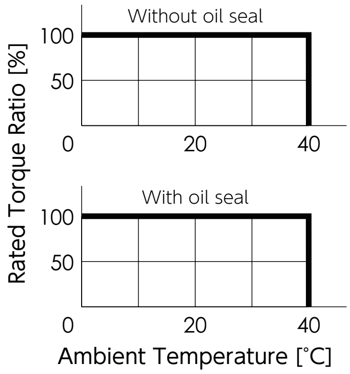
Permissible Load

Item	Unit	Specifications
Radial	N	490
Thrust	N	196

Rotational Speed vs. Torque

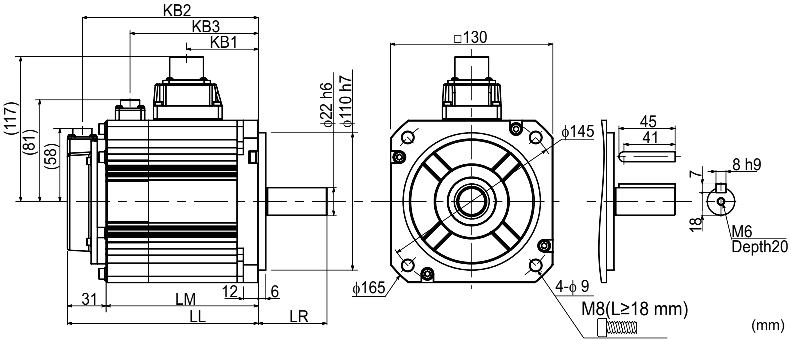


Derating Curve



(mm)

Brake	Without	With
Motor Model	MM202N	MM202A
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

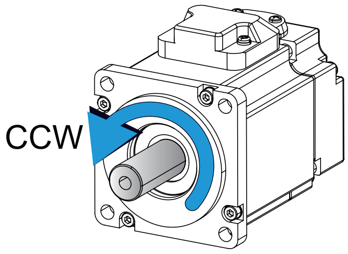
Item			Specifications		
Motor model			M□□□□P□□A** M□□□□B□□A**	M□□□□N□□A** M□□□□A□□A**	M□□□□N□□N** M□□□□A□□N**
Resolution			23 bit ENCODER Absolute **23 bit**	17 bit ENCODER Absolute **17 bit**	17 bit ENCODER Incremental **17 bit**
Environmental requirements	Ambient operating temperature		0–85℃		
	External 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	80 mA typ. (*1)	160 mA typ. (*1)	
	External battery	Voltage	DC 2.7–4.0 V	DC 2.4–4.2 V	–
		Current consumption	15 µA typ. (*2)	10 µA typ. (*2)	–
	Multi-turn count		65,536 counts(*3)		–
	Maximum revolving speed		6,000 r/min		
	Count-up direction		CCW (*4)		
Communication specification	Transmission method		Half-duplex asynchronous serial communication		
	Communication speed		4.0 Mbps	2.5 Mbps	

*1) Inrush-current is not included.

*2) Measurement conditions room temperature, the motor not in motion, battery voltage of 3.0 V.

*3) This is based on the use of the S-FLAG amplifier.
The encoder supports up to 16,777,216 counts.

*4) 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. (17 bit encoder)

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. Amplifiers

1. Model Codes

Models DB 6 Y Z 42

Series

Input Power Supply	
Code	Main Circuit Power & Control Power
6	AC200–240 V (*)

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

50–750 W	: Single-phase
1 kW	: Single-phase / Three-phase
850 W, 1.3–2 kW	: Three-phase

Specifications	
Code	Specifications
42	EtherCAT

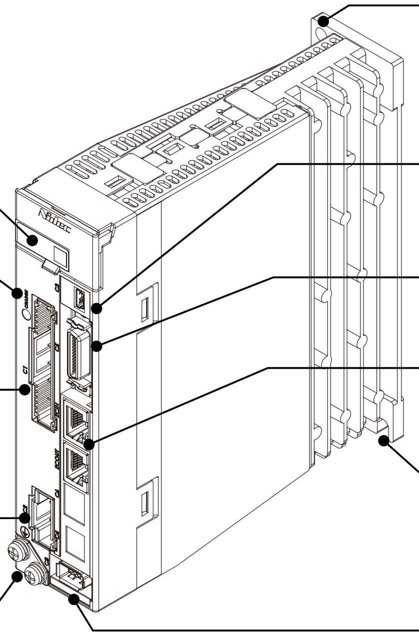
Compatible Motor		
Code	Motor Rated Power	Motor Models
Y	50 W	M□500
Z	100 W	M□101
1	200 W	M□201
2	400 W	M□401
3	750 W	M□751
4	1 kW	MX951 M□102
5	850 W	MJ851
6	1.5 kW	M□152
7	1.3 kW	MJ132
8	2 kW	M□202

Amplifier Main circuit power	
Code	Supply
Z	50 W
1	100 W
2	200 W
4	400 W
8	750 W
A	1 kW
B	1.5 kW
C	2 kW

Amplifier model, power supply used and connectors				
Model	Motor Rated Power	Main Circuit Power	Connection to main/motor power	Figure to be referenced
DB6YZ42	50 W	Single-phase	Connector	☞ Figure 1
DB6Z142	100 W	Single-phase	Connector	
DB61242	200 W	Single-phase	Connector	
DB62442	400 W	Single-phase	Connector	☞ Figure 2
DB63842	750 W	Single-phase	Connector	☞ Figure 3
DB64A42	1 kW	Single-/Three-phase	Connector	
DB65B42	850 W	Three-phase	Terminal block	☞ Figure 4
DB66B42	1.5 kW	Three-phase	Terminal block	
DB67C42	1.3 kW	Three-phase	Terminal block	
DB68C42	2 kW	Three-phase	Terminal block	

2. Names of parts

Figure 1 Amplifier model 50 W DB6YZ42 100 W DB6Z142 200 W DB61242



Setting panel
Used for EtherCAT communication node address setting and status display

Hazardous voltage display LED
This will be lit while there is residual hazardous voltage inside the amplifier.

Accessories
C1 Main power / Control power input
Main power input, Control power input, and Regenerative resistor connection

Accessories
C2 Motor power output
Motor power output

FG (Protective earth) terminal
Two terminals:
Attached M4x8 mm screw with spring washer

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

C3 USB connector
Used for parameter settings, tuning, and status display in the dedicated software "S-TUNE Ⅱ"

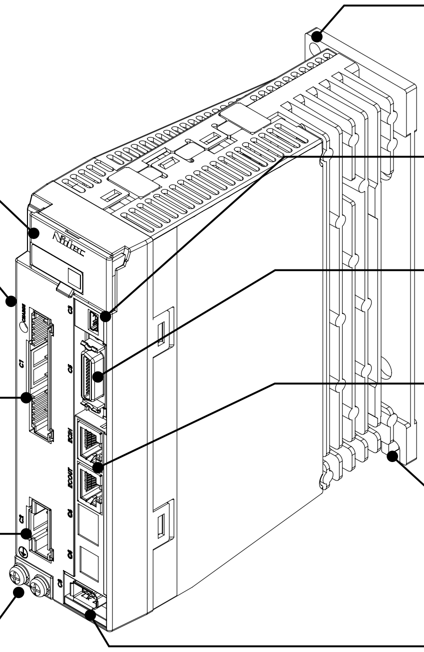
C5 User I/O connector
User I/O, ABZ output

ECIN, ECOUT connector
EtherCAT communication connector

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

C8 Encoder connector
Encoder connection

Figure 2 Amplifier model 400 W DB62442



Setting panel
Used for EtherCAT communication node address setting and status display

Hazardous voltage display LED
This will be lit while there is residual hazardous voltage inside the amplifier.

Accessories
C1 Main power / Control power input
Main power input, Control power input, and Regenerative resistor connection

Accessories
C2 Motor power output
Motor power output

FG (Protective earth) terminal
Two terminals:
Attached M4x8 mm screw with spring washer

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

C3 USB connector
Used for parameter settings, tuning, and status display in the dedicated software "S-TUNE Ⅱ"

C5 User I/O connector
User I/O, ABZ output

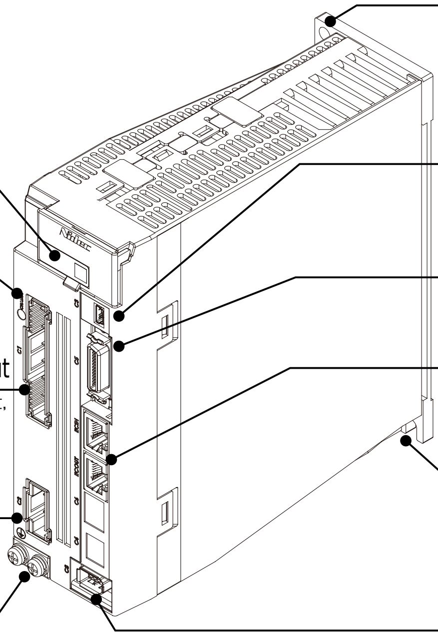
ECIN, ECOUT connector
EtherCAT communication connector

Mounting notch
⌀ 5.5 (two location)
The recommended screw: M5x12 mm, with spring washer

C8 Encoder connector
Encoder connection

3. Amplifier

Figure 3 Amplifier model 750W DB63842 1kW DB64A42



Setting panel
Used for EtherCAT communication node address setting and status display

Hazardous voltage display LED
This will be lit while there is residual hazardous voltage inside the amplifier.

Accessories

C1 Main power / Control power input
Main power input, Control power input, and Regenerative resistor connection

Accessories

C2 Motor power output
Motor power output

FG (Protective earth) terminal
Two terminals:
Attached M4x8 mm screw with spring washer

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

C3 USB connector
Used for parameter settings, tuning, and status display in the dedicated software "S-TUNE Ⅱ"

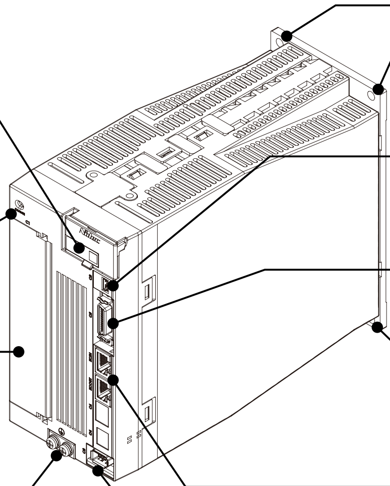
C5 User I/O connector
User I/O, ABZ output

ECIN, ECOUT connector
EtherCAT communication connector

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

C8 Encoder connector
Encoder connection

Figure 4 Amplifier model 850W DB65B42 1.3kW DB67C42 1.5kW DB66B42 2kW DB68C42



Setting panel
Used for EtherCAT communication node address setting and status display

Hazardous voltage display LED
This will be lit while there is residual hazardous voltage inside the amplifier.

Terminal block
Main power input, Control power input, Regenerative resistor connection, and Motor power output

(The recommended terminal:
2-4S insulation coating ring crimp terminals)

FG (Protective earth) terminal
Two terminals:
Attached M4x8 mm screw with spring washer

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

C3 USB connector
Used for parameter settings, tuning, and status display in the dedicated software "S-TUNE Ⅱ"

C5 User I/O connector
User I/O, ABZ output

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

ECIN, ECOUT connector
EtherCAT communication connector

C8 Encoder connector
Encoder connection

3. Specifications

Basic Specifications

Items		Specifications				
Amplifier model		DB6YZ42	DB6Z142	DB61242	DB62442	DB63842
Compatible Motor		M□500 50 W	M□101 100 W	M□201 200 W	M□401 400 W	M□751 750 W
External dimensions		(See "Dimensions")				
Mass (Kg)		0.8			1.0	1.1
Main circuit power & Control power		Single-phase AC200 V–240 V±10% 50 / 60 Hz				
Input current (Arms typ)		0.9	1.5	2.6	4.6	7.6
Control type		Three-phase PWM inverter sine-wave driven				
Output Rating	Rated current (A)	0.8	1.1	1.9	3.0	4.6
	Output frequencies (Hz)	0 - 500				
Encoder feedback		23 bit / 17 bit single-turn absolute (The product can function as a multi-turn absolute type when batteries are added.)				
Control signal (*2)	Input	7-point (24VDC system, photo-coupler input insulation)				
	Output	3-point (24VDC system, photo-coupler output insulation)				
Communication function		EtherCAT (Topology: "Daisy chain", "Star", or "Ring" are available) USB : connection to PC with "S-TUNE Ⅱ" installed				
Amplifier status display function		Amplifier status display function 2 digits of 7-segment display on Setup Panel (Indicate EtherCAT node ID)				
Regeneration function		A regenerative resistor may be installed externally (*3)				
Dynamic brake		Built-in				
Speed observer		Available				
Auto-tuning		Available				
Encoder output Division/Multiplication		Available				
Tuning & Function Setup		Available through the S-FLAG Ⅱ setup software "S-TUNE Ⅱ"				
Protective functions	By hardware	Overvoltage, low voltage, Overcurrent, Abnormal temperature, Overload				
	By software	Overspeed, Position deviation too high, Parameter errors, Encoder error				
Alarm Log		Can be referenced with the setup software "S-TUNE Ⅱ"				

3. Amplifier

Items		Specifications					
Amplifier model		DB64A42		DB65B42	DB66B42	DB67C42	DB68C42
Compatible Motor		MX951 1 KW	M□102 1 KW	MJ851 850 W	M□152 1.5 KW	MJ132 1.3 KW	M□202 2 KW
External dimensions		(See "Dimensions")					
Mass (Kg)		1.1		2.0			
Main circuit power & Control power		Three-phaseAC200–240 V (*1) ±10% 50 / 60 Hz					
Input current (Arms typ)		Single-phase : 9.9 Three-phase : 5.3		4.6	7.5	6.5	9.5
Control type		Three-phase PWM inverter sine-wave driven					
Output Rating	Rated current (A)	7.5		7.6	10.0	11.5	12.0
	Output frequencies (Hz)	0-500					
Encoder feedback		23 bit / 17 bit single-turn absolute (The product can function as a multi-turn absolute type when batteries are added.)					
Control signal (*2)	Input	7-point (24VDC system, photo-coupler input insulation)					
	Output	3-point (24VDC system, photo-coupler output insulation)					
Communication function		EtherCAT (Topology: "Daisy chain", "Star", or "Ring" are available) USB : connection to PC with "S-TUNE Ⅱ" installed					
Amplifier status display function		Amplifier status display function 2 digits of 7-segment display on Setup Panel (Indicate EtherCAT node ID)					
Regeneration function		A regenerative resistor may be installed externally (*3)					
Dynamic brake		Built-in					
Speed observer		Available					
Auto-tuning		Available					
Encoder output Division/Multiplication		Available					
Tuning & Function Setup		Available through the S-FLAG Ⅱ setup software "S-TUNE Ⅱ"					
Protective functions	By hardware	Overvoltage, low voltage, Overcurrent, Abnormal temperature, Overload					
	By software	Overspeed, Position deviation too high, Parameter errors, Encoder error					
Alarm Log		Can be referenced with the setup software "S-TUNE Ⅱ"					

3. Amplifier

Standard I/O

Items	Specifications
Control input	CW limit sensor, CCW limit sensor, Home sensor, External latch(2-point), Alarm reset, Emergency stop
Control output	Brake release, Alarm status, Servo ready

Operation mode

Item	Specifications
Operation mode	EtherCAT communication mode, test mode through S-TUNE Ⅱ

Environmental Specification

Items	Specifications
Ambient temperature	**For operation:** 0 to 55℃ (*4, 5), **For storage:** −20 to 65℃
Ambient humidity	**For operation/For storage:** 20 to 85%RH (No condensation)
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	Class Ⅰ (mandatory grounding)
Overvoltage category	Ⅲ
Installation environment	Pollution degree 2

EtherCAT communication Specifications

Items	Specifications
Device Profile	CoE (CANOpen over EtherCAT)
Control mode	csp, csv, cst, hm
hm method (homing mode)	1-6, 17-30, 33-37
Synchronous mode	DC (Synchronized), FreeRun (not-Synchronized)
Cycle Time	250 µs, 500 µs, 1 ms, 2 ms, 4 ms

3. Amplifier

Notice

*1) In the Amplifier DB64A41 (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.
For the control power supply, connect L1 and L3 of the main circuit power supply to L1C and L2C, respectively.

Item		Specifications	
Amplifier Model		DB64A42	
Compatible Motor		1 kW (MX951□2□□ **, M□102□2□□ **)	
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

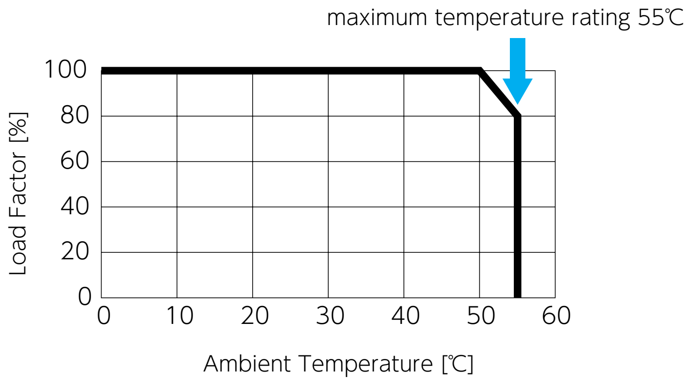
*2) Use SELV (Safety Extra Low Voltage/Non-Hazardous Voltage) power supply to User I/O with reinforced isolation from hazardous voltage.
As a countermeasure against amplifier failure, install overcurrent protection or use power output capacity of no higher than 100 W.

*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 S-TUNE Ⅱ.

*4) 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.

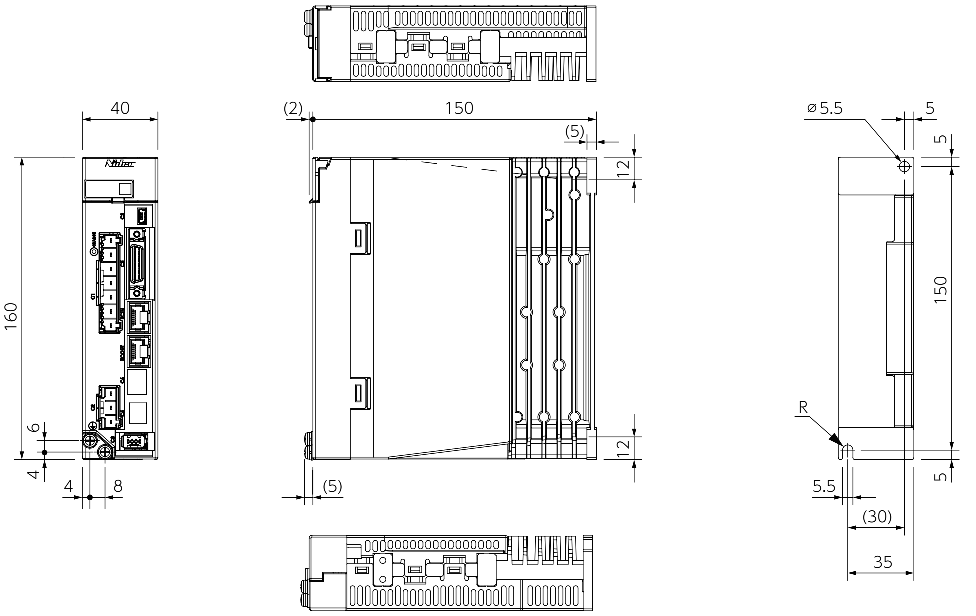
☞ **B- 2 Preparation**

*5) For 1.3 kW amplifier (DB67C11) and 2 kW amplifier (DB68C11), refer to the following temperature derating curve.



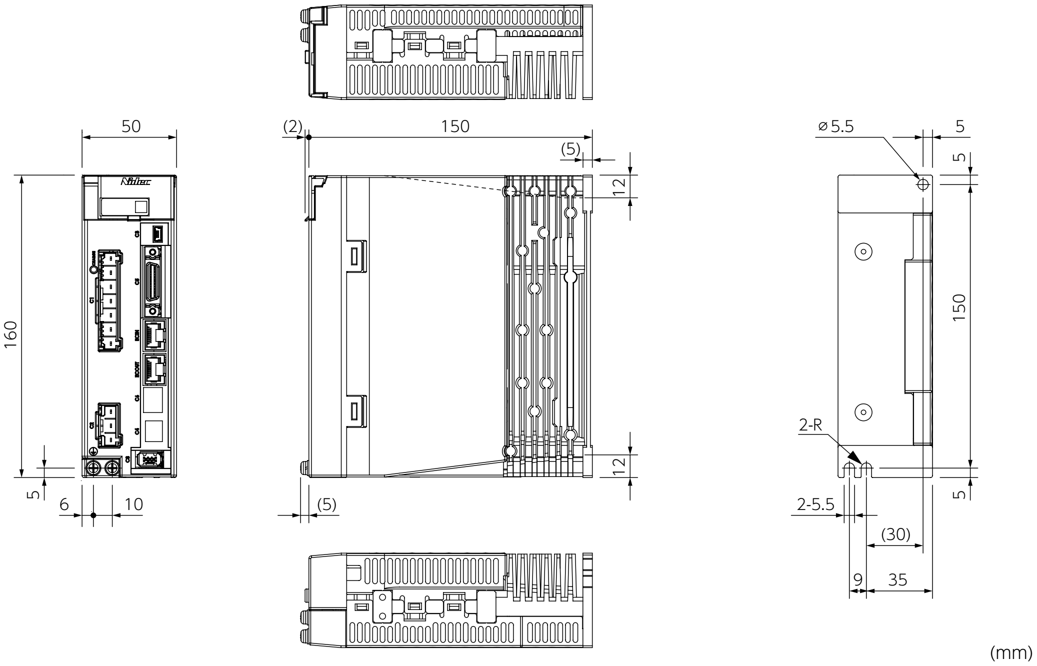
4. External Dimensions

Figure 1 Amplifier model 50W DB6YZ42 100W DB6Z142 200W DB61242



(mm)

Figure 2 Amplifier model 400W DB62442



(mm)

Figure 3 **Amplifier model** 750 W DB63842 1 kW DB64A42

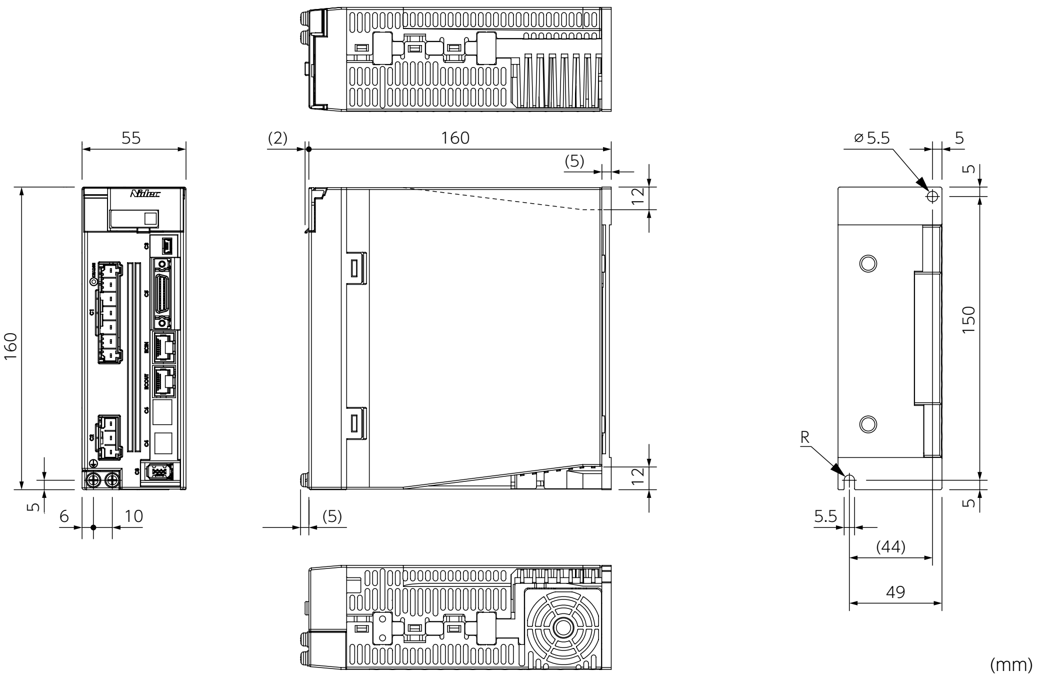
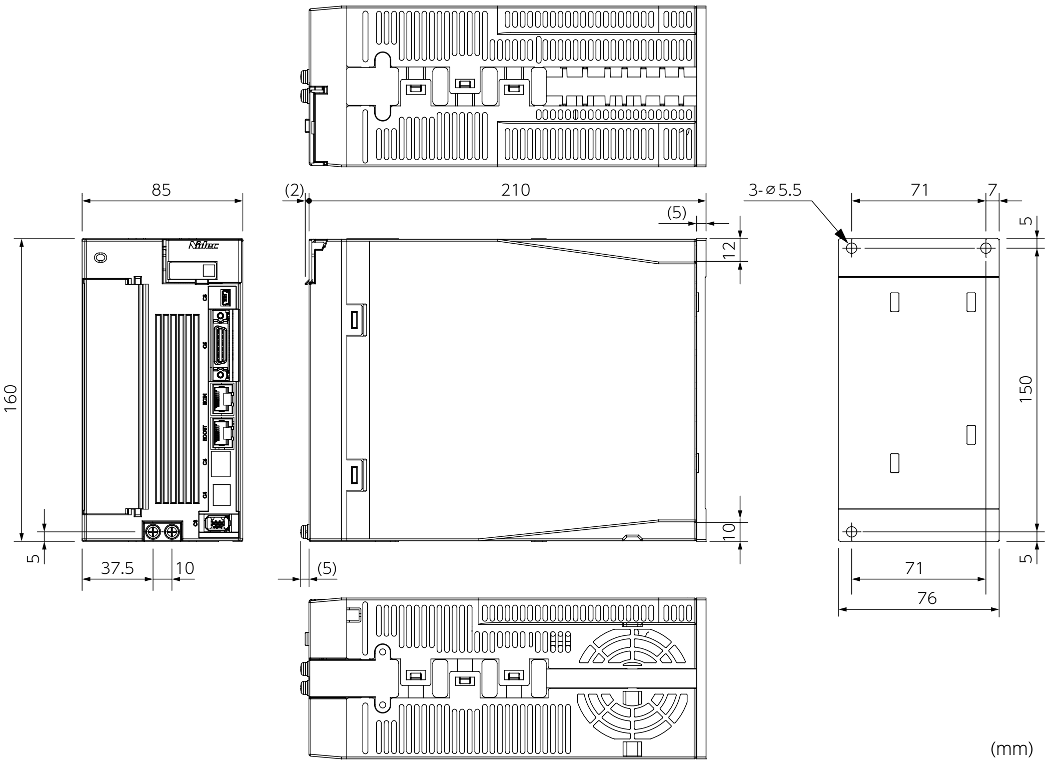
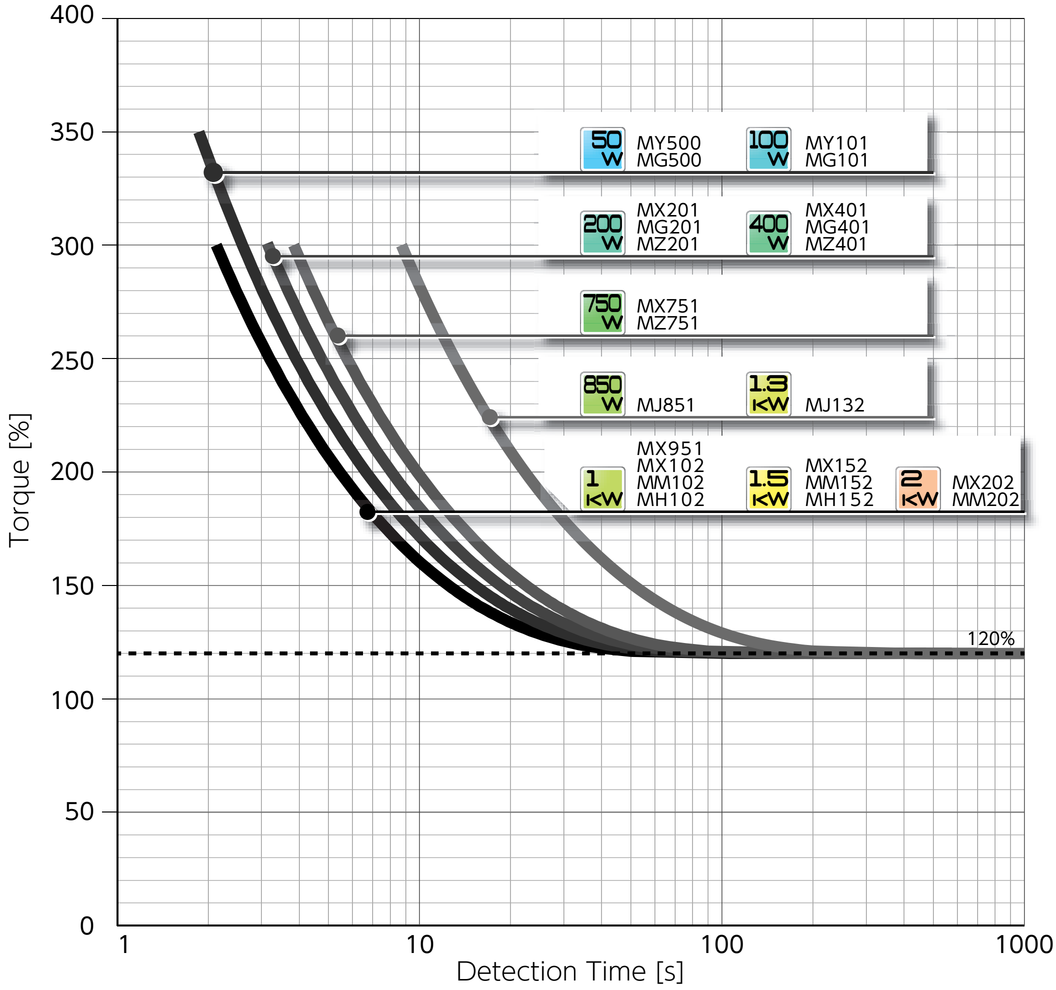


Figure 4 **Amplifier model** 850 W DB65B42 1.3 kW DB67C42 1.5 kW DB66B42 2 kW DB68C42



5. Overload Detection Feature

S-FLAG Ⅱ 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.



Overload detection feature is reference data.
Be sure to use the motor within the specification temperature range and in the enough radiation environment.
Detection time may change by the radiation condition of the motor.

MEMO

2

Mounting and Wiring

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

- I/O device 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 **15 minutes** after the main power shut off.
- Never attempt to replace a fuse.
- 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

Be sure to compliance with the IP-code of the motor and amplifier.

Amplifiers

S-FLAG Ⅱ Amplifiers are not waterproof structure.

Motors

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

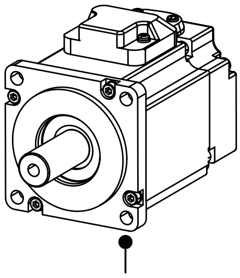
*) Except for the shaft output component and the connectors.

Rated output	Model			IP
50W	–	**MY500** **MG500**	–	IP65
100W	–	**MY101** **MG101**	–	IP65
200W	**MX201**	**MG201**	**MW201**	IP65
400W	**MX401**	**MG401**	**MW401**	IP65
750W	**MX751**	–	**MW751**	IP65
850W	–	**MJ851**	–	IP67
1kW	**MX951**	–	–	IP65
	MX102	–	–	IP67
	–	**MM102**	**MH102**	IP67
1.3kW	–	**MJ132**	–	IP67
1.5kW	**MX152**	–	–	IP67
	–	**MM152**	**MH152**	IP67
2kW	**MX202**	–	–	IP67
	–	**MM202**	–	IP67

1. Installation

1. Motor Installation

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



The motor mounting screws are depending on its flange size.

Rated output	Motor			Fitting flange size	Hexagon socket head bolt (Mounting Hole)
50W	–	MY500 MG500	–	40 mm x 40 mm	M4 × L12mm (2- ø 4.5)
100W	–	MY101 MG101	–	40 mm x 40 mm	M4 × L12mm (2- ø 4.5)
200W	**MX201**	**MG201**	**MW201**	60 mm x 60 mm	M5 × L12 mm (4- ø 5.5)
400W	**MX401**	**MG401**	**MW401**	60 mm x 60 mm	M5 × L12mm (4- ø 5.5)
750W	**MX751**	–	**MW751**	80 mm x 80 mm	M6 × L14mm (4- ø 6.6)
850W	–	**MJ851**	–	130 mm x 130 mm	M8 × L18mm (4- ø 9.0)
1kW	**MX951**	–	–	80 mm x 80 mm	M6 × L14mm (4- ø 6.6)
	MX102	–	–	100 mm x 100 mm	M8 × L18mm (4- ø 9.0)
	–	**MM102**	**MH102**	130 mm x 130 mm	M8 × L18mm (4- ø 9.0)
1.3kW	–	**MJ132**	–	130 mm x 130 mm	M8 × L18mm (4- ø 9.0)
1.5kW	**MX152**	–	–	100 mm x 100 mm	M8 × L18mm (4- ø 9.0)
	–	**MM152**	**MH152**	130 mm x 130 mm	M8 × L18mm (4- ø 9.0)
2kW	**MX202**	–	–	100 mm x 100 mm	M8 × L18mm (4- ø 9.0)
	–	**MM202**	–	130 mm x 130 mm	M8 × L18mm (4- ø 9.0)

Use a screw longer than the recommended length.

Installation Precautions

🚫	**Never remove the encoder from the motor or disassemble the motor.**
❗	**Before installing the motor, wipe off the oil completely.** The motor shaft has anti-rust oil applied at the time of shipment.
	Be sure to perform centering (shaft alignment) sufficiently. 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 not hold the encoder unit, cables, or connectors when carrying the motor.
	When attaching a coupling to the motor shaft end or removing it, avoid direct impact by a tool such as hammer.
❗	During installation or operation, radial load or axial load applied to each motor has to be within the withstand rating.
	To remove the pulley, coupling, or any other parts from the shaft, use a puller.

Shock resistance of the motor is 200 m/s^2 (20 G) or less.

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.)

1. Installation

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.
❗	Install the motor such that the cable side is facing downward.
	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 Oil Seal

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

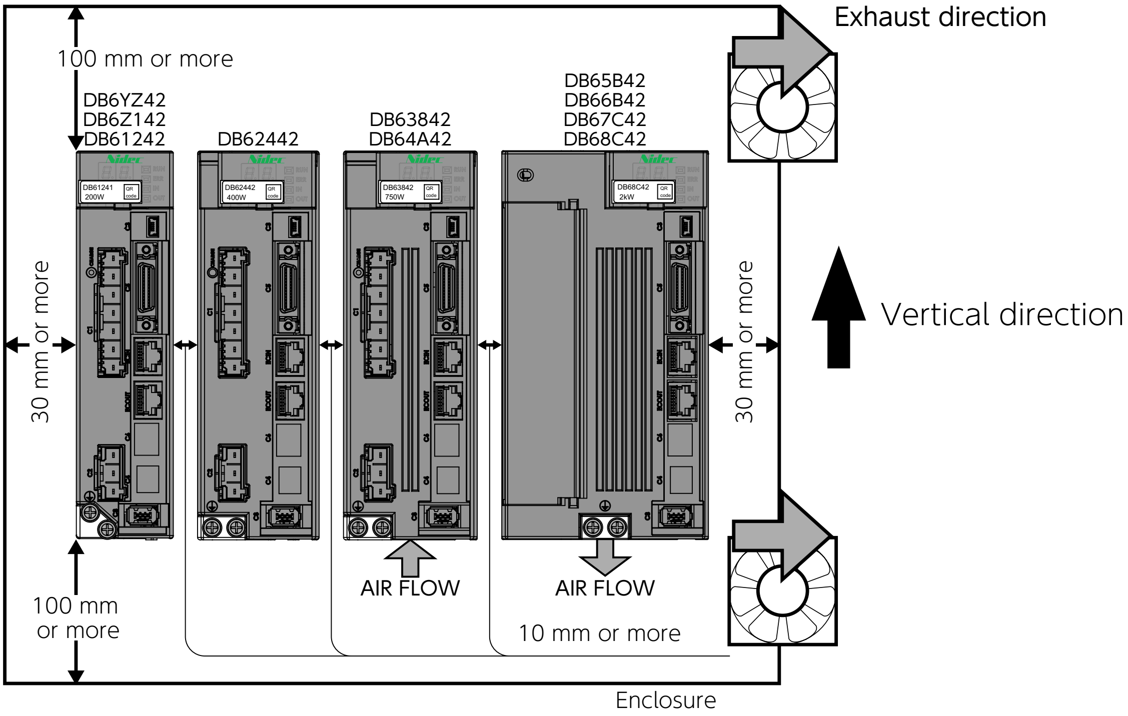
2. Amplifier Installation

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

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°C annual average temperature, 80% load factor, and 20 hours or less average daily operation.

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.

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°C.

Use heat resistant wiring materials and keep amplifiers away from heat-sensitive equipment and wiring.

*) The temperature of the heat sink at its surface may become 30°C (or more) higher than the ambient temperature.

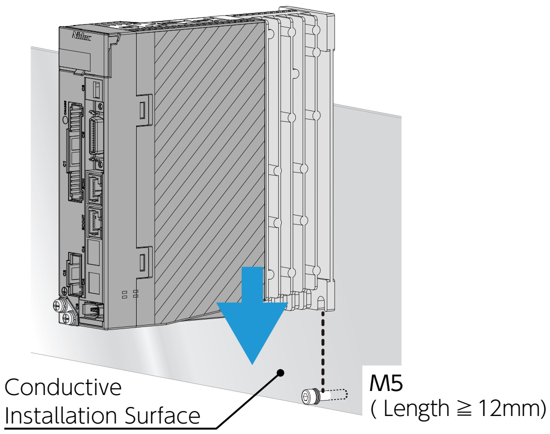
Mounting Amplifiers

Be sure to mount each amplifier on <u>conductive surface</u> such as aluminum brushed plate.

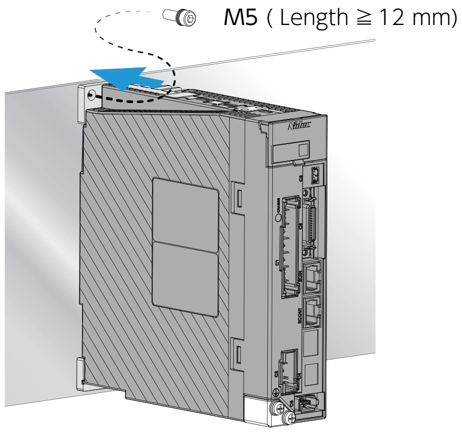
If the amplifier is mounted in a nonconductive location, such as a painted plate, it may be disturbed by noise and unable to perform at its full performance level.

Model						Mounting positions
DB6YZ42 50 W	DB6Z142 100 W	DB61242 200 W	DB62442 400 W	DB63842 750 W	DB64A42 1 kW	2
DB65B42 850 W	DB67C42 1.3 kW	DB66B42 1.5 kW	DB68C42 2 kW			3

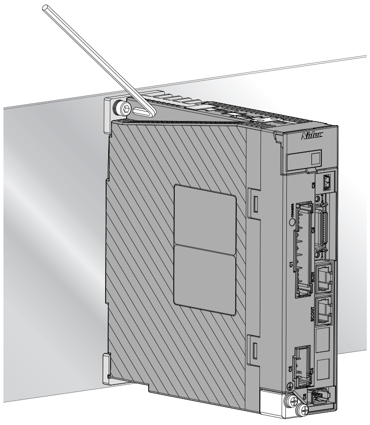
STEP 1 Hook the U-shaped installation notch of the amplifier to the bolt that has been screwed in advance.

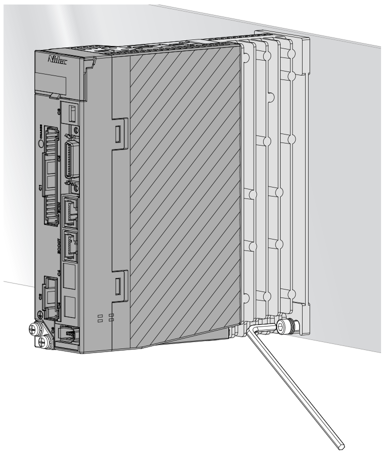


STEP 2 Tighten the mounting screws on the amplifier top.



STEP 3 Loosely screw all amplifier to the chassis first, and then securely tighten them all together. (Tightening torque: 1.4 to 1.6 N·m)





2. System Wiring

⚠ DANGER		
❗	Be mindful when wiring and handling high voltage materials	⚠ ⚠ ⚠
🚫	DO NOT use the electromagnetic contactor (installed on the primary circuit power side) to run or stop the motor.	
	DO NOT extend encoder wires by relay connectors or soldering.	
	DO NOT connect the EtherCAT communication cable directly to the public communication network such as Internet.	
❗	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.	
	For high-voltage cables, use wires of 600 V withstand voltage or more.	
	For stranded wire, use insulation coating, rod or ring crimp terminals.	
	The encoder cable length must be 20 meters or less.	
	Be sure to use shielded twisted pair wires for cables used for encoder lines.	
	Separate the motor power wires and encoder wires as much as possible.	
	For a C5 connector cable, use a shielded twisted-pair cable of 2 m or less.	
	To comply with the EC Directive, select appropriate devices, each of which is compliant with its applicable standards.	

2. System Wiring

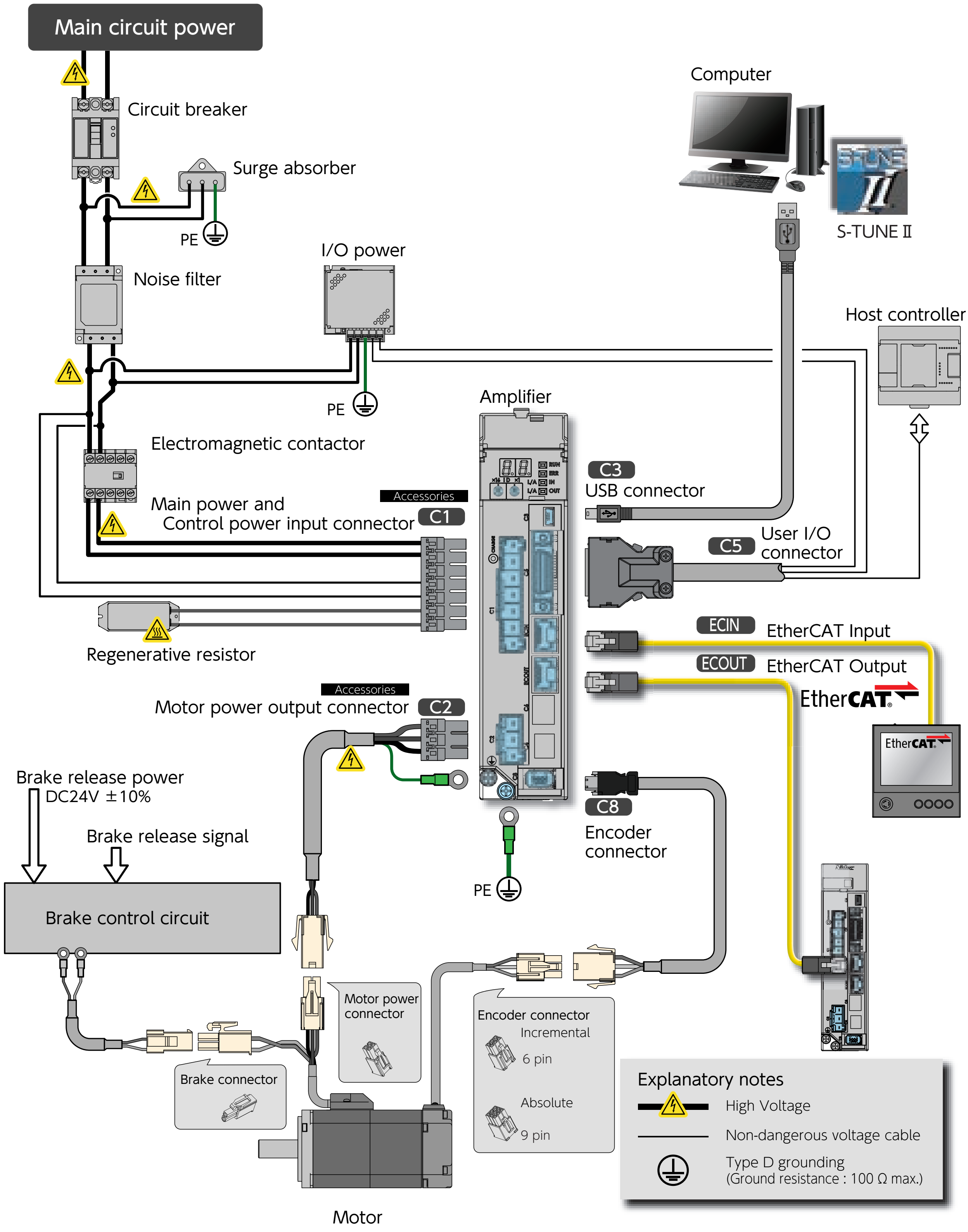
1. System Wiring

Rated output	Motor models			Supported amplifiers	Wiring Pattern
50W	–	**MY500** **MG500**	–	DB6YZ42	A (P. 11)
100W	–	**MY101** **MG101**	–	DB6Z142	A (P. 11)
200W	**MX201**	**MG201**	**MW201**	DB61242	A (P. 11)
400W	**MX401**	**MG401**	**MW401**	DB62442	A (P. 11)
750W	**MX751**	–	**MW751**	DB63842	A (P. 11)
850W	–	**MJ851**	–	DB65B42	D (P. 14)
1kW	**MX951**	–	–	DB64A42	B (P. 12)
	MX102	–	–		C (P. 13)
	–	**MM102**	**MH102**		C (P. 13)
1.3kW	–	**MJ132**	–	DB67C42	D (P. 14)
1.5kW	**MX152**	–	–	DB66B42	D (P. 14)
	–	**MM152**	**MH152**		D (P. 14)
2kW	**MX202**	–	–	DB68C42	D (P. 14)
	–	**MM202**	–		D (P. 14)

2. System Wiring

Wiring Pattern A

Motor rated output power: 50 W | 100 W | 200 W | 400 W | 750 W | 850 W | 1 kW | 1.3 kW | 1.5 kW | 2 kW



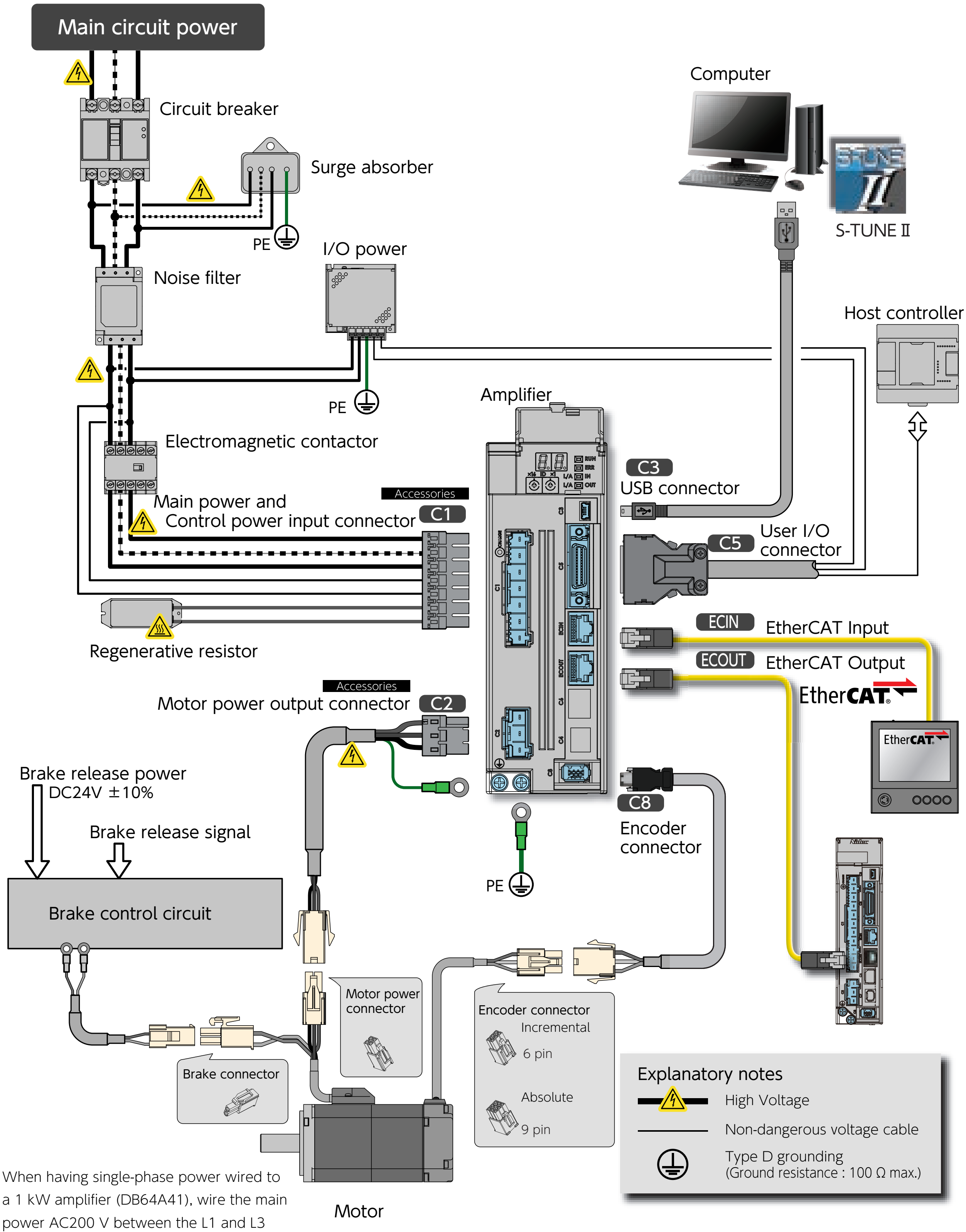
This wiring diagram depicts one example configuration:
a 200 W motor and its compatible amplifier.

2. System Wiring

Wiring Pattern B

Motor rated output power: 50 W | 100 W | 200 W | 400 W | 750 W | 850 W | **1 kW** | 1.3 kW | 1.5 kW | 2 kW

MX951



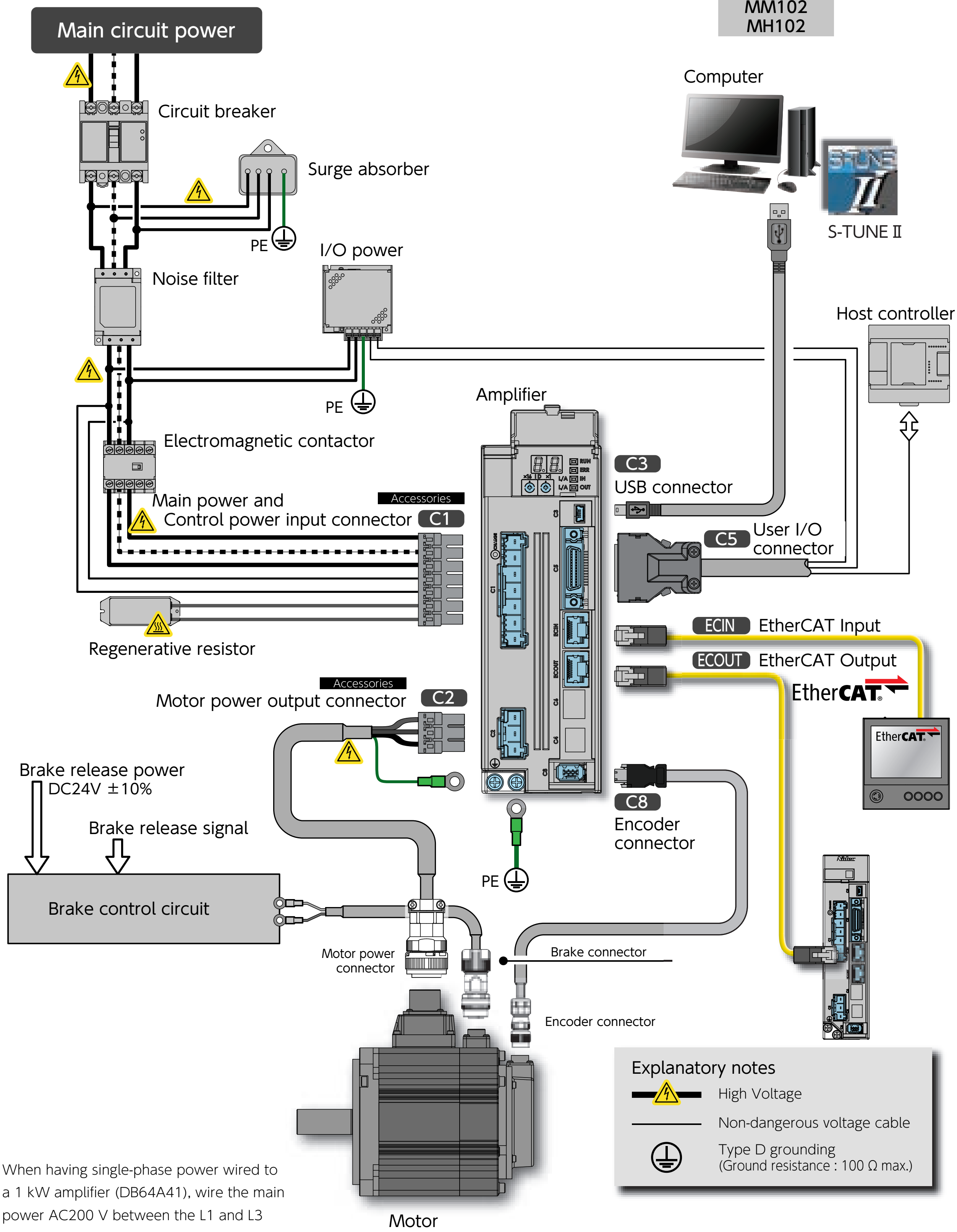
When having single-phase power wired to a 1 kW amplifier (DB64A41), wire the main power AC200 V between the L1 and L3 terminals of the amplifier.

2. System Wiring

Wiring Pattern **C**

Motor rated output power: 50 W | 100 W | 200 W | 400 W | 750 W | 850 W | **1 kW** | 1.3 kW | 1.5 kW | 2 kW

MX102
MM102
MH102



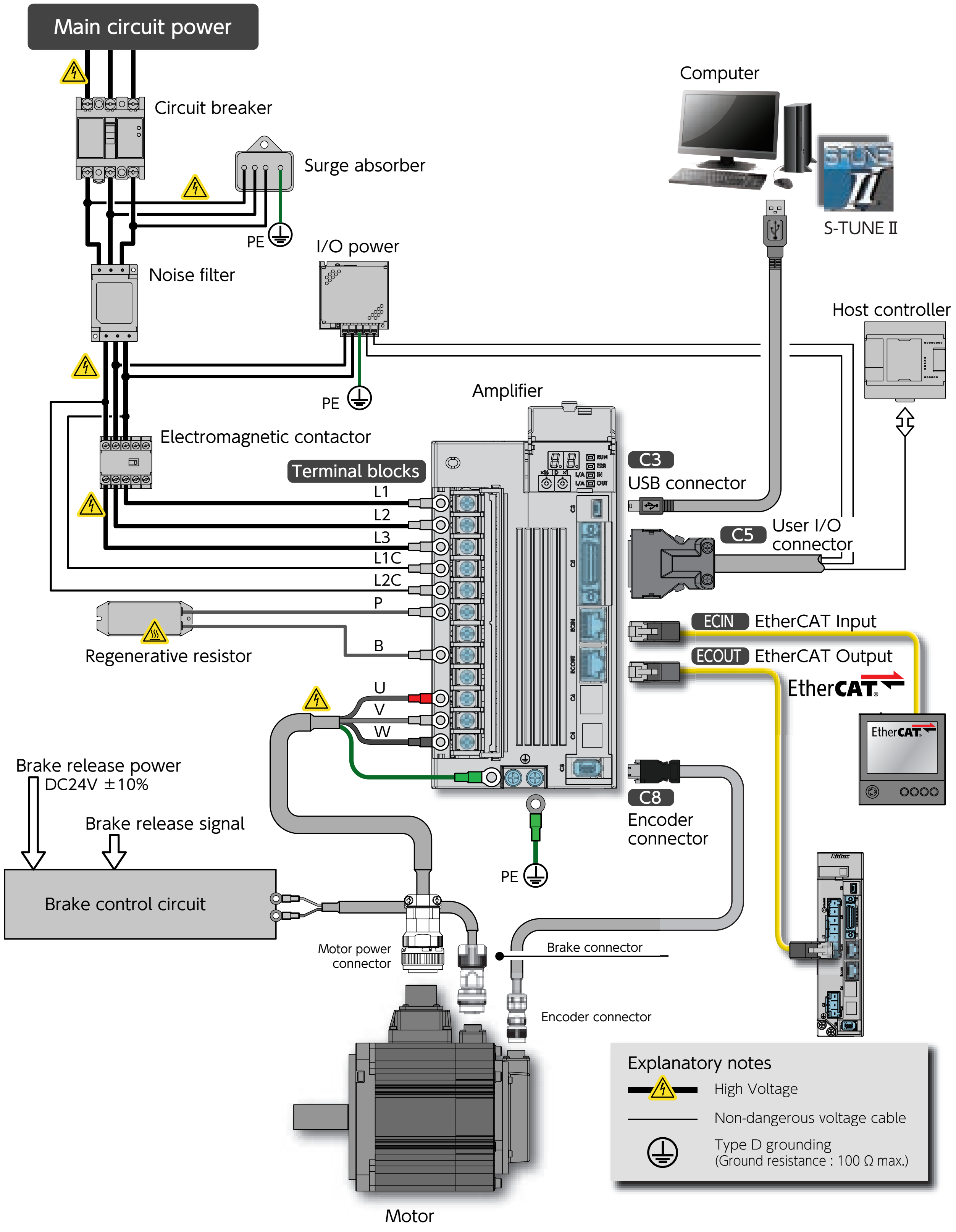
When having single-phase power wired to a 1 kW amplifier (DB64A41), wire the main power AC200 V between the L1 and L3 terminals of the amplifier.

2. System Wiring

Wiring Pattern D

Motor rated output power

50 W	100 W	200 W	400 W	750 W	850 W	1 kW	1.3 kW	1.5 kW	2 kW



Explanatory notes

⚠	High Voltage
—	Non-dangerous voltage cable
⏚	Type D grounding (Ground resistance : 100 Ω max.)

2. Connecting Equipment and Recommended Peripherals

Main circuit power / Controll 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.

Main circuit power:

50 W to 750 W : Single-phase AC200 V to 240 V ± 10% 50/60 Hz
850 W 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 circuit power:

All amp, models : Single-phase AC200 V to 240 V ± 10% 50/60 Hz

I/O power

This is power supply of DC24 V ± 10% for 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 (Main circuit power cable, Control power cable), FG cables:
  AWG14 / 600 V breakdown voltage or equivalent
Regenerative resistor connecting cable
  AWG18 / 600 V breakdown voltage or equivalent
Motor power cables:
  50–750 W : AWG18 / 300 V breakdown voltage or equivalent
  850 W-2 kW : AWG14 / 300 V breakdown voltage or equivalent
  NOTE: 1 kW motors may use AWG16 cables as well.
  Length not exceeding 20 m
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

2. System Wiring

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.	3SUPH-BE □□ -ER-6-E

Included in S-FLAG Ⅱ 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 S-FLAG Ⅱ amplifier's EMC testing

2. System Wiring

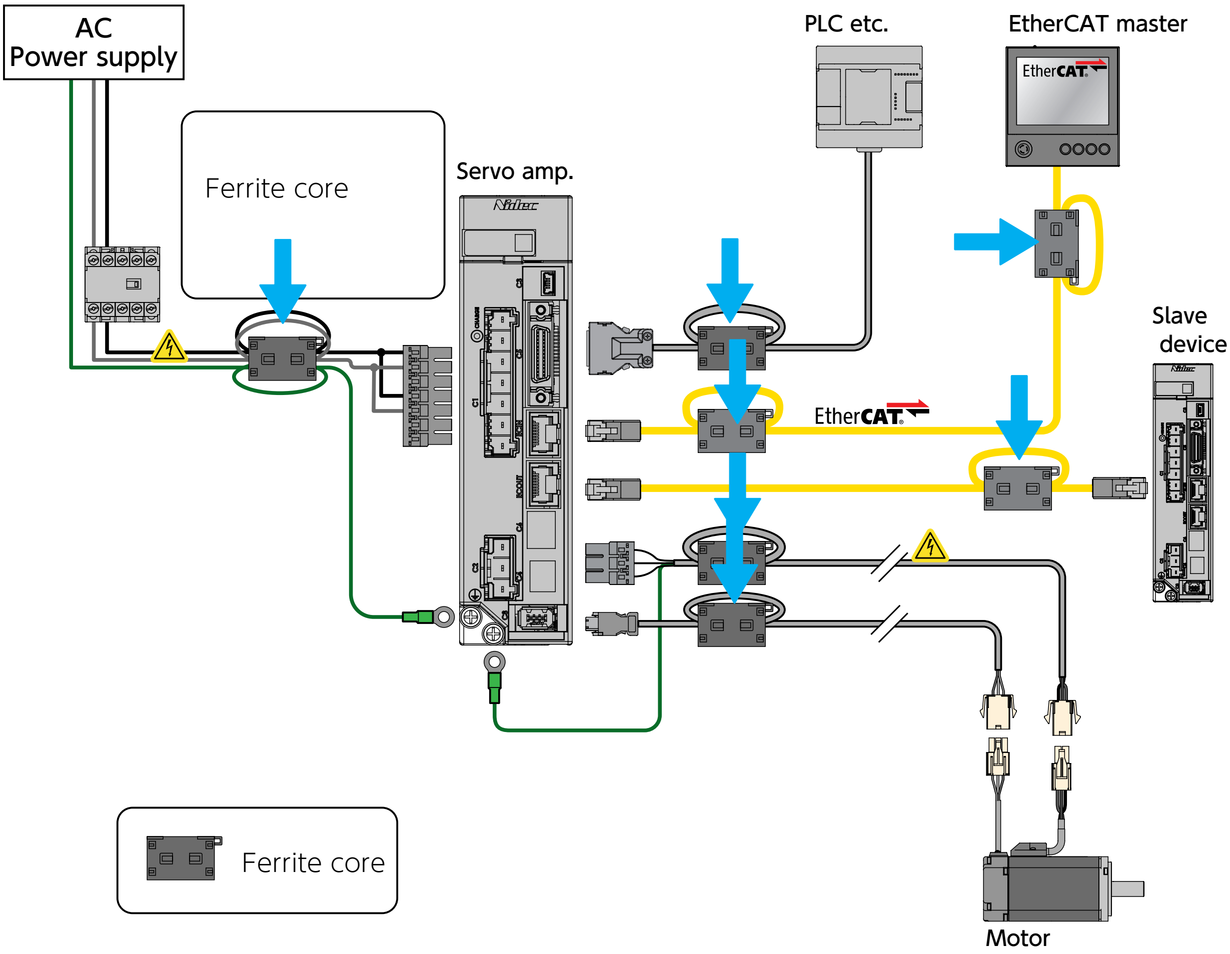
Signal line noise filter/ferrite core

To ensure compliance with EMC, use the recommended signal line noise filter/ferrite core. Attach the ferrite core with reference to the figure below.

- The figure below illustrates the attachment position of the ferrite core.
- Note that the figure below is an example of 200W, which is also the case for other than 200W.
- Refer to the wiring diagram for noise filters, surge absorbers, 24 VDC power supply, etc. on the AC power supply side.

Recommended Product	SEIWA ELECTRIC MFG. CO., LTD. (MISUMI)	E04SR482648

Included in S-FLAG Ⅱ 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 whose resistance is 20 Ohm or more, 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.

Motor Model	50 W M□500	100 W M□101	200 W M□201	400 W M□401	750 W M□751	1 kW MX951 M□102	850 W MJ851	1.3 kW MJ132	1.5 kW M□152	2 kW M□202
Rated output	50 W	100 W	200 W	400 W	750 W	1 kW	850 W	1.3 kW	1.5 kW	2 kW
Regeneration resistance	40–50 Ω					30 Ω	20 Ω			
Regeneration allowable voltage	20 W					40 W	60 W			
Recommended Wattage	100–200 W					400–800 W	600–1,200 W			

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

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.

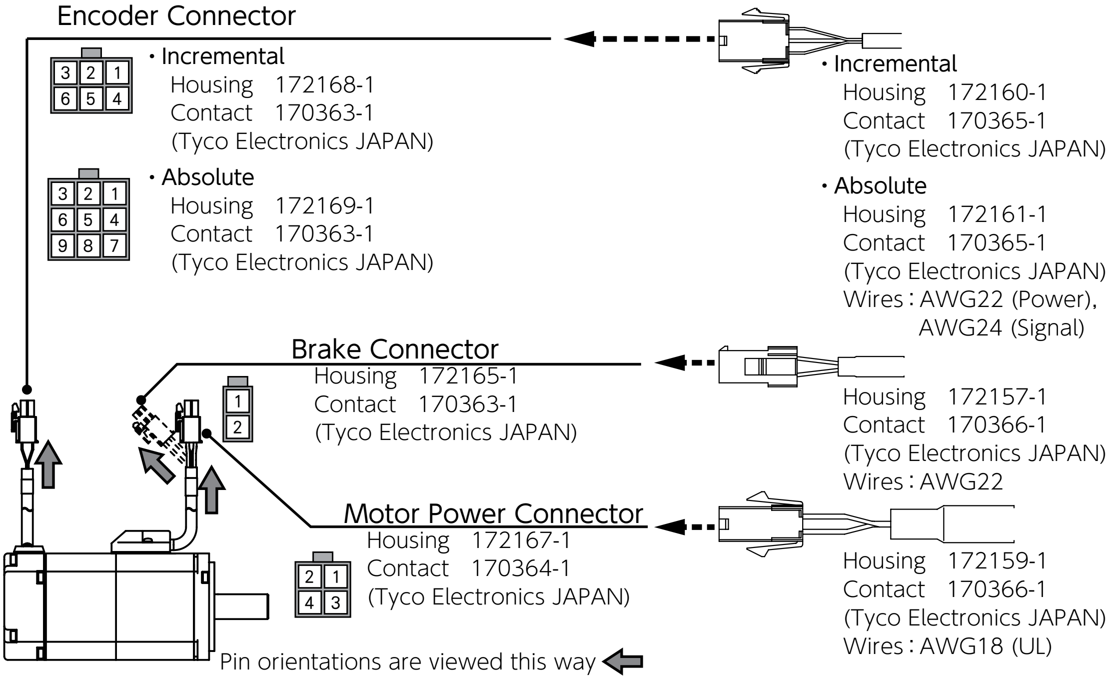
Grounding

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.

3. Wiring to Connectors and Signals

1. Motor Connector Pinouts

Motor rated output power	50 W	100 W	200 W	400 W	750 W	850 W	1 kW	1.3 kW	1.5 kW	2 kW
							MX951			



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 ⇦

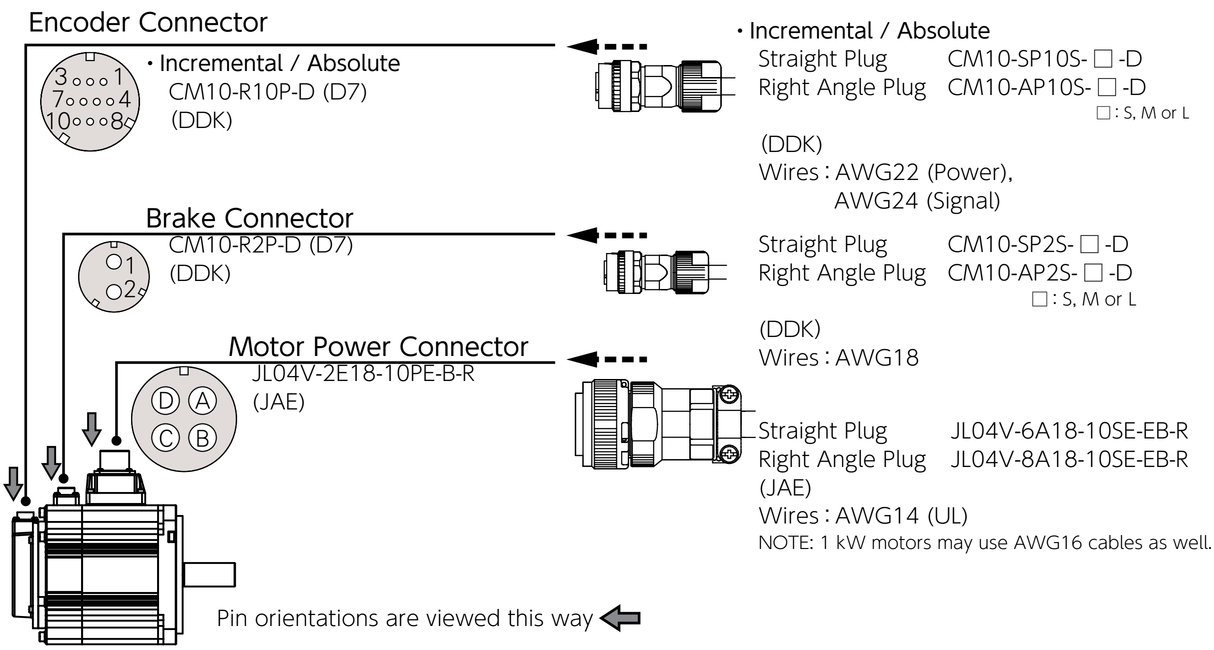
Name	Pin No.	Signal	Description
Motor Power	1	U	Motor power U-phase
	2	V	Motor power V-phase
	3	W	Motor power W-phase
	4	FG	Motor frame ground
Brake (*1)	1	BRK+	Brake power supply DC24V
	2	BRK−	Brake power supply GND
Encoder (Incremental)	1	−	(No Connect)
	2	+D	Serial communication data + Data
	3	−D	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).

3. Wiring to Connectors and Signals

Motor rated output power	50 W	100 W	200 W	400 W	750 W	850 W	1 kW	1.3 kW	1.5 kW	2 kW

MX102
MM102
MH102



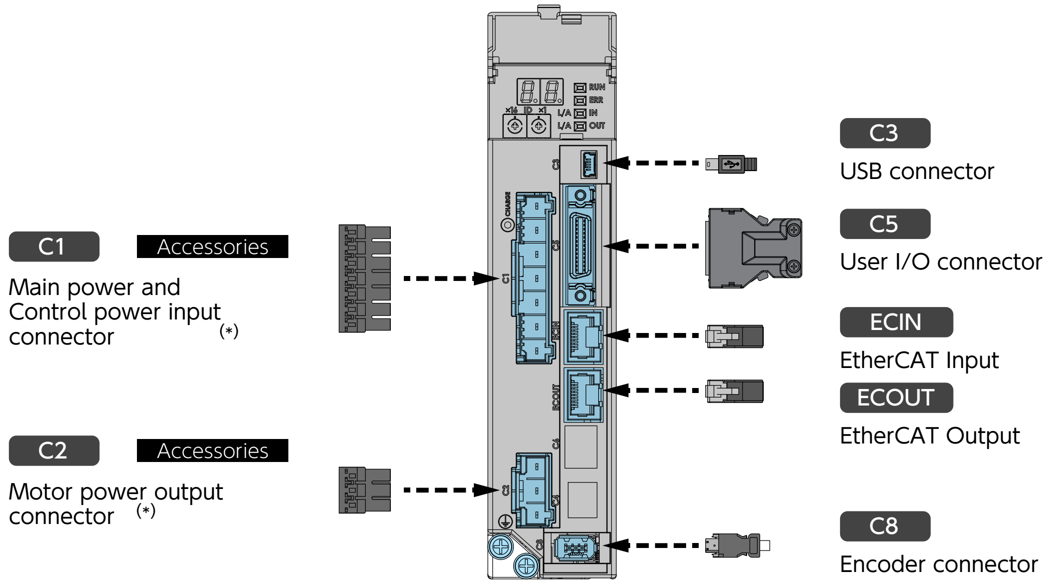
Name	Pin No.	Signal	Description
Motor Power	A	U	Motor power U-phase
	B	V	Motor power V-phase
	C	W	Motor power W-phase
	D	FG	Motor frame ground
Brake (*1)	1	BRK+	Brake power supply DC24V
	2	BRK−	Brake power supply GND
Encoder (Incremental)	1	VCC	Encoder power supply +5 V
	2	SG	Signal ground
	3, 4	–	(No 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).

2. Amplifier Connectors and Pinouts

Amplifier Connectors Pinout

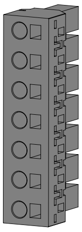
Model 50 W DB6YZ42 100 W DB6Z142 200 W DB61242 400 W DB62442 750 W DB63842 1 kW DB64A42



The shape of this amplifier is an example of 200 W.
The connector arrangement is the same for other amplifiers.

C1 Accessories

Main power and Control power input connector



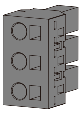
9EDGK-7.5 07P (7pin)
(DEGSON Electronics Co.,Ltd.)

Pin No.	Signal	Description
1	L1	Main Power (Main Circuit)
2	L2	Main Power (Main Circuit)
3	L3	Main Power (Main Circuit)
4	L1C	Main Power (Control Circuit)
5	L2C	Main Power (Control Circuit)
6	B1/+	External Regenerative resistor connection (+)
7	B2	External Regenerative resistor connection (−)

When having single-phase power wired to a 1 kW amplifier (DB64A41), wire the main power AC200 V between the L1 and L3 terminals of the amplifier.

C2 Accessories

Motor Power output connector

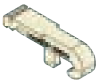


9EDGK-7.5 03P (3pin)
(DEGSON Electronics Co.,Ltd.)

Pin No.	Signal	Description
1	U	Motor power U-phase
2	V	Motor power V-phase
3	W	Motor power W-phase

Accessories

Spring Opener



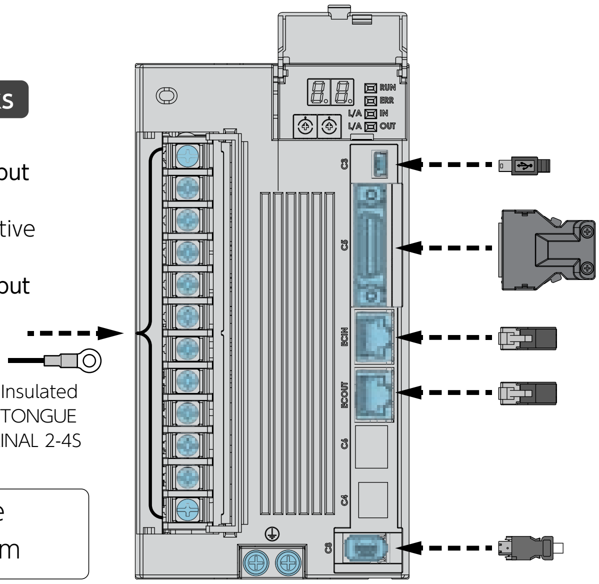
DG010
(DEGSON Electronics Co.,Ltd.)

*) A special spring opener commonly used in these connectors is an accessary.
To prevent loss, please store in the designated place after use.

3. Wiring to Connectors and Signals

Amplifier Connectors Pinout

Model 850 W DB65B42 1.3 kW DB67C42 1.5 kW DB66B42 2 kW DB68C42



Terminal blocks

- Main power and Control power input connector
- External regenerative resistor
- Motor power output connector

Vinyl Insulated RING TONGUE TERMINAL 2-4S

Tightening torque 1.0–1.2 N·m

C3 USB connector

C5 User I/O connector

ECIN EtherCAT Input

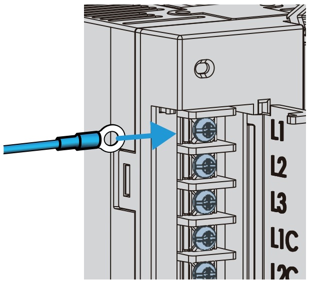
ECOUT EtherCAT Output

C8 Encoder connector

The 850 W and 1.3 -2 kW amplifiers shapes are all the same.

Terminal blocks

- Main power and Control power input connector
- External regenerative resistor
- Motor power output connector



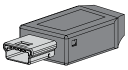
Signal	Description
L1	Main Power (Main Circuit)
L2	Main Power (Main Circuit)
L3	Main Power (Main Circuit)
L1C	Main Power (Control Circuit)
L2C	Main Power (Control Circuit)
P	External Regenerative resistor connection (+)
RB	(No Connect)
B	External Regenerative resistor connection (–)
N	(No Connect)
U	Motor power U-phase
V	Motor power V-phase
W	Motor power W-phase

Amplifier Connectors Pinout

All amp. models 50 W | 100 W | 200 W | 400 W | 750 W | 850 W | 1 kW | 1.3 kW | 1.5 kW | 2 kW

C3

USB connector

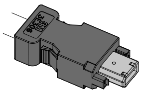


USB mini B

Pin No.	Signal	Description
1	VBUS	USB power supply +5 V
2	D−	USB data −
3	D+	USB data +
4	−	(No Connect)
5	SG	USB signal ground

C8

Encoder connector

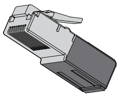


Connector: 3E206-0100KV (3M)
Cover: 3E306-3200-008 (3M)
Wires: AWG22 (Power), AWG24 (Signal)

Pin No.	Signal	Description
1	VCC	Encoder power supply +5 V
2	SG	Signal ground
3, 4	−	(No Connect)
5	+D	Encoder signal data +
6	−D	Encoder signal data −
SHELL	FG	SHIELD wired to the connector casing

ECIN **ECOUT**

EtherCAT Connector



RJ45

Pin No.	Signal	Description
1	TX+	Transmit / Receive data +
2	TX−	Transmit / Receive data −
3	RX+	Receive / Transmit data +
4, 5	−	(No Connect)
6	RX −	Receive / Transmit data −
7, 8	−	(No Connect)
SHELL	FG	SHIELD wired to the connector casing

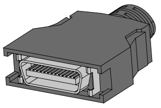
Be sure to use TIA/EIA -568 Category 5 e or higher (Shielded) cables.

3. Wiring to Connectors and Signals

Amplifier Connectors Pinout

C5

User I/O connector



(26 pin)

Connector 10126-3000-PE (3M)
Cover 10326 (3M)
or Equivalent alternatives
Wires : AWG26

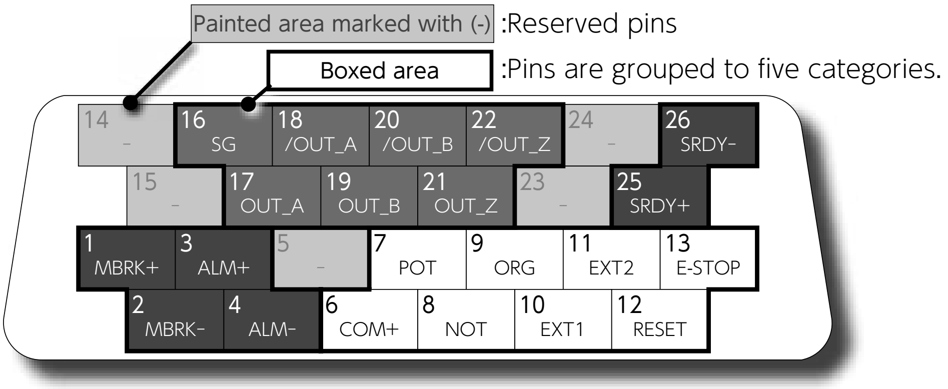
Pinout Diagram

A pinout diagram of C5 connector pinout. Pins are grouped to three categories.

Pins Group	Description
General-Purpose Input INPUT	Input terminals connecting from the host controller, such as I/O power, and control signals. You can change the input logic. (*)
General-Purpose Output OUTPUT	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.

*) ☞ P. 30 Descriptions of C5 Connector Signals

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



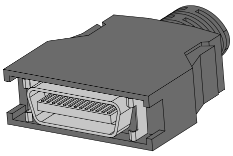
C5 Connector Wiring Example

Example of C5 Connector wiring.
For actual wiring, check the pin numbers etched on the connector body as well.
For further details, refer to Descriptions of C5 Connector Signals and Interface Circuit of C5 Connector.

☞ P. 30 Descriptions of C5 Connector Signals
☞ P. 36 I/F Circuit of C5 Connector

C5 User I/O Connector

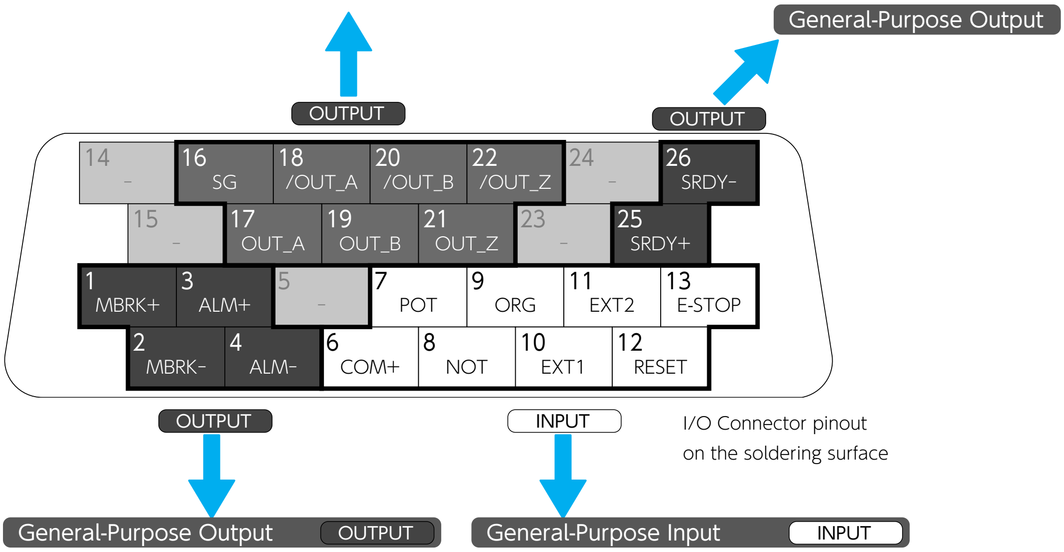
Pinout Diagram



Connector 10126-3000-PE (3M)
Cover 10326 (3M)
or Equivalent alternatives
Wires : AWG26

Encoder Output

Pin No.	Signal Description
16	**SG** Signal ground
17	**OUT_A** A-phase
18	**/OUT_A** /A-phase
19	**OUT_B** B-phase
20	**/OUT_B** /B-phase
21	**OUT_Z** Z-phase
22	**/OUT_Z** /Z-phase



I/O Connector pinout
on the soldering surface

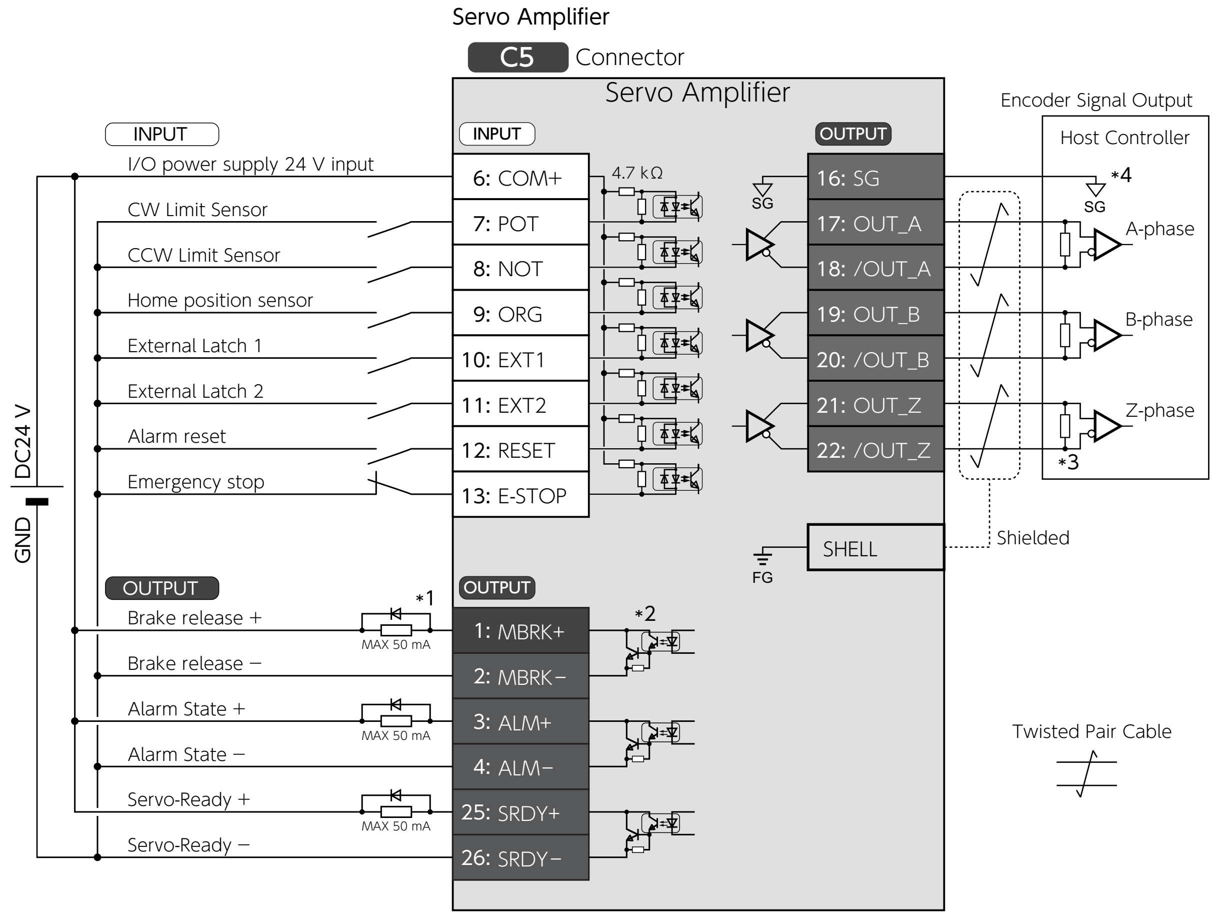
General-Purpose Output OUTPUT

Pin No.	Signal Description
1	**MBRK+** Brake release +
2	**MBRK−** Brake release −
3	**ALM +** Alarm status +
4	**ALM−** Alarm status −
25	**SRDY +** Servo ready +
26	**SRDY−** Servo ready −

General-Purpose Input INPUT

Pin No.	Signal Description
6	**COM+** I/O Power 24 V
7	**POT** CW Limit Sensor
8	**NOT** CCW Limit Sensor
9	**ORG** Home position sensor
10	**EXT1** External Latch 1
11	**EXT2** External Latch 2
12	**RESET** Alarm reset
13	**E-STOP** Emergency stop

C5 Connector Wiring Example



*1) 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.

☞ P. 37 PO Connections to General-Purpose Output Signal

*2) 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.

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

*4) 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.

How to allocate I/O functions

I/O function allocation is available in "Free Mapping".
Launch S-TUNE II and click on the "Auxiliary Functions" tab, then click on "I/O Settings".
Click the "Function Button" of the pin number to be changed and set the I/O function assignment.

☞ **D- 2 Operations**

I/O free mapping

The following products support the I/O free mapping function.

Supported Products	Version
PC Software S-TUNE Ⅱ	**2.3.0.0** or later
Servo amplifier S-FLAG II **DB6**42** series	**6.1.0.1** or later

Make sure to assign functions by I/O free mapping after completing tuning and test operation with S-TUNE II.

After changing the I/O function assignment, amplifier operation cannot be performed from S-TUNE II. (*)

---

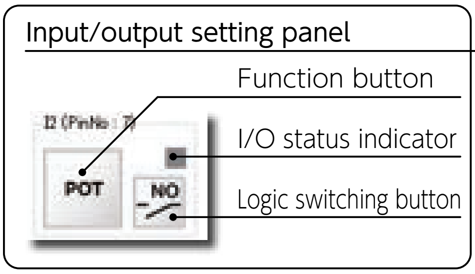
*) When the I/O function assignment is changed, the internal processing of S-TUNE II results in a mismatch with the I/O commands sent to the amplifier.
Note that this is a design specification and is not a product abnormality.

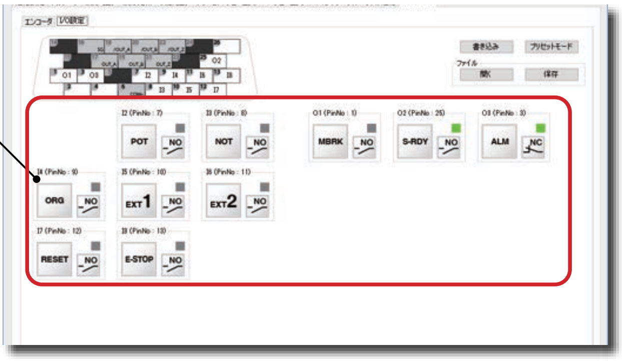
Start

1 Click on the button.: I/O free mapping mode

The amplifier must be rebooted to switch to I/O free mapping mode.

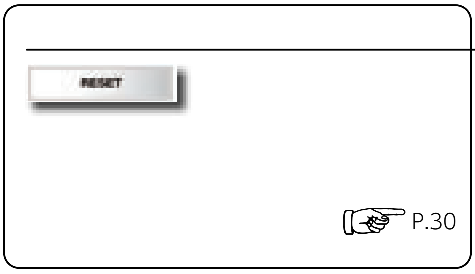
2 Function selection screen is available by clicking on the button corresponding to each pin.





The "I/O Settings" panel of the S-TUNE II

3 Select a function.



☞ P.30

Function selection panel

4 Click on the button.: Write

The amplifier should be restarted after the I/O allocation is changed.

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

Finished

3. Wiring to C1 and C2 connectors, or Terminal Blocks

DANGER

Be sure to follow the following precautions when wiring to the C1 and C2 connectors.

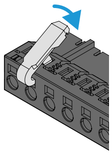
- Be sure to disconnect the connector from the amplifier before wiring.
- Insert one cable at each wire insertion point.
- When inserting the cable, be careful not to let the whiskers of the wires protrude from the wire insertion port, and do not touch other wires or electrodes.
- Connect the power to the amplifier after all wiring is completed.

1 Trimming the cable wrap.

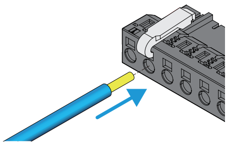
C1 and C2 connector: 50 W | 100 W | 200 W | 400 W | 750 W | 1 kW

2 Amplifiers of 1 kW and 750 W or less are wired to C1 and C2 connectors.
Remove the C1 and C2 connectors from the amplifier.

3 Attach the spring opener to the connector and press it down.



4 Insert the wires until they meet. Then release the spring opener to fix the wires.

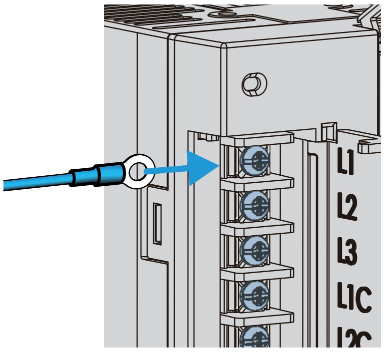


5 Connect the C1 and C2 connectors to the amplifier.

Terminal Blocks: 850 W | 1.3 kW | 1.5 kW | 2 kW

2 Amplifiers of 850 W and 1.3 kW or higher are screw terminals.
Connect the cable with round terminals.
Recommended Terminal:
2 -4 S Round Terminal with Insulation

3 Tighten the round terminals.
(tightening torque of 1.0 -1.2 N·m.)



4. Descriptions of C5 Connector Signals

Review the functions of each pin of C5 connector before using the product.

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

For the diagram, refer to this page

Pin number on C5

Pin No. 9	I/F Circuit **PI** (P. 36)
Signal	Descriptions
PN INPUT **ORG** Home Sensor	OPEN Home sensor has not been detected. CLOSED 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.

Indicates signal behaviors.

INPUT

- OPEN

  No contact with COM−

- CLOSED

  Contact with COM−

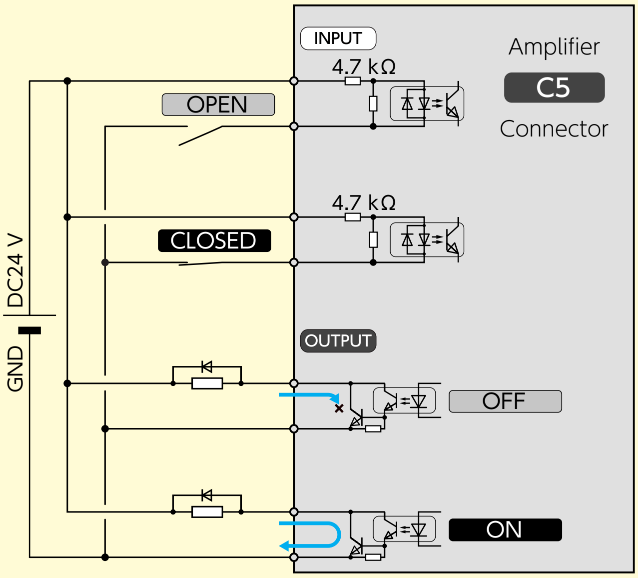
OUTPUT

- OFF

  Output transistor OFF

- ON

  Output transistor ON



General-Purpose Output

Pin No.	1, 2	I/F Circuit	PO (P. 37)
Signal		Descriptions	
OUTPUT **MBRK+** (Pin No.1) **MBRK−** (Pin No.2) Brake Release		OFF Does not release the brake. ON 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.	

Pin No.	3, 4	I/F Circuit	PO (P. 37)
Signal		Descriptions	
OUTPUT **ALM+** (Pin No.21) **ALM−** (Pin No.22) Alarm		OFF In one of the following conditions An alarm is occurring. Control power is not supplied to the amplifier. ON 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. ☞ **Z- 1 Troubleshooting** Alarms and Remedies	

3. Wiring to Connectors and Signals

<table>
<tr><td>Pin No.</td><td>25, 26</td><td>I/F Circuit</td><td>PO (P. 37)</td></tr>
<tr><td colspan="2">Signal</td><td colspan="2">Descriptions</td></tr>
<tr><td colspan="2">PN
OUTPUT
SRDY+ (Pin No.25)
SRDY− (Pin No.26)
Servo ready</td><td colspan="2">OFF
In one of the following conditions
An alarm is occurring.
The primary circuit power is not supplied to the amplifier.

ON
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.</td></tr>
</table>

General-Purpose Input

<table>
<tr><td>Pin No.</td><td>6</td><td>I/F Circuit</td><td>PS (P. 36)</td></tr>
<tr><td colspan="2">Signal</td><td colspan="2">Descriptions</td></tr>
<tr><td colspan="2">COM+
I/O power supply
24 V input</td><td colspan="2">A common power supply for optical isolators of general-purpose input circuit.
Power voltage: DC24 V ± 10%
Use SELV power supply with reinforced insulation that is isolated from hazardous voltages.</td></tr>
</table>

<table>
<tr><td>Pin No.</td><td>7</td><td>I/F Circuit</td><td>PI (P. 36)</td></tr>
<tr><td colspan="2">Signal</td><td colspan="2">Descriptions</td></tr>
<tr><td colspan="2">P⇄N
INPUT
POT
CW Limit Sensor</td><td colspan="2">OPEN
CW Limit Sensor signal input is not detected.
CLOSED
CW Limit Sensor signal input is detected.</td></tr>
</table>

<table>
<tr><td>Pin No.</td><td>8</td><td>I/F Circuit</td><td>PI (P. 36)</td></tr>
<tr><td colspan="2">Signal</td><td colspan="2">Description</td></tr>
<tr><td colspan="2">P⇄N
INPUT
NOT
CCW Limit Sensor</td><td colspan="2">OPEN
CCW Limit Sensor signal input is not detected.
CLOSED
CCW Limit Sensor signal input is detected.</td></tr>
</table>

<table>
<tr><td>Pin No.</td><td>9</td><td>I/F Circuit</td><td>PI (P. 36)</td></tr>
<tr><td colspan="2">Signal</td><td colspan="2">Descriptions</td></tr>
<tr><td colspan="2">P⇄N
INPUT
ORG
Home Sensor</td><td colspan="2">OPEN
Home sensor has not been detected.
CLOSED
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.</td></tr>
</table>

3. Wiring to Connectors and Signals

Pin No. 10, 11	I/F Circuit PI (P. 36)
Signal	Descriptions
INPUT **EXT1** External Latch 1 **EXT2** External Latch 2	OPEN Position feedback data is **not** latched. CLOSED Position feedback data is latched by the timing to which a signal was input.

Pin No. 12	I/F Circuit PI (P. 36)
Signal	Descriptions
INPUT **RESET** Alarm Reset	CLOSED 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. ☞ **Z- 1 Troubleshooting** Alarms and Remedies

Pin No. 13	I/F Circuit PI (P. 36)
Signal	Descriptions
INPUT **E-STOP** Emergency Stop	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. ☞ **Z- 2 Technical Information** Functions

3. Wiring to Connectors and Signals

Encoder Output

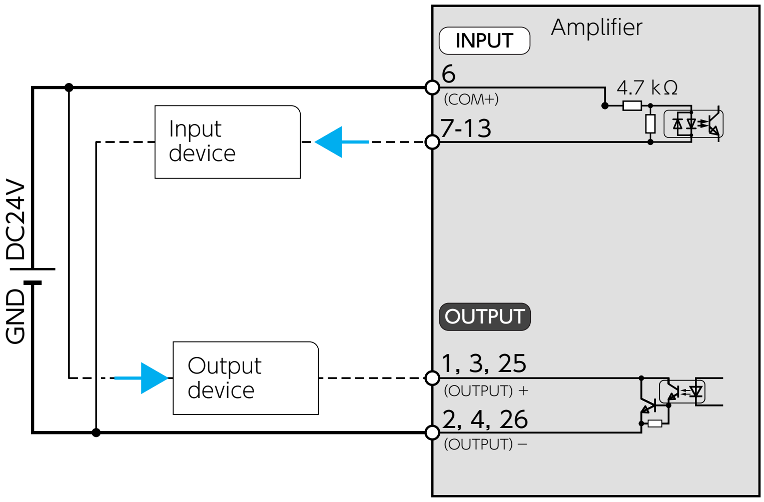
Pin No.	16–22	I/F Circuit	EO (P. 38)

Signal	Descriptions
OUT_A (Pin No.17) **/OUT_A** (Pin No.18) A-phase output **OUT_B** (Pin No.19) **/OUT_B** (Pin No.20) B-phase output **OUT_Z** (Pin No.21) **/OUT_Z** (Pin No.22) Z-phase output **SG** (Pin No.16) Signal ground	**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.

5. C5 I/F Circuit

PS Connection to DC24V Power Supply

Connect I/O power supply.



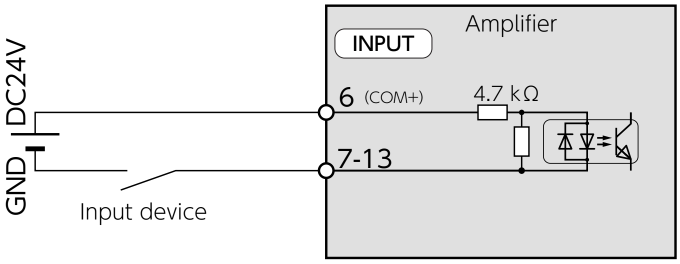
PI Connections to General-Purpose Input Signal

Pin No.6

Connect to I/O power supply. Use power supply of 24 V ± 10%.

Pin No.7 to No.13

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.

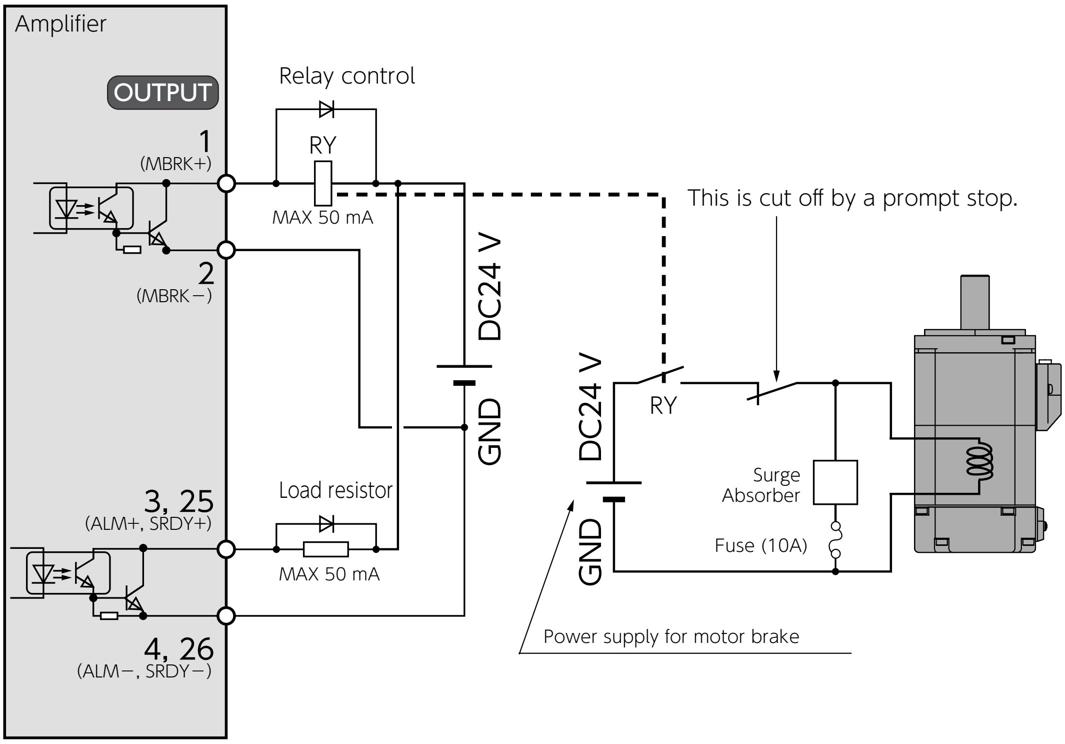


PO Connections to General-Purpose Output Signal

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.
The emitter side of the output transistor is independent.



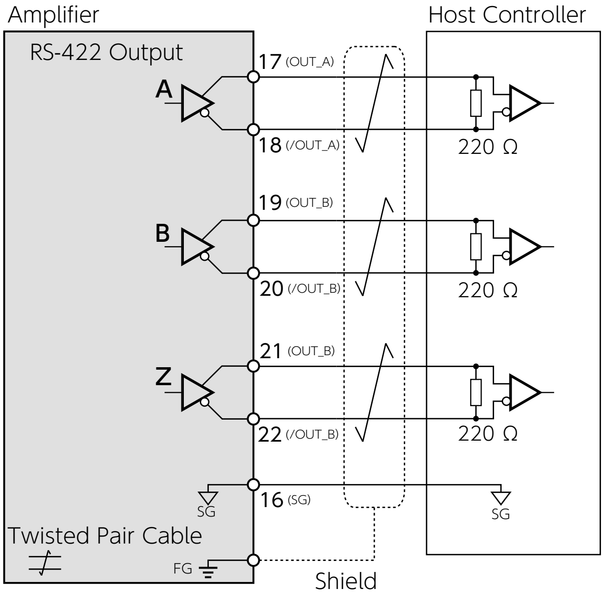
3. Wiring to Connectors and Signals

EO Connection to Encoder Output Circuit

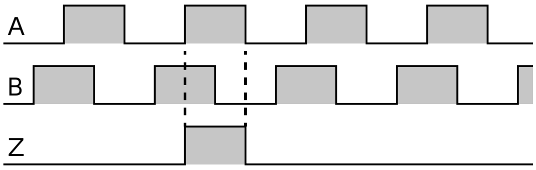
Differential output of encoder signal (A-phase, B-phase, Z-phase) which has been processed with pulse division ratio.

Be sure to connect a termination resistor to the receiver circuit of the host controller.
Approximately 220 Ω (1/4 W 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.16.

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



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



4. Cables

Recommended cable wires

Connection cables required for this product are sold separately. Those can be purchased at the MISUMI online store.
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°C	300 V	
Motor power (≧ 850 W)	14	2517	105°C	300 V	AWG16 wires can be used only for 1 kW motors
Main circuit power (Including FG cable)	14	1015	105°C	600 V	AWG16 wires can be used only for 1 kW motors.
Control circuit power	18	1015	105°C	600 V	
Encoder	Power : 22 Signal : 24	20276	80°C	30 V	Shielded twisted pair cables of length no exceeding 20 m
User I/O	26	1007	80°C	300 V	Shielded twisted pair cables of length no exceeding 2 m
Regenerative resistor	18	1015	105°C	600 V	
Brake	18	2517	105°C	300 V	2-core cable

Cable Name	Specification	Note
EtherCAT communication	CAT5e	Shielded cable is recommended

4. Cables

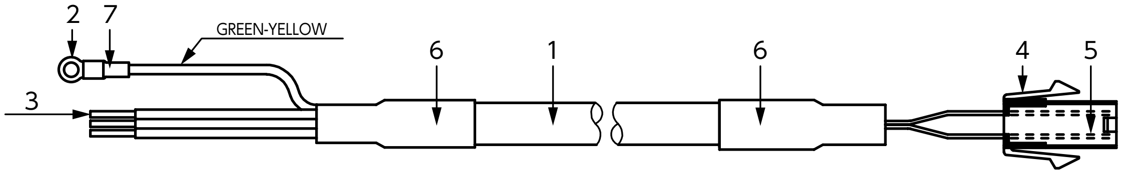
Motor Power Cable

Motor rated output power: 50 W | 100 W | 200 W | 400 W | 750 W | 850 W | 1 kW | 1.3 kW | 1.5 kW | 2 kW

MX951

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)

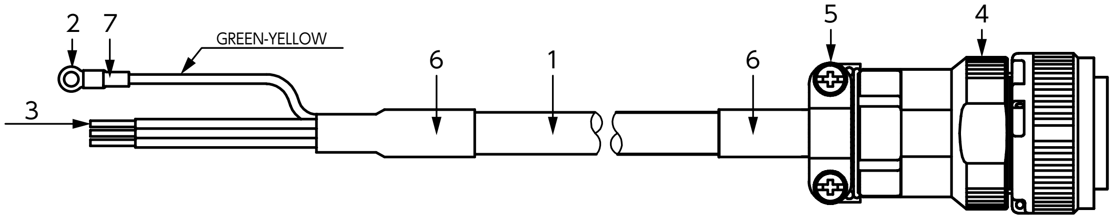
Motor Power Cable

Motor rated output power: 50 W | 100 W | 200 W | 400 W | 750 W | 850 W | 1 kW | 1.3 kW | 1.5 kW | 2 kW

MX102
MM102
MH102

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)

4. Cables

Encoder Cable

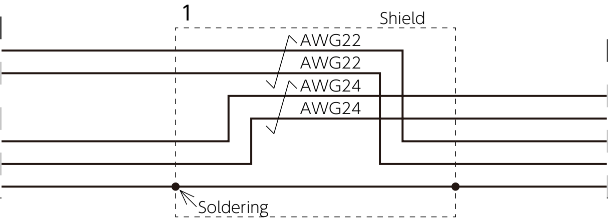
Motor rated output power: 50 W | 100 W | 200 W | 400 W | 750 W | 850 W | 1 kW | 1.3 kW | 1.5 kW | 2 kW

MX951

(Incremental)

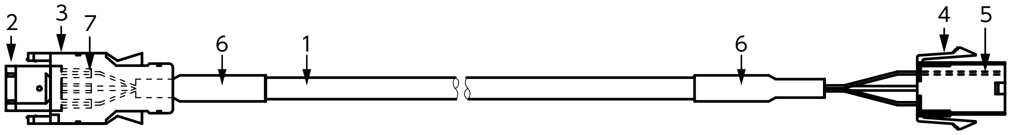
2 HOUSING

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

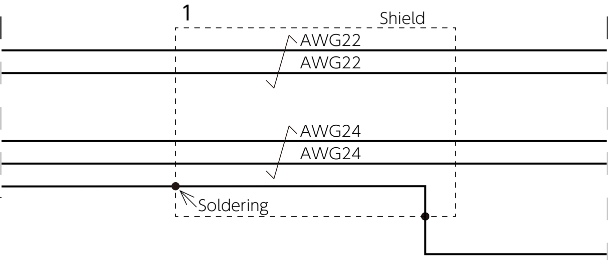
Motor rated output power: 50 W | 100 W | 200 W | 400 W | 750 W | 850 W | 1 kW | 1.3 kW | 1.5 kW | 2 kW

**MX102
MM102
MH102**

(Incremental)

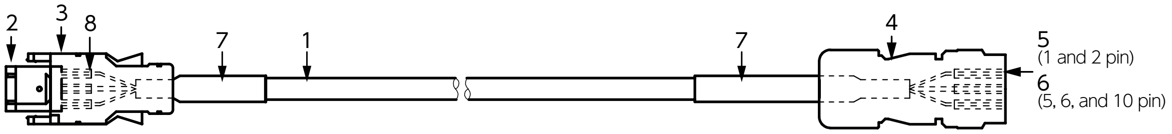
2 HOUSING

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

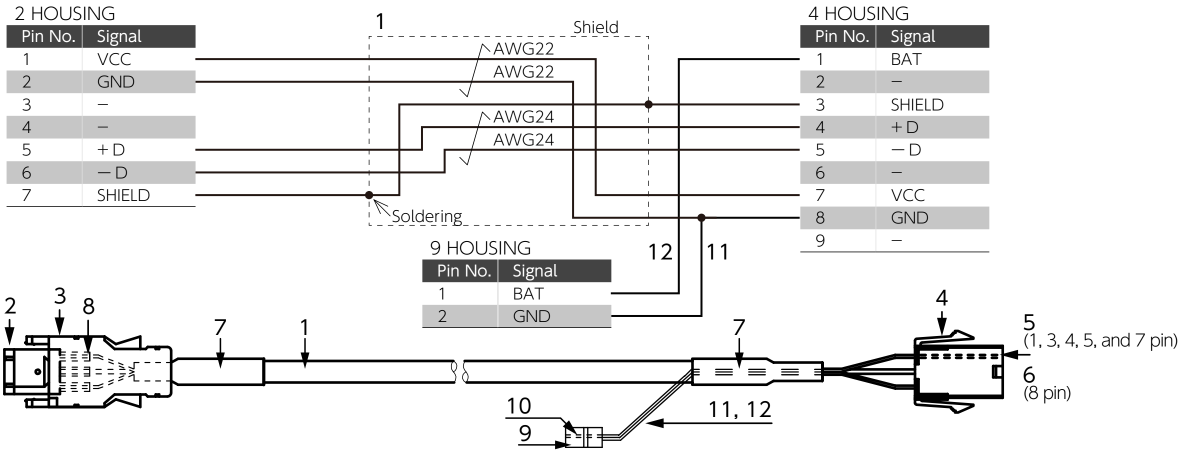
4. Cables

Encoder Cable

(Absolute)

Motor rated output power: 50 W | 100 W | 200 W | 400 W | 750 W | 850 W | 1 kW | 1.3 kW | 1.5 kW | 2 kW

MX951 (1 kW)



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

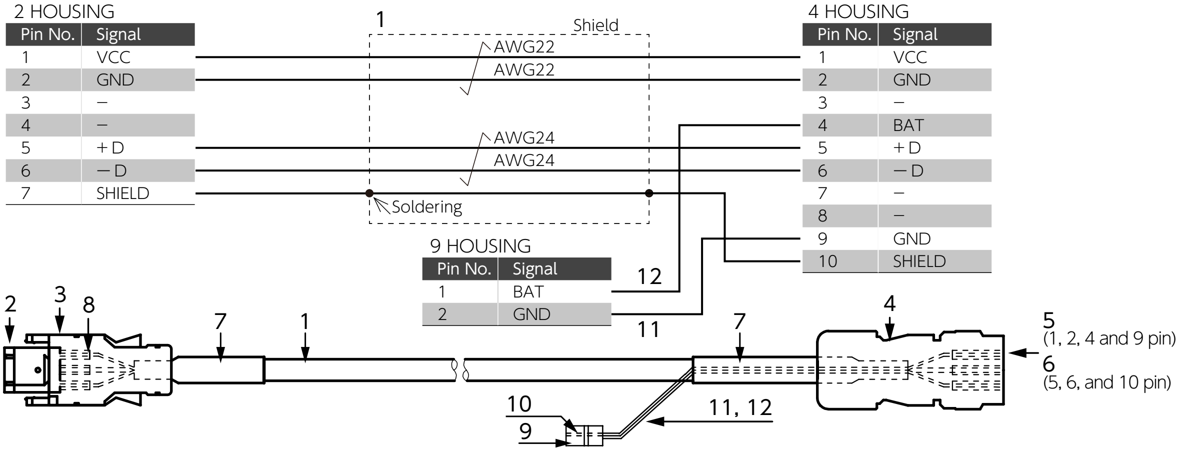
Pin No.	Signal
1	BAT
2	GND

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

(Absolute)

Motor rated output power	50 W	100 W	200 W	400 W	750 W	850 W	1 kW	1.3 kW	1.5 kW	2 kW
							MX102 MM102 MH102			



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

4. Cables

Brake Cable

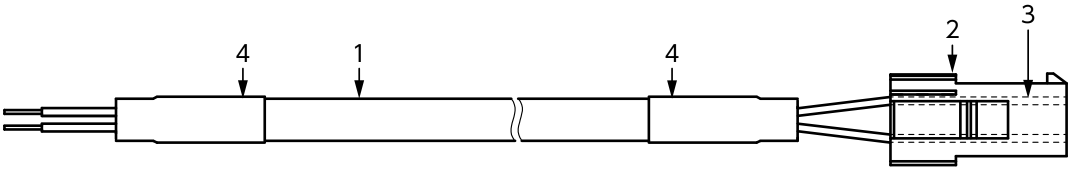
Motor rated output power

50 W 100 W 200 W 400 W 750 W 850 W 1 kW 1.3 kW 1.5 kW 2 kW

MX951

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

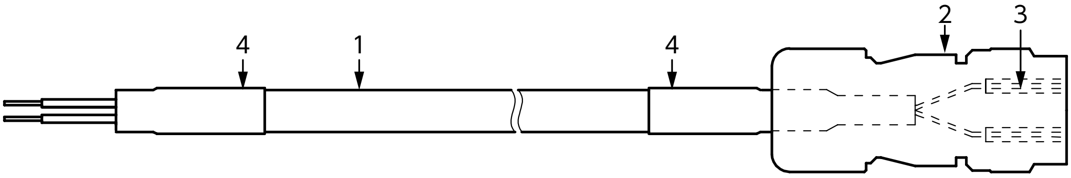
Motor rated output power

50 W 100 W 200 W 400 W 750 W 850 W 1 kW 1.3 kW 1.5 kW 2 kW

MX102
MM102
MH102

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

S-FLAG Ⅱ　Instruction Manual
- EtherCAT -

C

PARAMETERS

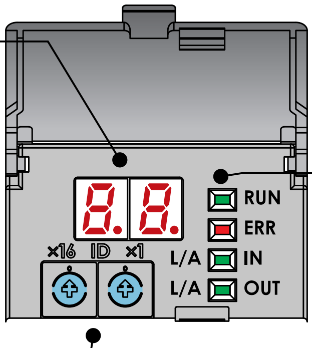
AMO-NP-35475-42
SF2-E-C
APR. 2023

MEMO

1

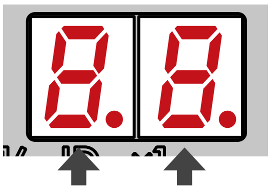
Setup Panel

1. Names of Parts



7-segment display

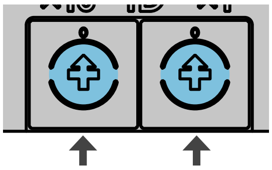
2-digit
EtherCAT node address
Status (Alarm and Warning)
Servo status



Rotary Switch

Setting the EtherCAT node address

Left Switch: Setting the 10th place of node address
Right Switch: Setting the 1st place of node address



Set the node address before turning on the power.

EtherCAT Status Indicator LED

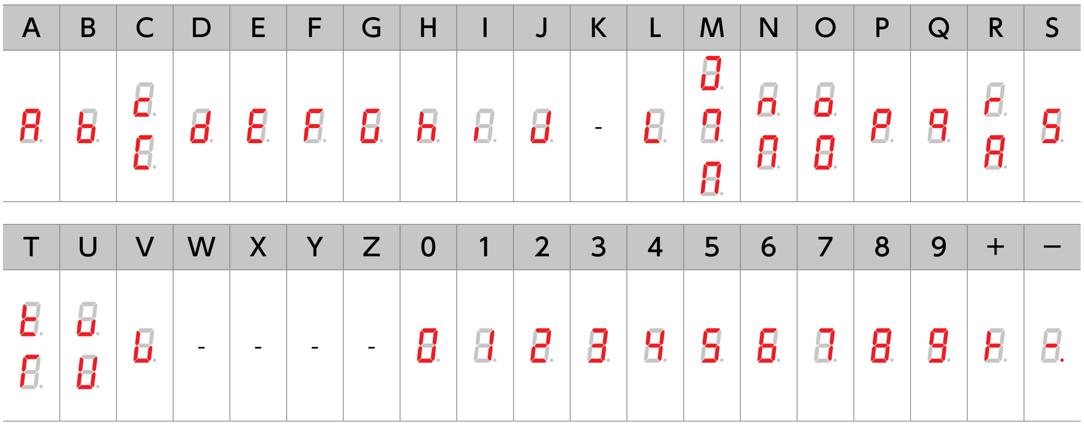
RUN(Green)
This shows an operational status of a servo amplifier.

ERR(Red)
It lights up when an error occurs.

L/A IN (Green) Link/Activity IN
This shows the EtherCAT communication state.

L/A OUT(Green) Link/Activity OUT
This shows the EtherCAT communication state.

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	+	–
			-	-	-	-												

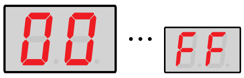
1. Setup Panel

2. Functions — 7-segment display

When the control power supply is turned on, the following items are displayed on the 7-segment display.

Turn on the control power

EtherCAT Communication node address



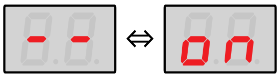
Displays the node address of the EtherCAT communication.

Displays for approximately 2 seconds.

If an alarm occurs when the amplifier is started, the node address is not displayed.

2 seconds later

Servo Status

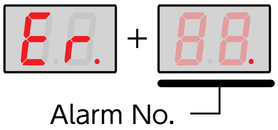


Indicates the servo status of the amplifier.

It is not displayed when an alarm occurs.

- - Servo **OFF**   on Servo **ON**

Alarm Status

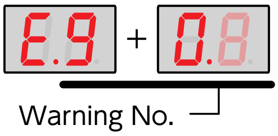


Displays the alarm number that has occurred.

The alarms are from No. 00 to No. 34.

☞ Z- 1 Troubleshooting

Warning Status



Displays the warning number that has occurred.

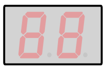
The warnings are from No. 900 to No. 904.

☞ Z- 1 Troubleshooting

How to distinguish by lighting a period

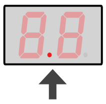
You can identify the status displayed by the lighted position of the period segment.

Node address



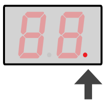
No period LED lights up

Warning



The left side period LED lights up.

Alarm

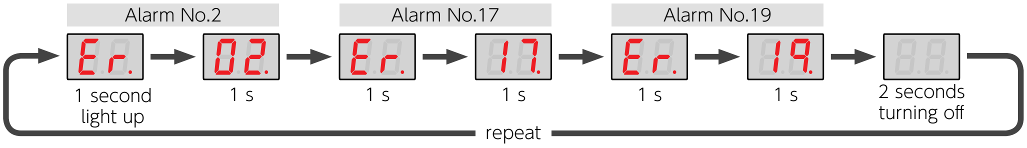


The right side period LED lights up.

How to display multiple alarms and/or warnings

When multiple alarms (and /or warnings) are generated, the alarm is displayed at one-second intervals.
When all alarms are displayed, the lamp goes off for 2 seconds and the alarm is displayed repeatedly.

Example) When alarm No. 2, No. 17 or No. 19 is happening



MEMO

2

Parameters

1. Introduction

Remark

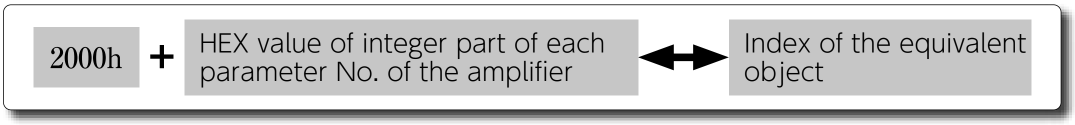
Some of the tuning parameters are dependent on the settings of other parameters, which makes the values of dependent parameters invalid even if they are within the specification range.

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

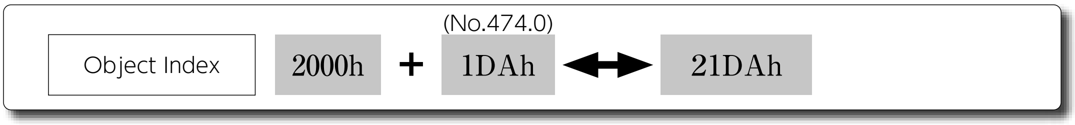
How to access amplifier parameters

The amplifier parameters are assigned to the object dictionary (2000h series).

Object Index equivalent to the amplifier parameter No.

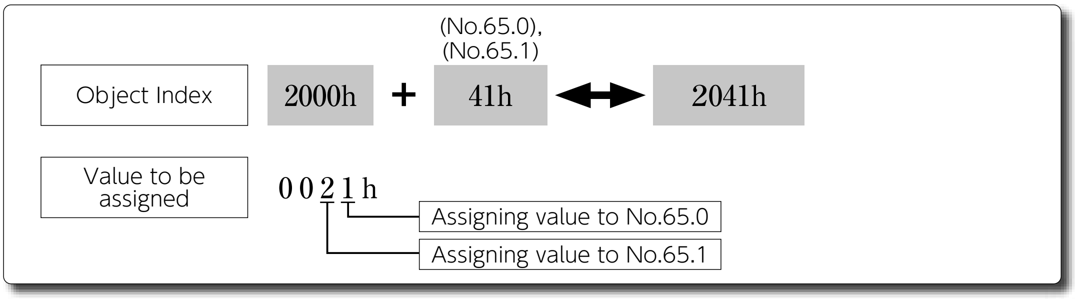


Example1: Amplifier parameter No. 474.0



Example 2: Sub parameters which are separated by 4 bits

The object indexes are grouped into a single object.
To assign "1" to No.65.0 and "2" to No.65.1, set them all at once.



1. Introduction

How to change the amplifier parameters stored in 2000h-2FFFh

When the amplifier is booted up, the parameters 2000h-2FFFh are automatically loaded into the object dictionary from the amplifier. The busy flag of 2FFFh is set to "1" while loading.
To change the parameters, make sure that the Busy flag is set to "0", and then follow the procedure below.

1 Check the bit8(busy bit) in object 2FFFh.

Parameter access is inhibited until bit8 is turned to "0".

bit8	Status	Parameter access
0	not busy	Permitted
1	busy	NOT Permitted

2 Write a value to each object to be changed.

3 Set "2 (=0010(b))" to the control command of object 2FFFh.

Transfers and stores the values from the object dictionary (0x2000-0x2FFE) to the servo amplifier.

After writing data to the amplifier, restart the amplifier.

Tip !

NOTE on changing amplifier parameters

After the amplifier is started and EtherCAT communication is established, it may take some time before parameter access is permitted. (about 5 seconds)

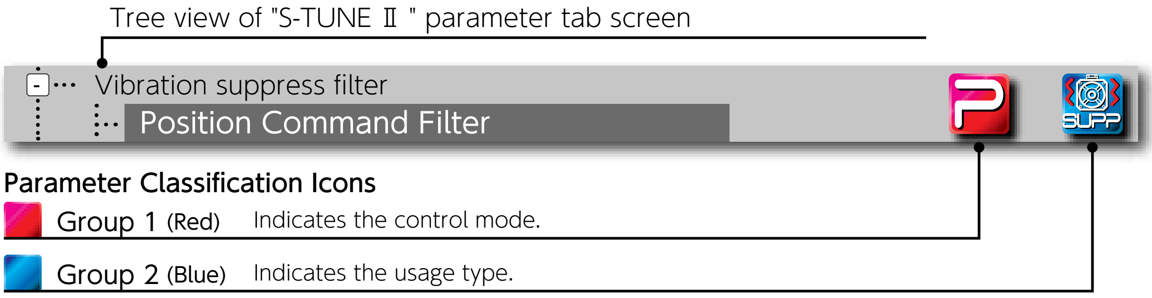
Parameter access with object 2FFFh is permitted only when the servo is OFF.
(This means that the CiA402 status is "Ready To SwitchON" or lower.)

The object 2FFFh accesses only objects in the 2000h series, and 6091h.

1. Introduction

Overview of the parameter list

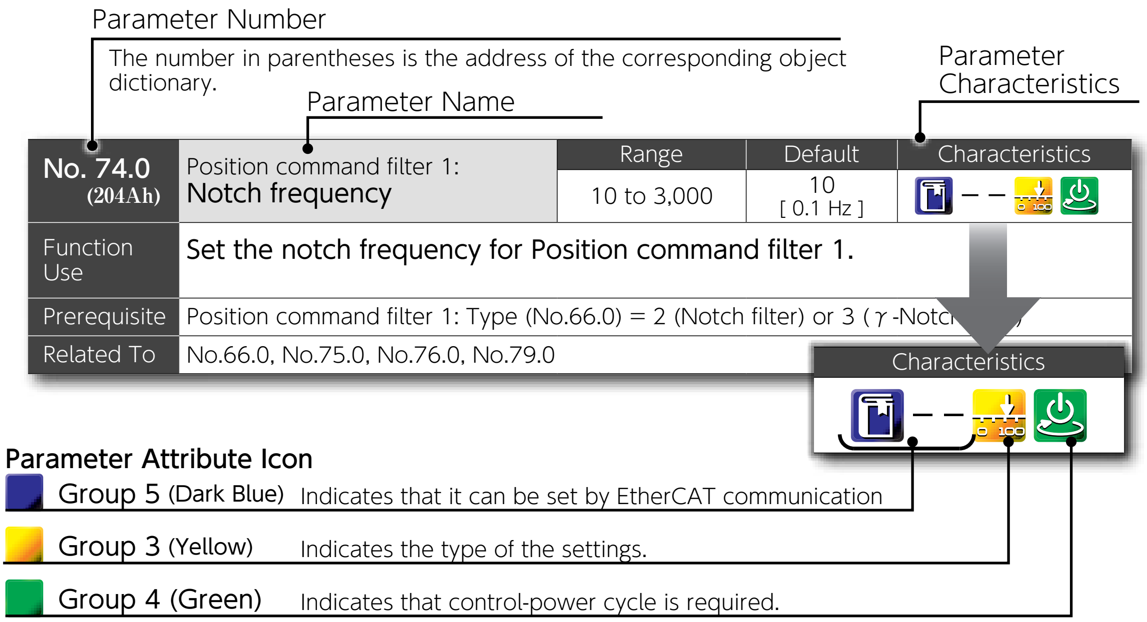
Title Header



Parameter Classification Icons

🟥	Group 1 (Red)	Indicates the control mode.
🟦	Group 2 (Blue)	Indicates the usage type.

Parameter Description



The number in parentheses is the address of the corresponding object dictionary.

No. 74.0 (204Ah)	Position command filter 1: Notch frequency	Range	Default	Characteristics
		10 to 3,000	10 [0.1 Hz]	🟦 – – 🟨 🟩
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 -Notc)			
Related To	No.66.0, No.75.0, No.76.0, No.79.0			

Parameter Attribute Icon

🟦	Group 5 (Dark Blue)	Indicates that it can be set by EtherCAT communication
🟨	Group 3 (Yellow)	Indicates the type of the settings.
🟩	Group 4 (Green)	Indicates that control-power cycle is required.

Tip!

NOTE on initial values

The initial values of each parameter described in this document are the values when the amplifier is not being connected to a master device.

Once the amplifier communicates with the master device, the parameters are overwritten with the values set by the master device. Therefore, the parameter values read out may be different from those initial values described in this manual, but this is not a problem.

1. Introduction

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)	⚙	Basic	Used for all Control Modes
	P	Position Control Mode	Used for Position Control Mode
	V	Velocity Control Mode	Used for Velocity Control Mode
	T	Torque Control Mode	Used for Torque Control Mode
2 (Blue)	▶ CTRL	Operation Control	Used for setting the operation method.
	STOP	Stop Setting	Used for configuring Stop processes in case of emergency or drive restriction
	TUNE	Tuning Parameters	Gain parameters that require Tuning
	HOME	Homing	Used for positioning operation in Position Control Mode
	ALM	Alarm Detection	Used for configuring Alarm Detection and Timing of Alarm Detection
	IN POS	Position Control Internal Command	Used for Internal Position Command in Position Control Mode
	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)	CAT	EtherCAT Communication	These parameters allow access to the amplifier via EtherCAT communication.
		Object Dictionary	These parameters are related to the EtherCAT communication object dictionary.
	🚫	Hide	These parameters are hidden by S-TUNE Ⅱ during EtherCAT communication.
	🔒	Read Only	These parameters cannot be written from S-TUNE Ⅱ to the amplifier during EtherCAT communication.

2. List of Parameters

1. In the order of S-TUNE Ⅱ display

Basic Parameters

Name				EtherCAT		No.
Basic Settings	Control mode			–		2.0
	Command mode			–	🔒	3.0
	Torque command limit	Switch		–	🔒	144.0
		Torque limit output		–	🔒	144.1
		Value 1		–	🔒	147.0
	Torque command offset			2092h		146.0
	Servo OFF: Delay time			20EDh		237.0
	Brake release: Delay time			20EEh		238.0
	Absolute system			2101h		257.0
	E-pulse output	C-pulse ratio	Numerator	–		276.0
			Denominator	–		278.0
	Power supply	AC/DC		2130h		304.0
		Single-phase/Three-phase		–		304.1
	Auto notch-filter	Selection		–		409.1
	Wraparound	Switch		2021h		33.1
		Minimum value		607Bh		458.0
		Maximum value		607Bh		460.0
	Multi-turn limit	Value		21D8h		472.0
		Notification to Encoder		21D9h		473.0
☞ P.16–	EtherCAT Communication - "Digital inputs" I/O mapping setting			21DAh		474.3
Stop Settings	Drive Restriction Input	Setup		2043h		67.0
		Deceleration method		2043h		67.1
		Standstill state		2043h		67.2
		Keep position deviation counter		2043h		67.3
	Deceleration stop	At Servo Off	Method	20E0h		224.0
			DBRK output after stopping	20E0h		224.3
		When alarm is on	Method	20E9h		233.0
			DBRK output after stopping	20E9h		233.3
		Release conditions		20E0h		224.1
		Working time		20E2h		226.0
		Cancellation speed		20E3h		227.0
		In case of control power error	Switch	20E0h		224.2
			Working time	20E4h		228.0
		Status during free-run		20E8h		232.1
		Brake engagement	Timing	20E8h		232.3
			Delay time	20EAh		234.0
☞ P.23-			Rotational speed	20EBh		235.0

2. List of Parameters

In the order of S-TUNE Ⅱ display

Basic Parameters

Name				EtherCAT		No.
Stop Settings	Immediate Stop	Torque command limit		–		151.0
		Smoothing filter	Switch	20E1h		225.2
			Moving average counter	20E5h		229.0
		Short brake operation after a stop		20E8h		232.2
		Time extension		20ECh		236.0
		Deceleration time		20EFh		239.0
☞ P.23-	Emergency Stop (*1)	Warning output	Switch	20E1h		225.0
			Timing	20E1h		225.1
Error detection settings	Warning latch time			200Ch		12.0
	Alarm output timing			200Dh		13.0
	Position deviation Error detection	Switch		2041h		65.0
		Value		6065h	🔒	87.0
		Delay time		–		89.0
	Position deviation Warning detection	Value		216Bh		363.0
		Delay time		206Dh		365.0
	Speed deviation Error detection	Switch		2041h		65.1
		Value		205Ah		90.0
		Delay time		205Bh		91.0
	Emergency stop	Warning output	Switch	20E1h		225.0
			Timing	20E1h		225.1
	Encoder	Overheat detection	Switch	2103h		259.0
			Value	210Bh		267.0
		Battery Voltage drop detection	Switch	2103h		259.1
			Value	210Ch		268.0
		Motor rotating position at encoder error	Holding method	2178h		376.0
			Holding time	2179h		377.0
	Voltage Sag Detection Delay time			2131h		305.0
	SRDY detection	Switch		–		374.0
	Vibration detection	Switch		–		400.0
	EtherCAT communication setting			21DAh		474.0
☞ P.32-	Internal position - Overflow detection(*2)			–		643.0

This list may be different from the order in which S-TUNEII displays it.

*1) This parameter is described in "Error detection setting".

*2) This parameter is described in "Position Control Mode / Internal Position Command".

In the order of S-TUNE Ⅱ display

Position Control Mode

Name				EtherCAT	No.
Position Command input ☞ P.37-	EtherCAT communication	Rotational direction		2020h	32.1
		Paired ratio	Interpolation	2020h	32.2
			Numerator	6091-01h	34.0
			Denominator	6092-02h	36.0
		Feed-forward delay compensation		2042h	66.3
Tuning Parameters	Tuning	Inertia ratio		2066h	102.0
		Damping ratio		2067h	103.0
		Inertia ratio upper bound		206Ah	106.0
		Mode switch		206Eh	110.0
		Tuning items		206Eh	110.1
		Control gain set	Automatic switch	2078h	120.0
			Upper bound	2078h	120.1
			Tuning constant	2079h	121.0
	Gain parameter	Control gain set		2071h	113.0
		Inertia conditions		2071h	113.1
		Control level		2072h	114.0
		Control gain 1		2073h	115.0
		Control gain 2		2074h	116.0
		Gain FF compensation 1		2075h	117.0
		Gain FF compensation 2		2076h	118.0
		Integral gain		2077h	119.0
	Quadrant glitch compensation	Switch		–	145.0
		Compensation rate (CCW)		–	153.0
		Compensation rate (CW)		–	154.0
		Compensation delay time (CCW)		–	155.0
		Compensation delay time (CW)		–	156.0
		Peak time		–	427.0
☞ P.40-	Current control gain			20C1h	193.0

The point table parameters for internal position control are not displayed on the parameter tab screen of S-TUNE Ⅱ.
These parameters are displayed in the Point Table tabbed screen. See page 54 and later for detailed descriptions of the parameters.

2. List of Parameters

Name			EtherCAT		No.
Homing HOME	Home reference signal selection		–	🚫	645.0
	Encoder Z-phase selection		–	🚫	645.1
	Re-detection of home position dog		–	🚫	645.3
	Direction		–	🚫	646.0
	Sensor dog polarity		–	🚫	646.1
	Timeout	Switch	–	🚫	646.2
		Time	–	🚫	659.0
	Torque command limit	Switch	–	🚫	647.0
		Value	–	🚫	656.0
	Time to detect press stopper		–	🚫	655.0
	Creeping speed switch		–	🚫	647.1
	Homing speed		–	🚫	648.0
	Creep speed		–	🚫	649.0
	Acceleration/Deceleration time		–	🚫	650.0
	Amount of home position shift		–	🚫	651.0
	Home position data		–	🚫	653.0
☞ P.48-	Z-phase invalidation distance		–	🚫	657.0

2. List of Parameters

In the order of S-TUNE Ⅱ display

Velocity Control Mode

Name			EtherCAT			No.
Velocity Command Input ☞ P.60-	EtherCAT communication	Rotational direction	203Eh			62.0
Tuning Parameters ☞ P.61-	Tuning Parameter (*)	Inertia ratio	2066h			102.0
		Damping ratio	2067h			103.0
		Inertia ratio upper bound	206Ah			106.0
		Mode switch	206Eh			110.0
		Items	206Eh			110.1
	Gain Parameter	Control gain set	2081h			129.0
		Control level	2082h			130.0
		Control gain 1	2083h			131.0
		Gain FF compensation 1	2084h			132.0
		Integral gain	2085h			133.0
	Current control gain		20C1h			193.0

*) These parameters are common to the position control mode. For details of each parameter, refer to the corresponding page of the position control mode.

Torque Control Mode

Name			EtherCAT			No.
Torque Command Input ☞ P.63-	EtherCAT communication	Rotational direction	212Eh			302.0
		Speed Limit	6080h		🔒	152.0

2. List of Parameters

In the order of S-TUNE Ⅱ display

Vibration Suppress Filter

P V T

Name			EtherCAT	No.
Position Command Filter (*) SUPP	Filter 1	Selection	2042h	66.0
		Smoothing 1 Moving average counter	2050h	80.0
		Notch frequency	204Ah	74.0
		Notch width	204Bh	75.0
		High frequency gain	204Ch	76.0
		Notch depth	204Fh	79.0
	Filter 2	Selection	2052h	82.0
		Notch frequency	2053h	83.0
		Notch width	2054h	84.0
		High frequency gain	2055h	85.0
		Notch depth	2056h	86.0
	Filter 3	Selection	2052h	82.1
		Notch frequency	2165h	357.0
		Notch width	2166h	358.0
		High frequency gain	2167h	359.0
		Notch depth	2168h	360.0
	Filter 4	Selection	2042h	66.1
☞ P.64-		Smoothing 2 Moving average counter	2051h	81.0
Torque Command Filter SUPP	Low-pass filter	Switch	20A0h	160.0
		Auto setting	20A0h	160.2
		Time constant	20A2h	162.0
	Notch filter	Switch	20A0h	160.1
		Frequency	20A8h	168.0
		Width	20A9h	169.0
		Depth	20AAh	170.0
	Notch filter 2	Switch	20A0h	160.3
		Frequency	20ABh	171.0
		Width	20ACh	172.0
☞ P.70-		Depth	20ADh	173.0

*) The position command filter is used only in the position control mode.

2. List of Parameters

2. In the order of parameter No.

No.	Name	CAT EtherCAT			☞
2.0	Control mode	–			P. 16
3.0	Command mode	–		🔒	P. 16
12.0	Warning latch time	▣ 200Ch			P. 32
13.0	Timing for alarm output	▣ 200Dh			P. 32
32.1	EtherCAT Communication Position command - Rotational direction	▣ 2020h			P. 38
32.2	EtherCAT Communication - Auto interpolations for paired ratio	▣ 2020h			P. 38
33.1	Wraparound Switch	▣ 2021h			P. 21
34.0	EtherCAT Communication - Paired ratio (Numerator)	▣ 6091h			P. 39
36.0	EtherCAT Communication - Paired ratio (Denominator)	▣ 6091h			P. 39
62.0	EtherCAT Communication Velocity command - Rotational direction	▣ 203Eh			P. 60
65.0	Position deviation excess detection - Switch	▣ 2041h			P. 33
65.1	Velocity deviation error detection - Switch	▣ 2041h			P. 33
66.0	Position command filter 1 - Type	▣ 2042h			P. 64
66.1	Position command filter 4 - Selection	▣ 2042h			P. 64
66.3	EtherCAT Communication - Feed-forward delay compensation	▣ 2042h			P. 39
67.0	Drive restriction input - Setup	▣ 2043h			P. 23
67.1	Drive restriction input - Deceleration method	▣ 2043h			P. 23
67.2	Drive restriction input - Standstill state	▣ 2043h			P. 23
67.3	Drive restriction input - Keep position deviation counter	▣ 2043h			P. 23
74.0	Position command filter 1 - Notch frequency	▣ 204Ah			P. 65
75.0	Position command filter 1 - Notch width	▣ 204Bh			P. 65
76.0	Position command filter 1 - High frequency gain constant	▣ 204Ch			P. 65
79.0	Position command filter 1 - Notch depth	▣ 204Fh			P. 65
80.0	Position command smoothing filter 1 Moving average order	▣ 2050h			P. 66
81.0	Position command filter 4 - smoothing 2 moving average order	–			P. 66
82.0	Position command filter 2 - Type	▣ 2052h			P. 67
82.1	Position command filter 3 - Type	▣ 2052h			P. 67
83.0	Position command filter 2 - Notch frequency	▣ 2053h			P. 67
84.0	Position command filter 2 - Notch width	▣ 2054h			P. 67
85.0	Position command filter 2 - High frequency gain constant	▣ 2055h			P. 68
86.0	Position command filter 2 - Notch depth	▣ 2056h			P. 68
87.0	Position deviation error detection - Value	▣ 6065h		🔒	P. 33
89.0	Position deviation error detection - Delay time	–			P. 33
90.0	Velocity deviation error detection - Value	▣ 205Ah			P. 34
91.0	Velocity deviation error detection - Delay time	▣ 205Bh			P. 34

Icon Description

CAT	EtherCAT Communication	These parameters allow access to the amplifier via EtherCAT communication.
▣	Object Dictionary	These parameters are related to the EtherCAT communication object dictionary.
🚫	Hide	These parameters are hidden by S-TUNE Ⅱ during EtherCAT communication.
🔒	Read Only	These parameters cannot be written from S-TUNE Ⅱ to the amplifier during EtherCAT communication.

2. List of Parameters

In the order of parameter No.

No.	Name	EtherCAT		☞
102.0	Inertia ratio	2066h		P. 40
103.0	Damping ratio	2067h		P. 40
106.0	Tuning - Inertia ratio upper limit	206Ah		P. 40
110.0	Tuning - Mode switch	206Eh		P. 40
110.1	Tuning - Tuning option	206Eh		P. 41
113.0	Position control - Control gain set	2071h		P. 41
113.1	Position control - Inertia condition	2071h		P. 42
114.0	Position control - Control level	2072h		P. 42
115.0	Position control - Control gain 1	2073h		P. 43
116.0	Position control - Control gain 2	2074h		P. 43
117.0	Position control - Gain FF compensation 1	2075h		P. 44
118.0	Position control - Gain FF compensation 2	2076h		P. 44
119.0	Position control - Integral gain	2077h		P. 44
120.1	Tuning - Control gain set upper limit	2078h		P. 45
121.0	Tuning - Tuning Constant	2079h		P. 45
129.0	Velocity control - Control gain set	2081h		P. 61
130.0	Velocity control - Control level	2082h		P. 61
131.0	Velocity control - Control gain 1	2083h		P. 62
132.0	Velocity control - Gain FF compensation 1	2084h		P. 62
133.0	Velocity control - Integral gain	2085h		P. 62
144.0	Torque command limit - Switch	-	🔒	P. 16
144.1	Torque command limit - Torque limit output	-	🔒	P. 17
145.0	Quadrant glitch compensation - Switch	-		P. 46
146.0	Torque command offset	2092h		P. 17
147.0	Torque command limit - Value 1	-	🔒	P. 17
151.0	Immediate stop - Torque command limit	-		P. 24
152.0	EtherCAT Communication Torque command - Speed limit	6080h	🔒	P. 63
153.0	Quadrant glitch compensation - Compensation rate (CCW)	-		P. 46
154.0	Quadrant glitch compensation - Compensation rate (CW)	-		P. 46
155.0	Quadrant glitch compensation - Compensation delay time (CCW)	-		P. 46
156.0	Quadrant glitch compensation - Compensation delay time (CW)	-		P. 46
160.0	Torque command filter - Low-pass filter switch	20A0h		P. 70
160.1	Torque command filter - Notch filter switch	20A0h		P. 70
160.2	Torque command filter - Auto setting	20A0h		P. 70
160.3	Torque command filter 2 - Notch filter switch	20A0h		P. 70
162.0	Torque command filter - Low-pass filter time constant	20A2h		P. 71
168.0	Torque command filter - Notch filter frequency	20A8h		P. 71
169.0	Torque command filter - Notch filter width	20A9h		P. 71
170.0	Torque command filter - Notch filter depth	20AAh		P. 72
171.0	Torque command filter 2 - Notch filter frequency	20ABh		P. 72
172.0	Torque command filter 2 - Notch filter width	20ACh		P. 72
173.0	Torque command filter 2 - Notch filter depth	20ADh		P. 73

2. List of Parameters

In the order of parameter No.

No.	Name	EtherCAT		☞
193.0	Current Control Gain Switch	20C1h		P. 47
224.0	Deceleration stop - Method (at Servo Off)	20E0h		P. 24
224.1	Deceleration stop - Release condition	20E0h		P. 24
224.2	Deceleration stop - Switch (in case of control power error)	20E0h		P. 25
224.3	Deceleration stop - DBRK output after deceleration stop (at Servo Off)	20E0h		P. 25
225.0	Emergency stop - Warning output switch	20E1h		P. 25
225.1	Emergency stop - Timing for alarm output	20E1h		P. 25
225.2	Immediate stop - Smoothing filter switch	20E1h		P. 26
226.0	- Working time	20E2h		P. 26
227.0	Deceleration stop - Rotational speed to end deceleration stop	20E3h		P. 26
228.0	Deceleration stop - Working time (in case of control power error)	20E4h		P. 27
229.0	Immediate stop - Moving average counter for velocity command smoothing filter	20E5h		P. 27
232.1	Deceleration stop - Deceleration stop state during free-run	20E8h		P. 28
232.2	Immediate stop - Short brake after the stop	20E8h		P. 28
232.3	Deceleration stop - Timing for braking	20E8h		P. 28
233.0	Deceleration stop - Method (in case of alarm)	20E9h		P. 29
233.3	Deceleration stop - DBRK output after the stop (in case of alarm)	20E9h		P. 30
234.0	Deceleration stop - Delay time for brake to engage	20EAh		P. 31
235.0	Deceleration stop - Rotational speed to have brake engaged	20EBh		P. 31
236.0	Immediate stop - Time extension	20ECh		P. 31
237.0	Delay time for Servo off	20EDh		P. 18
238.0	Delay time for mechanical brake release	20EEh		P. 18
239.0	Immediate stop - Decelerating time	20EFh		P. 31
257.0	Selection of an encoder system / Absolute system	2101h		P. 18
259.0	Encoder - Overheat detection output switch	2103h		P. 34
259.1	Encoder - Low battery voltage detection output switch	2103h		P. 34
267.0	Encoder - Temperature to detect overheat	210Bh		P. 35
268.0	Encoder - Voltage to detect low battery voltage	210Ch		P. 35
276.0	E-pulse output - C-pulse ratio - Numerator	–		P. 19
278.0	E-pulse output - C-pulse ratio - Denominator	–		P. 19
302.0	EtherCAT Communication Torque command - Rotational direction	212Eh		P. 63
304.0	Power supply - AC/DC	2130h		P. 19
304.1	Power supply - Single-phase/Three-phase	–		P. 20
305.0	Momentary voltage drop detection - Delay time	2131h		P. 35
357.0	Position command filter 3 - Notch frequency	2165h		P. 69
358.0	Position command filter 3 - Notch width	2166h		P. 69
359.0	Position command filter 3 - High frequency gain constant	2167h		P. 69
360.0	Position command filter 3 - Notch depth	2168h		P. 69
363.0	Position deviation warning detection - Value	216Bh		P. 35
365.0	Position deviation warning detection - Delay time	216Dh		P. 35
374.0	SRDY detection - Switch	–		P. 36
376.0	Motor rotating position at encoder error - Holding method	2178h		P. 36
377.0	Motor rotating position at encoder error - Holding time	2179h		P. 36

2. List of Parameters

In the order of parameter No.

No.	Name	EtherCAT			☞
400.0	Vibration detection - Switch	–			P. 37
409.1	Auto notch-filter - Selection	–			P. 21
427.0	Quadrant glitch compensation - Peak time	–			P. 47
458.0	Wraparound minimum	607Bh			P. 21
460.0	Wraparound maximum	607Bh			P. 22
472.0	Multi-turn limit - Value	21D8h			P. 22
473.0	Multi-turn limit - Notification to Encoder	21D9h			P. 22
474.0	EtherCAT Communication setting - Error detection setting	21DAh			P. 37
474.3	EtherCAT Communication - "Digital inputs" I/O mapping setting	21DAh			P. 22
643.0	Internal position - Overflow detection	–			P. 54
645.0	Homing - Home base signal selection	–	⊘		P. 48
645.1	Homing - Encoder Z-phase as base signal	–	⊘		P. 48
645.3	Homing - Re-detection of home position dog	–	⊘		P. 48
646.0	Homing - Direction	–	⊘		P. 49
646.1	Homing - Sensor dog polarity	–	⊘		P. 50
646.2	Homing - Timeout switch	–	⊘		P. 50
647.0	Homing - Torque command limit switch	–	⊘		P. 50
647.1	Homing - Creeping switch	–	⊘		P. 51
648.0	Homing - Homing speed	–	⊘		P. 51
649.0	Homing - Creeping speed	–	⊘		P. 52
650.0	Homing - Acceleration/Deceleration time	–	⊘		P. 52
651.0	Homing - Shift-to-home-position quantity	–	⊘		P. 52
653.0	Homing - Home position data	–	⊘		P. 52
655.0	Homing - Detection time after stopper press	–	⊘		P. 52
656.0	Homing - Torque limit value	–	⊘		P. 53
657.0	Homing - Z-phase invalidation distance	–	⊘		P. 53
659.0	Homing - Timeout Time	–	⊘		P. 53
720.0···	Internal Position - Point table Command method	–	⊘		P. 54
720.1···	Internal Position - Point table Operation	–	⊘		P. 55
720.3···	Internal Position - Point table Enable/Disable	–	⊘		P. 56
722.0···	Internal Position - Point table Position	–	⊘		P. 57
724.0···	Internal Position - Point table Rotational speed	–	⊘		P. 57
726.0···	Internal Position - Point table Acceleration time	–	⊘		P. 57
727.0···	Internal Position - Point table Deceleration time	–	⊘		P. 57
728.0···	Internal Position - Point table Dwell time	–	⊘		P. 58
729.0···	Internal Position - Point table Positioning completion	–	⊘		P. 58

The internal position control point table parameters (No.720.0 or later) are not displayed on the parameter tab screen of S-TUNE Ⅱ.
These parameters are displayed in the Point Table tabbed screen. See page 54 and later for detailed descriptions of the parameters.

1. Basic Parameters

Basic Parameters

Basic Settings

No. 2.0	Control mode	Settings	Default	Characteristics
		0, 1, 2	0	— — — AB ⏻

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. 3.0	Command mode	Settings	Default	Characteristics
		3, 10	10	— — 🔒 AB ⏻

Function Use

Select Command Mode.

Settings \ Control Mode (No.2.0)	Position (0)	Velocity (1)	Torque (2)
3: Internal command	Yes	–	–
10: EtherCAT	Yes	Yes	Yes

Related To	No.2.0

No. 144.0	Torque command limit: Switch	Settings	Default	Characteristics
		0, 1	0	— — 🔒 ON OFF —

Function Use

Enable/Disable Torque Command Limit

Settings	Selection	Error Detection	
		Position deviation: No.65.0 Velocity 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 Velocity 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

About Unit Notation

- In this manual, [E-pulse] and [C-pulse] represent the pulse unit that represents the position information of the motor shaft.
  [E-pulse] = [Encoder pulse] :
  This is the value obtained by dividing and multiplying the command pulse of the Host controller by parameter No.34.0 and No.36.0.
  It is used for calculation inside the amplifier.
  [C-pulse] = [Command pulse] :
  The unit of command pulse for the Host controller.
- The unit of each parameter is described in the [initial value] column. Unitless is a dimensionless quantity.

Basic Parameters

Basic Settings

No. 144.1	Torque command limit: **Torque limit output**	Settings	Default	Characteristics
		0, 1, 2	0	– – 🔒 AB –

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	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.152.0, No.656.0

No.146.0 (2092h)	**Torque command offset**	Settings	Default	Characteristics
		−1,000 to 1,000	0 [0.1%]	📖 – – 0 100 –

Function Use

Adjust this parameter when the constant offset load torque is always applied to the motor by the gravity in the vertical axis. Set Torque command offset as a proportion relative to rated torque.

No. 147.0	Torque command limit: **Value 1**	Range	Default	Characteristics
		0 to 65,535	(See below)	– – 🔒 0 100 –

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.
- 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

Basic Parameters

Basic Settings

No. 237.0 (20EDh)	Servo OFF: Delay time	Range	Default	Characteristics
		0 to 3,125	0 [100µs]	■ – – ■ –

Function Use

This parameter indicates the delay time the motor excitation off after the Enable Operation (0x6040,3) 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: 0 ms

Related To No.238.0

No. 238.0 (20EEh)	Bake release: Delay time	Range	Default	Characteristics
		0 to 3,125	40 [100µs]	■ – – ■ –

Function Use

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: 4 ms

Related To No.237.0

No. 257.0 (2101h)	Selection of an encoder system / Absolute system	Settings	Default	Characteristics
		0, 1, 2	0	■ – – ■ ■

Function Use

Select either Absolute system or Incremental system.

Settings	System	Multi-rotation counter Overflow detection
0	Incremental system No absolute system is used This configuration is for when the backup battery is not used	–
1	Absolute system Use the absolute system This configuration uses a backup battery to hold the encoder position data.	Disable
2		Enable

<u>Using this parameter in absolute systems</u>

- 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.

Basic Parameters

Basic Settings

No.	Name	Range	Default	Characteristics
No. 276.0	E-pulse output: Pulse ratio (Numerator)	1 to 8,388,608	10 [-]	– – – ▣ –
No. 278.0	E-pulse output: Pulse ratio (Denominator)	0 to 8,388,608	5,120 [-]	

Function Use

Set the E-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,

$$\frac{\boxed{276.0}}{\boxed{278.0}} = \frac{\text{host C-pulse count per rotation}}{\text{motor pulse count per rotation}}$$

Setting 0 to No.278.0 enables automatic setting of the encoder resolution for one motor revolution.
(For 17 bits, 131,072 and for 23 bits, 8,388,608 are automatically specified.)

If the Z-phase pulse width is too narrow to be measured accurately by the host controller, decrease this E-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.272.2, No.276.0, No.278.0

No.	Name	Range	Default	Characteristics
No. 304.0 (2130h)	Main circuit power selection AC/DC	0 to 1	0	▣ – – ▣ –

Function Use

Select the main circuit power to be input to the amplifier.

Settings	Input Power Supply
0	AC power supply
1	DC power supply
2-5	DO NOT set it.

Related To

No.304.1

Remark

Do not modify this parameter from its default value.

Tip !

About parameter No. 304.0

Parameter No. 304.0 is a parameter to switch the input main circuit power "AC/DC". The standard amplifier is designed for AC power input only, so it cannot be used with DC power even if this parameter is changed.
If you wish to use a model that supports DC power supply, please contact our distributor.

Basic Parameters
Basic Settings

No. 304.1	Main circuit power selection **Phase**	Range	Default	Characteristics
		1, 2	(Amplifier dependent)	– – –
Function Use	Select the main circuit power to be input to the amplifier.			

Settings	Input Power Supply
1	Single-phase power supply
2	Three-phase power supply

Related To	No.304.0
Remark	This parameter is displayed as "for maintenance" in S-TUNE II.

Tip !

About parameter No. 304.1

This parameter is applied to the following models.

850W DB65B42, 1.5kW DB66B42, 1.3kW DB67C42, 2kW DB68C42

The main circuit power of these amplifiers is three-phase AC200V, but when this parameter is set to "1 "Single-phase power", they can also be used with single-phase AC200V.
If the setting of this parameter is switched to "1 "Single-phase power supply", the amplifier must be restarted.

When using single-phase AC200V, connect the main circuit power lines to L1 and L3, referring to the "Overall Wiring Diagram" for the corresponding model.

When used with single-phase AC200V, the performance described in the motor specifications cannot be achieved. It is recommended that the motor be used with three-phase AC200V as the default setting as much as possible. When single-phase AC200V is used, more current flows than when three-phase AC200V is used. For this reason, please pay attention to the heat generation of the amplifier itself. In addition, make sure that the entire unit, including the breaker, noise filter, and other connected equipment, can be operated safely before use.

The warranty does not cover defects caused by the use of a single-phase AC200V power supply.

If single-phase AC200V is input to the amplifier without setting "Single-phase power supply" in parameter No. 304.1, "Err15 Power failure (main circuit AC power)" will occur when the servo ON signal is input.

Note: The main circuit power supply for the following models is both single-phase and three-phase.

1kW DB64A42

Note: The main circuit power supply for the following models is single-phase only.

50W DB6YZ42, 100W DB6Z142, 200W DB61242, 400W DB62442, 750W DB63842

Basic Parameters

Basic Settings

		Range	Default	Characteristics
No. 409.1	Auto notch-filter **Selection**	0, 1	0	📖 – – ON OFF –

Function Use

Enable/Disable the Automatic notch-filter function.
Select an automatic notch-filter mode.

Settings	Automatic notch-filter function
0	Disable
1	Torque notch filter 1 only
2	Torque notch filter 2 only
3	Torque notch filter 1 and 2 in both
4	Vibration suppression only

Related To –

		Range	Default	Characteristics
No. 33.1 (2021h)	Wraparound **Switch**	0, 1	0	📖 – – ON OFF –

Function Use

Enable/Disable the Wraparound function.

Settings	Wraparound function
0	Disable
1	Enable

Related To No.458.0, No.460.0

		Range	Default	Characteristics
No. 458.0 (607B-01h)	Wraparound **Minimum value**	−2,147,483,648 to 0	−2,147,483,648	📖 – – 0 100 –

Function Use

Set the minimum value for wraparound.

Related To No,33.1, No.460.0

Basic Parameters

Basic Settings

No. 460.0 (607B-02h)	Wraparound **Maximum value**	Range	Default	Characteristics
		0 to 2,147,483,648	2,147,483,648	▣ – – ▣ –
Function Use	Set the maximum value for wraparound.			
Related To	No.33.1, No.458.0			

No. 472.0 (21D8h)	Multi-turn limit Value	Range	Default	Characteristics
		0 to 65,535	0	▣ – – ▣ –
Function Use	Specifies the multi-turn limit value.			
Related To	No.473.0			
Remark	No. 473.0 should be set first.			

Settings	Description
0	Disable the function
1-65,535	Value

No. 473.0 (21D9h)	Multi-turn limit Notification to Encoder	Range	Default	Characteristics
		0, 1	0	▣ – – ON OFF –
Function Use	Enable notification to encoder after changing the multi-turn limit value.			
Related To	No.472.0			
Remark	No. 473.0 should be set first. After that, set No. 472.0.			

Settings	Disable/Enable
0	Disable
1	Enable

No. 474.3 (21DAh)	EtherCAT Communication "Digital inputs" I/O mapping setting	Range	Default	Characteristics
		0, 1	0	▣ – – ▣ ▣
Function Use	Set the I/O mapping for the object dictionary "60FDh (Digital inputs)".			
Remark	Note: Use this parameter as "0". Changing this setting may cause the master device to not recognize the I/O correctly.			

Basic Parameters

Stop Settings

No. 67.0 (2043h)	Drive restriction input: Setup	Settings	Default	Characteristics
		0 to 3	0	– –

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 (2043h)	Drive restriction input: Deceleration method	0, 1, 2	1	– –
No. 67.2 (2043h)	Drive restriction input: Standstill state	0, 1	0	

Function Use

Select the deceleration method upon drive restriction input and specify the standstill state after the motor stopped its motion.

Use one of the following four combinations.

Possible Combinations	Deceleration method (No.67.1)	Standstill state (No.67.2)
1	0: Free Run	0: Free Run
2	1: Short Brake	
3	2: Immediate 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 (2043h)	Drive restriction input: Keep position deviation counter	Settings	Default	Characteristics
		0, 1, 2	0	– –

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	Holding
1	Clearing (Cleared only once upon input of drive inhibit.)
2	Clearing (Keeping clearing during drive inhibit input.)

Related To No.67.0, No.67.1, No.67.2

Basic Parameters

Stop Settings

		Range	Default	Characteristics
No. 151.0	Immediate stop: Torque command limit	0 to 65,535	2,400 [0.1%]	– – – 0 100 –

Function Use

If [Deceleration stop: Method (when the servo is off) (No.224.0)] = 2 (Immediate stop), set the value of torque command limit at the time of an Immediate 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 (Immediate stop)
Related To	No.224.0

		Settings	Default	Characteristics
No. 224.0 (20E0h)	Deceleration stop: Method (at Servo Off)	0 to 3	3	📖 – – AB –

Function Use

Specify the deceleration stop method in case of servo off while motor is rotating.

Settings	Descriptions
0	F RUN Free run
1	S STOP Short brake
2	P STOP Immediate 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 (20E0h)	Deceleration stop: Release conditions	0, 1	1	📖 – – AB –

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(*)	○	○

*)The deceleration stop condition is released when either condition is satisfied earlier.

Prerequisite	Deceleration stop Method (upon servo off) (No.224.0) = 1 (Short brake) or 2 (Immediate stop)
Related To	No.224.0, No.226.0, No.227.0

The "Immediate stop" may also be referred to as a "Prompt stop" or a "Quick stop".

Basic Parameters

Stop Settings

No. 224.2 (20E0h)	Deceleration stop: Switch (in case of control power error)	Settings	Default	Characteristics
		0, 1	1	📘 – – ON OFF –

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 (20E0h)	Deceleration stop: DBRK output after stopping (at Servo Off)	Settings	Default	Characteristics
		0, 1	1	📘 – – A⇄B –

Function Use

Select Stop State when the servo is off

Settings	Descriptions
0	F RUN Free run
1	D STOP Dynamic brake

Prerequisite No.224.0, No.232.1

No. 225.0 (20E1h)	Emergency stop: Warning output switch	Settings	Default	Characteristics
		0, 1	0	📘 – – A⇄B –

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 (20E1h)	Emergency stop: Warning output timing	Settings	Default	Characteristics
		0, 1	0	📘 – – A⇄B –

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)

Basic Parameters

Stop Settings

STOP

No. 225.2 (20E1h)

Immediate stop:
Smoothing filter - Switch

Settings	Default	Characteristics
0, 1	0	▮ – – ON OFF –

Function Use

Enable/Disable the Velocity Command smoothing filter at the time of an Immediate 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 (20E2h)

Deceleration stop:
Operating time

Range	Default	Characteristics
0 to 16,383	500 [100μs]	▮ – – ▨ –

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: 50 ms (Converted to Time)

Prerequisite: Deceleration stop Method (upon servo off) (No.224.0) = 1 (Short brake) or 2 (Immediate stop)

Related To: No.224.0, No.224.1, No.227.0

No. 227.0 (20E3h)

Deceleration stop:
Rotational speed to end deceleration stop

Range	Default	Characteristics
0 to 1,000	50 [r/min]	▮ – – ▨ –

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).

Prerequisite: Deceleration stop: Method (No.224.0) = 1 (Short brake) or 2 (Immediate stop)
& Deceleration stop: Release conditions (No.224.1) = 1

Related To: No.224.0, No.224.1, No.226.0

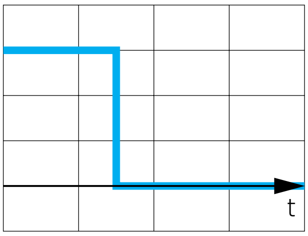
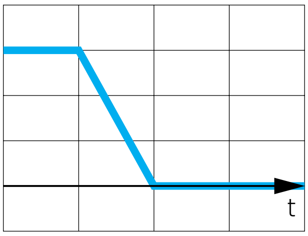
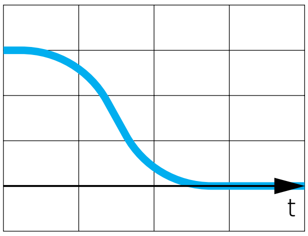
Basic Parameters

Stop Settings

No. 228.0 (20E4h)	Deceleration stop: Working time (in case of control power error)	Range	Default	Characteristics
		0 to 16,383	50 [100μs]	— — —
Function Use	Set Deceleration stop time in the event of the alarm output due to a control power error. ■ Default: 10 ms (Converted to Time)			
Prerequisite	Deceleration stop: Switch (upon control power failure) (No.224.2) = 1 (Enable)			
Related To	No.224.2			

No. 229.0 (20E5h)	Immediate stop: Smoothing filter - Moving average counter	Range	Default	Characteristics
		1 to 1,000	40 [-]	— — —
Function Use	Sets the number of moving average times of the velocity command smoothing filter during an immediate stop. The lager the parameter value, the smoother acceleration/deceleration is and the slower the response. Delay Time Calculation Formula 100μs × Moving average count = delay time The positioning will take as long as the delay time specified above, set this item within the range acceptable to the equipment.			
Prerequisite	Immediate 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			

Basic Parameters

Stop Settings

No. 232.1 (20E8h)

Deceleration stop:
Status during free-run

Settings	Default	Characteristics
0, 1	1	📖 — — AB —

Function Use

Select on or off for deceleration stop status during free-run.

Settings	Handling of the "deceleration stop" state
0 NOT Recommended	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.

No. 232.2 (20E8h)

Immediate stop:
Short brake operation after a stop

Settings	Default	Characteristics
0, 1	0	📖 — — AB —

Function Use

Enable/Disable short braking after a Immediate stop.

Settings	Short braking
0	Enable
1	Disable

Prerequisite Deceleration stop: Method (when servo off) (No.224.0) = 2 (Immediate stop)

No. 232.3 (20E8h)

Deceleration stop:
Brake engagement - Timing

Settings	Default	Characteristics
0, 1	0	📖 — — AB —

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 rotational 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 rotational speed becomes lower than the setting of **Deceleration stop: Brake engagement - Rotational 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

Basic Parameters

Stop Settings

No. 233.0 (20E9h)	Deceleration Stop: Method (when alarm is on)	Settings	Default	Characteristics
		0 to 7	1	📘 — — AB —

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.

F RUN Free run	P STOP Immediate stop (*)	S STOP Short brake	D STOP Dynamic brake

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*) The "Immediate stop" may also be referred to as a "Prompt stop" or a "Quick stop".

Basic Parameters

Stop Settings

Group	Alarm No.	Alarm Name
①	14	Overvoltage error
	23	Switch circuitry error
	24	Overcurrent error
	25	Inverter error 1
	26	Inverter error 2
	27	Current sensor error
	29	Voltage error (Internal control power DC5V)
②	22	Voltage error (Internal control power DC24V)
	32	Power supply error (Control circuit AC power)
③	16	Encoder error (Received data)
	17	Encoder error (No response)
	18	Encoder error (Hardware)

Group	Alarm No.	Alarm Name
④	0	System error
	1	EEPROM data error
	2	Product code error (Mismatching code)
	7	Overload error
	19	Encoder error (Communication)
	20	Encoder error (Multi-turn data)
	21	Encoder error (Voltage drop)
	34	Product code error (Undefined model code)
⑤	3	EtherCAT communication error
	4	Overspeed error
	5	Velocity deviation error
	6	Position deviation error
	8	Command overspeed error
	10	Positioning command overflow error /Homing failure
	11	Multi-turn counter error
	12	Overheat error
	15	Power supply error (Primary circuit AC power)
	28	Encoder error (Overheat)
	40	Vibration prediction

No. 233.3 (20E9h)	Deceleration Stop: DBRK output after stopping (when alarm is on)	Settings	Default	Characteristics
		0, 1	1	📖 — — AB —

Function Use

Specify the stopped state in the case of alarming.

Settings	Stopped state
0	F RUN Free run
1	D STOP Dynamic brake

Basic Parameters

Stop Settings

No. 234.0 (20EAh)	Deceleration Stop: **Brake engagement - Delay time**	Range	Default	Characteristics
		0 to 16,383	0 [100µs]	▣ – – ▨ –
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. ■ Default: 0 ms (Converted to Time)			
Prerequisite	Timing of brake engagement (No.232.3) = 1			

No. 235.0 (20EBh)	Deceleration Stop: **Brake engagement - Rotational speed**	Range	Default	Characteristics
		0 to 1,000	50 [r/min]	▣ – – ▨ –
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.			
Prerequisite	Timing of brake engagement (No.232.3) = 1			

No. 236.0 (20ECh)	Immediate stop: **Time extension**	Range	Default	Characteristics
		0 to 3,125	0 [100µs]	▣ – – ▨ –
Function Use	This item indicates how long the Immediate stop to be kept after the deceleration stop complete conditions were met. It is used to compensate the brake response time. ■ Default: 0 ms (Converted to Time) This parameter is valid only when the Deceleration Stop Method is "Immediate 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.			
Prerequisite	Deceleration stop: Method (No.224.0) = 2 (Immediate stop)			
Related To	No.224,0, No.233.0, No.237.0			

No. 239.0 (20EFh)	Immediate stop: **Deceleration time**	Range	Default	Characteristics
		0 to 100	0 [ms]	▣ – – ▨ –
Function Use	This item indicates decelerating time after an Immediate stop. Set the time-length for speed command to change from 1,000 r/min to 0 r/min.			
Related To	No.224.0, No.232.2, No.236.0			

Basic Parameters

Error Detection Settings

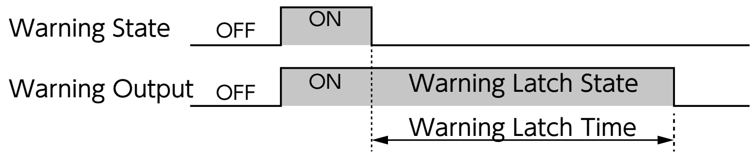
No. 12.0 (200Ch)	Warning latch time	Range	Default	Characteristics
		0 to 200	1 [50ms]	– – –

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 (200Dh)	Timing for alarm output	Settings	Default	Characteristics
		0, 1	0	– – –

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.

Basic Parameters

Error Detection Settings

No. 65.0 (2041h)

Position deviation error detection: **Switch**

Settings	Default	Characteristics
0 to 3	1	📖 – – A⇄B –

Function Use

Specify what to output when excessive position deviation is detected.

Settings	Behavior when detecting the error.
0	No detection (no output)
1	Output an alarm
2	Output a warning
3	Output both alarm and warning

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

No. 65.1 (2041h)

Velocity deviation error detection: **Switch**

Settings	Default	Characteristics
0, 1	1	📖 – – ON OFF –

Function Use

Enable/Disable Velocity deviation error detection.

Settings	Velocity 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. 87.0 (6065h)

Position deviation error detection: **Value**

Range	Default	Characteristics
0 to 10,000	1,500 [0.001rev]	📖 – 🔒 0 100 –

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.

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	400 [100µs]	– – – 0 100 –

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: 40 ms (Converted to Time)

Prerequisite Position deviation error detection: Switch (No.65.0) = 1 (Enable)

Related To No.65.0, No.87.0

Basic Parameters

Error Detection Settings

No. 90.0 (205Ah)	Velocity deviation error detection: **Value**	Range	Default	Characteristics
		0 to 10,000	1,500 [r/min]	— — —
Function Use	This parameter sets a threshold value for a velocity deviation error detection. The higher the value, the less likely to detect a velocity deviation error.			
Prerequisite	Velocity deviation error detection - Switch (No.65.1) = 1 (Enable)			
Related To	No.65.1, No.91.0			

No. 91.0 (205Bh)	Velocity deviation error detection: **Delay time**	Range	Default	Characteristics
		0 to 32,767	400 [100μs]	— — —
Function Use	This parameter sets a delay time for a velocity deviation error (Alarm No.5) to be detected after the velocity deviation exceeded the setting of "Velocity deviation error - Detection value"(No.90.0). The higher the value, the longer the error detection time. ■ Default: 40 ms (Converted to Time)			
Prerequisite	Velocity deviation error detection - Switch (No.65.1) = 1 (Enable)			
Related To	No.65.1, No.90.0			

No. 259.0 (2103h)	Encoder: **Overheat detection - switch**	Settings	Default	Characteristics
		0, 1, 2	0	— — —

Function Use

Select what to output when overheat of the encoder is detected.

Settings	Behavior when detecting encoder overtemperature
0	No output
1	Output a warning
2	Output an alarm

No. 259.1 (2103h)	Encoder: **Battery voltage drop detection - switch**	Settings	Default	Characteristics
		0, 1	0	— — —

Function Use

Select what to output when encoder battery voltage drop is detected.

Settings	Behavior when detecting encoder battery voltage drop
0	No warning output.
1	Output a warning

Basic Parameters

Error Detection Settings

No. 267.0 (210Bh)	Encoder: Overheat detection - Value	Range	Default	Characteristics
		0 to 127	85 [℃]	📖 – – 0 100 –
Function Use	Set the value to detect overheat of the encoder. (for reference only)			
Related To	No.259.0			

No. 268.0 (210Ch)	Encoder: Battery voltage drop detection - Value	Range	Default	Characteristics
		0 to 100	24 [0.1V]	📖 – – 0 100 –
Function Use	Set the value to detect voltage drop of the encoder.			
Related To	No.259.0			

No. 305.0 (2131h)	Voltage Drop Detection: Delay time	Range	Default	Characteristics
		20 to 50,000	80 [ms]	📖 – – 0 100 –
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.			

No. 363.0 (216Bh)	Position deviation warning detection: Value	Range	Default	Characteristics
		0 to 2,147,483,647	100 [E-pulse]	📖 – – 0 100 –
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 (216Dh)	Position deviation warning detection: Delay time	Range	Default	Characteristics
		0 to 65,535	500 [100μs]	📖 – – 0 100 –
Function Use	Set the delay time to detect the position deviation warning. ■ Default: 50 ms (Converted to Time)			
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			

Basic Parameters

Error Detection Settings

No. 374.0	SRDY state detection Switch	Settings	Default	Characteristics
		1, 2	1	📘 – – AB –

Function Use

Selects an output signal type from Warning/Alarm when a servo-on command is input while SRDY state is not in ready.

Settings	Warning / Alarm
1	Output a warning
2	Output an alarm

No.376.0 (2178h)	Motor rotating position at encoder error Holding method	Range	Default	Characteristics
		0, 2	0	📘 – – AB –

Function Use

Sets the item to hold the motor shaft position when an encoder error occurs.

Settings	Holding items
0	Disable
2	Continue to hold the torque command value.

Related To No.377.0

No.377.0 (2179h)	Motor rotating position at encoder error Holding time	Range	Default	Characteristics
		0 to 200	100 [ms]	📘 – – 0 100 –

Function Use

Set operation time for motor rotating position holding at encoder error.

Related To No.376.0

Basic Parameters

Error Detection Settings

No. 400.0	Vibration detection Switch	Range	Default	Characteristics
		0, 1	0	🟦 – – 🟨 –

Function Use

Selects an output signal type from Warning/Alarm when vibrations are detected.

(This setting is applied when the automatic notch filter function is enabled.)

Settings	Warning / Alarm
0	Output an alarm
1	Output a warning

Related To No.409.1

No.474.0 (21DAh)	Error detection settings EtherCAT Communication setting	Range	Default	Characteristics
		0, 1	1	🟦 – – 🟨 –

Function Use

Select whether the amplifier detects alarm No.3 when EtherCAT communication error occurs.

Settings	Alarm No.3
0	NOT detect
1	Detect

2. Position Control Mode

Position Control Mode

Position Command Input

No. 32.1 (2020h)	EtherCAT Communication - Position command: Rotational direction	Settings	Default	Characteristics
		0, 1	1	▯ – – A⇄B ⏻

Function Use

Selects the rotational direction for EtherCAT communication position commands.

Settings	Rotational direction
0	CW rotation by incrementing the position command
1	CCW rotation by incrementing the position command

Related To No.2.0, No.3.0, No.32.1, No.33.0

No. 32.2 (2020h)	EtherCAT Communication - Position command: Interpolation with pulse ratio	Settings	Default	Characteristics
		0, 1	1	▯ – – ON OFF ⏻

Function Use

Enable/Disable the interpolation to smooth a command where C-pulse Ratio is set.

Settings	Interpolation with pulse ratio
0	Disable
1	Enable

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

Position Control Mode

Position Command Input

		Range	Default	Characteristics
No. 34.0 (6091-01h)	EtherCAT Communication - Position command: Paired ratio (Numerator)	17bit 0 to 65,535 23bit 0 to 8,388,608	1,000 [-]	
No. 36.0 (6091-02h)	EtherCAT Communication - Position command: Paired ratio (Denominator)	17bit 1 to 65,535 23bit 1 to 8,388,608		

Function Use

Use these two parameters to set the multiplier and divider for the position C-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).

$$\frac{\boxed{34.0}}{\boxed{36.0}} = \frac{\text{motor pulse count per rotation}}{\text{host C-pulse count per rotation}}$$

Setting **"0"** for No.34.0 will automatically set the encoder resolution for one motor turn.
(The automatically set values are 131,072 for the 17bit encoder and 8,388,608 for the 23bit encoder.)

Remark

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

		Settings	Default	Characteristics
No. 66.3 (2042h)	EtherCAT Communication - Position command: Feed-forward delay compensation	0, 1	1	

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 S-TUNE Ⅱ , not with the Setup Panel.

Position Control Mode

Tuning Parameters

No. 102.0 (2066h)	Tuning: Inertia ratio	Range	Default	Characteristics
		100 to 10,000	250 [%]	📘 – – ⇩ –
Function Use	Specify the ratio of the device load inertia to motor rotor inertia (moment of inertia). $$\text{Inertia Ratio} = \frac{\text{Load Inertia} + \text{Rotor Inertia}}{\text{Rotor Inertia}} \times 100\%$$ 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.			

No. 103.0 (2067h)	Tuning: Damping ratio	Range	Default	Characteristics
		10 to 5,000	100 [%]	📘 – – ⇩ –
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 (206Ah)	Tuning: Inertia ratio upper bound	Range	Default	Characteristics
		100 to 10,000	3,000 [%]	📘 – – ⇩ –
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 (206Eh)	Tuning: Mode switch	Settings	Default	Characteristics
		1, 2	2	📘 – – ⟳ –
Function Use	Select a tuning condition depending on the direction of load or the presence of unbalanced load.			
Prerequisite	Position Control Mode, Velocity Control Mode			

Settings	Modes	Motion direction of the device connected to the motor
1	Standard	Horizontal
2	Offset Load	Non-horizontal

Use Offset Load Mode even for the case of axis force (horizontal motion)

Position Control Mode
Tuning Parameters

No. 110.1 (206Eh)	Tuning: **Items**	Settings	Default	Characteristics
		0, 1, 2	0	■ — — ■ —

Function Use

Select Start or Stop for tuning depending on the your willing to estimate items.

Settings (Tuning)	Items to be estimated	
	Inertia ratio	Damping ratio
0 (Stop)	No estimate.	No estimate.
1 (Start)	Estimating.	
2 (Start)		Estimating.

Prerequisite Position Control Mode, Velocity Control Mode

No. 113.0 (2071h)	Tuning: **Position control mode - Control gain set**	Range	Default	Characteristics
		5 to 45	15 [-]	■ — — ■ —

Function Use

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.

Setting	Command Response	Rigidity	Settling Time	Possibility of Noise
5	Slower	Lower	Longer	Lower
↕	↕	↕	↕	↕
45	Faster	Higher	Shorter	Higher

Prerequisite Position Control Mode

Remark

- 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.

Related To No.113.1, No.114.0, No.115.0, No.116.0, No.117.0, No.118.0, No.119.0, No.162.0

Position Control Mode
Tuning Parameters

No. 113.1 (2071h)	Tuning: **Position control mode - Inertia conditions**	Settings	Default	Characteristics
		1, 2, 3	2	📘 — — AB —

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

No. 114.0 (2072h)	Tuning: **Position control mode - Control level**	Range	Default	Characteristics
		5 to 45	15 [-]	📘 — — 0 100 —

Function Use

Set the Control Level of Position Control Mode.

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

Position Control Mode

Tuning Parameters

No. 115.0 (2073h)	Tuning: Position control mode - Control gain 1	Range	Default	Characteristics
		5 to 1,000	50 [rad/s]	■ – – ■ –

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

No. 116.0 (2074h)	Tuning: Position control mode - Control gain 2	Range	Default	Characteristics
		80 to 5,000	200 [rad/s]	■ – – ■ –

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

Position Control Mode

Tuning Parameters

<table>
<tr><td rowspan="2">No. 117.0
(2075h)</td><td rowspan="2">Tuning:
Position control mode
- Gain FF compensation 1</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>0 to 15,000</td><td>10,000
[0.01%]</td><td>▣ – – ▣ –</td></tr>
<tr><td>Function
Use</td><td colspan="4">Set the Feed-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.</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Position Control Mode</td></tr>
<tr><td>Related To</td><td colspan="4">No.113.0, No.115.0, No.118.0</td></tr>
</table>

<table>
<tr><td rowspan="2">No. 118.0
(2076h)</td><td rowspan="2">Tuning:
Position control mode
- Gain FF compensation 2</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>0 to 15,000</td><td>0
[0.01%]</td><td>▣ – – ▣ –</td></tr>
<tr><td>Function
Use</td><td colspan="4">Set Feed-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.</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Position Control Mode</td></tr>
<tr><td>Related To</td><td colspan="4">No.113.0, No.116.0, No.117.0</td></tr>
</table>

<table>
<tr><td rowspan="2">No. 119.0
(2077h)</td><td rowspan="2">Tuning:
Position control mode - Integral gain</td><td>Range</td><td>Default</td><td>Characteristics</td></tr>
<tr><td>45 to 5,000</td><td>160
[rad/s]</td><td>▣ – – ▣ –</td></tr>
<tr><td>Function
Use</td><td colspan="4">Set the Integral Gain for Position Control mode.

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</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Position Control Mode</td></tr>
<tr><td>Remark</td><td colspan="4">This parameter will reset to the default if Inertia conditions (No.113.1) or Control Gain Set (No.113.0) is changed.</td></tr>
<tr><td>Related To</td><td colspan="4">No.113.0</td></tr>
</table>

Position Control Mode

Tuning Parameters

No. 120.1 (2078h)	Tuning: Control gain set - Upper bound	Range	Default	Characteristics
		5 to 45	15 [-]	📖 – – 0 100 –
Function Use	Set the upper bound of Control Gain Set in Auto Tuning of Control Gain Set.			
Prerequisite	Position Control Mode			
Remark	This parameter is used in amplifier version 6.0.3.0 or lower. It is not used in versions 6.0.3.1 and later.			
Related To	No.106.0, No.120.0			

No. 121.0 (2079h)	Tuning: Control gain set - Tuning constant	Range	Default	Characteristics
		1 to 200	24 [-]	📖 – – 0 100 –
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			

Position Control Mode

Tuning Parameters

		Settings	Default	Characteristics
No. 145.0	Tuning: Quadrant glitch compensation - Switch	0, 1	0	– – – AB –
Function Use	Enable/Disable Quadrant glitch compensation function.			
Related To	No.153.0, No.154.0, No.155.0, No.156.0, No.427.0			

Settings	Quadrant glitch compensation function
0	Disable
1	Enable

		Range	Default	Characteristics
No. 153.0	Tuning: Quadrant glitch compensation - CCW rate	0 to 1,000	0 [0.1%]	– – – 0 100 –
No. 154.0	Tuning: Quadrant glitch compensation - CW rate	0 to 1,000		
Function Use	Sets the peak compensation rate for quadrant glitch compensation in the CCW/CW direction.			
Related To	No.145, No.155.0, No.156.0, No.427.0			

		Range	Default	Characteristics
No. 155.0	Tuning: Quadrant glitch compensation - CCW delay time	0 to 30,000	100 [μs]	– – – 0 100 –
No. 156.0	Tuning: Quadrant glitch compensation - CW delay time	0 to 30,000		
Function Use	Sets the delay time for Quadrant glitch compensation from the command start to the onset of compensation in the CCW/CW direction.			
Related To	No.145, No.153.0, No.154.0, No.427.0			

Position Control Mode

Tuning Parameters

		Settings	Default	Characteristics
No. 427.0	Tuning: Quadrant glitch compensation - Peak time	0 to 30,000	10 [µs]	— — — AB —
Function Use	Sets the time from the beginning of compensation to the maximum compensation value in the Quadrant glitch compensation function.			
Related To	No.145.0, No.153.0, No.154.0, No.155.0, No.156.0			

		Settings	Default	Characteristics
No. 193.0 (20C1h)	Tuning: Current control gain	0, 1	0	■ — — AB ⏻
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.			
Remark	· If you changed the setting, perform tuning again. · Selecting 1 hurts response; Adjust within the acceptable range.			

Settings	Level	Noise	Response
0	Standard	More	Faster
1	Low	Less	Slower

Position Control Mode

Homing

No. 645.0	Homing: Home base signal selection	Settings	Default	Characteristics
		0, 1	0	– ⊘ – A⇄B –

Function Use

Select the signal that the home position will be referenced to.

Settings	Reference Signal 1
0	Any user specified position
1	Stopper

No. 645.1	Homing: Encoder Z-phase as base signal	Settings	Default	Characteristics
		0, 1	0	– ⊘ – ON OFF –

Function Use

To add encoder Z-phase as the reference position after the Home Reference Signal is detected, set this parameter to 1.

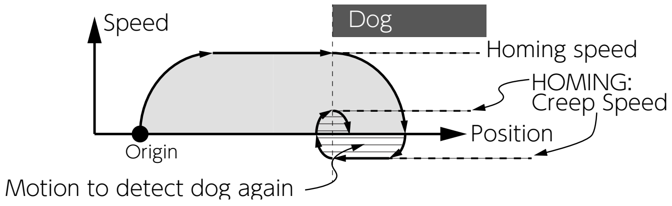
Settings	Encoder Z-phase Signal
0	Disable
1	Enable

No. 645.3	Homing: Re-detection of home position dog	Settings	Default	Characteristics
		0, 1	0	– ⊘ – ON OFF –

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



Note

Not used in this product.

Position Control Mode

Homing

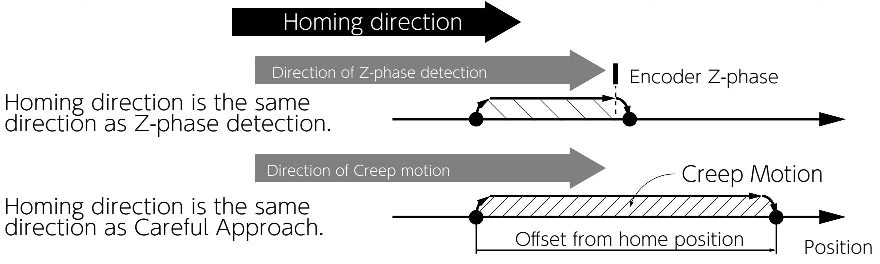
No. 646.0	Homing: Direction	Settings	Default	Characteristics
		0, 1	0	– ⊘ – ON OFF –

Function Use

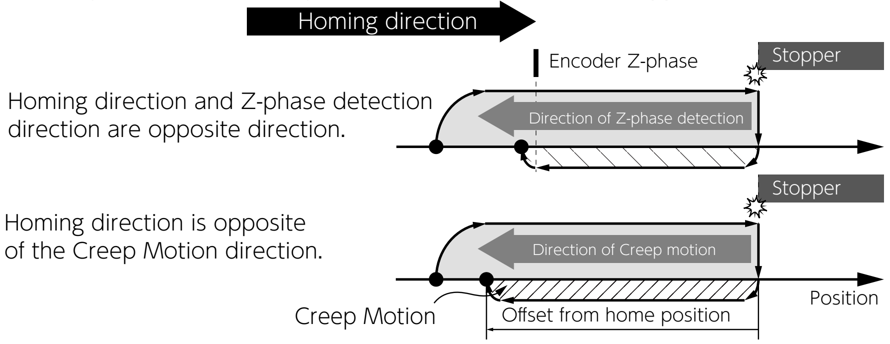
Specify the homing direction.

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)



Related To No.645.0, No.645.1, No.645.3

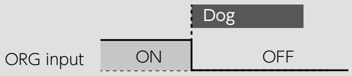
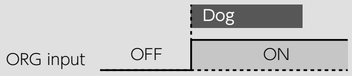
Position Control Mode

Homing

		Settings	Default	Characteristics
No. 646.1	Homing: Sensor dog polarity	0, 1	0	– ⊘ – A B –

Function Use

Select the polarity for the home sensor signal input ORG (Pin No.11) of C5 to detect the dog-front-end. (Not used in this product.)

Settings	Detection Polarity
0	Detect where ORG = OFF 
1	Detect where ORG = ON 

		Settings	Default	Characteristics
No. 646.2	Homing: Timeout switch	0, 1	1	– ⊘ – ON OFF –

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.

		Settings	Default	Characteristics
No. 647.0	Homing: Torque command limit switch	0, 1	0	– ⊘ – ON OFF –

Function Use

Enable/Disable torque command limit during Homing. This item is a safety measure against collisions during Homing.

Settings	Torque Command Limit
0	Disable
1	Enable

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

Position Control Mode

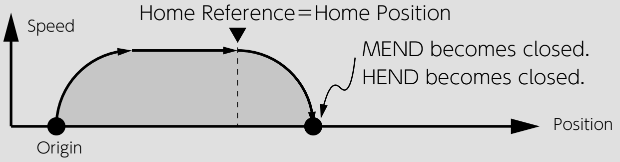
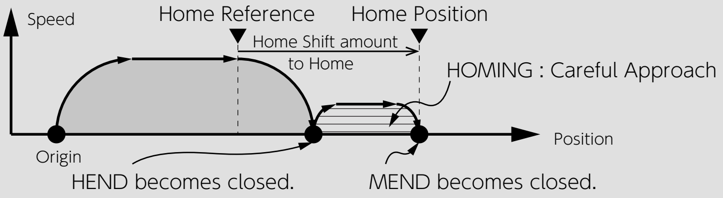
Homing

No. 647.1	Homing: Creeping switch	Settings	Default	Characteristics
		0, 1	0	– 🚫 – ON OFF –

Function Use

Enable/Disable homing motion after home reference signal detection.

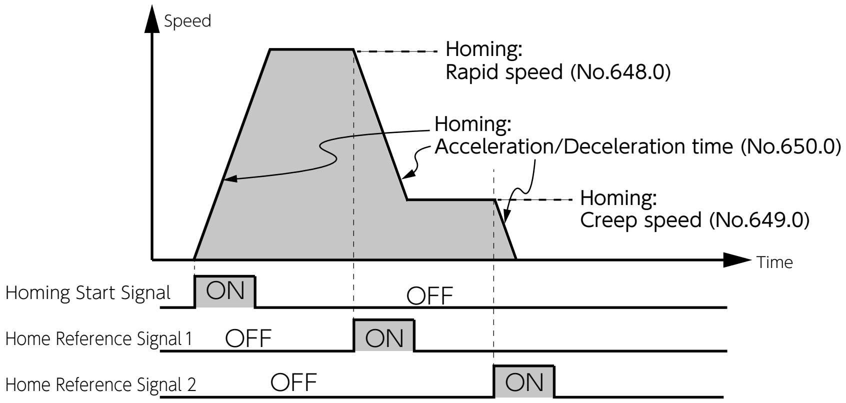
Set to 0 to only detect the home reference signal.
Set to 1 if any motions are intended after the reference signal detection.

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: Homing speed	Range	Default	Characteristics
		0 to 6,300	500 [r/min]	– 🚫 – 0 100 –

Function Use

Specify the speed value for rough approach motion before the home reference signal is detected.



3. Details of Parameters

Position Control Mode

Homing

No. 649.0	Homing: Creeping speed	Range	Default	Characteristics
		0 to 6,300	10 [r/min]	– ⊘ – ↓ –
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: Creeping 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]	– ⊘ – ↓ –
Function Use	Set Acceleration/Deceleration Time for homing. This item indicates time amount for a speed to change 1,000 r/min. Applies to **Homing Speed** (No.648.0) and **Creeping 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: Shift to home position quantity	Range	Default	Characteristics
		0 to 1,000,000,000	0 [C-pulse]	– ⊘ – ↓ –
Function Use	Use this parameter to set shift amount from home signal or encoder Z-phase to home.			
Related To	No.646.0			

No. 653.0	Homing: Home position data	Range	Default	Characteristics
		−1,000,000,000 to 1,000,000,000	0 [C-pulse]	– ⊘ – ↓ –
Function Use	This parameter value overwrites the home coordinate (ABS position feedback value) upon Homing complete.			

No. 655.0	Homing: Detection time after stopper press	Range	Default	Characteristics
		5 to 1,000	100 [ms]	– ⊘ – ↓ –
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			

Position Control Mode

Homing

No. 656.0	Homing: Torque limit value	Range	Default	Characteristics
		10 to 3,000	500 [0.1%]	– ⊘ – ⚡ –
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 base 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			

No. 657.0	Homing: Z-phase invalidation distance	Range	Default	Characteristics
		0 to1,000,000,000	0 [C-pulse]	– ⊘ – ⚡ –
Function Use	Set the shift amount between a detection position of home signal and a starting position of z-phase detection.			

No. 659.0	Homing: Timeout time	Range	Default	Characteristics
		0 to 60,000	60,000 [10ms]	– ⊘ – ⚡ –
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			

Position Control Mode

Internal Position Command

No. 643.0	Internal position: Overflow detection	Settings	Default	Characteristics
		0, 1	1	— — — ON OFF —

Function Use

Enable/Disable the multi-turn 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-turn 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

No. 720.0 No. 740.0 … No. 1020.0	Internal Position: Point table Command method (*)	Settings	Default	Characteristics
		0, 1	0	— — — ON OFF —

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

---

The internal position control point table parameters (No.720.0 or later) are not displayed on the parameter tab screen of S-TUNEⅡ.
These parameters are displayed in the Point Table tabbed screen.

*) See the Point Table Parameter List to look up a point number and its corresponding parameter numbers.

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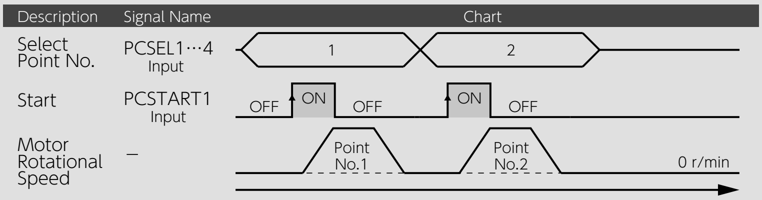
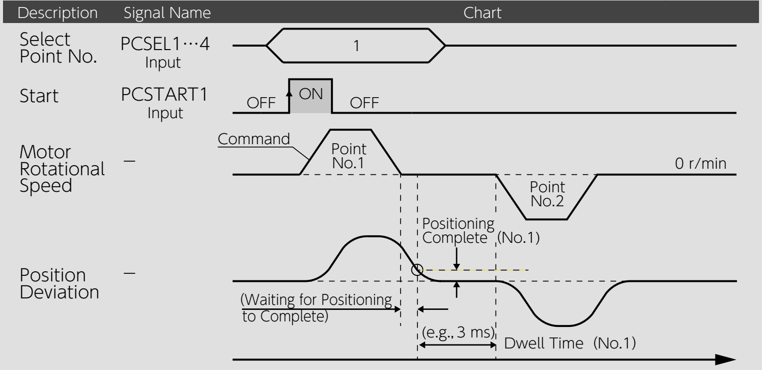
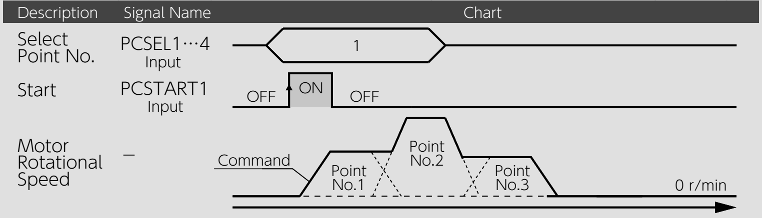
Position Control Mode

Internal Position Command

No. 720.1 No. 740.1 … No. 1020.1	Internal Position: Point table Operation (*)	Settings	Default	Characteristics
		0, 1	0	– – – ▣ –

Function Use

Select the Running Motion of Point Table.

Settings	Running Motion
0	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". 
1	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.  Example-2: The dwell time is set to 0. The motor will keep rotating and the rotational speed will continuously change. 

Position Control Mode

Internal Position Command

No. 720.3 No. 740.3 … No. 1020.3	Internal Position: Point table Enable/Disable (*)	Settings	Default	Characteristics
		0, 1	0	— — — ON OFF —

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

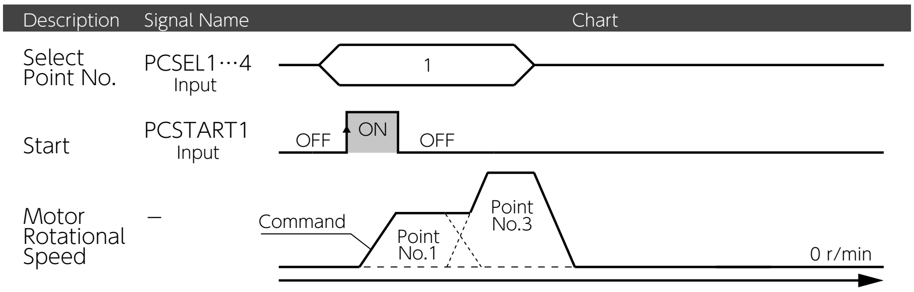
If the point number with the "disable" setting is specified,
among the subsequent point numbers, the first one with "enable" will be executed.

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.

S-TUNE Ⅱ operation
Turn the servo off or click the STOP button.

Position Control Mode

Internal Position Command

		Range	Default	Characteristics
No. 722.0 No. 742.0 … No. 1022.0	Internal Position: Point table Position (*)	−1,073,741,823 to +1,073,741,823	0 [C-pulse]	– – – 0 100 –
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			

		Range	Default	Characteristics
No. 724.0 No. 744.0 … No. 1024.0	Internal Position: Point table Rotational speed (*)	0 to 6,300	0 [r/min]	– – – 0 100 –
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.			

		Range	Default	Characteristics
No. 726.0 No. 746.0 … No. 1026.0	Internal Position: Point table Acceleration time (*)	0 to 5,000	30 [ms]	– – – 0 100 –
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.			

		Range	Default	Characteristics
No. 727.0 No. 747.0 … No. 1027.0	Internal Position: Point table Deceleration time (*)	0 to 5,000	30 [ms]	– – – 0 100 –
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.			

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*) See the Point Table Parameter List to look up a point number and its corresponding parameter numbers.

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Position Control Mode

Internal Position Command

		Range	Default	Characteristics
No. 728.0 No. 748.0 … No. 1028.0	Internal Position: Point table Dwell time (*)	0 to 20,000	1 [ms]	– – – 0 100 –

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.

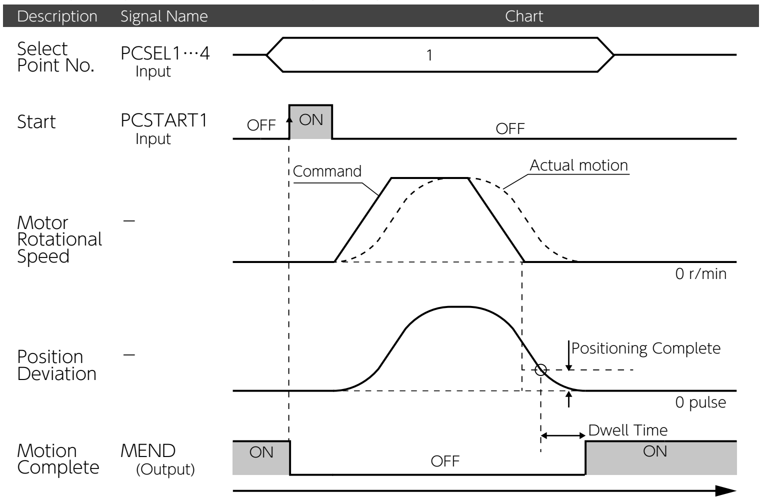
		Range	Default	Characteristics
No. 729.0 No. 749.0 … No. 1029.0	Internal Position: Point table Positioning completion (*)	0 to 32,767	20 [C-pulse]	– – – 0 100 –

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



Position Control Mode

Internal Position Command

Point Table Parameter List

Point No.	Position [C-pulse]	Rotational speed [r/min]	Acceleration time [ms]	Deceleration time [ms]	Command method [-]	Dwell time [ms]	Operation [-]	Positioning completion [E-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

The internal position control point table parameters (No.720.0 or later) are not displayed on the parameter tab screen of S-TUNEⅡ. These parameters are displayed in the Point Table tabbed screen.

3. Velocity Control Mode

Velocity Control Mode

Velocity Command Input

No. 62.0 (203Eh)	EtherCAT Communication Velocity command: Rotational direction	Settings	Default	Characteristics
		0, 1	1	▨ – – ▨ ▨

Function Use

Select the rotational direction of EtherCAT Communication velocity command input.

Settings	Backward command Input	Forward command Input
0	CCW Rotation	CW Rotation
1	CW Rotation	CCW Rotation

Velocity Control Mode
Tuning Parameters

No. 129.0 (2081h)	Tuning: Velocity control mode - Control gain set	Range	Default	Characteristics
		1 to 46	15 [-]	▣ – – ▨ –

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	Settling 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

No. 130.0 (2082h)	Tuning: Velocity control mode - Control level	Range	Default	Characteristics
		1 to 46	15 [-]	▣ – – ▨ –

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

The following common parameters are described in "position control tuning parameter".
No.102.0, No.103.0, No.106.0, No.110.0, No.110.1

Velocity Control Mode

Tuning Parameters

<table>
<tr><th rowspan="2">No. 131.0
(2083h)</th><th rowspan="2">Tuning:
Velocity control mode - Control gain 1</th><th>Range</th><th>Default</th><th>Characteristics</th></tr>
<tr><td>100 to 6,000</td><td>399
[rad/s]</td><td>📘 — — 0 100 —</td></tr>
<tr><td>Function
Use</td><td colspan="4">Set Control Gain 1 for <u>Velocity Control Mode</u>.

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.</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Velocity Control Mode</td></tr>
<tr><td>Remark</td><td colspan="4">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)</td></tr>
<tr><td>Related To</td><td colspan="4">No.129.0, No.130.0, No.132.0</td></tr>
</table>

<table>
<tr><th rowspan="2">No. 132.0
(2084h)</th><th rowspan="2">Tuning:
Velocity control mode
- Gain FF compensation 1</th><th>Range</th><th>Default</th><th>Characteristics</th></tr>
<tr><td>0 to 15,000</td><td>0
[0.01%]</td><td>📘 — — 0 100 —</td></tr>
<tr><td>Function
Use</td><td colspan="4">Set Feed-Forward Compensation Rate with respect to Control Gain 1 for <u>Velocity Control Mode</u>.

Increase the value of this parameter to provide faster command response. In the event of noise, decrease the setting value a little.</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Velocity Control Mode</td></tr>
<tr><td>Related To</td><td colspan="4">No.129.0, No.130.0, No.131.0, No.133.0, No.162.0</td></tr>
</table>

<table>
<tr><th rowspan="2">No. 133.0
(2085h)</th><th rowspan="2">Tuning:
Velocity control mode - Integral gain</th><th>Range</th><th>Default</th><th>Characteristics</th></tr>
<tr><td>45 to 5,000</td><td>300
[rad/s]</td><td>📘 — — 0 100 —</td></tr>
<tr><td>Function
Use</td><td colspan="4">Set the Integral Gain for <u>Velocity Control Mode</u>.

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.</td></tr>
<tr><td>Prerequisite</td><td colspan="4">Velocity Control Mode</td></tr>
<tr><td>Remark</td><td colspan="4">This parameter will reset to the prearranged value if Inertia conditions or Control Gain Set is changed.</td></tr>
<tr><td>Related To</td><td colspan="4">No.129.0, No.130.0, No.131.0, No.132.0, No.162.0</td></tr>
</table>

4. Torque Control Mode

Torque Control Mode

Torque Command Input

No. 152.0 (6080h)	EtherCAT Communication Torque command: **Speed limit**	Range	Default	Characteristics
		0 to 10,000	Max. motor speed [r/min]	📖 – 🔒 0 100 –
Function Use	Set the speed limit for Torque Control Mode.			
Prerequisite	Torque Control Mode			

No. 302.0 (212Eh)	EtherCAT Communication Torque command: **Rotational directional**	Settings	Default	Characteristics
		0, 1	1	📖 – – A⇄B –
Function Use	Specify the rotational direction of EtherCAT Communication torque command input.			

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

5. Vibration Suppress Filter

Vibration suppress filter

Position Command Filter

No. 66.0 (2042h)	Position command filter 1: Selection	Settings	Default	Characteristics
		0 to 3	0	📖 – – A⇄B ⏻

Function Use

Select no filter or one of the three filters:

Settings	Filter type to be applied
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

No. 66.1	Position command filter 4: Selection	Settings	Default	Characteristics
		0, 1	1	– – – ON OFF ⏻

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

Vibration suppress filter

Position Command Filter

		Range	Default	Characteristics
No. 74.0 (204Ah)	Position command filter 1: **Notch frequency**	10 to 3,000	10 [0.1Hz]	— —
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			

		Range	Default	Characteristics
No. 75.0 (204Bh)	Position command filter 1: **Notch width**	128 to 2,048	512 [-]	— —
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

		Range	Default	Characteristics
No. 76.0 (204Ch)	Position command filter 1: **High frequency gain**	50 to 200	100 [-]	— —
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

		Range	Default	Characteristics
No. 79.0 (204Fh)	Position command filter 1: **Notch depth**	0 to 100	0 [-]	— —
Function Use	Set the notch depth of Position command filter 1.			

Setting	Notch Depth
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 1: Type (No.66.0) = 2 (Notch filter) or 3 (γ -Notch filter)
Related To	No.66.0, No.74.0, No.75.0, No.76.0

Vibration suppress filter

Position Command Filter

No.		Range	Default	Characteristics
No. 80.0 (2050h)	Position command filter 1: Smoothing 1 - Moving average counter	1 to 6,250	40 [-]	– –
No. 81.0	Position command filter 4: Smoothing 2 - Moving average counter	1 to 1,250	16 [-]	

Function Use

These items are used to smooth the speed changes in high acceleration/deceleration, 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.

Delay time Calculation Formula
100 µs × Moving average count = Delay time

■ 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.

Moving average count and Vibration interval to compress
10,000 × Vibration interval [s] = Moving average count

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 C-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.

The default value of Position command filter 1: Type (No.66.0) is 0 (no filter).

Related To

No.66.0, No.66.1

Vibration suppress filter

Position Command Filter

No. 82.0 (2052h)	Position command filter 2: Selection	Settings	Default	Characteristics
		0 to 3	0	– –

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

No. 82.1 (2052h)	Position command filter 3: Selection	Settings	Default	Characteristics
		0 to 3	0	– –

Function Use: Set Position Command Filter 3.

Settings	Filter type to be applied
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

No. 83.0 (2053h)	Position command filter 2: Notch frequency	Range	Default	Characteristics
		10 to 3,000	10 [0.1Hz]	– –
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			

No. 84.0 (2054h)	Position command filter 2: Notch width	Range	Default	Characteristics
		128 to 2,048	512 [-]	– –

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

Vibration suppress filter

Position Command Filter

No. 85.0 (2055h)	Position command filter 2: High frequency gain	Range	Default	Characteristics
		50 to 200	100 [-]	– –

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 (2056h)	Position command filter 2: Notch depth	Range	Default	Characteristics
		0 to 100	0 [-]	– –

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

Vibration suppress filter

Position Command Filter

<table>
<tr><td rowspan="2">No. 357.0
(2165h)</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 3,000</td><td>10
[0.1Hz]</td><td>▣ — — ▦ ⏻</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>

<table>
<tr><td rowspan="2">No. 358.0
(2166h)</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>▣ — — ▦ ⏻</td></tr>
<tr><td>Function
Use</td><td colspan="4">Set the width of notch of Position Command Filter3.
<table>
<tr><td>Setting</td><td>Notch Width</td></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>

<table>
<tr><td rowspan="2">No. 359.0
(2167h)</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>▣ — — ▦ ⏻</td></tr>
<tr><td>Function
Use</td><td colspan="4">Set the high frequency gain for Position Command Filter3.
<table>
<tr><td>Setting</td><td>Effect</td></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>

<table>
<tr><td rowspan="2">No. 360.0
(2168h)</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>▣ — — ▦ ⏻</td></tr>
<tr><td>Function
Use</td><td colspan="4">Set the depth for Position Command Filter 3.
<table>
<tr><td>Setting</td><td>Notch Depth</td></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>

Vibration suppress filter

Torque Command Filter

P V T SUPP

No. 160.0 (20A0h)	Torque command filter: Low-pass filter - Switch	Settings	Default	Characteristics
		0, 1	1	📘 – – ON OFF –

Function Use

Enable/Disable Low-pass filter.

This filter is a first-order IIR filter.

Settings	Low-pass filter
0	Disable
1	Enable

Related To No.113.0, No.160.2, No.162.0

No. 160.1 (20A0h)	Torque command filter: Notch filter - Switch	Settings	Default	Characteristics
		0, 1	0	📘 – – ON OFF –

Function Use

Enable/Disable Notch filter.

Settings	Notch filter
0	Disable
1	Enable

Related To No.168.0, No.169.0, No.170.0

No. 160.2 (20A0h)	Torque command filter: Low-pass filter - Auto setting	Settings	Default	Characteristics
		0, 1	0	📘 – – ON OFF –

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

No. 160.3 (20A0h)	Torque command filter: Notch filter 2 - Switch	Settings	Default	Characteristics
		0, 1	0	📘 – – ON OFF –

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

Vibration suppress filter

Torque Command Filter

P V T SUPP

No. 162.0 (20A2h)

Torque command filter:
Low-pass filter - Time constant

Range	Default	Characteristics
0 to 65,535	(See below) [0.01 ms]	▣ — — 0 100 —

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

No. 168.0 (20A8h)

Torque command filter:
Notch filter - Frequency

Range	Default	Characteristics
0 to 2,500	2,500 [Hz]	▣ — — 0 100 —

Function Use

Set the notch frequency for the Torque command filter - notch filter.

This item is measured with S-TUNE Ⅱ .

Prerequisite Torque command filter: Notch filter switch (No.160.1) = 1 (Enable)

Related To No.160.1, No.169.0, No.170.0

No. 169.0 (20A9h)

Torque command filter:
Notch filter - Width

Range	Default	Characteristics
1 to 16	8	▣ — — 0 100 —

Function Use

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.

Setting	Factor	Notch Width
16	x2	Large
12	x1.5	↕
8	x1	
4	x0.5	Small

Prerequisite Torque command filter: Notch filter switch (No.160.1) = 1 (Enable)

Related To No.160.1, No.168.0, No.170.0

Vibration suppress filter

Torque Command Filter

		Range	Default	Characteristics
No. 170.0 (20AAh)	Torque command filter: **Notch filter - Depth**	0 to 256	0 [-]	▣ – – ▨ –
Function Use	Set the depth at the notch frequency of Torque command Notch filter.			

Setting	Notch Depth
0	Complete shutoff of notch frequency input
↕	↕
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.160.1 No.168.0 No.169.0

		Range	Default	Characteristics
No. 171.0 (20ABh)	Torque command filter: **Notch filter 2 - Frequency**	0 to 2,500	2,500 [Hz]	▣ – – ▨ –
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			

		Range	Default	Characteristics
No. 172.0 (20ACh)	Torque command filter: **Notch filter 2 - Width**	1 to 16	8	▣ – – ▨ –
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

Vibration suppress filter

Torque Command Filter

P V T SUPP

No. 173.0 (20ADh)	Torque command filter: Notch filter 2 - Depth	Range	Default	Characteristics
		0 to 256	0 [-]	📖 – – 0 100 –

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

MEMO

3

Tuning

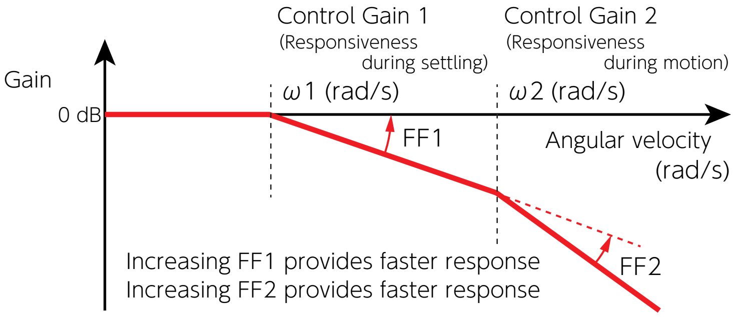
1. Introduction

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.

S-FLAG Ⅱ is a servo system that does not let overshooting and undershooting happen when the equipment inertia ratio is set appropriately.

S-FLAG Ⅱ 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) : $\dfrac{\omega1\omega2}{\omega1+\omega2}$
- 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

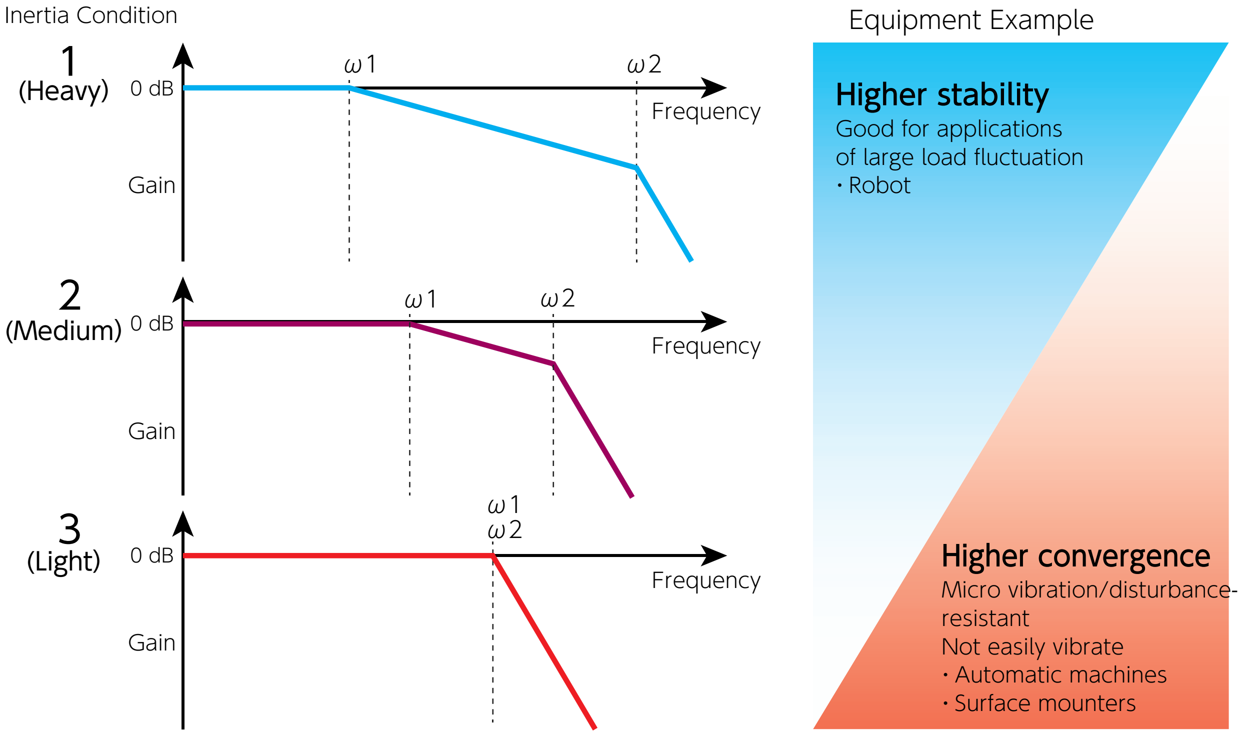
The following prearranged sets of parameters for each control mode enable you to perform tuning easily. (*)

*) 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 P	**Control Gain 1**, **Control Gain 2**, and **Integral Gain**
Velocity Control Mode V	**Control Gain 1** and **Integral Gain**

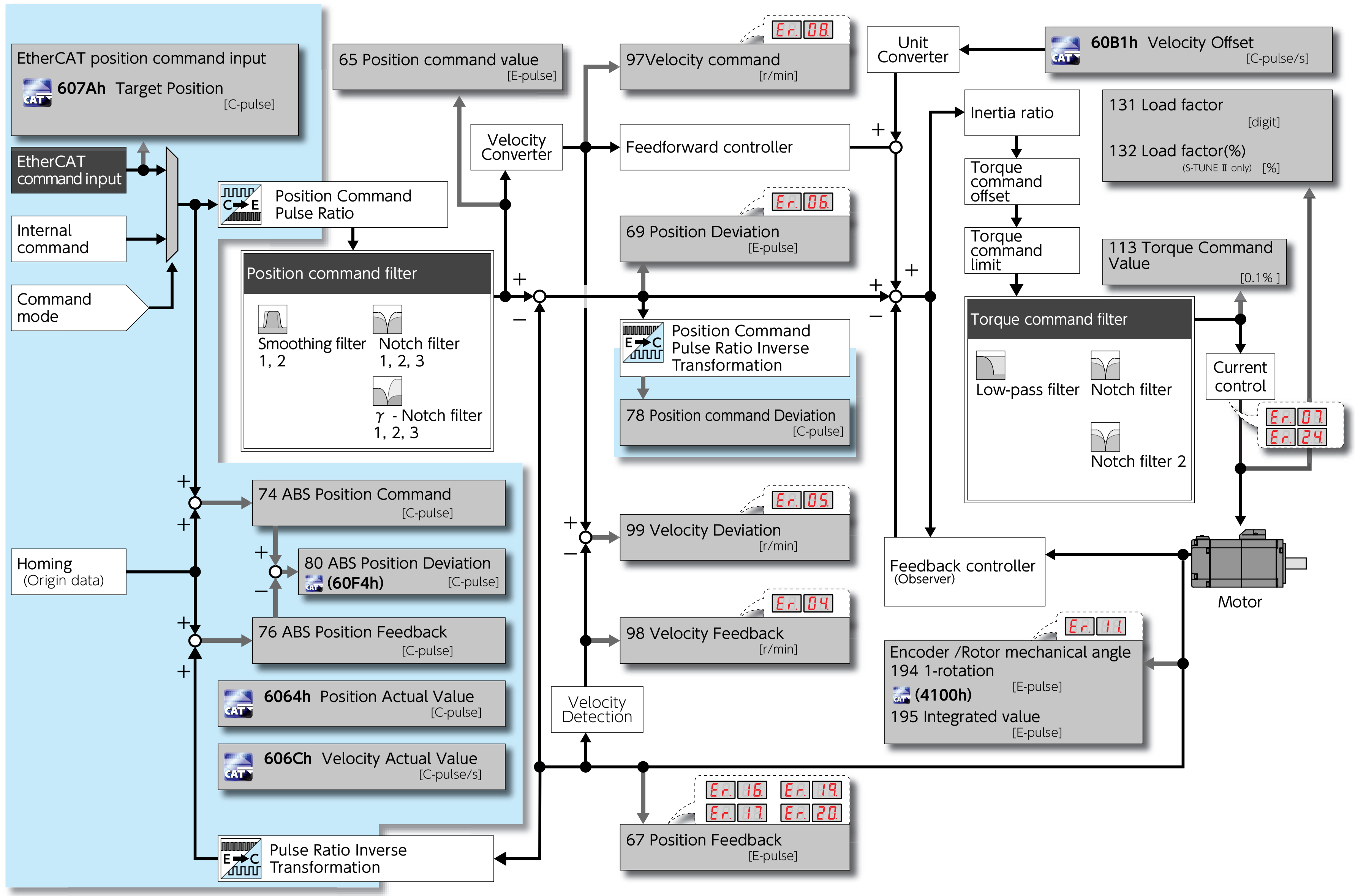
Inertia Condition

S-FLAG Ⅱ features three response models to support a variety of equipment.
Three models are different in ratios of Control Gain 1 ($\omega 1$) and Control Gain 2 ($\omega 2$) and you can select the one suitable to the stability and convergence of your equipment.

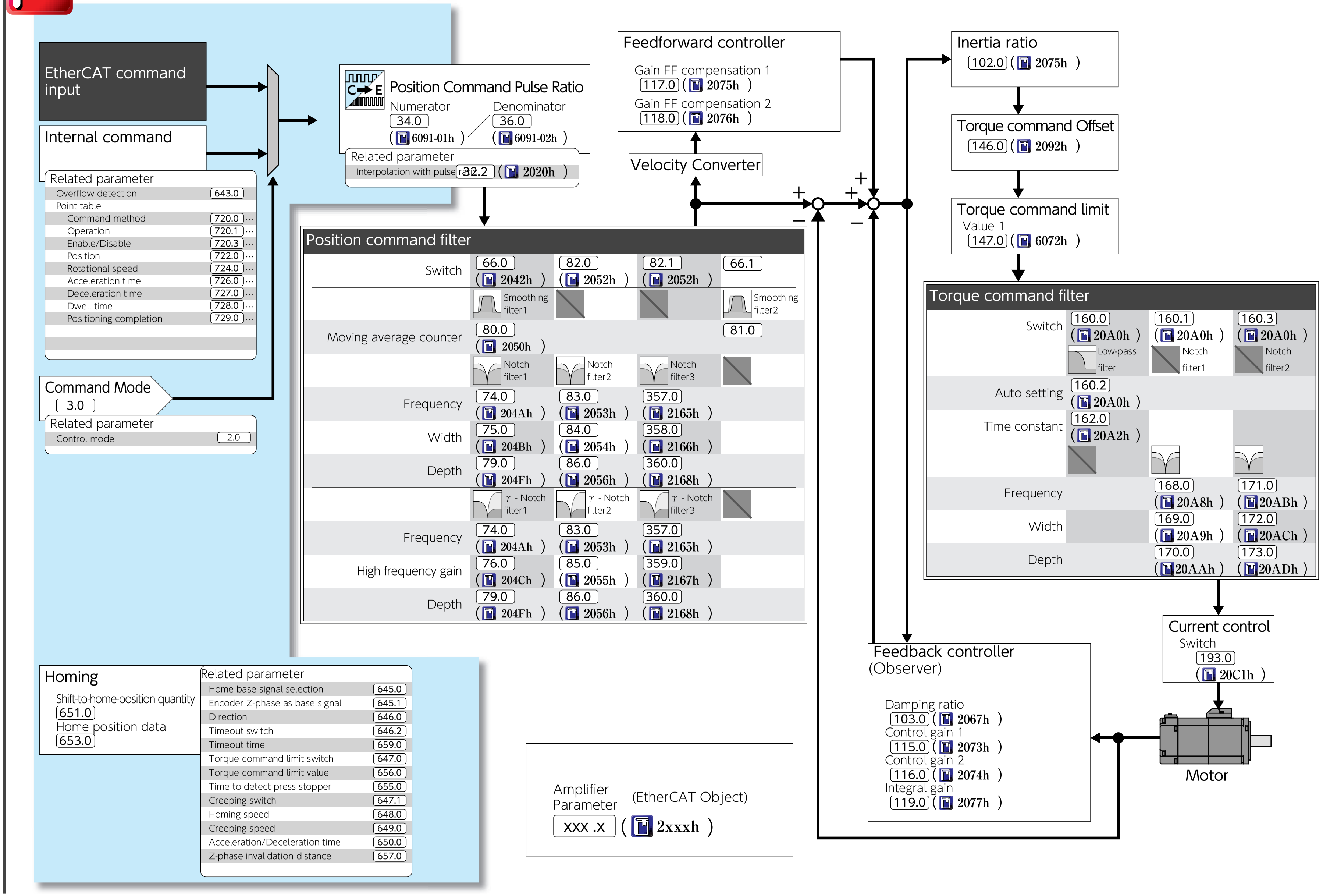


1. Control Block Diagram

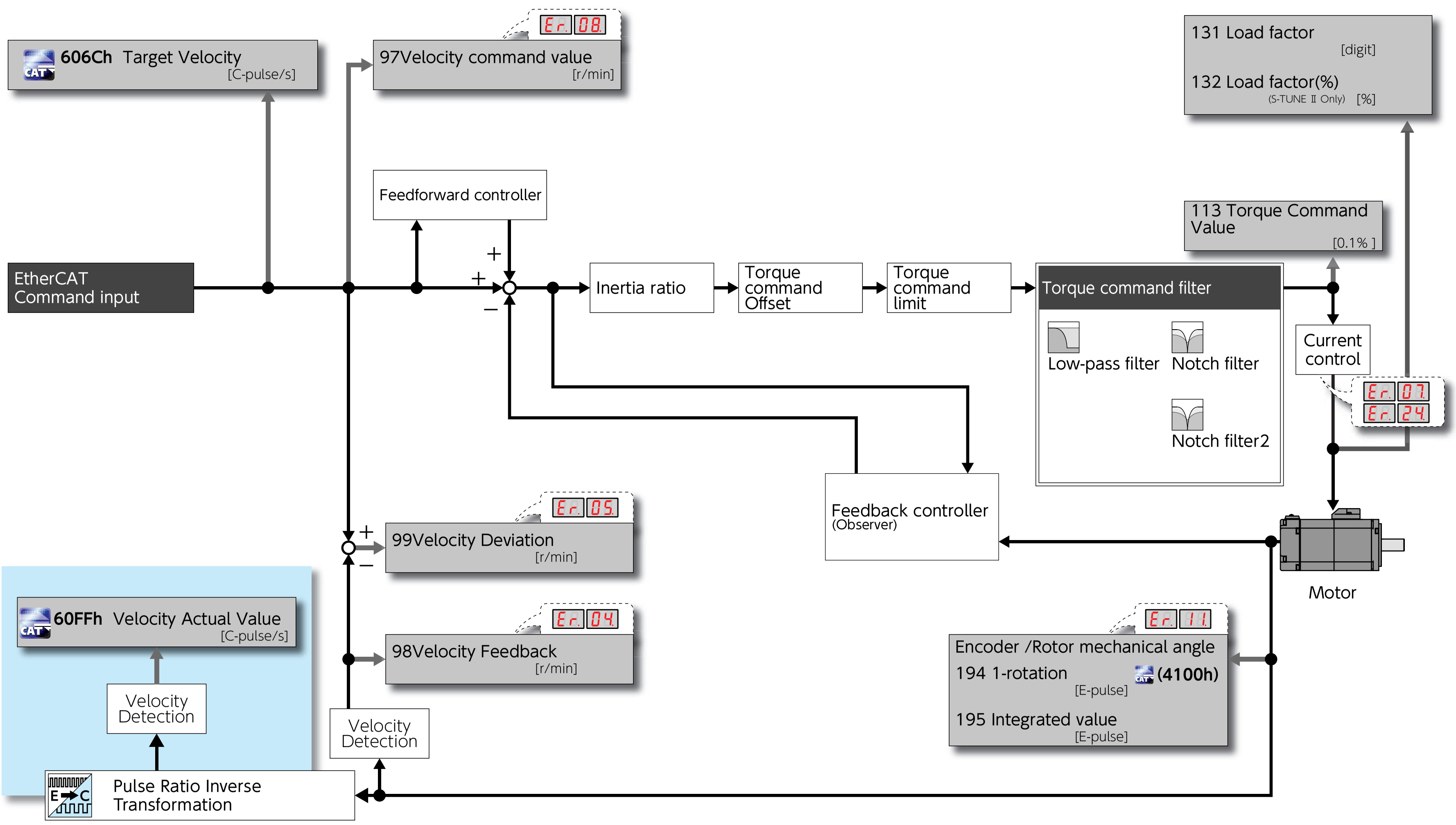
Position Control Mode



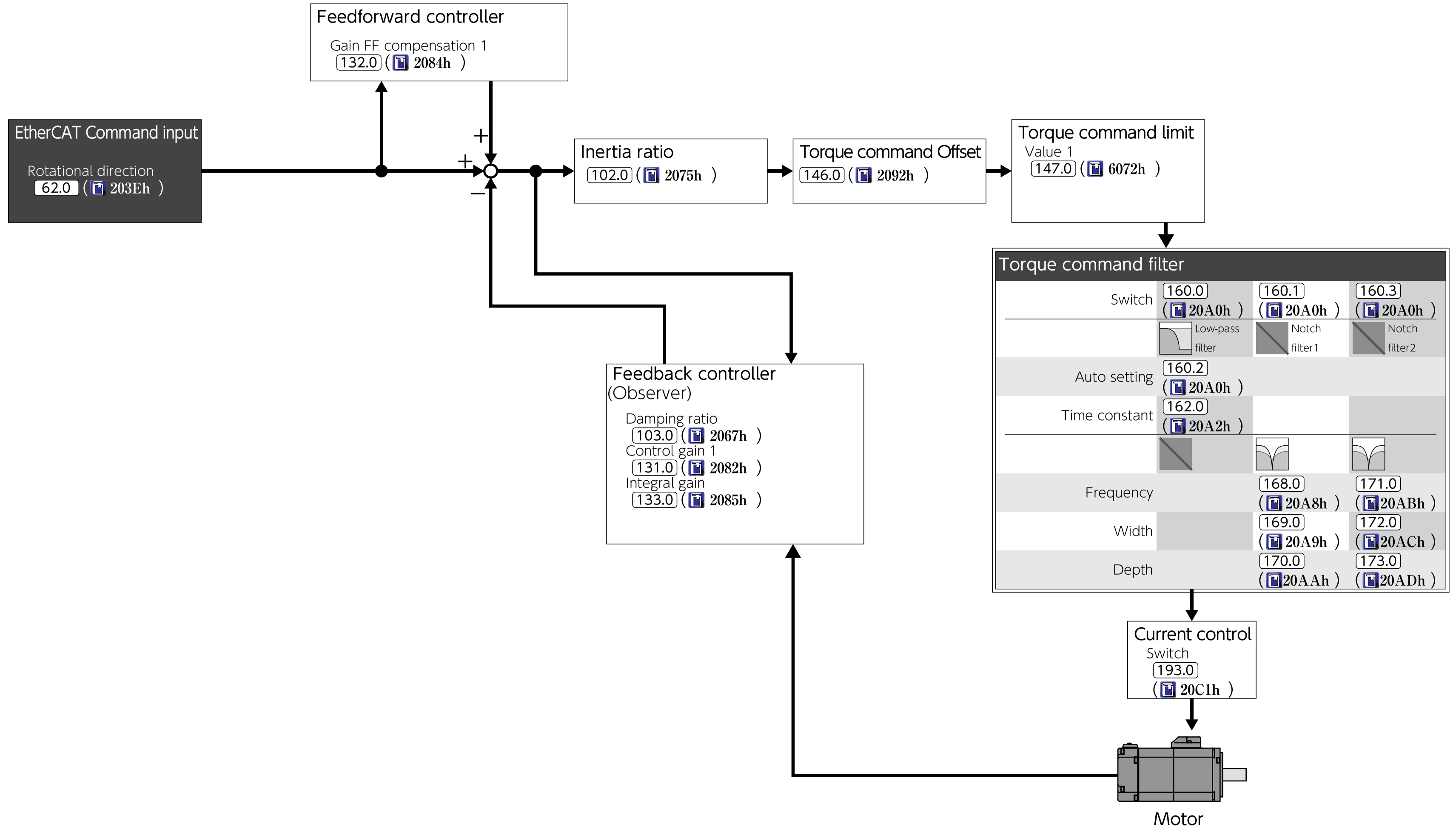
Position Control Mode (Related parameter)



Velocity Control Mode



Velocity Control Mode (Related parameter)

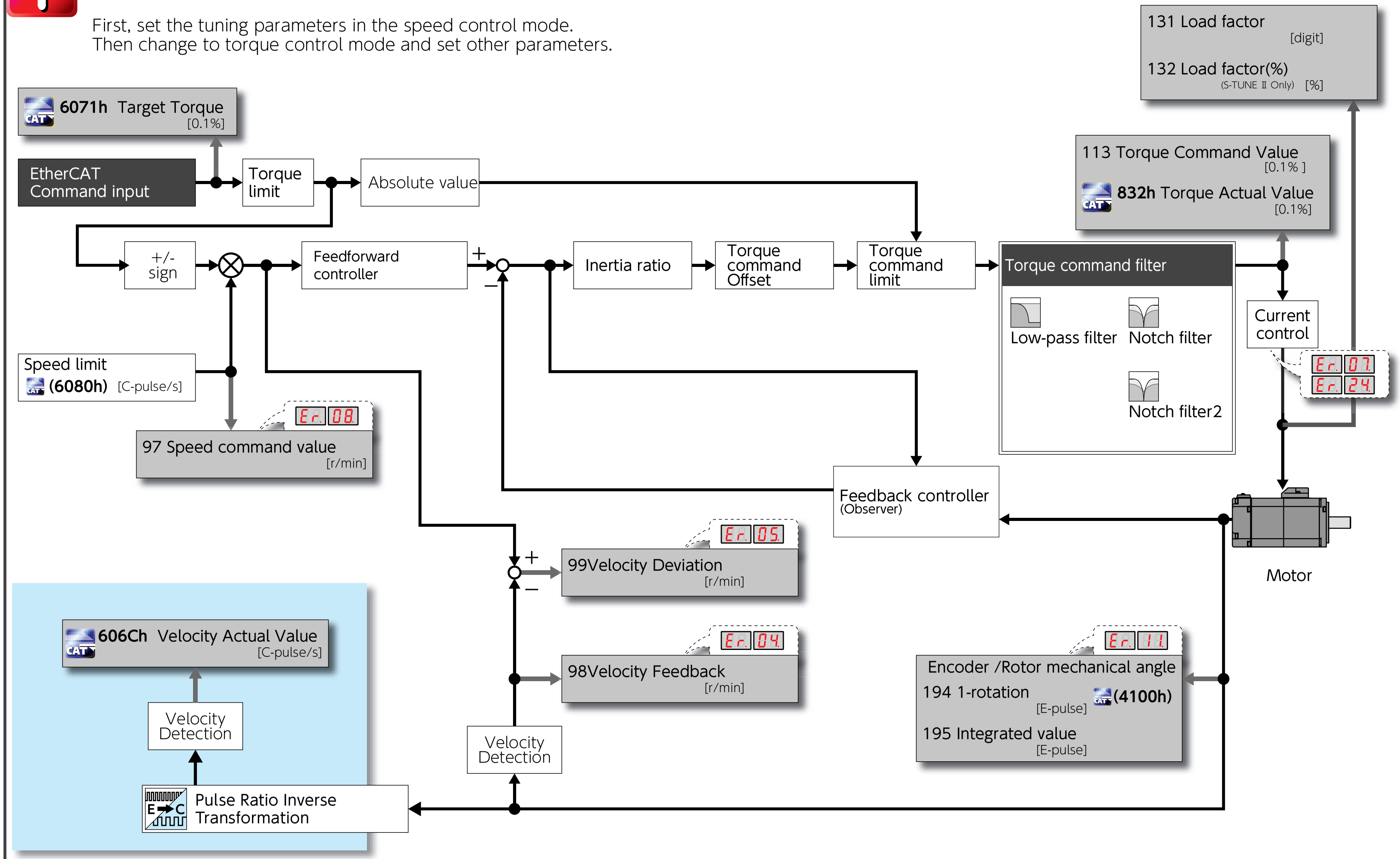


Torque command filter

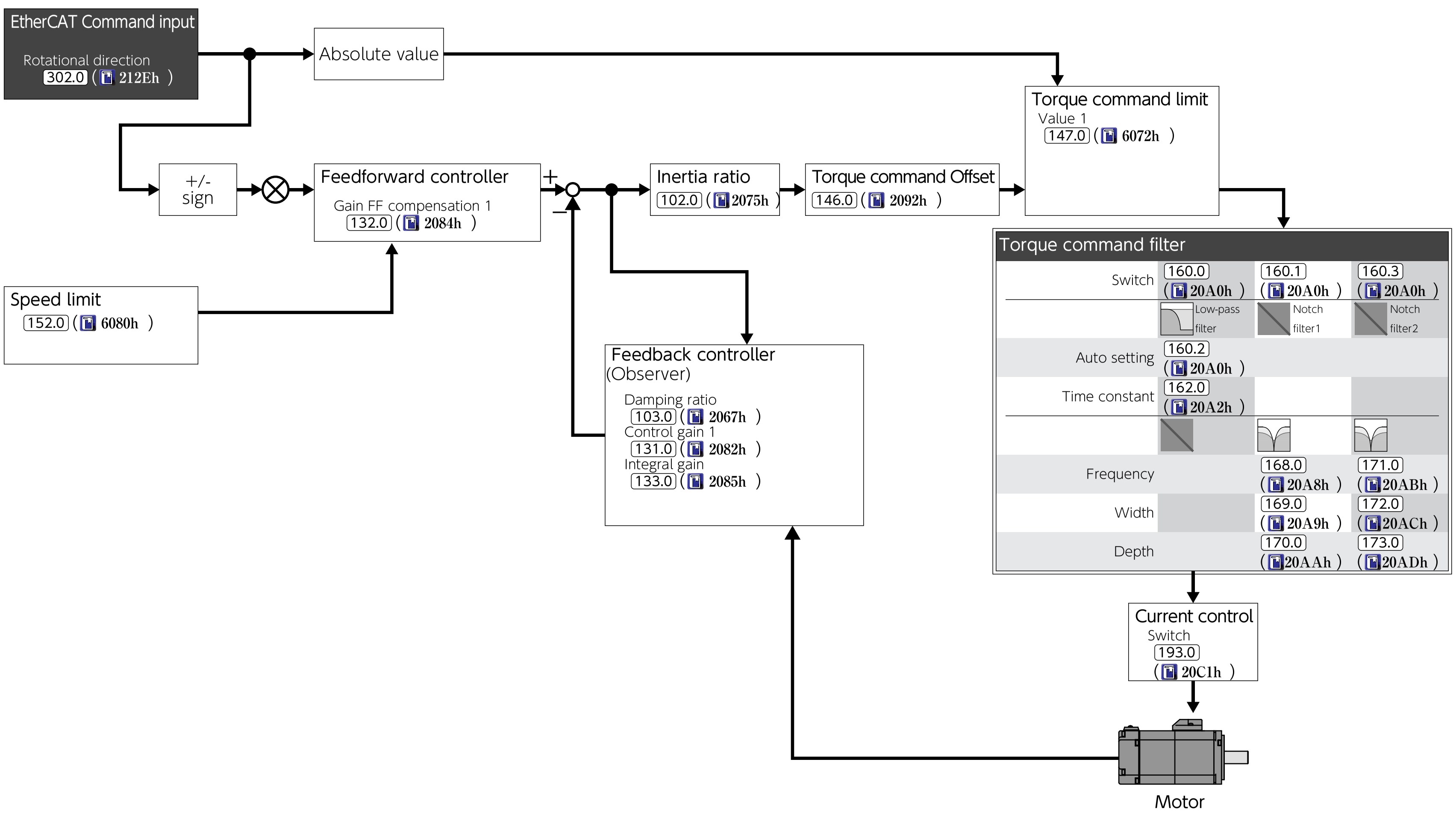
Switch	160.0 (20A0h)	160.1 (20A0h)	160.3 (20A0h)
	Low-pass filter	Notch filter1	Notch filter2
Auto setting	160.2 (20A0h)		
Time constant	162.0 (20A2h)		
Frequency		168.0 (20A8h)	171.0 (20ABh)
Width		169.0 (20A9h)	172.0 (20ACh)
Depth		170.0 (20AAh)	173.0 (20ADh)

Torque Control Mode

First, set the tuning parameters in the speed control mode.
Then change to torque control mode and set other parameters.



Torque Control Mode (Related parameter)



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.	

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	Input the Enable Operation (0x6040,3) signal to turn the servo ON.
5	Input the EtherCAT command from the host controller and operate the motor at low speed.
6	Use the setup support software S-TUNE Ⅱ. Install it on a user-supplied computer.

Any of the following may interrupt proper performance of Auto Tuning.

The inertia ratio is less than 1 or above 30. (*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

Position Control Mode

If your amplifier and S-TUNE II are the following versions or later, you can use the more accurate auto-tuning "Z-TUNING".

Z-Tuning is an auto-tuning function that is performed by operating the motor from S-TUNE II.

Supported Models and Versions

Supported Models		Supported Versions
Software S-TUNE Ⅱ		**2.1.0.0** or later
Servo Amplifier S-FLAG Ⅱ Series	EtherCAT Communication model **DB6**42** Series	**6.1.0.0** or later

If you are using a product other than those listed above, you can still use "Quick Tuning" to automatically adjust the control parameters.

Quick Tuning on S-TUNE Ⅱ ☞ **Z-** 2 Technical Information

Velocity Control Mode

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 28 Auto Tuning on S-TUNE Ⅱ
Stage 2 Final Tuning	**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 32 Final Tuning: Velocity control mode

2. Tuning Procedure

1. Position Control Mode

Z-Tuning is an auto-tuning function that is performed by operating the motor from S-TUNE II.

⚠ DANGER

🚫	**DO NOT** execute Z-tuning on the vertical axis or the axis that is under a load such as spring mechanism.	⚠
	DO NOT operate the amplifier's settings panel while tuning from S-TUNE II.	
❗	Before tuning, make sure to have safety measures such as hazard prevention measures, immediate stop measures, or impact reduction measures.	

Z-Tuning is an auto-tuning function that is performed by operating the motor from S-TUNE II.

Supported Models and Versions

Supported Models		Supported Versions
Software S-TUNE Ⅱ		**2.1.0.0** or later
Servo Amplifier S-FLAG Ⅱ Series	EtherCAT Communication model **DB6**42** Series	**6.1.0.0** or later

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Getting version information

Version information can be monitored in S-TUNE II.

2. Tuning Procedure

Z-Tuning

Outline of Z-Tuning

Z-tuning is for Position control mode.

It is not available in the Velocity control mode and Torque control mode.

Z-tuning is only applicable to horizontal axis motions.

It is not applicable to the axis that is under a permanent load such as vertical axis and spring mechanism.

Z-Tuning automatically searches for the load inertia ratio, gain set, torque notch filter, and position command smoothing filter to fulfill the set positioning completion range and settling time targets.

To start Z-tuning, the user sets the operating range for tuning and some tuning conditions.

Once Z-Tuning starts, the motor will be run while changing tuning parameters from S-TUNE II, and the trials are repeated until the tuning parameters become optimal.

During Z-Tuning, the maximum motor speed is 1,000 r/min and the acceleration time is 100ms.

The tuning process ends after the set positioning completion range and settling time conditions are reached.

To ensure servo stability, depending on the customer's equipment, the tuning may be completed before the conditions are reached, but this is not an abnormality.

The motion control parameters(*) required for Z-tuning operation are changed automatically and return to the previous settings automatically after Z-tuning is finished.

*) These are the control mode, command mode, and other parameters.

The result of Z-tuning can be saved in a data file. Saved data files can be read and displayed even when the connection between S-TUNE II and the amplifier is offline.

Any of the following may interrupt proper performance of Z-Tuning.

The inertia ratio is less than 1 or above 30. (*1)
The load inertia is fluctuating.
Machine rigidity is extremely low.
Non-linear characteristics such as backlash exist.
The torque is extremely large or small.

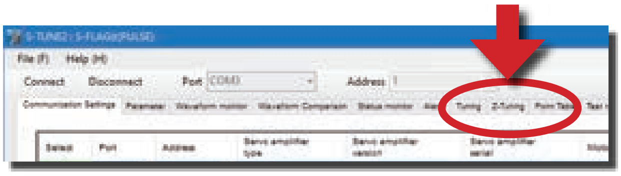
*1) If an extremely large load with an inertia ratio greater than 100 times is connected, parameter No. 102.0 (the value of the inertia ratio) will be clamped at 10,000.

2. Tuning Procedure

Overall flow of Z-tuning

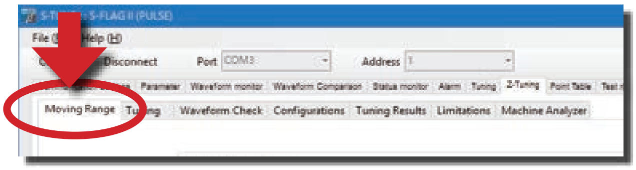
Start tuning. Start Z-tuning.

1 Connect the S-TUNE II to the amplifier and select the **[Z-Tuning]** tab.



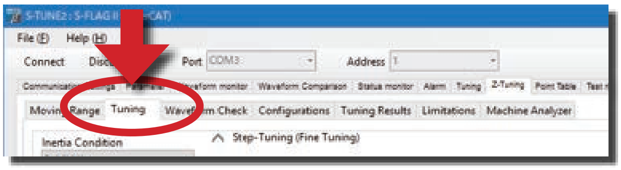
2 Sets up the range where you want to perform Z-tuning.

This is carried out
in the **[Moving Range]** tab.



3 Start tuning.

This is carried out
in the **[Adjustment]** tab.



Tuning complete Z-Tuning is complete.

Tip!

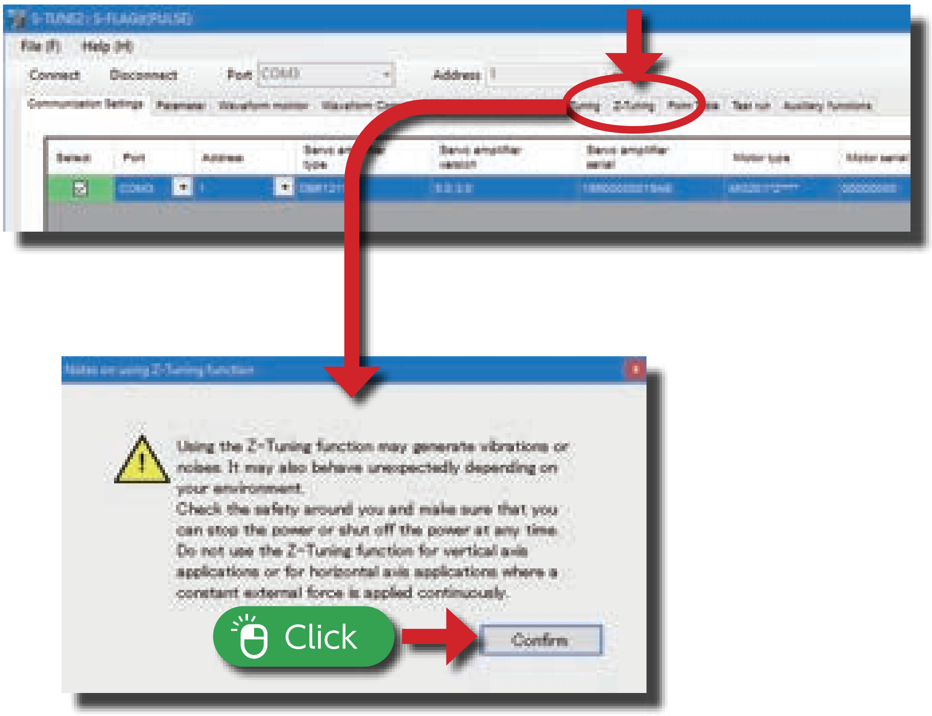
Limitations of "Z-Tuning"

There are some Limitations on Z-tuning.
Please be sure to fully understand the Limitations before tuning.

P. 22

1 Connect the S-TUNE II to the amplifier and select the **[Z-Tuning]** tab.

When Z-Tuning is started for the first time, a warning message pops up.
Please click the **[Confirm]** button after you have fully understood the notes.



Notes on using Z-Tuning function

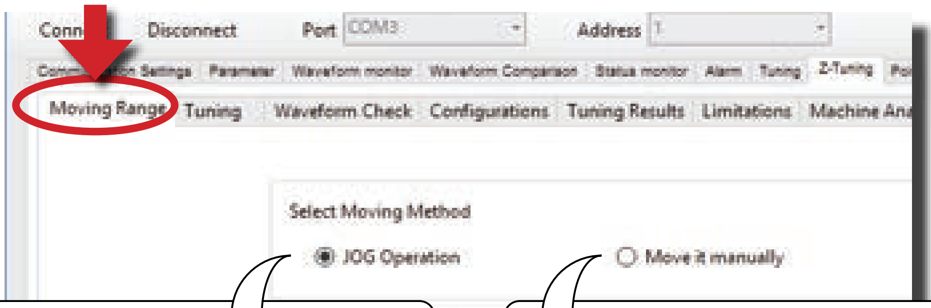
Using the Z-Tuning function may generate vibrations or noises. It may also behave unexpectedly depending on your environment.
Check the safety around you and make sure that you can stop the power or shut off the power at any time.
Do not use the Z-Tuning function for vertical axis applications or for horizontal axis applications where a constant external force is applied continuously.

NEXT 2 Sets up the range where you want to perform Z-tuning.

If an/some alarm(s) is/are present, you cannot move into the [Z-Tuning] tab. Check the contents of the "Alarm" tab and clear the alarm.

2 Sets up the range where you want to perform Z-tuning.

On the **[Moving Range]** tab, choose one way to move the motor.



Select Moving Method

● JOG Operation ○ Move it manually

Jog Operation

☞ P. 17

Use the jog operation buttons in the motion range setting frame.

(The motor turns into SERVO ON state.)

Move by hand

☞ P. 18

Manually move your device, which is connected to the motor, without turning on the servo.

(This operation is not supported for motors with brakes.)

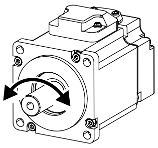
⚠ DANGER

🚫	**DO NOT** use "Move by hand" if your machine is a device with a blade or a press, or something like that.	
❗	**BE EXTREMELY CAREFUL** not to roll or collide with the equipment while moving by "Move by hand".	⚠ ⚠
	MAKE SURE there are no one(s) or obstacles in/around the moving area before you start.	
	RESET the operating range setting if it collides with an obstacle while setting the operating range. Please set the motion range again.	

Tip !

In case the motor movable range is less than 180° .

Z-tuning cannot be executed.

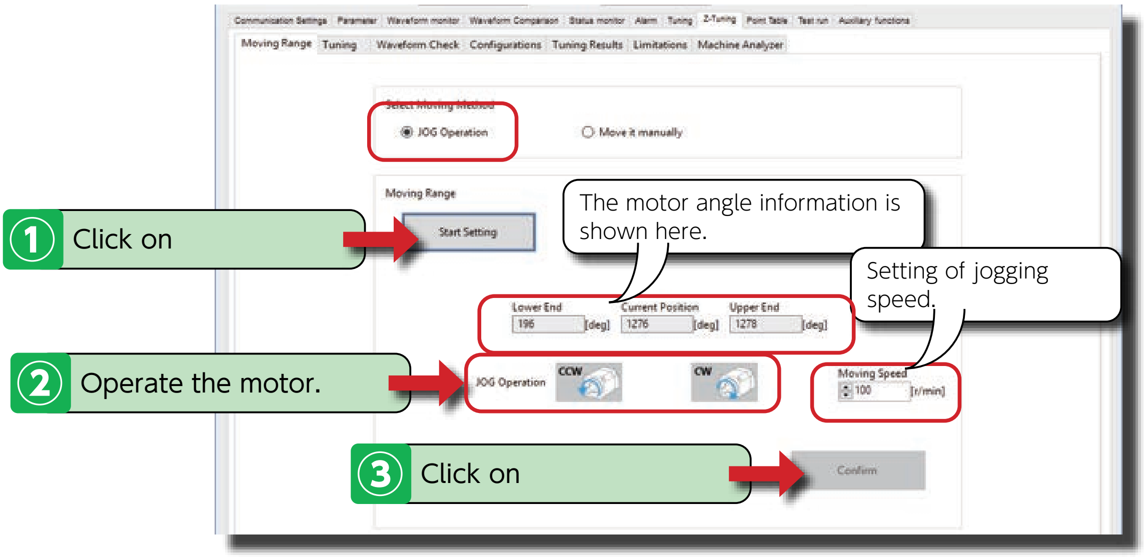


Working range of the device
Motor shaft rotation is less than 180° .

For safety reasons, the jog operation will stop after three rotations (1080°) of movement, even if the CW/CCW button is held down.

2 Sets up the range where you want to perform Z-tuning.

Jog Operation



Lower End 196 [deg]
Current Position 1276 [deg]
Upper End 1278 [deg]
Moving Speed 100 [r/min]

① Click on

② Operate the motor.

③ Click on

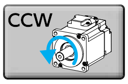
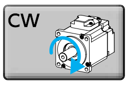
The motor angle information is shown here.

Setting of jogging speed.

① Click on it. The motor turns into "servo on".

② Press the jog operation buttons to get the motor running.

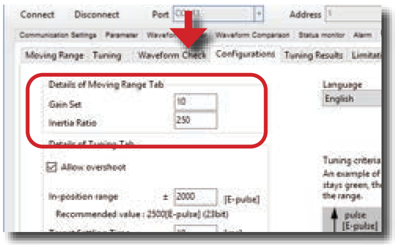
The motor operates while the button is being pushed.

Jog motion buttons	Action
	Move in the **CCW** direction.
	Move in the **CW** direction.

Changing the **[Moving speed]** value will change the jogging speed. The jogging speed should be set to a value that allows you to operate your device safely. The jogging speed can be set from 1 r/min to 100 r/min.

③ Click the "Set Moving Range" button to complete the configuration.

If the load connected to the motor is extremely high, it may cause some oscillation, noise or abnormal vibration during jogging. These problems may be solved by modifying the "Details of Moving Range" in the **[Settings Details]** tab.
To change the settings, click the "Reset" button.

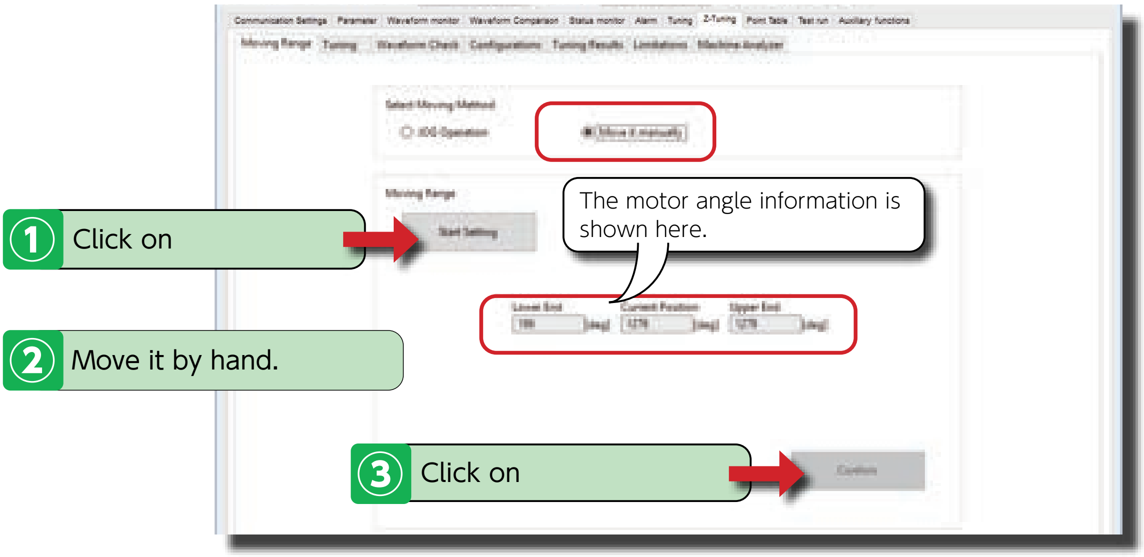


Gain Set 10
Inertia Ratio 250
In-position range ± 2000 [E-pulse]
Recommended value : 2500[E-pulse] (23bit)

2. Tuning Procedure

2 Sets up the range where you want to perform Z-tuning.

Move by hand (A motor with a built-in brake is not supported.)



① Click on it.

② Move it by hand.

③ Click the "Set Moving Range" button to complete the configuration.

NEXT 3 Get the tuning started.

☞ P. 20

2 Sets up the range where you want to perform Z-tuning.

Tip !

Specify the ranges to be tuned.

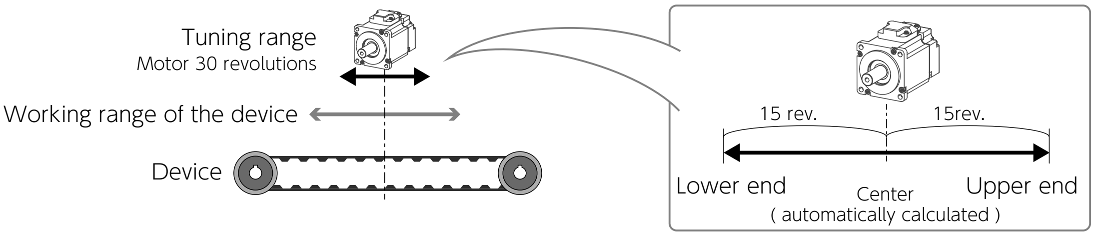
Please refer to this section if your S-TUNE II or amplifier version corresponds to ANY of the following.

Product and Version	S-TUNE Ⅱ : 2.1.0.0

Z-tuning is executed in a range of 30 motor shaft revolutions.
The tuning range should be set to the range actually used in your device.
In [Moving range] tab, set the lower and upper end positions for tuning.
The median value is automatically calculated from the set lower and upper end positions.
The range for tuning is the range of 15 motor revolutions from the median value to the lower and upper ends, respectively.

In case of ... Operating range of your device > Range to be tuned .

The range to be tuned should be set near the center of the operating range of your device.

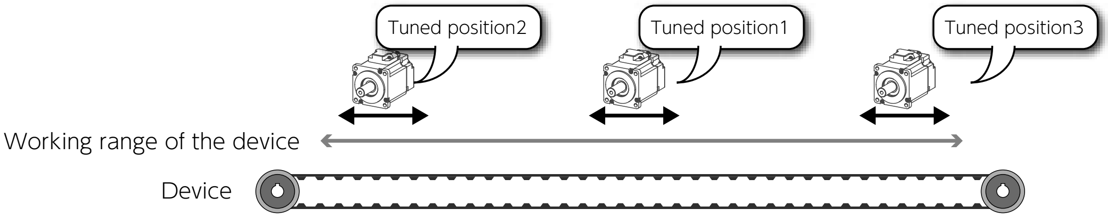


In case of ... Operating range of your device >> Range to be tuned .

In case the actual working range is excessively larger than the range where the Z-tuning is executed.

Perform Z-tuning in at least three locations (*) in the center and both ends of the operating range of the device. Of the tuning results obtained, set the result with the smallest value.

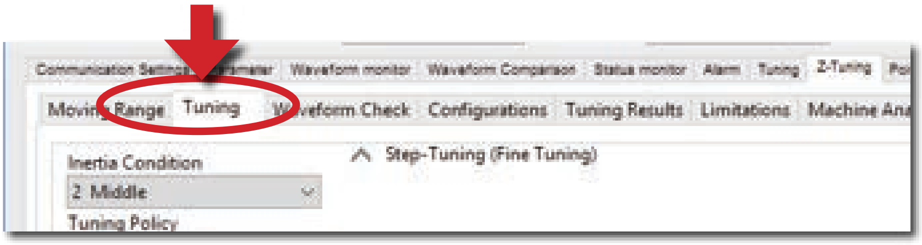
Untuned positions may cause vibration, noise, oscillation, etc. while the device is working.



*) In addition, it is recommended that tuning should be executed at characteristic locations within the operating range. (For example, locations where there is a possibility of rattling due to device connections, or where there are local friction load fluctuations due to deflection.

3 Start tuning.

Tuning is handled in the "Tuning" tab.



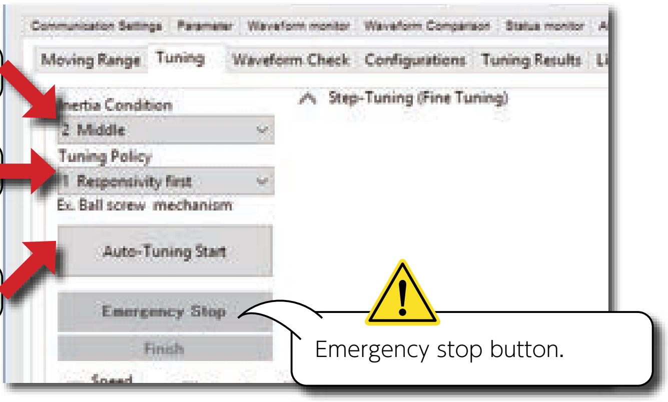
Inertia Condition: 2 Middle

Tuning Policy

① Select an "Inertia Condition".

② Select a "Tuning Policy".

③ Click to start.



Inertia Condition: 2 Middle

Tuning Policy: 1 Responsivity first

Ex. Ball screw mechanism

Emergency stop button.

① Select an "Inertia Condition".

Inertia Condition	Intended Use
1 Heavy	- Heavy-load, high fluctuation equipment, low-rigid equipment - For robot arms etc.
2 Middle	- General transport machines
3 Light	- Light-load equipment - Equipment that demands high-speed operation or settling-required

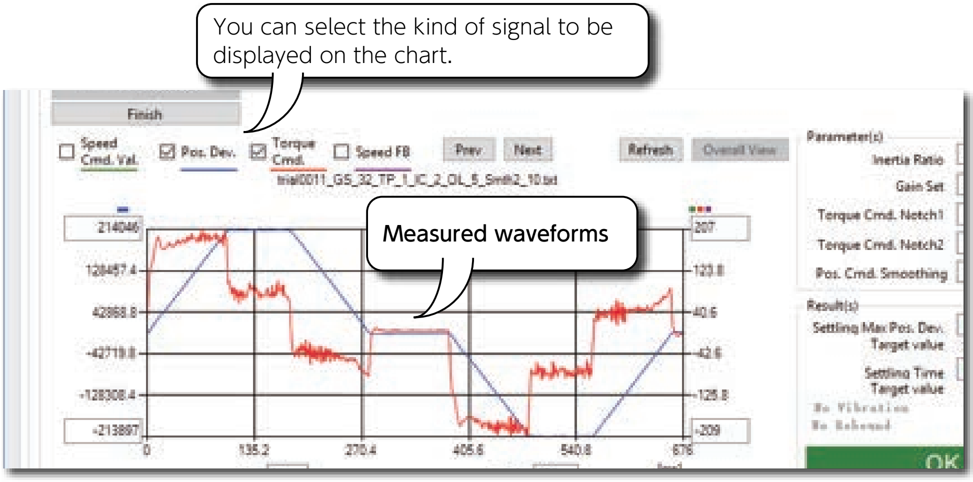
② Select a "Tuning Policy".

Tuning Policy	Intended Use
0 Stability first	**Suitable for tuning the Belt Mechanism.** This tuning policy will not cause noise or oscillation. The position command smoothing filter is automatically applied, therefore the response becomes mild. In some cases, the torque command notch filter is also set automatically.
1 Responsibility first	**Suitable for tuning the ball screw mechanism.** This tuning policy is for devices with light or low load variation. In some cases, the torque command notch filter is also set automatically.

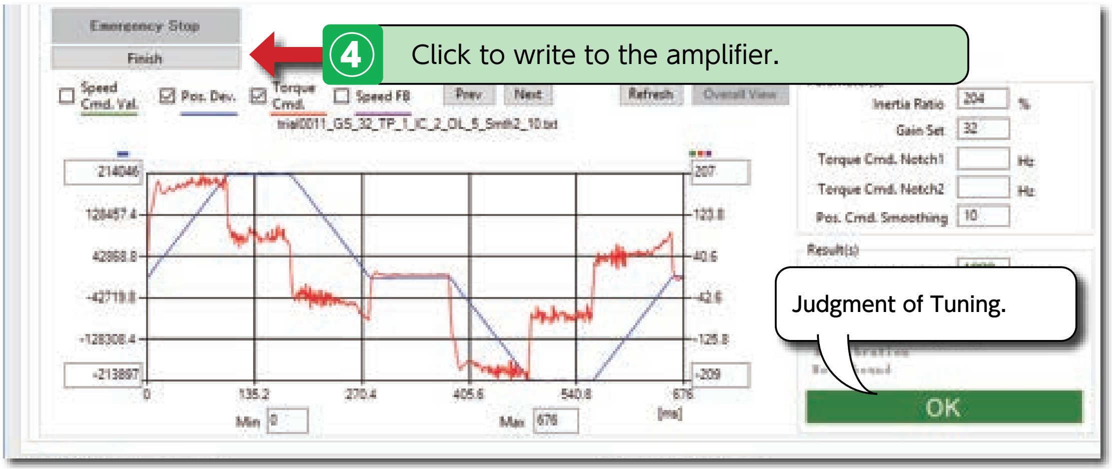
3 Start tuning.

③ Click the "Auto-Tuning Start" button to start tuning.

Waveform data is displayed during tuning, and the waveform is updated at the end of each trial.



If you can accept the settling time and positioning range in the waveform at the end of tuning, the tuning is complete.



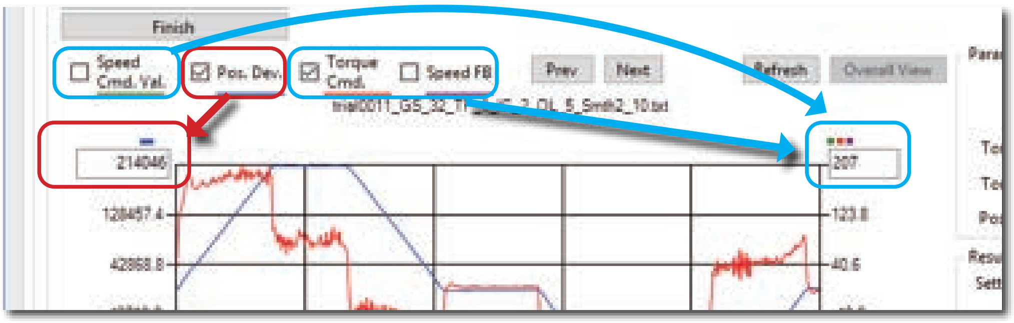
④ Click the **[Write to Amp.]** button to write the tuning parameters to the amplifier.

Completion Z-Tuning is complete.

Tip !

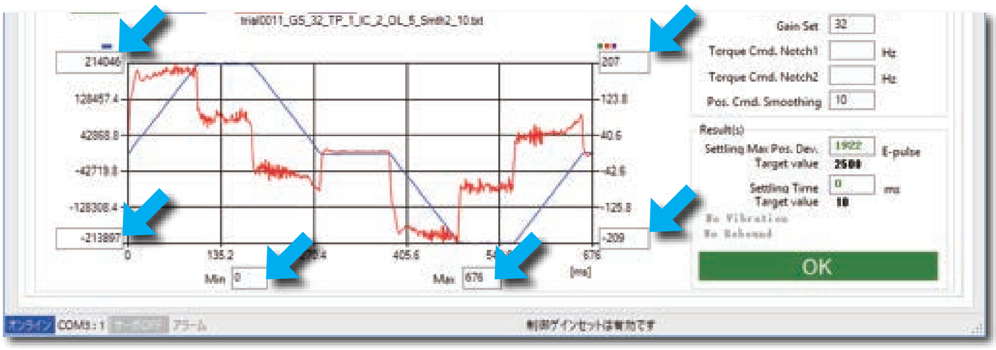
About the Vertical Axis and its Displayed Items in Waveform Chart

The vertical axis of the waveform graph is identified by the underlined color of the displayed item.



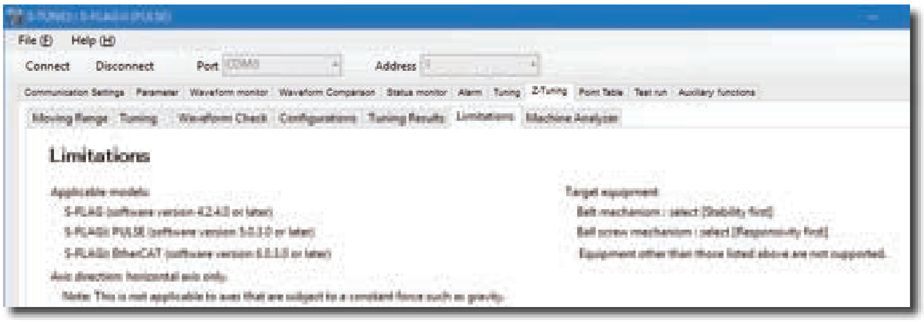
About zooming in on waveform graphs

To enlarge the waveform graph, enter values in the maximum/minimum values surrounded by the squares (blue arrows in the figure below) and click the **[Refresh]** button. To turn the display back to whole view, click the **[Overall View]** button.



The Limitations on Tuning

You can check the conditions and Limitations of Z-tuning in the Limitations tab.



Limitations

Applicable models:
S-FLAG (software version [illegible] or later)
S-FLAGII PULSE (software version [illegible] or later)
S-FLAGII EtherCAT (software version [illegible] or later)
Axis direction: horizontal axis only.
Note: This is not applicable to axes that are subject to a constant force such as gravity.

Target equipment:
Belt mechanism : select [Stability first]
Ball screw mechanism : select [Responsivity first]
Equipment other than those listed above are not supported.

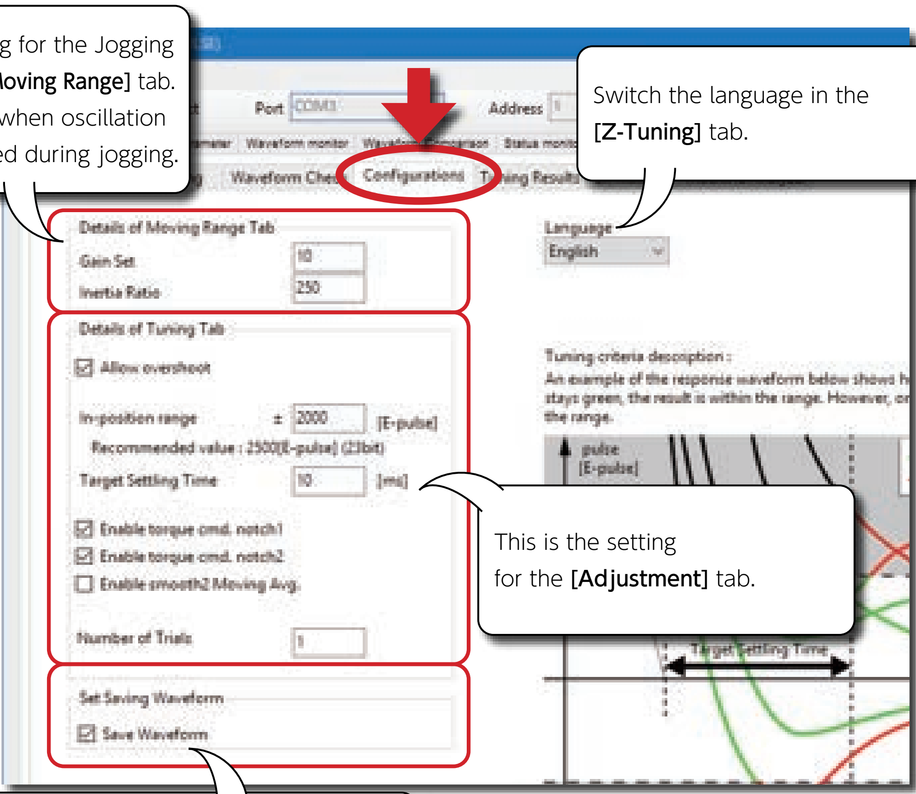
This screen shows an example of connecting a motor with a 23-bit encoder.

Changing tuning settings / saving results

"Z-Tuning" tuning can be configured in the **[Setting Details]** tab.

This is the setting for the Jogging motion on the **[Moving Range]** tab. Use this setting when oscillation or noise is caused during jogging.

Switch the language in the **[Z-Tuning]** tab.



Details of Moving Range Tab
Gain Set 10
Inertia Ratio 250

Details of Tuning Tab
☑ Allow overshoot
In-position range ± 2000 [E-pulse]
Recommended value : 2500[E-pulse] (23bit)
Target Settling Time 10 [ms]
☑ Enable torque cmd. notch1
☑ Enable torque cmd. notch2
☐ Enable smooth2 Moving Avg.
Number of Trials 1

Set Saving Waveform
☑ Save Waveform

Language
English

Tuning criteria description :
An example of the response waveform below shows h
stays green, the result is within the range. However, or
the range.

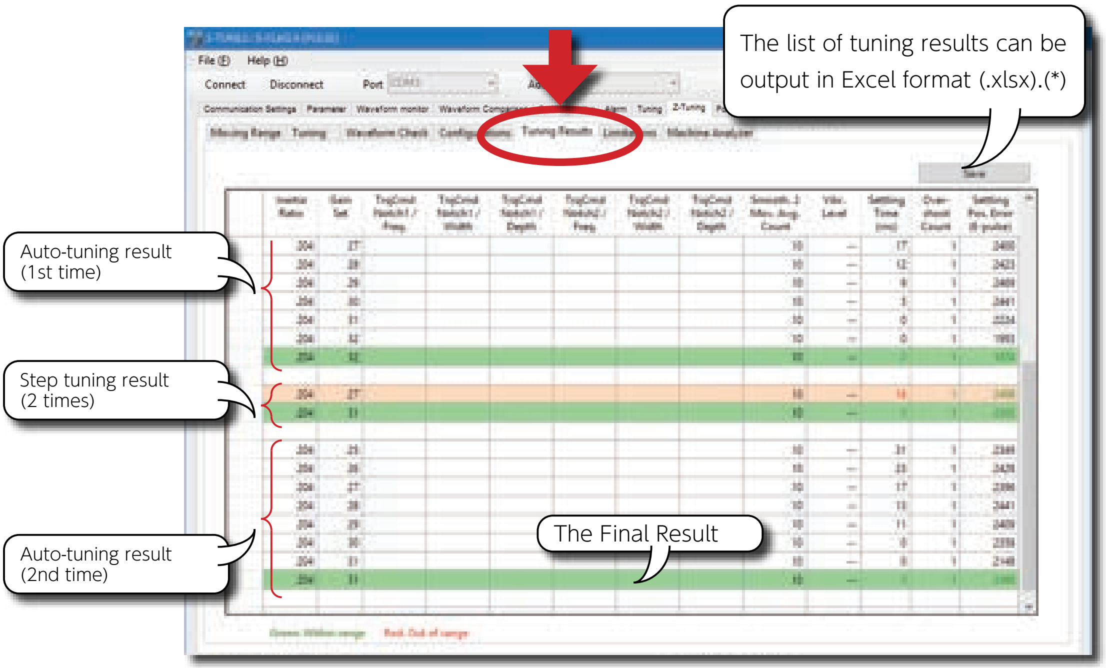
This is the setting for the **[Adjustment]** tab.

When you CHECK in this box, the waveform data of all tuning results are automatically saved.

Show the list of tuning results

All the tuning results are listed in the "Tuning Result" tab.

The results where the vibration level, settling time and number of overshoots are within the target range are highlighted in **GREEN**.
The results that are out of the target range are highlighted in **RED**.


The list of tuning results can be output in Excel format (.xlsx).(*)

The examples shown in the figure above shows a series of results from the first auto-tuning executed, then the step tuning is executed twice, and then the second auto-tuning is executed.
This list remains on display until you exit S-TUNE II. when you restart S-TUNE II, the list will be cleared.

When adopting the FINAL RESULT:

Go to the other tabs from the Z-Tuning tab.
When you click on the other tabs, a dialog appears asking you to confirm the saving of tuning parameters.

When adopting a result OTHER THAN the final result:

Back to the [Adjustments] tab, and then set each parameter in Step Tuning (Detailed Adjustment).

☞ P. 25

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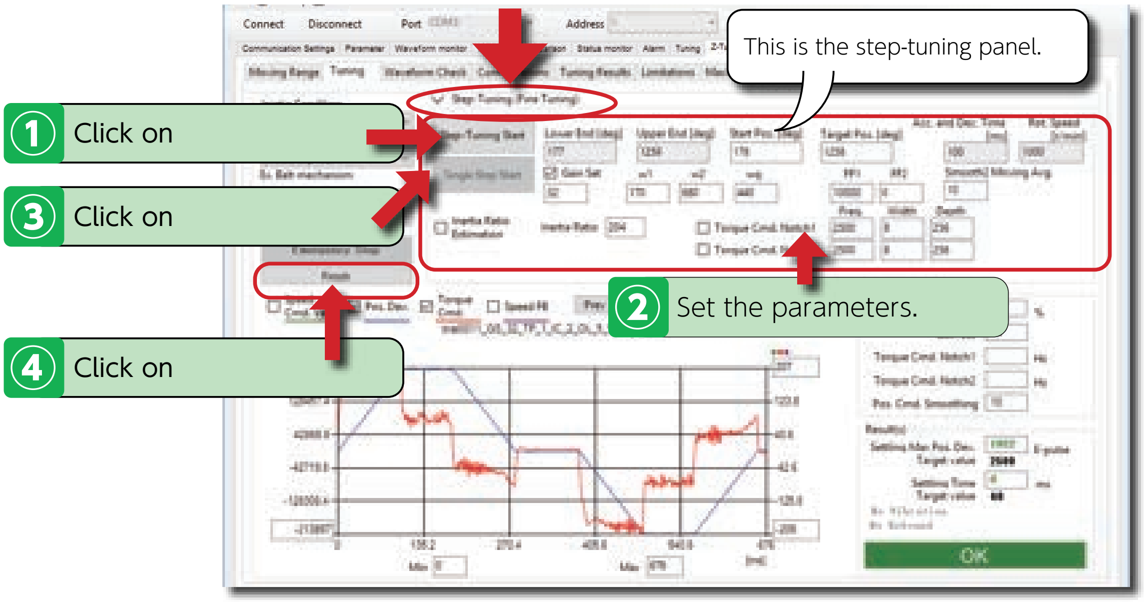
*) The file name is "TuningResult_(Acquisition date yymmdd)_Acquisition time hhmmss).xlsx".
Example : TuningResult_200123_153055.xlsx
Excel is a registered trademark or trademark of Microsoft Corporation in the United States and other countries.

For more fine tuning: "Step Tuning".

You can adjust the tuning parameters individually for detailed tuning (step-tuning).
This step-tuning is for the advanced users who are experienced in tuning parameters.

DANGER

Only those with expert knowledge of tuning should operate it.



① Click the [Step-Tuning Start] button to turn the motor to servo-on status.

② Adjust the parameters on the step tuning screen.

③ Click the **[Single Step Start]** button to start tuning.

-The waveform is updated after each tuning sequence.

-When the amplifier detects vibration or oscillation, a dialog box will pop up.
Try to set the notch filter or change the gain set, and then click the **[Single Step Start]** button again.

④ Click the **[Write to Amp.]** button to write the parameters to the amplifier.

Machine Analyzer: Investigate mechanical properties.

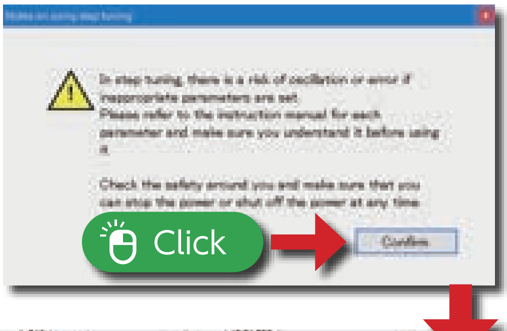
"Machine Analyzer" allows you to automatically investigate the mechanical properties (resonance point/anti-resonance point) of a mechanical part.

(Results are for reference.)

⚠ DANGER

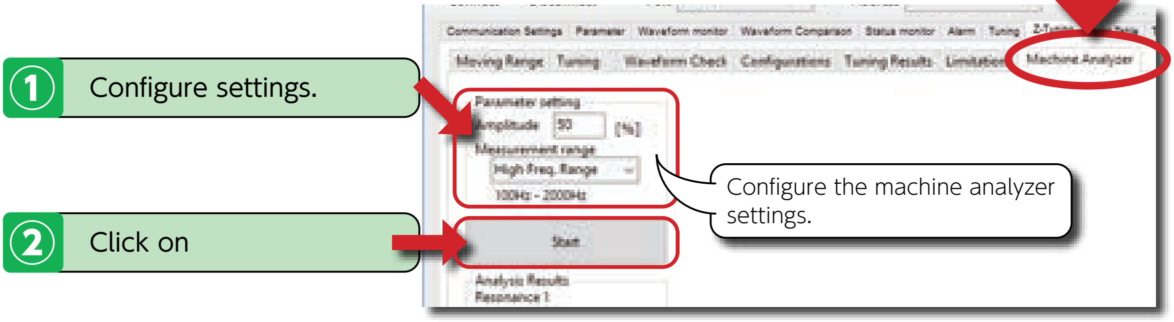
DO NOT apply to vertical axes, or even horizontal axes that have constant loads such as springs.

Once the machine analyzer is started, a note will pop up. After fully understanding the precautions, click the [Confirm] button.



In step tuning, there is a risk of oscillation or error if inappropriate parameters are set.
Please refer to the instruction manual for each parameter and make sure you understand it before using it.

Check the safety around you and make sure that you can stop the power or shut off the power at any time.



① Configure settings.

② Click on

Configure the machine analyzer settings.

① Configure the machine analyzer settings.

Items	Setting value
Amplitude	5–100% (Recommended value：50%)
Measurement range	Low frequency range(10–400 Hz) High frequency range(100–2,000 Hz)

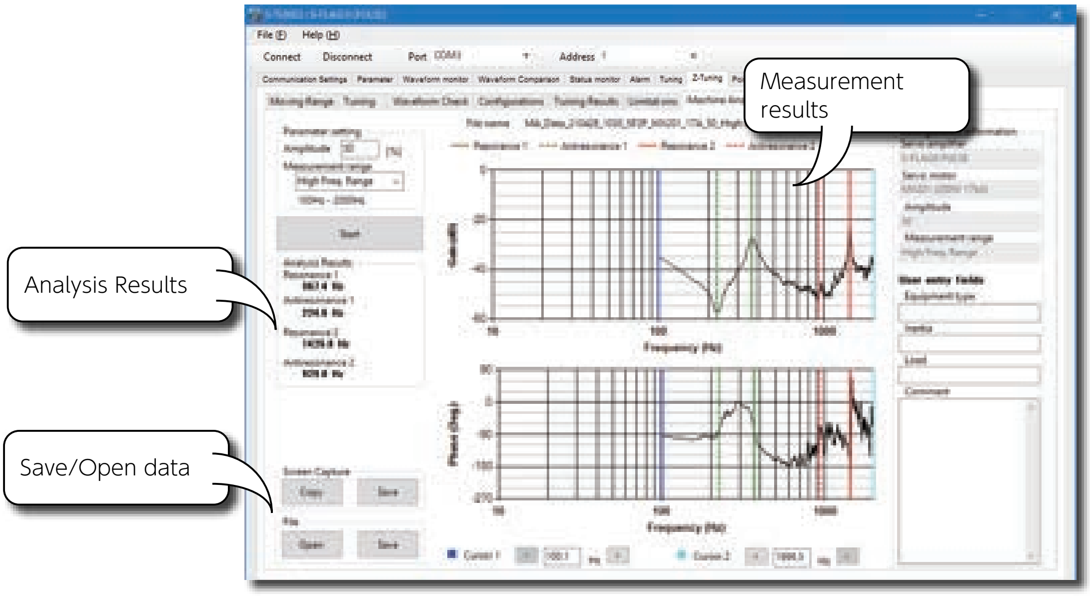
② Click the Start button to start the investigation.

Tip !

Note on Amplitude

The recommended amplitude setting is 50%. Look at the investigation results, and if the device characteristics are not clear, try again with a larger amplitude setting.
If the amplitude setting is set too high, a loud noise may be caused during investigation.

(Machine Analyzer: Investigate mechanical properties.)



Investigation result (Bode plot)

Displays a combination of a gain(=magnitude) plot, expressing the gain of the frequency response, and a phase plot, expressing the phase shift.

Analysis Results

Detects the frequency of the resonance point and anti-resonance point of the graph displayed in the measurement result automatically. (Automatically detects up to two resonance points and two anti-resonance points respectively.)

Save/Open data

Screen Capture

The graph of the displayed measurement result is handled an image data.

Copy	Copy to clipboard.
Save	Save the file in ".png" format.

File

The graph of the displayed measurement result is handled as numerical data.

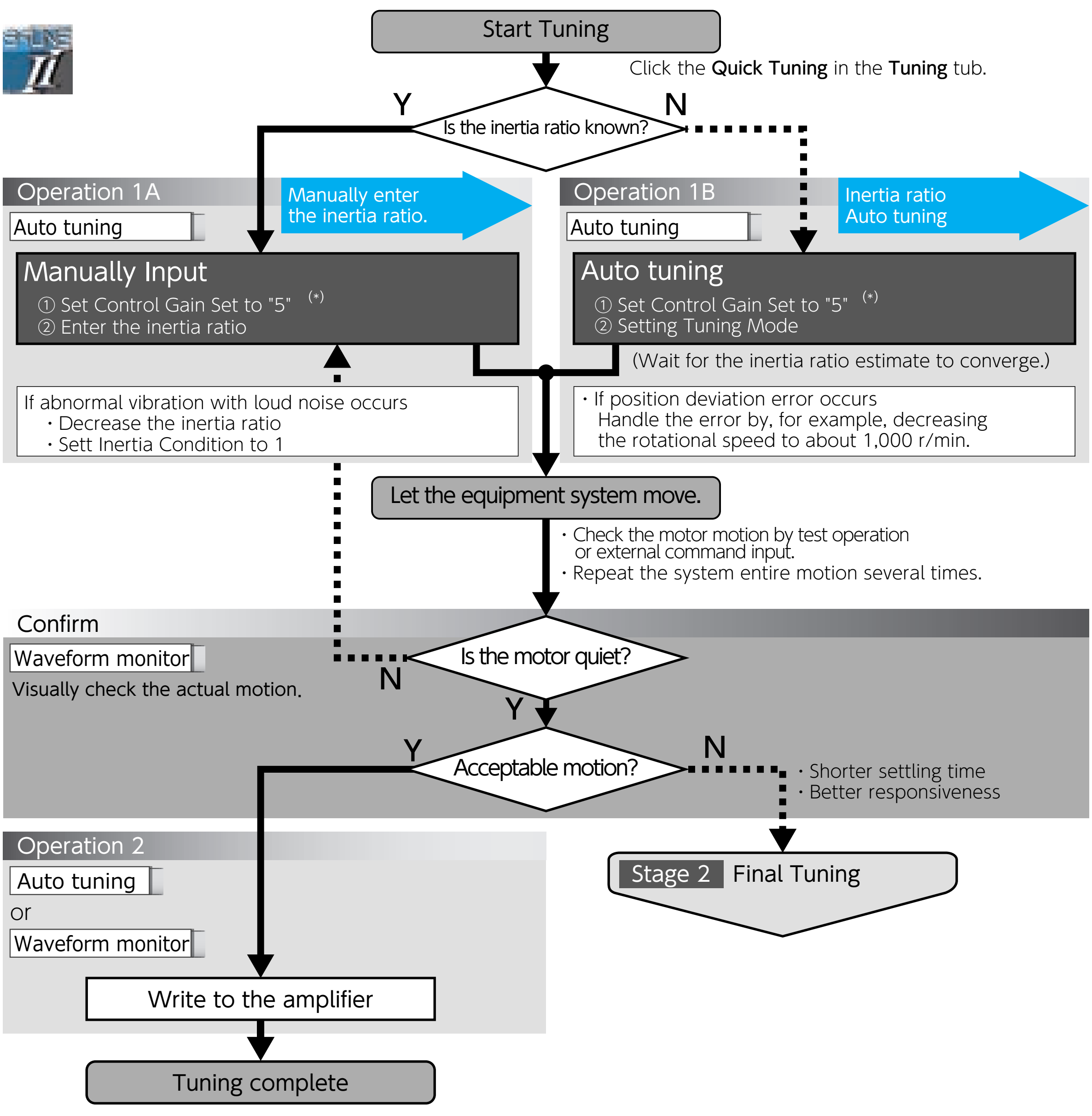
Save	Saves the numerical data of the displayed measurement result in text format.
Open	Open the saved measurement data.

The measurement results of this machine analyzer may not match the notch frequency of the torque command notch filter that is automatically set upon execution of Z-tuning. This is due to the characteristics of servo control and is not an anomaly.

2. Velocity Control Mode

Auto Tuning on S-TUNE Ⅱ

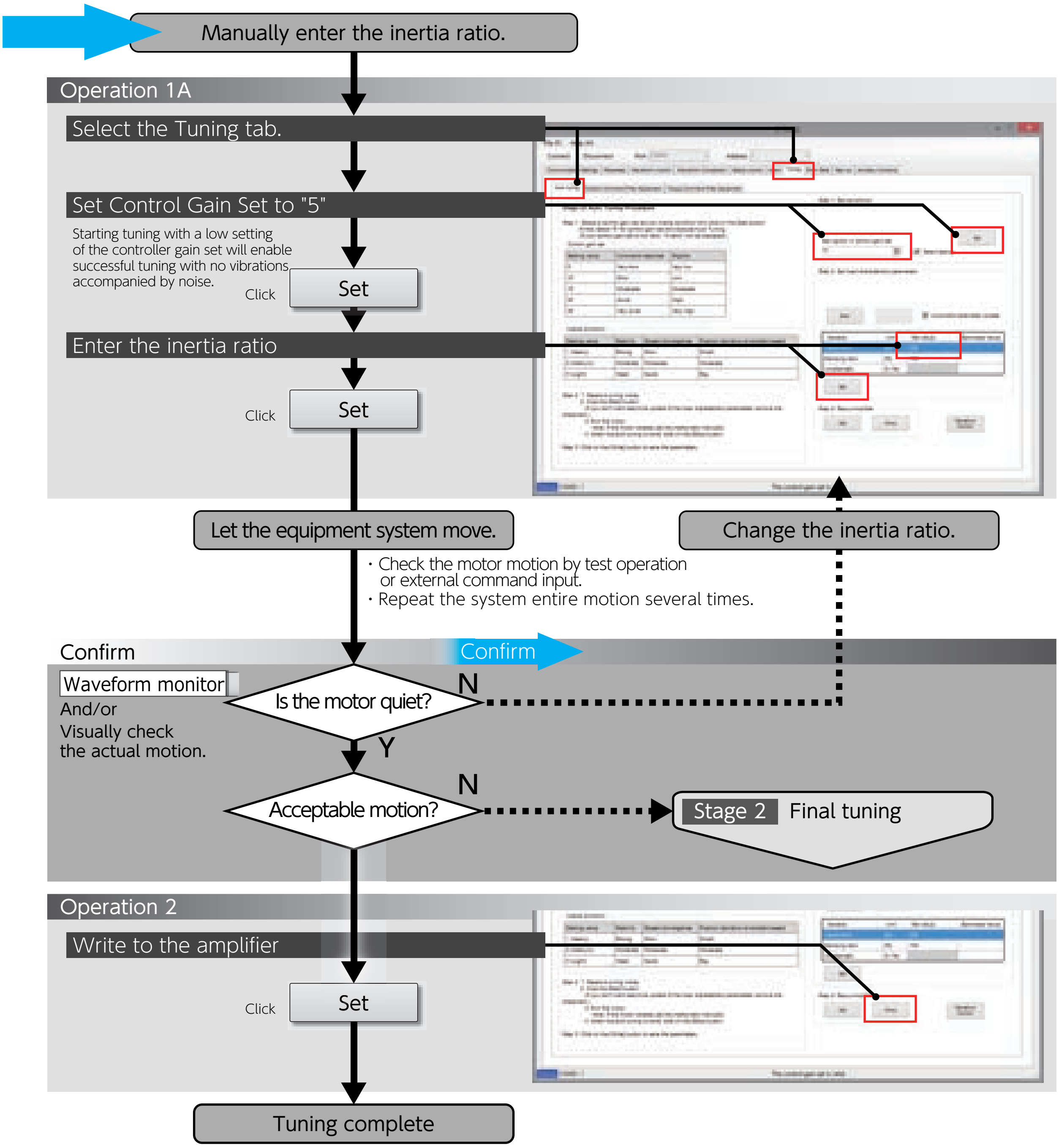
Stage 1 Setting the Inertia ratio and Optimizing Control Gain Set



*) Starting tuning with a low setting of the controller gain set will enable successful tuning with no vibrations accompanied by noise.

2. Tuning Procedure

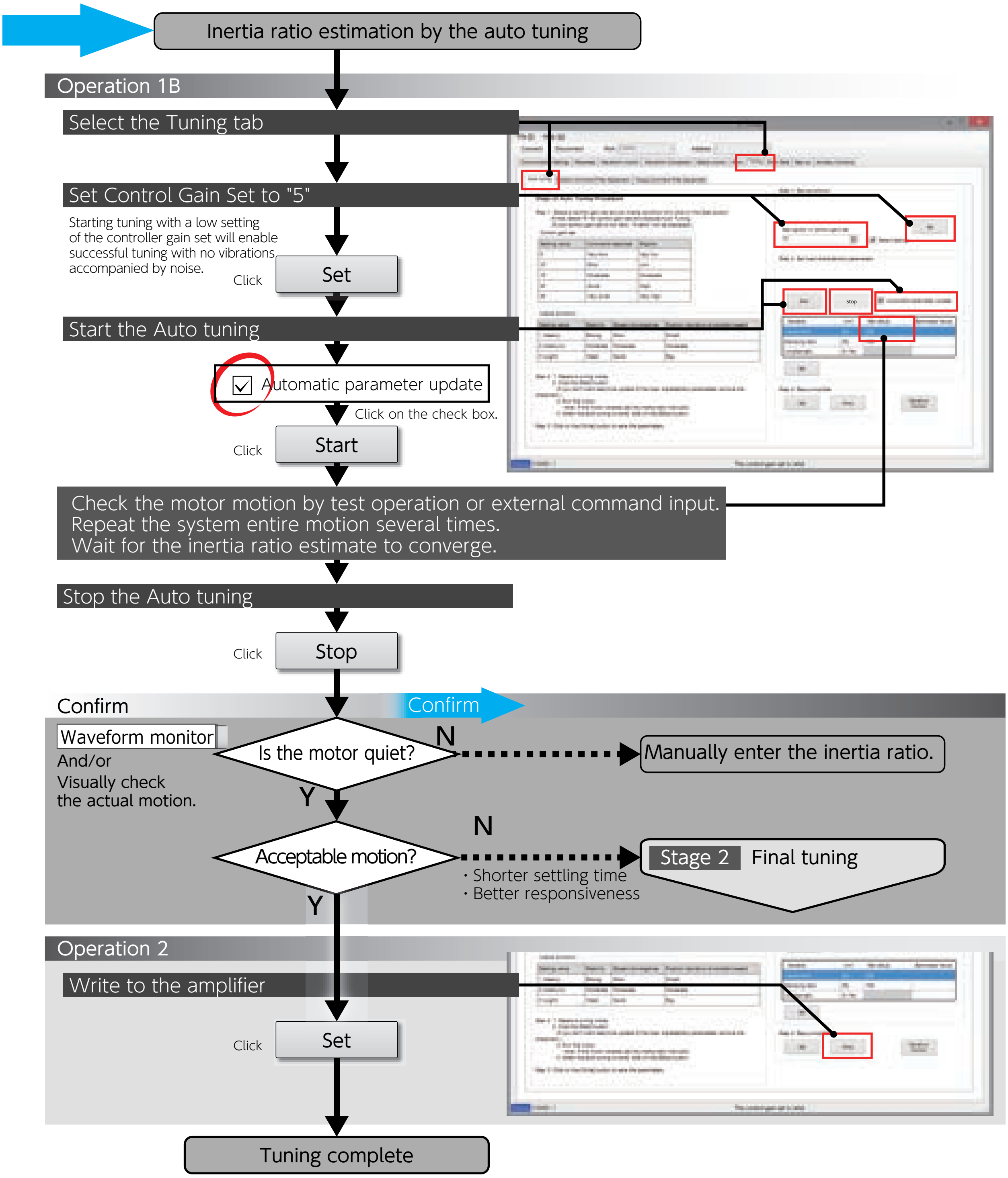
Auto Tuning on S-TUNE Ⅱ : Operation 1A



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.

Auto Tuning on S-TUNE Ⅱ : Operation 1B

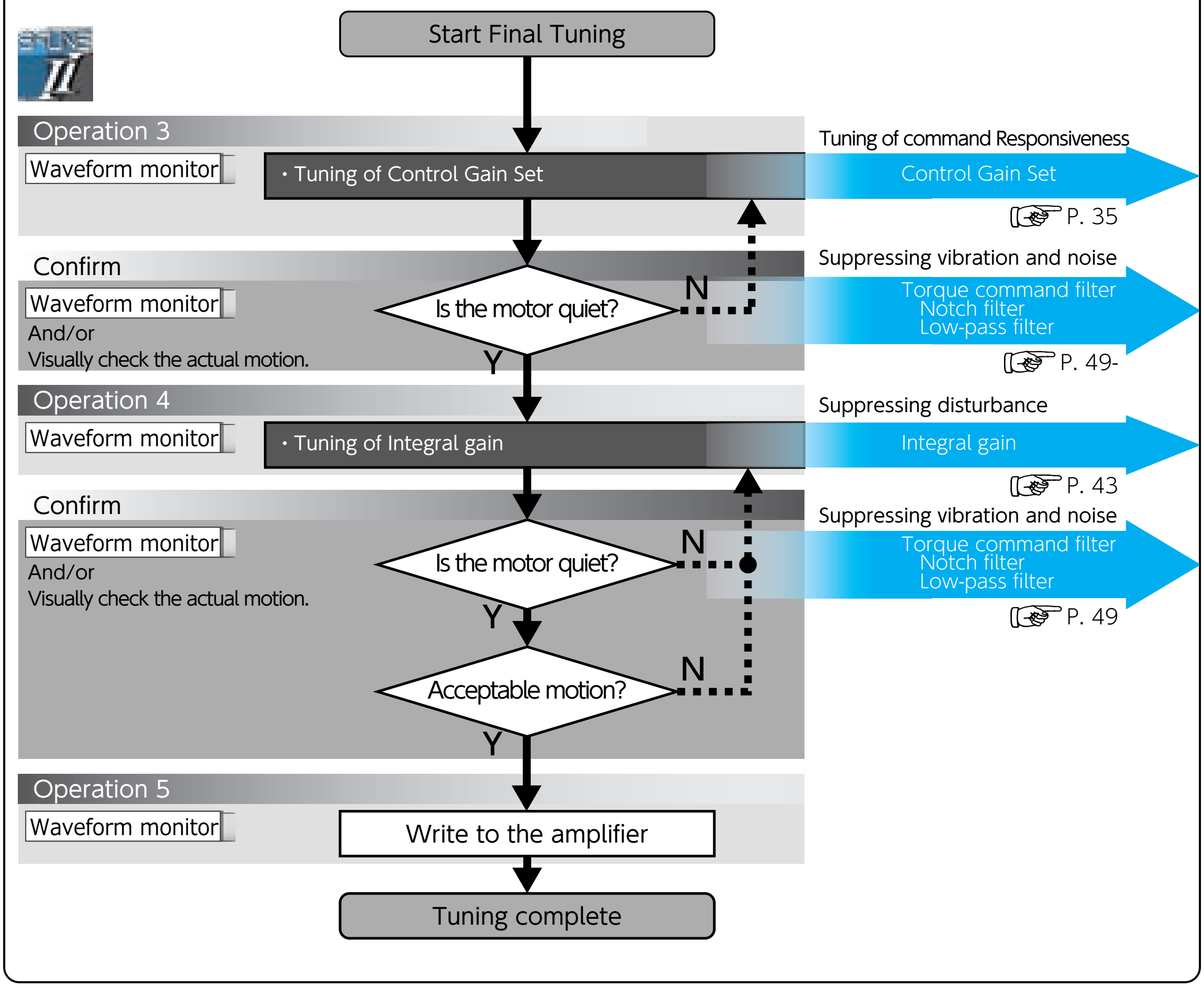


Make sure to click on Stop to finish Auto Tuning.

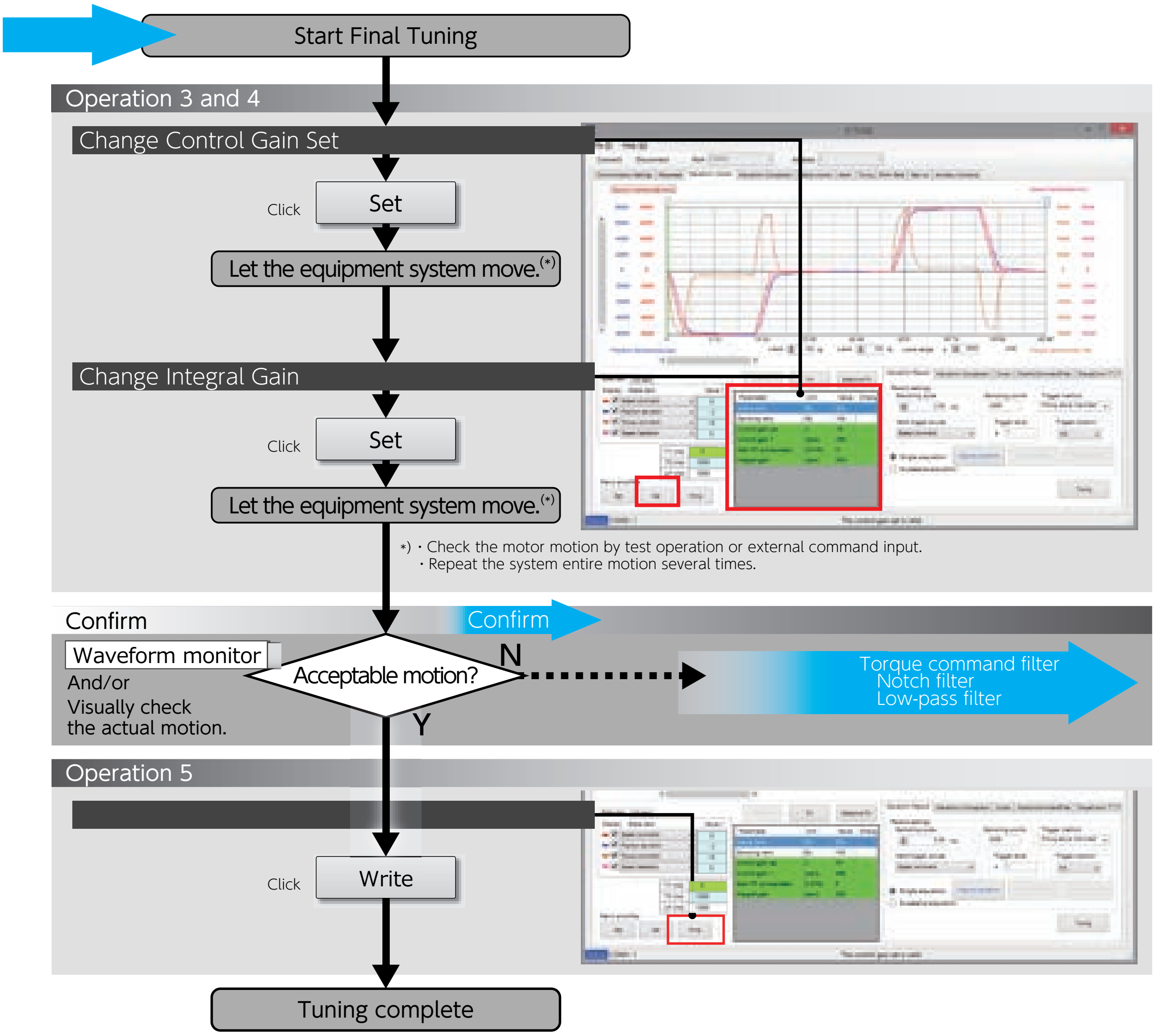
Starting Final Tuning Mode while Auto Tuning is still in process will make the tuning difficult because of inertia ratio changes.

Final Tuning: Velocity Control Mode

Stage 2 Optimizing the settling time and deviation Suppressing vibration and noise



Final Tuning



*) · Check the motor motion by test operation or external command input.
· Repeat the system entire motion several times.

Confirm

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.

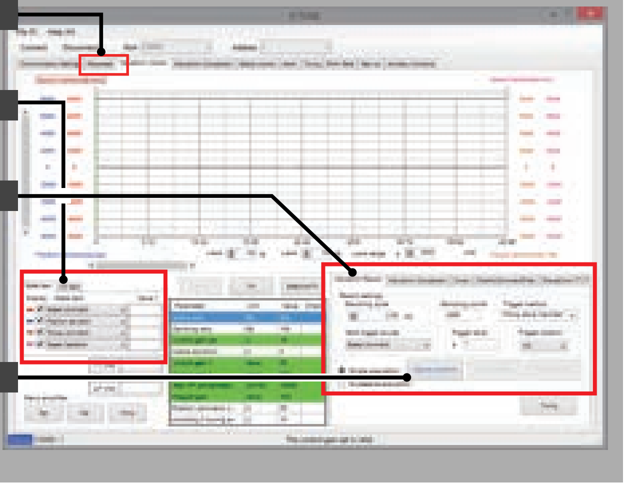
State Item tab

Select measurement conditions.

Waveform Record tab

Start Measuring

Click Capture waveform



3. Tuning Parameters

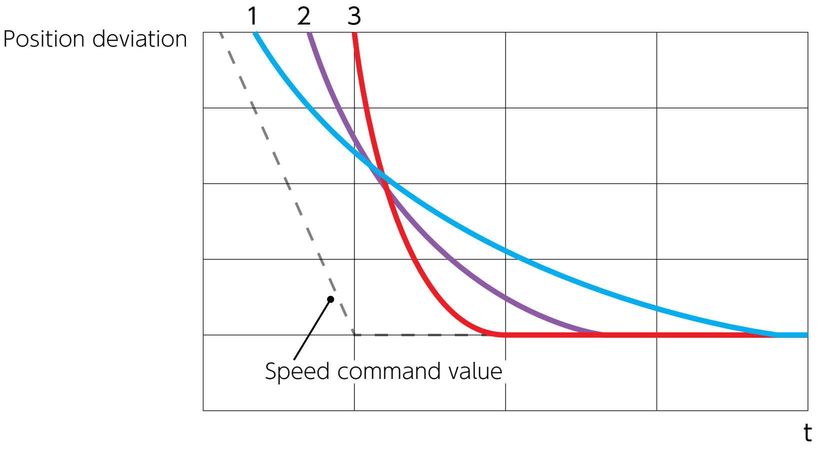
1. Tuning

Inertia Condition

P V T

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	



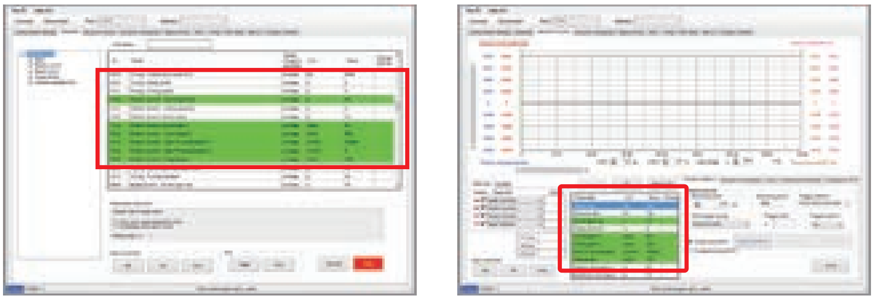
Difference in convergence characteristics depending on the inertia condition settings

Control Gain Set

P V T

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 49 Torque Command Filter		

*1) In the S-TUNE Ⅱ parameters grouped in the control gain set are highlighted in green.



*2) This is when Low-pass filter auto Setting (No.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.

Mode Switch

P V T

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

P V T

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		

2. Final Tuning

Inertia Ratio

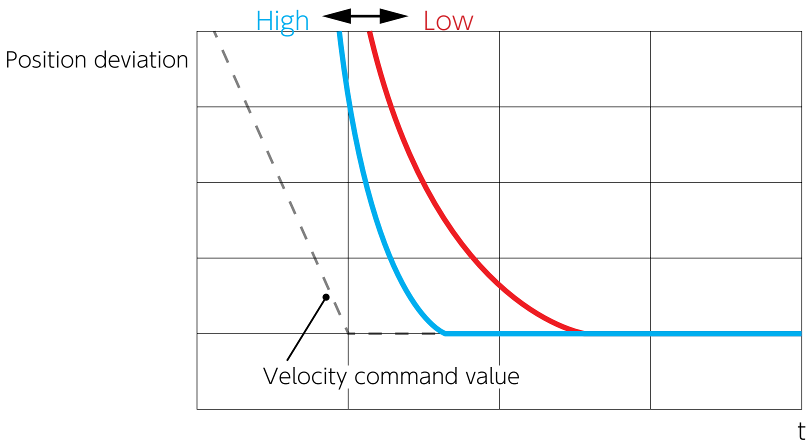
P V T

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 S-FLAG Ⅱ 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% $\text{Inertia ratio} = \frac{(\text{load inertia}) + (\text{Rotor inertia})}{(\text{Rotor inertia})} \times 100\ [\%]$
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

P V T

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.

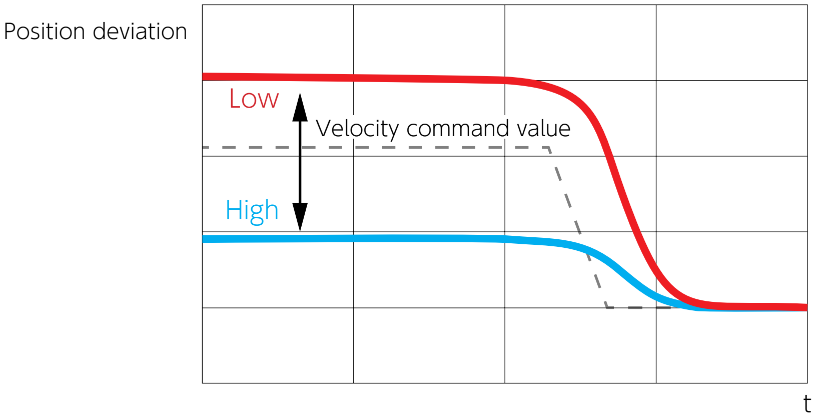


Differences in Position Deviation Convergence

Position Control Mode: Control Gain 2

P V T

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 No.116.0 value.

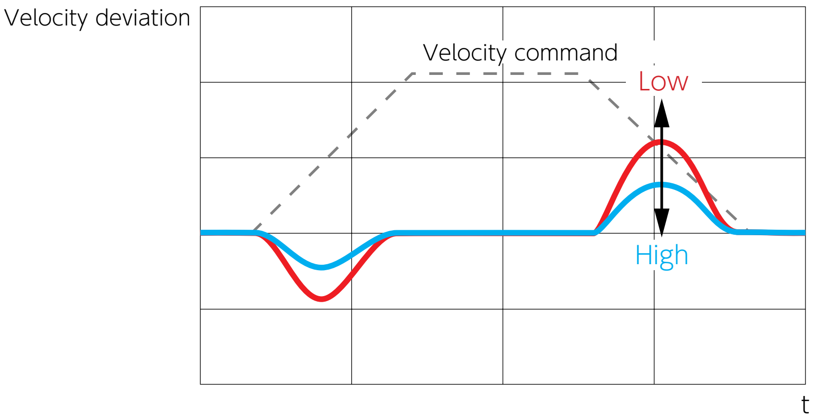


Differences in Position Deviation Convergence

Velocity Control Mode: Control Gain 1

P V T

Function	Increasing this parameter value will reduce the velocity deviation during the acceleration/ deceleration. 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.

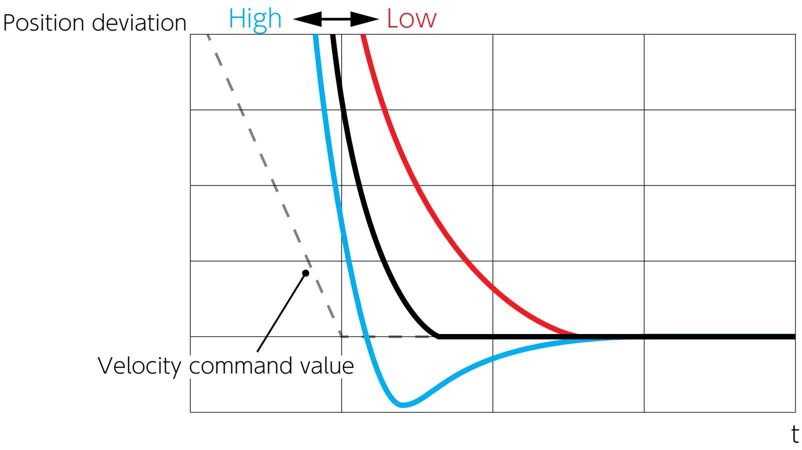


Differences in Velocity Deviation Convergence

Position Control Mode: Gain FF Compensation 1

P V T

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 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



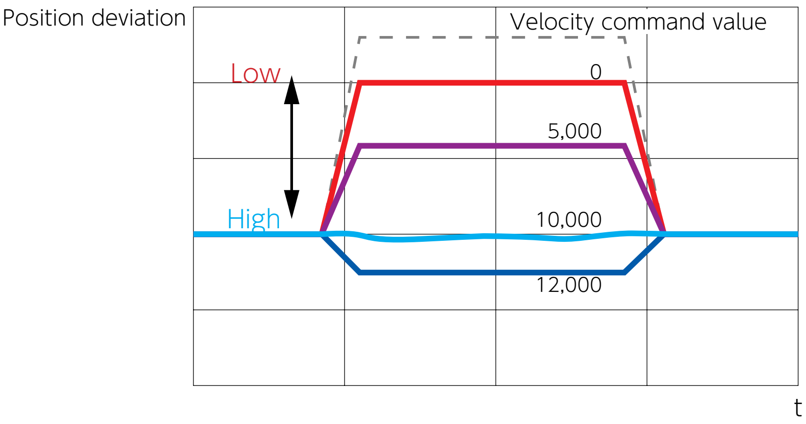
Differences in Position Deviation Convergence

3. Tuning Parameters

Position Control Mode: Gain FF Compensation 2

P V T

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.



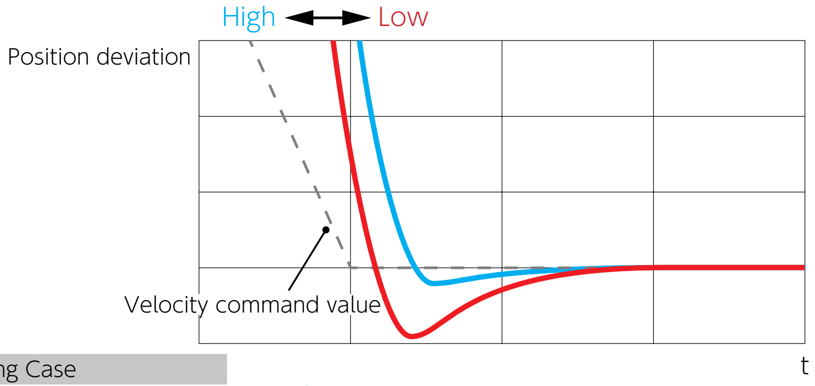
Differences in Position Deviation Convergence

Integral Gain

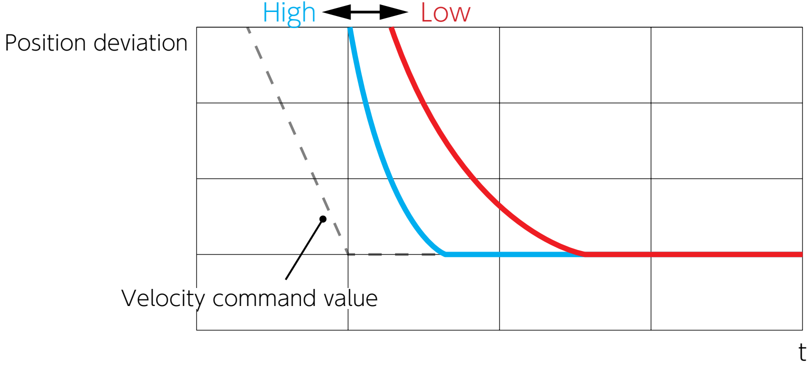
P V T

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 49** Torque Command Filter		

Overshooting Case



Undershooting Case



Differences in Position Deviation Convergence

3. Position Command Filter

Optimizing the settling time and deviation Suppressing vibration and noise

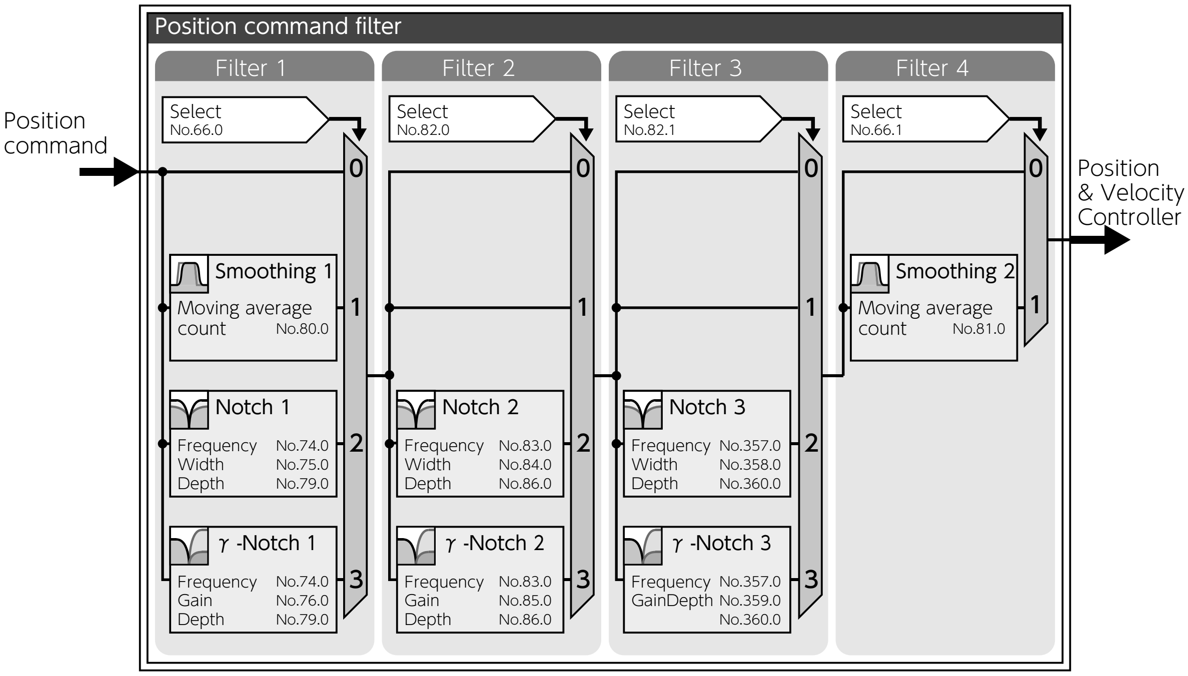
Check the following before using Position command filter
- The command from the host controller is correct.
- The equipment is installed firmly and properly.
- The gain parameters such as inertia ratio are correctly set.
- The command smoothing filters 2 (and 1) are set.
- Vibration is now unlikely to 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.	P.46

Apply the following notch filters if the machine end point is still vibrating after sufficient tuning was performed and the smoothing filter was set.

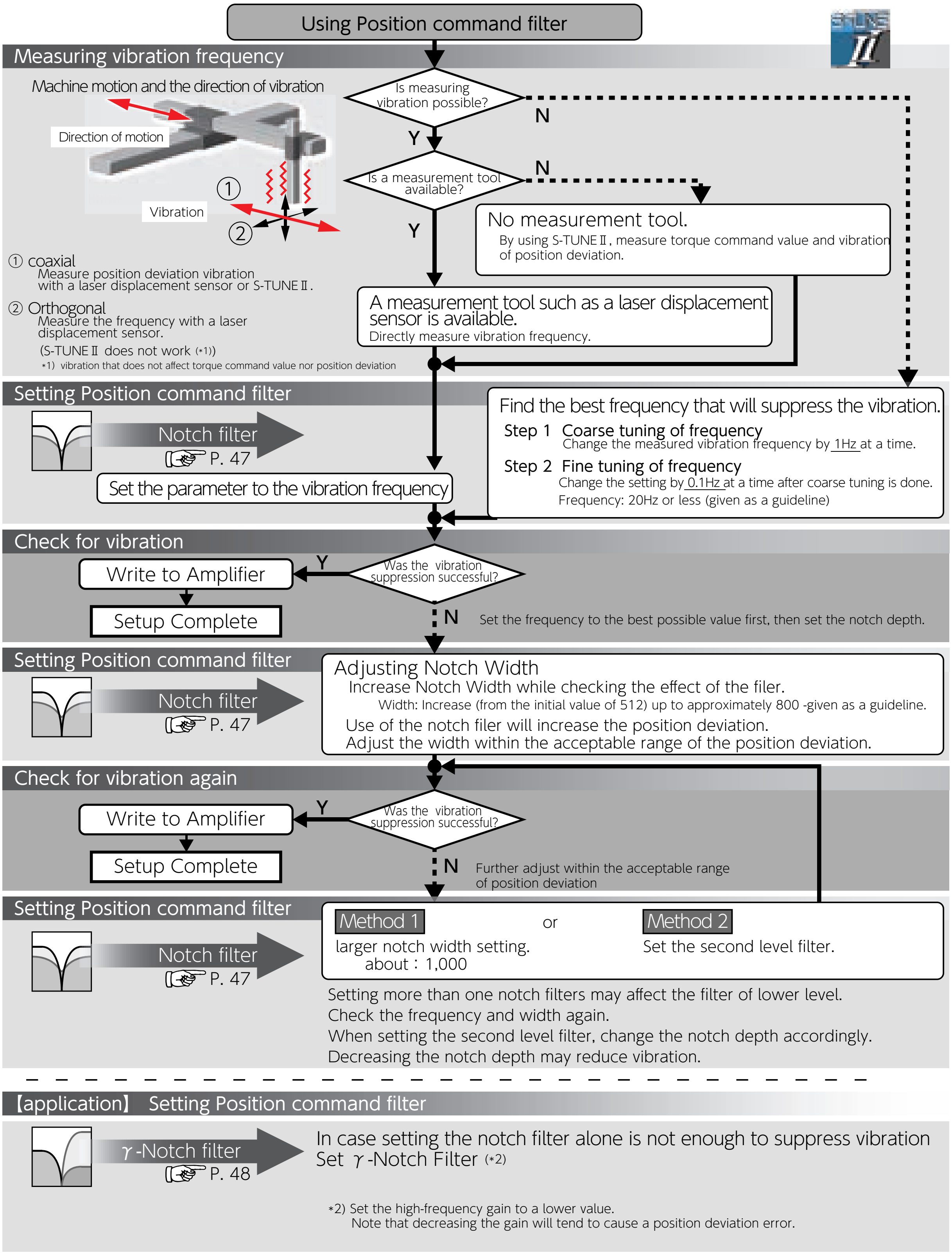
Filter	Overview	Refer to
Notch	**Position Command Notch filter** Effective in suppressing vibration of mechanical systems where the vibration does not appear in the torque output waveform. When compared to the command smoothing filter, the position command filter is more effective in reducing the absolute position deviation (Status No.80).	P. 45 P. 47
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.	P. 45 P. 48

Up to four levels of Position command filter are available.



Block Diagram of Position Command Filter (Details)

3. Tuning Parameters



Using Position command filter

Measuring vibration frequency

Machine motion and the direction of vibration

① coaxial
Measure position deviation vibration with a laser displacement sensor or S-TUNE II.

② Orthogonal
Measure the frequency with a laser displacement sensor.
(S-TUNE II does not work (*1))
*1) vibration that does not affect torque command value nor position deviation

Is measuring vibration possible? — Y / N

Is a measurement tool available? — Y / N

No measurement tool.
By using S-TUNE II, measure torque command value and vibration of position deviation.

A measurement tool such as a laser displacement sensor is available.
Directly measure vibration frequency.

Setting Position command filter

Notch filter ☞ P. 47

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)

Check for vibration

Was the vibration suppression successful? — Y: Write to Amplifier → Setup Complete

N: Set the frequency to the best possible value first, then set the notch depth.

Setting Position command filter

Notch filter ☞ P. 47

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.

Check for vibration again

Was the vibration suppression successful? — Y: Write to Amplifier → Setup Complete

N: Further adjust within the acceptable range of position deviation

Setting Position command filter

Notch filter ☞ P. 47

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.

【application】 Setting Position command filter

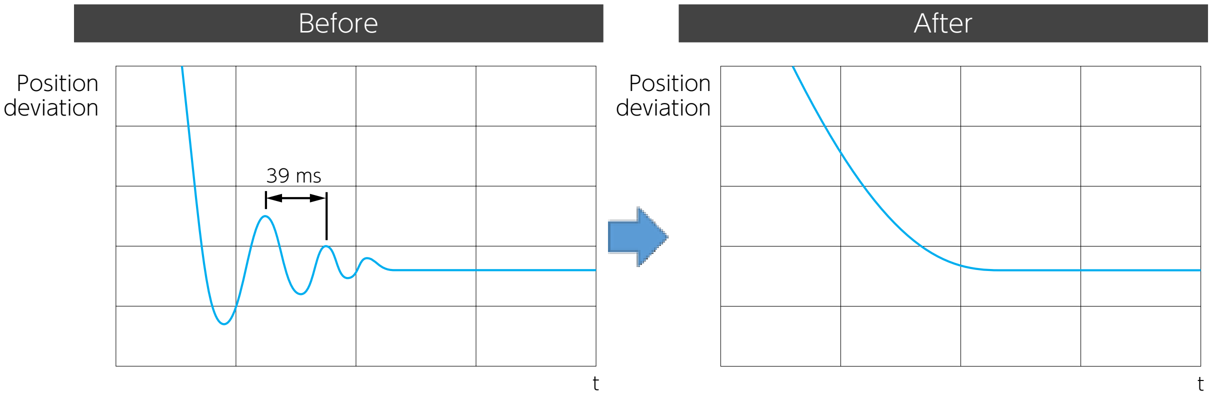
γ-Notch filter ☞ P. 48

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

Function	The smoothing filters smooth the position command and suppress vibrations.			
Parameter	Position command filter 1: Type Select	No.66.0	Default:	0
			Setting range:	0 to 3
	Position command filter 4: Switch Select	No.66.1	Default:	1
			Setting range:	0, 1
	Position command filter 1: Smoothing 1 -Moving average counter	No.80.0	Default:	40
			Setting range:	1 to 6,250
	Position command filter 4: Smoothing 2 -Moving average counter	No.81.0	Default:	16
			Setting range:	1 to 1,250
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	① Measure the vibration period from the position deviation of setting and the vibration waveform of the torque command value. ② Use the following formula to calculate the moving average:. ③ Setting filter 4 may suppress resonance. ④ If the damping effect is small, calculate the moving average frequency from the vibration period again and set it to Filter 1.Calculation formula: Moving Average Count Derived from Vibration Frequency 10,000 × vibration frequency[s] = parameter value In the example below, when the vibration frequency is 39 ms, the average count = 10,000 x 0.039 = 390; the delay time will be 39 ms. ☞ C- 2 Parameters			



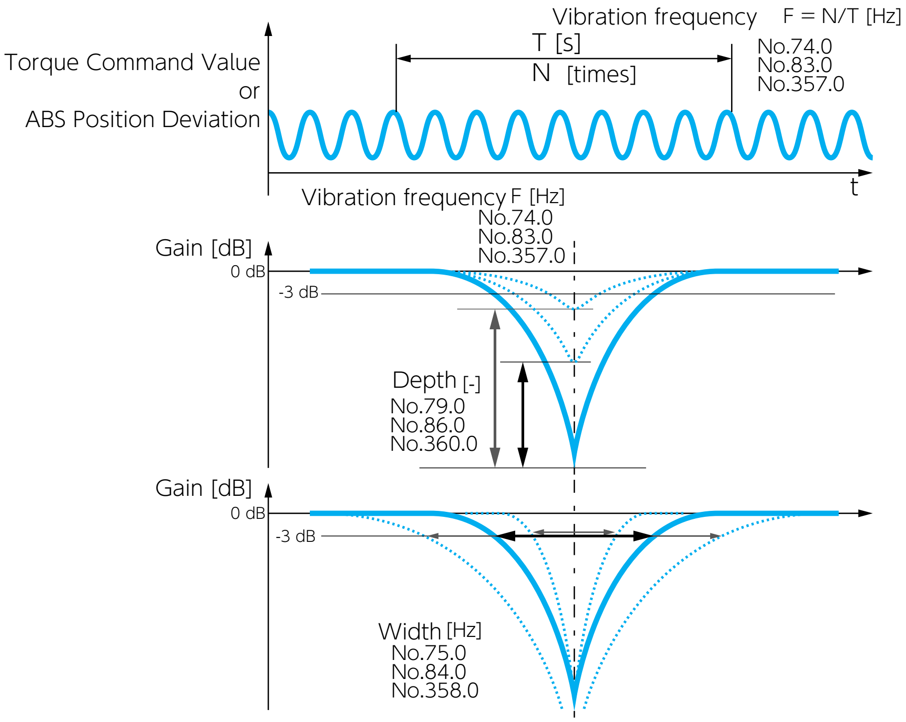
Effect of Smoothing Filter

Position Command Notch Filter

P V T

<table>
<tr><td>Function</td><td colspan="6">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).</td></tr>
<tr><td rowspan="7">Parameter</td><td colspan="3">Notch Filter</td><td>Filter 1</td><td>Filter 2</td><td>Filter 3</td></tr>
<tr><td rowspan="2">Frequency</td><td>Default:</td><td>10 [0.1 Hz]</td><td rowspan="2">No.74.0</td><td rowspan="2">No.83.0</td><td rowspan="2">No.357.0</td></tr>
<tr><td>Setting range:</td><td>10 to 3,000</td></tr>
<tr><td rowspan="2">Width</td><td>Default:</td><td>512</td><td rowspan="2">No.75.0</td><td rowspan="2">No.84.0</td><td rowspan="2">No.358.0</td></tr>
<tr><td>Setting range:</td><td>128 to 2,048</td></tr>
<tr><td rowspan="2">Depth</td><td>Default:</td><td>0</td><td rowspan="2">No.79.0</td><td rowspan="2">No.86.0</td><td rowspan="2">No.360.0</td></tr>
<tr><td>Setting range:</td><td>0 to 100</td></tr>
<tr><td>Remark</td><td colspan="6">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.</td></tr>
<tr><td>Tuning Tip</td><td colspan="6">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.

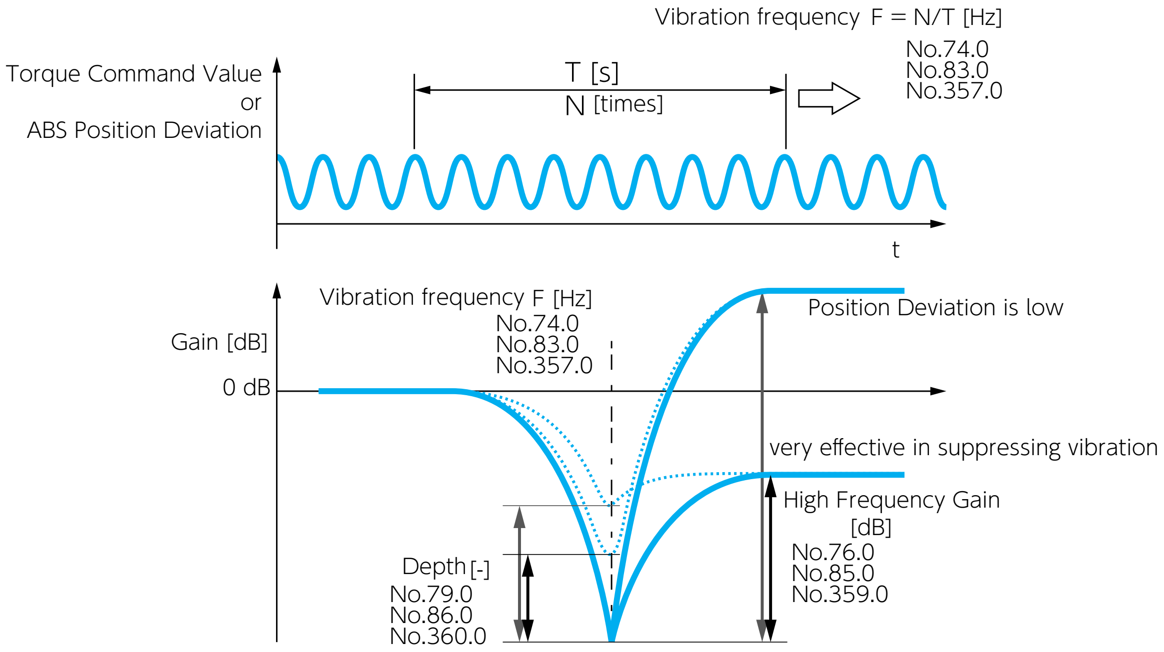
Start the equipment operation and apply the vibration frequency (measured at the equipment end) to the notch frequency. If the vibration cannot be suppressed, increase the notch width (by 800 as a rough standard). To reduce the position deviation during operation, increase the notch depth of a smaller vibration frequency.
☞ C- 2 Parameters</td></tr>
</table>



Position Command γ -Notch Filter

P V T

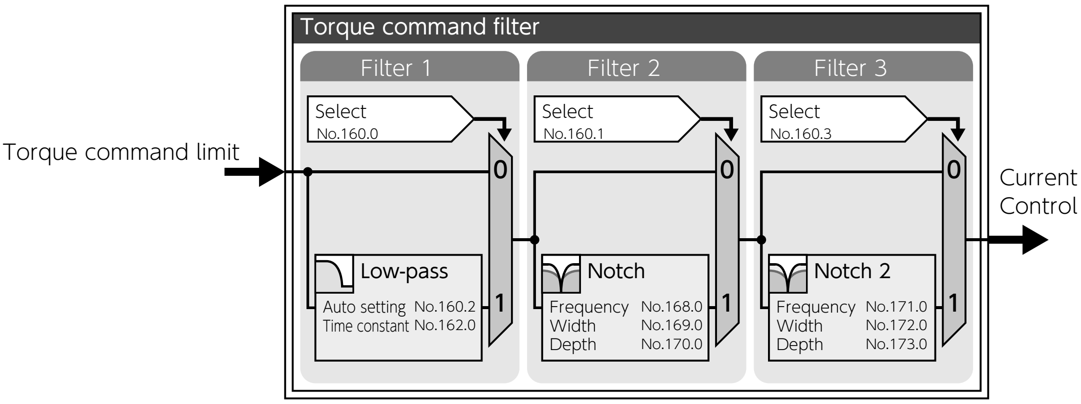
Function	Use this filter, if the machine end point is still vibrating even after applying a notch filter in addition to sufficient tuning and a smoothing filter. This filter has vibration suppression effect on mechanical systems where the vibrations don't appear in the torque output waveform. It has 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. ☞ C-2 Parameters



4. Torque Command Filter

P V T

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.	P. 50
Low-pass	**Torque Command Low-Pass Filter** This filter is effective in smoothing the position command and suppressing vibration at the time of positioning.	P. 51



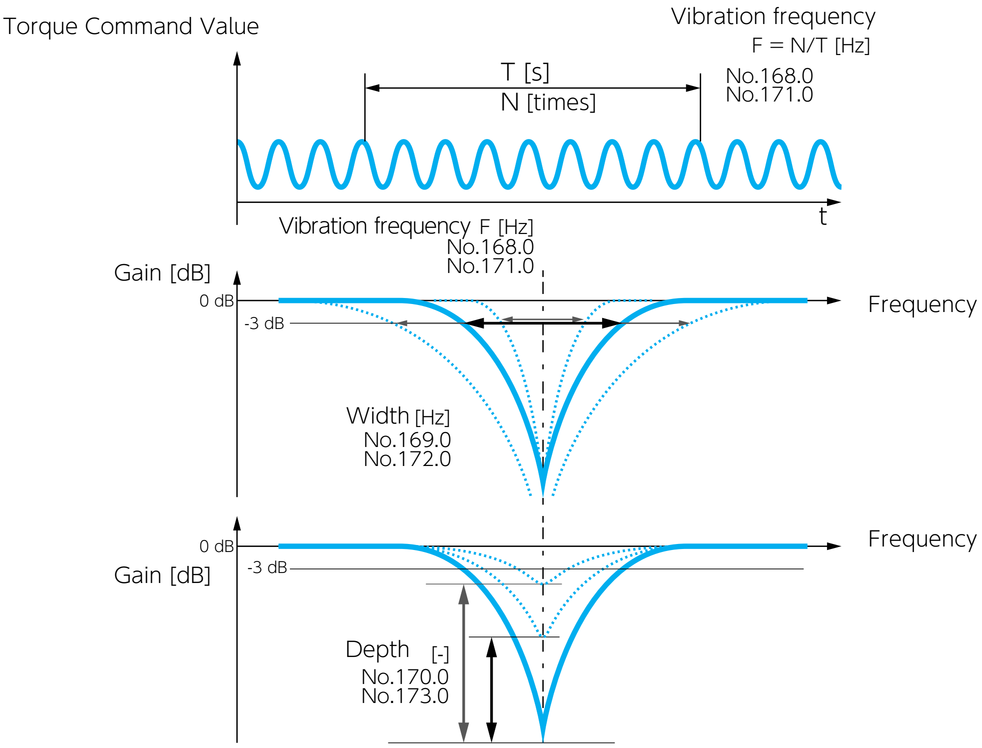
Block Diagram of Torque Command Filter with Details

3. Tuning Parameters

Torque Command Filter: Notch Filter

P **V** **T**

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. ☞ **C- 2 Parameters**				



Torque Command Low-Pass Filter

P V T

Function	Setting relatively a large value may suppress vibrations.			
Parameter	Low-Pass Filter			
	Switch	Default:	1	No.160.0
		Settings:	0, 1	
	Auto setting	Default:	0	No.160.2
		Settings:	0, 1	
	Time constant	Default:	0 [0.01 ms/rad](less than 100 W) 10 [0.01 ms/rad](over 200 W)	No.162.0
		Setting range:	0 to 65,535	
Remark	Setting a larger value means getting closer to the control range of the response model: another type of vibration will occur.			
Tuning Tip	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.			

$$\frac{(0.1 \text{ to } 0.2)}{\max((\omega 1+\omega 2), \omega_q)} \text{ [s] or below}$$

	Position Control Mode		Velocity Control Mode	
ω 1	Control Gain 1	No.115.0	Control Gain 1	No.131.0
ω 2	Control Gain 2	No.116.0	–	–
ω q	Integral Gain	No.119.0	Integral Gain	No.133.0

☞ C- 2 **Parameters**

4. Using S-TUNE Ⅱ to Measure Vibration Frequency (FFT)

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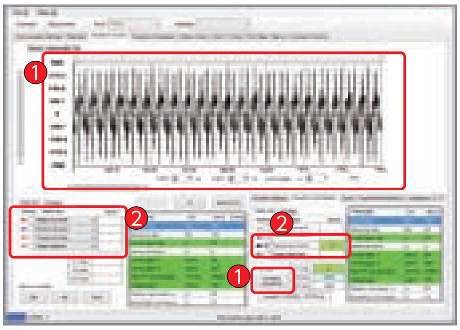
① Load the waveforms measured or waveform data saved to display.
(The example shown on the right is saved waveform data.)

② Select a parameter of which the vibration frequency is to be investigated.
Mark the check box to display the waveform.



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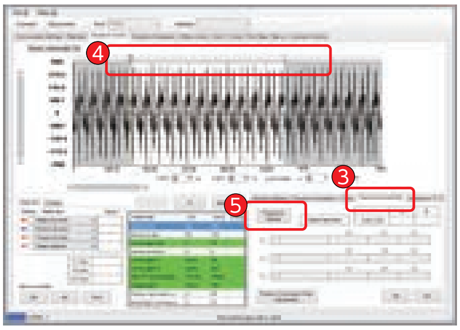
③ Select **Position Command Filter** or **Torque Command Filter**

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.

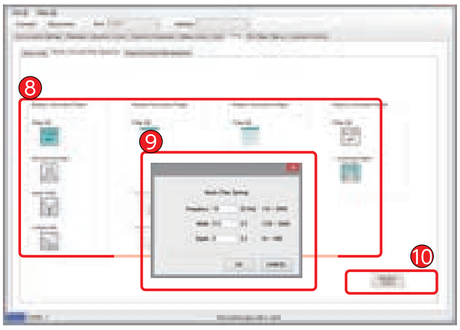
⑦ Click on **Position Command Filter Adjustment** or **Torque Command Filter Adjustment**
This will take you to the filter setup window under the tuning tab where a filter can bet set.

4. Using S-TUNE Ⅱ 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.

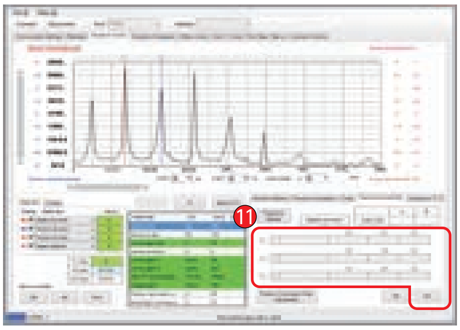
⑨ Set the filter parameters.
For the notch filer, enter the vibration frequency measured.

⑩ Click on Waveform monitor to return to the waveform monitor.



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

S-FLAG Ⅱ　Instruction Manual
- Standard model-
- EtherCAT communication model -

D

SOFTWARE

MEMO

1

About S-TUNE Ⅱ

1. Cautions for Proper Use

⚠ DANGER

Sign	Precautionary Measures	If Not Observed
Connections and Operations		
🚫	Do not make drastic changes to parameters during tuning. If this precaution is not followed, the motor motion will become unstable.	⚠ ⚠
❗	Before making parameter changes, carefully review the S-FLAG Ⅱ Instruction Manual and technical data.	⚠ ⚠ ⚠
	Before operating the motor for test run or homing, ensure the safety of its surrounding area.	⚠ ⚠

❗	Please study this manual first and use the product properly and safety.

- ■ Nidec Sankyo shall not be liable for any injuries or damages caused by any parameters or programs set by non-Sankyo personnel, or by malfunctions or failures of S-TUNE Ⅱ .
- ■ S-TUNE Ⅱ , the Instruction Manual, and any documentations related to S-TUNE Ⅱ , including the trademarks, logos and copyrights in them, are all attributed to Nidec Sankyo Corporation, regardless of whether they are registered or not.
- ■ The law prohibits copying S-TUNE Ⅱ or the Instruction Manual, in whole or in part, to a hard drive, CD-R, DVD or other media, or distributing them to the network without our permission.
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- ■ Nidec Sankyo strictly prohibits reverse engineering, decompiling, disassembling or any similar act on our product by users.

S-TUNE Ⅱ might be upgraded irregularly to improve its performance and quality or to add new functions.
Therefore, the software screen shown in this instruction manual may differ from that of your S-TUNE Ⅱ .
For the latest version of S-TUNE Ⅱ , please contact our website or our distributors.

2. System Requirements for S-TUNE Ⅱ

Product Overview

S-TUNE Ⅱ is a dedicated setup software to be installed on a user-supplied Computer connecting to a S-FLAG Ⅱ 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 S-TUNE Ⅱ

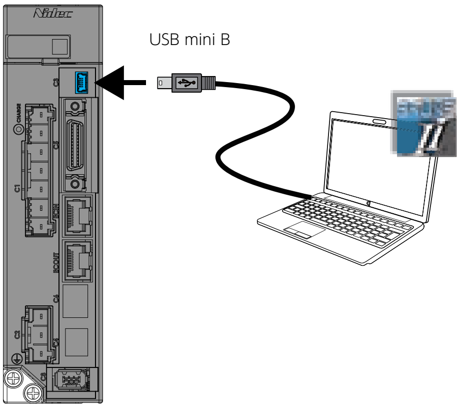
Computer	OS	Windows® 7 (32-bit, 64-bit) Windows® 8 (64-bit) Windows® 10 (64-bit)
	Language	Japanese, Chinese (Simplified), Chinese (Traditional), Korean, and English
	CPU	1 GHz or higher (32-bit or 64-bit)
	RAM	1 GB or more (32-bit) 2 GB or more (64-bit)
	Hard Disk	Free space of 512 MB or more
	Serial 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 S-TUNE Ⅱ is used with other programs at the same time, S-TUNE Ⅱ operation may become unstable. Use S-TUNE Ⅱ alone.

Connecting Amplifier and Computer

Install S-TUNE Ⅱ on your Computer.
Connect a USB cable to C3 at the front of the amplifier.



3. Installing S-TUNE Ⅱ

Installing

❗	S-TUNE II should be installed on a computer dedicated for maintenance purposes.	⚠

<table>
<tr><th>Step</th><th>Operation</th></tr>
<tr><td>Step 1</td><td>Turn on your computer to start Windows.
• Close any applications if they are opened.
• If your amplifier is connected to the computer, disconnect it before turning on the computer.</td></tr>
<tr><td>Step 2</td><td>Unzip the S-TUNE2 installer zip file on your desktop.
• S-TUNE Ⅱ cannot be installed on network drives.
• The computer must have .NET Framework installed. If not, Microsoft .NET Framework 4.0 installer will start when you try to install S-TUNE Ⅱ.
<table>
<tr><td>For the first time installation :</td><td>S-TUNE2-FULL_Ver- “<i>Version No.</i>” .zip
Included ".NET Framework"</td></tr>
<tr><td>For upgrading :</td><td>S-TUNE2_Ver- “<i>Version No.</i>” .zip
Does not included ".NET Framework"</td></tr>
</table></td></tr>
<tr><td>Step 3</td><td>Double-click on setup.exe in the unzipped folder.
Do not turn off the computer until installation finishes. Do not start other programs during installation.</td></tr>
<tr><td>Step 4</td><td>When installation finishes, a desktop shortcut icon will be created.</td></tr>
<tr><td>Step 5</td><td>S-TUNE Ⅱ will be installed in the following folder.
C:\Program Files \NIDEC-SANKYO CORP\S-TUNE2
C:\Program Files (x86)\NIDEC-SANKYO CORP\S-TUNE2 (in 64-bit version)</td></tr>
</table>

What to Do If Installation Is Cancelled

To communicate with the amplifier, S-TUNE Ⅱ uses Windows system files (see below). S-TUNE Ⅱ installer automatically cancels installation if it cannot find those system files in your computer. If the installation is cancelled, be sure that the system files reside in the exact locations shown below.

C:\WINDOWS\system32\drivers\usbser.sys
C:\WINDOWS\inf\mdmcpq.inf

Uninstalling S-TUNE Ⅱ

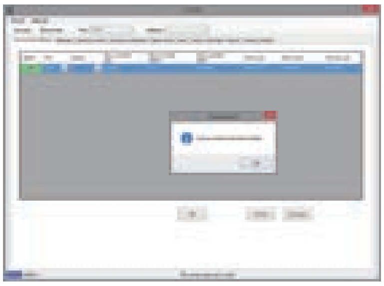
Go to **Control Panel** → **Programs**.
Click on **Uninstall a program**. Select **S-TUNE2** and click **Uninstall**.

2

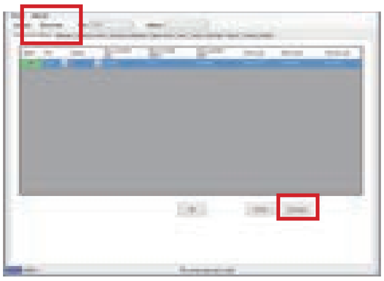
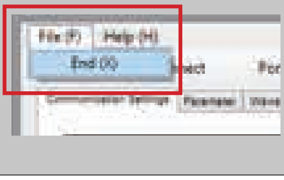
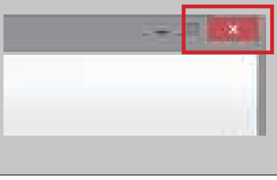
Operations

1. Overview

Start S-TUNE Ⅱ

Step	Operation
Step 1	Turn on the control power to the amplifier and plug in the USB cable to C3 firmly.
Step 2	Double-click on the desktop icon of S-TUNE Ⅱ.
Step 3	S-TUNE Ⅱ starts and the window under the communications setup tab opens. 

Close S-TUNE Ⅱ

Step	Operation
Step 1	Click on **Disconnect** on the Quick Access Tool bar at the top or click on Disconnect in the Communication Settings view. 
Step 2	In the S-TUNE Ⅱ view menu, select File -> End (X). (Or click × on the S-TUNE Ⅱ title bar.)  

1. Overview

Using Keyboard

The following table explains key notations used in this document.

Key/Symbol	Explanation
[↑] [←] [↓] [→]	Up, Down, Left, and Right Arrow keys. Use these to toggle menu items. Selected items will be highlighted.
Numbers (0～9)	Number keys. Use them to type in a number.
[ESC]	Escape key (ESC or Esc). Press to redo an entry.
[ENTER]	Enter key (ENTER, Enter, RETURN, or Return). Use this key to execute the item you selected under a menu, or to finish entering a number.

Selecting Menu Items

Using the mouse, move the cursor to the menu item or the button you want, and left click to execute. Alternatively, you can use arrow keys to navigate to the menu you want and press Enter key to an item.

Entering Numbers

Type in using number keys.
Numeric data such as parameter values are decimal. Enter a number in a decimal format. Binary and hexadecimal numbers are not acceptable.
To cancel a number that you are typing, press the ESC key.

1. Overview

Common Buttons

The following are the common buttons you can use under S-TUNE Ⅱ tabs.

Button	Function
Get	Read information from the amplifier RAM
Set	Write the parameters to the amplifier RAM
Write	Write the parameters to the amplifier EEPROM
Read	Read a file* saved in your Computer and display on the screen. *For example, a parameter file or point table file
Save	Save the current settings to your Computer. Use this button, for example, when you want to copy the same information to another amplifier.
Waveform Monitor	Jump to the **Waveform monitor** tab

1. Overview

Files Used in S-TUNE Ⅱ

S-TUNE Ⅱ allows you to save the following data files in your Computer.
Use these files to analyze motor motions or copy the same settings to another amplifier.

File	Default File Name	Extension	Tab to use
Parameters	**PR** (timestamp)_(AUX Info.)	.xml	· Parameters
Waveforms	**WF** (timestamp)_(AUX Info.)	.csv	· Waveform Monitor · Waveform Comparison
Status log	**SV** (timestamp)_(AUX Info.)	.csv	· Status Monitor
Point table parameters	**PT** (timestamp)_(AUX Info.)	.xml	· Point Table
I/O pinouts	**IO** (timestamp)_(AUX Info.)	.xml	· Auxiliary Functions
	TuningResult_	.xlsx	
	MA_Data_ MA_Image_	.txt .png	

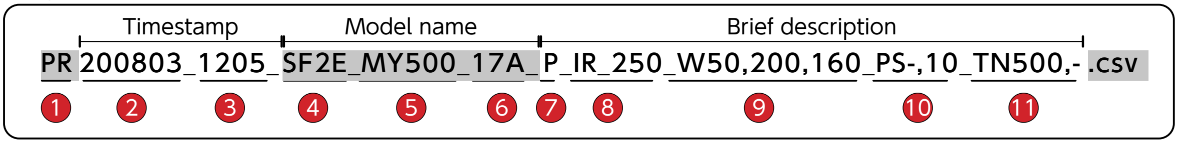
The default file names include time stamps (YYMMDD_hhmmss).
The "timestamp" consists of YYMMDD (year, month, day) and hhmm (hour and minute).
The "AUX. Info" consists of "model information" and "summary information such as parameters.
For files other than "parameter files" and "machine analyzers," the only additional information is "model information.

🚫	**Do not edit any saved files or change their extension.** If you do, S-TUNE Ⅱ will not be able to load the file.	⚠

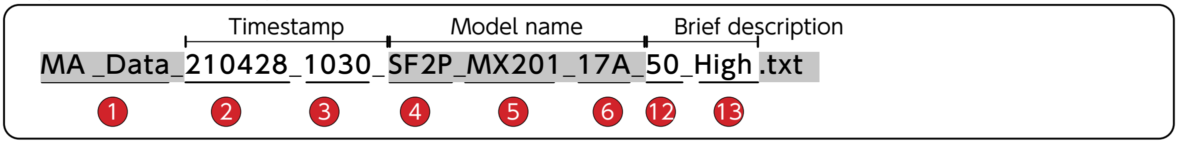
About the "AUX Info"

The AUX Info in the file name contains the following information.

Example: Parameter file name



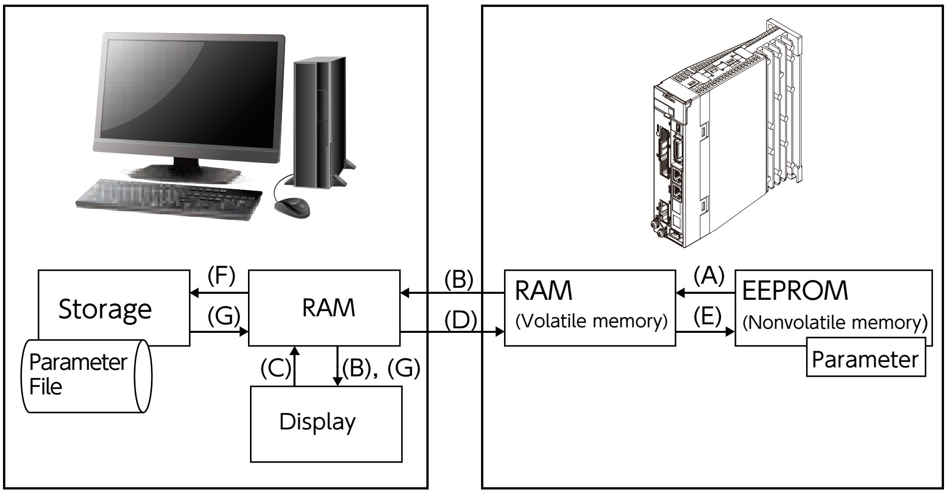
Example: Machine analyzer file name



No.	Description
①	File type (eg. **PR**: Parameter file)
②	Date: **YYMMDD**
③	Time: **hhmm**
④	Type of amplifier models **SF2P**: DB6 □□ 11(Standard model), **SF2E** : DB6 □□ 41, DB6 □□ 42 (EtherCAT model), **SF1**: DA2 □□23、DA2□□ 24
⑤	Type of motor (Refer to the motor model.)
⑥	Type of encoders **17I**: 17bit Incremental encoder **17A**: 17bit Absolute encoder, **23A**: 23bit Absolute encoder
⑦	Control Modes **P**: Position control mode, **V**: Velocity control mode, **T**: Torque control mode
⑧	Inertia ratio
⑨	Gain Parameters (delimited by commas) ・Position control mode: **(No.115.0), (No.116.0), (No119.0)** ・Velocity control mode: **(No.131.0), (No.133.0)**
⑩	Position command smoothing filter(delimited by commas) **(No.80.0), (No.81.0)**
⑪	Torque command notch filter frequency(delimited by commas) **(No.1680.0), (No.171.0)**
⑫	vibration of amplitude (Machine Analyzer Configuration)
⑬	Investigation range (Machine Analyzer Configuration) **Low:** 10–400 Hz **High:** 100–2,000 Hz

1. Overview

Parameter Data Flow



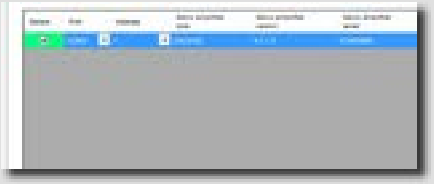
Tracer Arrow	Execution Timing	Operation
(A)	Turning on the control power	Read the parameters from the amplifier EEPROM to its RAM.
(B)	Completing communications connection between S-TUNE Ⅱ and the amplifier	Obtain the parameter data from the amplifier RAM to the computer and display on the screen.
(C)	Entering parameter values	Enter parameter values in the input fields on the screen and prepare to set them to the amplifier.
(D)	Set	Set the parameters to the amplifier RAM.
(E)	Write	Write the parameters to the amplifier EEPROM.
(F)	Save	Save the parameter settings to the file.
(G)	Read	Read the parameters from the file and display on the screen.

2. Using Tabs in S-TUNE Ⅱ

This section describes functions of the tabs in S-TUNE Ⅱ. For details, refer to the pages listed below.

1 Communication Settings

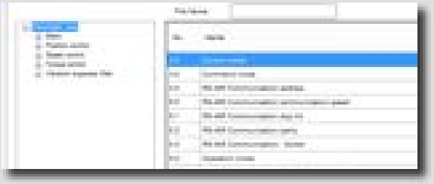
☞ P. 10



- Controls the communication with the amplifier.
- Displays the model information and serial number.

2 Parameter

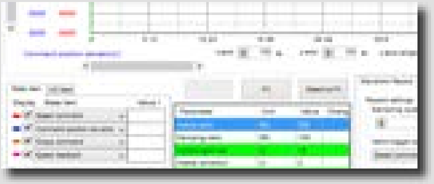
☞ P. 11



- Parameters setting, checking, saving, and loading.

3 Waveform monitor

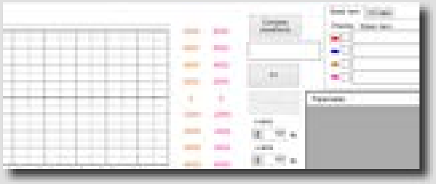
☞ P. 14



- Displays waveforms such as positioning time and vibration.
- Adjust the tuning parameters and filters.
- Saving waveform data in a file or reading it from the file

4 Waveform Comparison

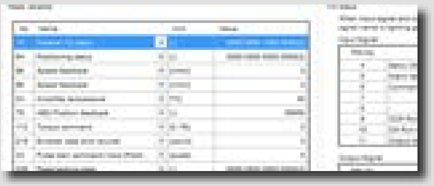
☞ P. 23



- The acquired waveforms are compared and displayed on two screens.

5 Status monitor

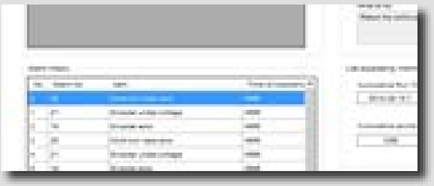
☞ P. 24



- Monitoring status data of the amplifier
- Saving the status data in a file

6 Alarm

☞ P. 25



- Displaying alarm status and its histry of the amplifier
- Checking remedy of the alarm
- Checking how to reset the alarm signal of the amplifier
- Checking the life information on the amplifier

2. Using Tabs in S-TUNE Ⅱ

7 Tuning

☞ P. 26

- Automatically adjusting the tuning parameters
- Setting filters

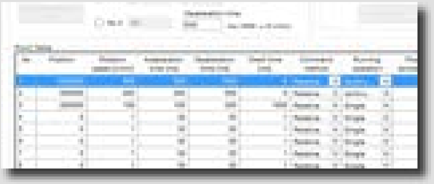
8 Z-Tuning

☞ P. 30

- Automatically adjusting the tuning parameters with high accuracy. Note: See the supported amp version.
- Notch filter is also automatically set.

9 Point Table

☞ P. 46



- Setting motions by Positioner function
- Saving the point table data in a file, or reading it from the file

10 Test run

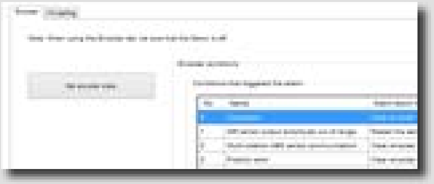
Auxiliary functions

☞ P. 48

- Without connecting to the host controller, performing simulation of motor's repetitive motions for tuning

11 Auxiliary functions

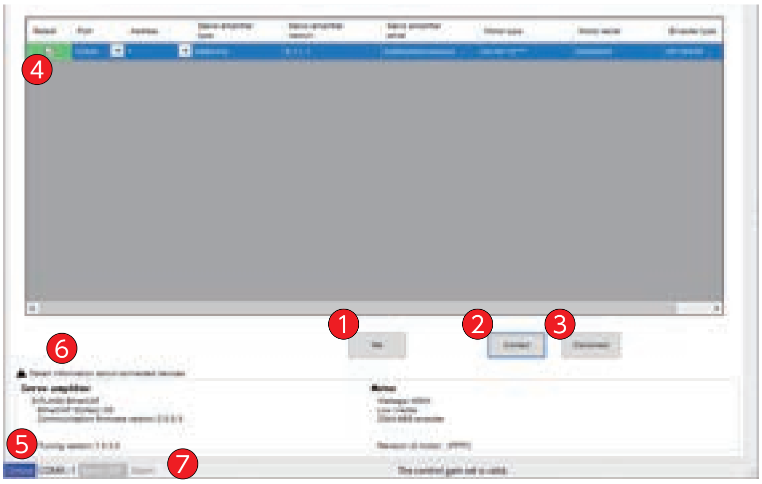
☞ P. 50



- Clearing multi-turn data after checking alarm status
- I/O configurations (Preset & Free mapping)

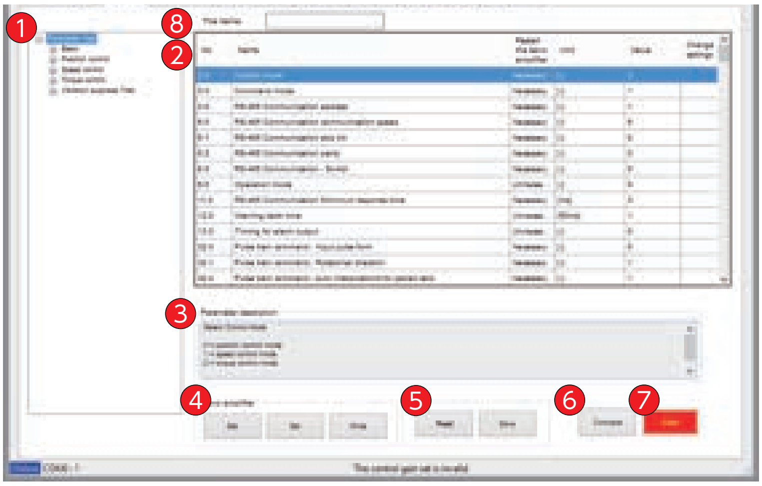
2. Using Tabs in S-TUNE Ⅱ

1. Communications Setup



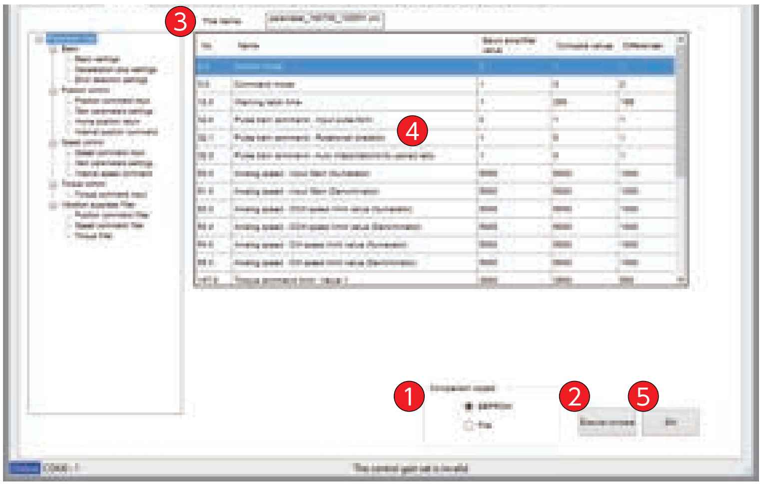
No.	Button/Function	Explanation
①	Get	Click to obtain information about the amplifier.
②	Connect	Click to open the serial port to interface with the amplifier. When the connection is complete, ④ turns blue and ⑤ changes to Online .
③	Disconnect	Click to close the serial port and disconnect communications from the amplifier. When the communications are closed, ④ turns blue and ⑤ changes to Offline .
④	Connection confirmation 1	The checkbox (in the **Select** column) of the selected port is ticked. When the serial port becomes open, the color of checkbox cell changes from blue to green.
⑤	Connection confirmation 2	This box can be seen under any tabs and lets you check the connection status anytime. Offline : Not connected Online : Connected
⑥	Connected Device Information	Displays about the connected amplifiers and motors.
⑦	Amplifier status	Displays the servo status and alarm status.

2. Parameters



No.	Button/Function	Explanation
①	List of Parameter Groups	In this list, related parameters are grouped together according to their usages. Select a group to display the parameters of the group in ②
②	Parameter Table	Parameters are displayed in ascending order of the parameter numbers. Select the parameter number and double-click the value to edit. An asterisk appears on the rightmost cell when you make a value change or read a file. Click Set ; the asterisk disappears. If the Restart the servo amplifier column shows "necessary", you need cycle power for changes that you made to parameter settings to take effect. Click Write and cycle the control power of the amplifier.
③	Parameter Description	This box displays explanation for the parameter selected in ② .
④	Servo amplifier	Get : Pull the values of selected parameters from the amplifier RAM. Set : Write new parameter settings to the amplifier RAM. Write : Write the new parameter settings to the amplifier EEPROM.
⑤	File	Read : Read the data you created before and display. Save : Save the parameter values you edited to a file. Use this to copy the same settings to another amplifier.
⑥	Compare	Compare : Jump to the parameter comparison screen. Comparing the parameter value in the RAM of the amplifier with the parameter value editing on the S-TUNE Ⅱ . Execute compare : Compare the edited parameters with the data saved in EEPROM or a file. Edit : Return to the parameter table ② .
⑦	Clear	Delete the parameter data in EEPPROM. Use this for factory reset or when replacing the motor. Parameter settings of the motor model that you connect next will be automatically set. We recommend data backup before you start operations.
⑧	File Name	Name of the parameter data file that S-TUNE Ⅱ read. PRYYMMDD···.xml

Comparing Parameter Values



No.	Button/Function	Explanation
①	What data to compare	Select which data you want to compare with the data in RAM. Select EEPROM or File.
②	Execute compare	At first, click on the Set button. (The parameter(s) is/are written in at the RAM of the amplifier.) Execute compare Executes Compare and shows the result in the data display area. If two sets of data are completely matching, the table will be blank.
③	File Name	Name of the parameter data file you selected for comparison. PRYYMMDD···.xml
④	Parameter settings comparison table	No. : Parameter number Name : Parameter name Servo amplifier value : Parameter value residing in the amplifier RAM. Compare value : Value to compare with (in EEPROM or the file that you selected) Difference : The difference between the value in RAM and the value compared.
⑤	Edit	Jump to the parameter edit window.

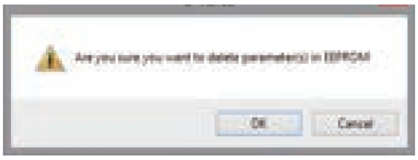
2. Using Tabs in S-TUNE Ⅱ

(2. Parameters)

Replacing with a Different Type of Motor

Use a right pair of motor and amplifier.
If a wrong pair has been set accidentally, clear the parameter data in the amplifier EEPROM first, then use a right pair.

Procedure for Parameter Clear

Step	Description
Step 1	Connect the amplifier and the computer. Turn on the control power. (You don't need to turn on the primary circuit power.)
Step 2	Click on **Clear** under the Parameter tab.
Step 3	 Are you sure you want to delete parameter(s) in EEPROM OK Cancel →  Finished deleting parameters in EEPROM Restart the servo amplifier. OK Click **OK** : to clear parameter data, Click **Cancel** : to cancel. If Parameter Clear failed, repeat this procedure from the beginning.

After clearing the parameter data in EEPROM, be sure to do the control power cycling according the following procedures.

Automatically Identifying Motor Model and Output Rating

Step	Description
Step 1	Clear the parameters.
Step 2	Disconnect the primary circuit power supply and the control power supply.
Step 3	Replace the motor and connect the encoder cable.
Step 4	Reapply the control power to the amplifier. The default parameter values for the new motor will be automatically set to EEPROM.
Step 5	Verify that the alarm statuses are all normal.

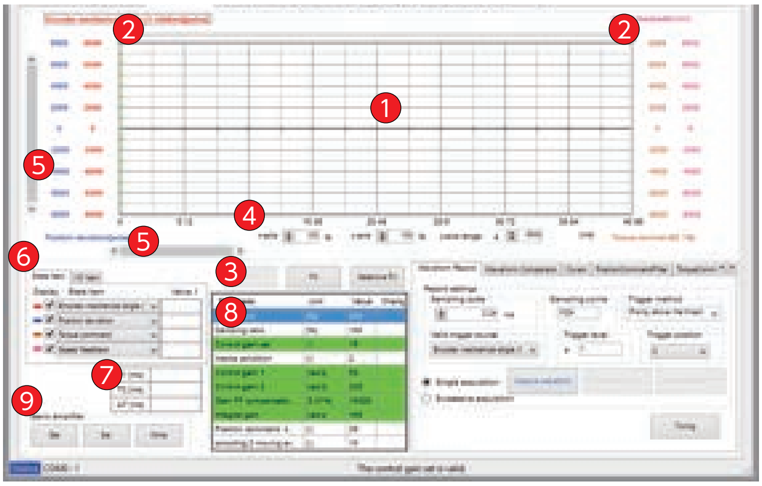
3. Waveform Monitor

⚠ DANGER

Do not use an inappropriate value for any parameter.
Or the motor will become uncontrolled. Secure safety for the work area before gain tuning.

Secure safety in surrounding areas and take safety measures such as emergency stop.

To optimize gain tuning, observe not only waveforms, but also noise and vibrations, jerky or smooth movements in the motor and the equipment.



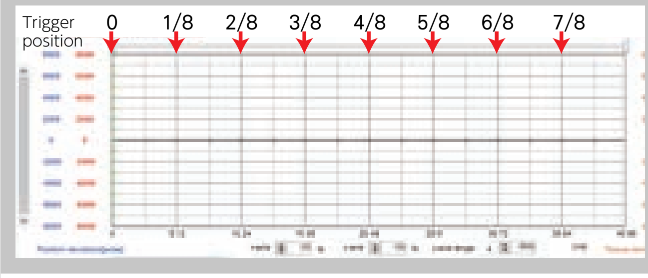
(3. Waveform Monitor)

No.	Button/Function	Explanation
①	Chart Display Area	You can use the mouse in this area. • Drag to zoom a rectangle area that you select. • Right-click to capture the waveform. • Wheel button Use the Scroll wheel to change the max value to be included in the chart while the waveform is selected. This can be done in the x-axis or y-axis zoom %, or y-axis range cell where the cursor is blinking. Scrolling without specifying the area moves the left green cursor on the chart.
②	Cursor icons	Move the cursor icons horizontally to display the time values in ⑦ . Cursor 1 (green) for T1, Cursor 2 (blue) for T2.
③	Fit	Click to fit the waveform chart to the chart display area such that the max value.
	Selective Fit	This icon adjusts the selected waveform display range such that the average of the max and min y-values of the data is centered in the chart display window. When y-value fluctuations are relatively small, the waveform you want to see might appear only at the upper side or lower side of the display window. **Selective Fit** can fix this problem. To select a variable for which you want to change the waveform display range, click on the variable label (i.e. a status name) in the chart area. The status variable selected will be shown with a black border (e.g., Speed command [r/min]).
	Return	Click Return to see the previous display view of the waveform. You can go back up to the fifth one. Click Fit to clear the history of display changes.
④	X-axis scale	Enter a zoom percentage for x-axis.
	Y-axis scale	Enter a zoom percentage for y-axis.
	Y-axis range	Specify the display range for y-axis.
⑤	Scroll bars	Use the horizontal bar to change the x-axis display range. Use the vertical bar to change the y-axis display range.

No.	Button/Function	Explanation
⑥	State Item	Select up to four state items (i.e. status variables), from the pull-down menu, that you want to display in waveform. Those four items you selected will be saved in a file. In the case of 4-byte status data, only the lower 2-byte is displayed.
	I/O Item	The I/O items are also displayed in waveform. Four I/O items selected here will be saved to a file.
⑦	Time	Time measured at the location of the cursor positions. T1 : time at the green cursor T2 : time at the blue cursor △T : difference between T1 and T2
⑧	Parameters Window	Displays parameters that can be set in the **Waveform monitor** tab and display-only parameters. The rows highlighted in green are parameters grouped together in the control gain set. Parameters with grayed out **Value** cells are display-only.
⑨	Servo amplifier Click Get	: to read the parameters from the amplifier.
	Click Set	: to set the parameters to the amplifier RAM.
	Click Write	: to save the parameter to the amplifier EEPROM.

(3. Waveform Monitor)

Waveform Record Set the waveform measurement conditions here.
Save the obtained waveforms and tuning parameters to a file.

<table>
<tr><th>Button/Function</th><th>Explanation</th></tr>
<tr><td>Sampling cycle</td><td>Default : 2.00 [ms]   Set in increments of: 0.05 [ms]
Sampling cycle = (Range of motor moving time) ÷ (Sampling Points)</td></tr>
<tr><td>Sampling Points</td><td>Enter the number of sampling points per measurement.
Initial value: 1,000 points, Range: 1 to 4,096 points</td></tr>
<tr><td>Trigger method</td><td>Select the trigger method to obtain waveform data. At first, select rising edge to measure the series of motions from start to finish.
<table>
<tr><th>Setting</th><th>Preferred when</th><th>Recording starts when</th><th>Recording ends when</th></tr>
<tr><td>Rising above the threshold (i.e. Rising edge)</td><td>• Checking statuses immediately after a motion starts.
• Trying to get a general idea on the whole movement.</td><td>The value of Valid trigger source has exceeded the Trigger Level setting.</td><td>The number of points sampled has exceeded the Sampling points setting.</td></tr>
<tr><td>Force trigger</td><td>• Actual motion is too slow for the rising edge trigger to get to work.
• Checking a specific part of consecutive operations.</td><td>Capture waveform has been clicked.</td><td></td></tr>
</table>
Note: "Falling edge" option is not available.</td></tr>
<tr><td>Valid trigger source</td><td>Select a state variable that will work as the trigger to start recording waveform data (state variables).</td></tr>
<tr><td>Trigger level</td><td>Set the threshold value to start recording waveform data.
When the selected variable exceeds the threshold, recording will start.
Range: 0 to 32,767</td></tr>
<tr><td>Trigger position</td><td>Set the trigger position. You can select up to eight positions starting from the left.
0 : Left end of the chart, 1/8 : Leftmost solid line, 7/8 : Rightmost solid line

</td></tr>
<tr><td>Sampling method</td><td>Single acquisition: to obtain data only once for the specified number of sampling points.
Successive acquisition: "Single acquisition" is repeated and waveform chart continues to update until Stop sampling is clicked.</td></tr>
<tr><td>Capture waveform</td><td>Start obtaining waveform data.</td></tr>
<tr><td>Stop sampling</td><td>Stop obtaining waveform data.</td></tr>
<tr><td>Save waveform(s)</td><td>Save the obtained waveform data and the tuning parameter settings in a CSV file.</td></tr>
<tr><td>Tuning</td><td>Jump to the Quick Tuning tab under the Tuning tab.</td></tr>
<tr><td>Save</td><td>Saves parameters to a file.</td></tr>
</table>

Waveform Comparison

Use this tab to display and compare waveforms of the data read from the waveform file and waveforms of sampled data.

Button/Function	Explanation
State Item (i.e. Status variables)	Select items that you want to display in waveforms. Eight waveforms including those from the sampled items ⑥ can be displayed. Y-axis units are displayed for four items from the top selected in ⑥ .
I/O Item	I/O data from another waveform file. Displays up to four when Parallel I/O Status is selected as status item.
Parameters	Parameter values of waveform that have been read from wave form the file.
Time	T1 and T2 are time figures indicated by the cursor positions. (*)
Compare waveforms	Read the saved data.
WFYYMMDD_hhmm···.csv	Name of the file that has been read from the computer.

Cursor

Enables numeric comparison of the waveforms displayed in the chart area. Up to eight waveforms can be displayed - your measured waveforms at the top and waveforms-read by the waveform comparison tab from the file- on the bottom.

Value 1 at Cursor 1 (green), Value 2 at Cursor 2 (blue)

Button/Function	Explanation
State items (i.e. Status variables) I/O items	Y values (at the cursors) of the items you selected are displayed.

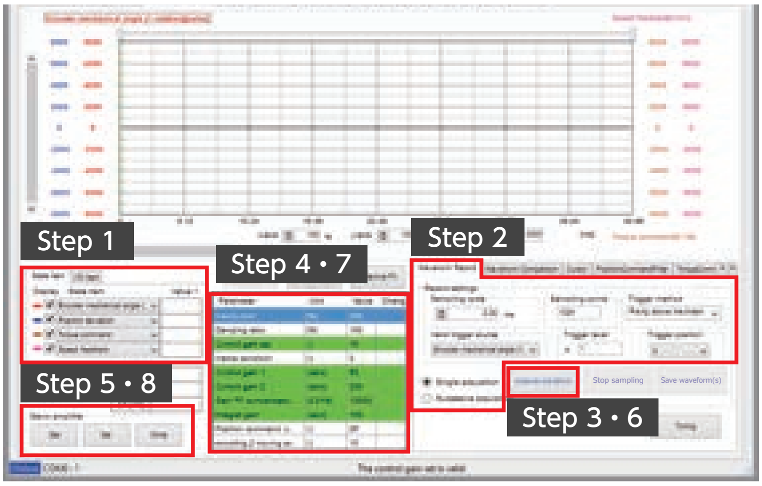
(3. Waveform Monitor)

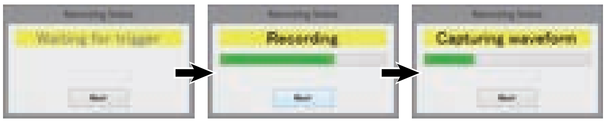
Position Command Filter Torque Command Filter	Use these tabs to check fluctuating position deviation values and torque command values in waveform chart and select the filters that you want to set. (*)

Button/Function	Explanation
Frequency display	This item changes the chart units from time [ms] to frequency [Hz]. When the display mode is changed to frequency, the cursor colors change to red and blue. Column A and Column B show frequencies at the red and blue cursors respectively. In frequency charts, Cursor 2 position is determined to be at 2^n sampling point starting from the Cursor 1 position. Read the peak value; use Position Command Filter Adjustment or Torque Command Filter Adjustment to jump to the Tuning tab to set filters. You can set to four levels of filters. After setting filters, you can check the settings under Position Command Filer tab and the Torque Command Filter tab.
Time View	Click to switch the chart units from frequency [Hz] to time [ms]. In the time unit mode, the cursor colors are green and light blue, and Columns A and B are blank.
Position Command Filter Adjustment	Click to jump to **Position Command Filter Adjustment** under the **Tuning** tab.
Torque Command Filter Adjustment	Click to jump to **Torque Command Filter Adjustment** under the **Tuning** tab.
Get	Read filter parameters from the amplifier.
Set	Write the filter parameters to the amplifier RAM.
☑ (Checkbox)	You can enable or disable the filter that you set by checking or unchecking the checkbox. Unchecking the checkbox does not erase the filter setting.

*) Under these tabs, the second cursor in the time unit mode is positioned at the 2^n sampling point starting from the first cursor position.
Conversion to frequency is applied to the range between the 1st and 2nd cursors

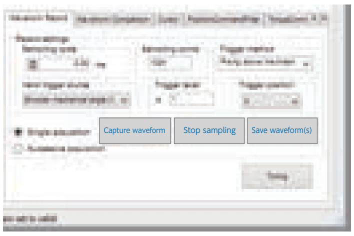
Procedure 1　Waveform Display



Step	Description
Step 1	Select status items that you want to obtain waveforms for.
Step 2	Set measurement conditions.
Step 3	Click on Capture waveform  ・The popup dialog "Waiting for trigger" does not change to "Recording" until the enabled trigger source reaches the trigger specified level. In case that the dialog "Waiting for trigger" remains unchanged, select the "Force trigger" method instead or decrease the trigger level. ・If you click Abort in the middle of the process, the data will have been captured up to the point of abort.
Step 4	Adjust the parameters. ☞ C- 3 Tuning
Step 5	Click Set to write the parameters to the amplifier RAM.
Step 6	Click Capture waveform to see the waveforms.
Step 7	Continue adjusting the parameters until you obtain desired waveforms.
Step 8	Click Write to write the parameters to EEPROM of the amplifier.

(3. Waveform Monitor)

Procedure 2　Saving waveform data

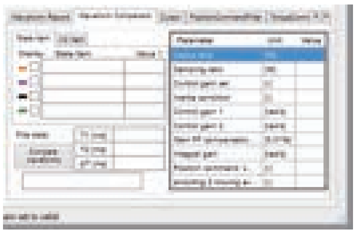


Step	Description
Step 1	Click on Save waveform(s) under the **Waveform Record** tab.
Step 2	A dialog box will prompt you to select a waveform file name.
Step 3	Select the name of a waveform file you want to save the waveform data to and click Save .

Use the saved file when you want to use the same measurement conditions next time.

File content	Data of waveforms displayed and parameters
Default directory to save waveform files	C:\Users******\Documents\NIDEC-SANKYO\S-TUNE2\Waves
Default file name	**WF**YYMMDD_hhmm···.csv

Procedure 3　Reading waveform data



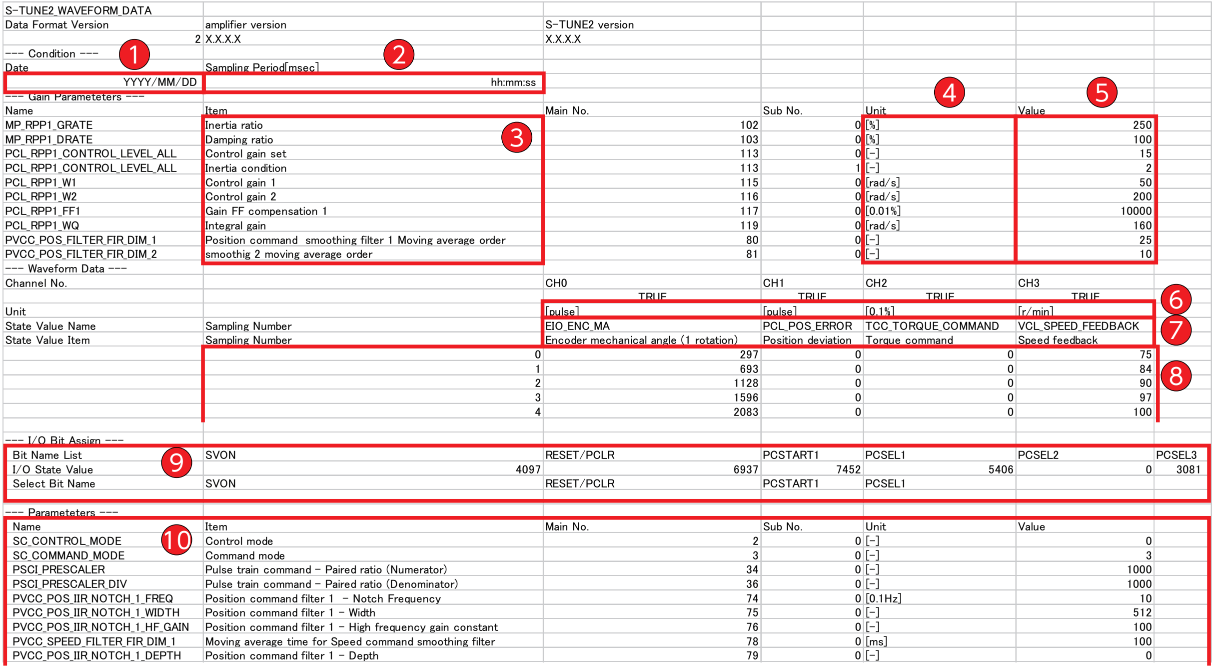
Step	Description
Step 1	Click Compare waveforms under the **Waveform Comparison** tab.
Step 2	A dialog box will prompt you to select a waveform file.
Step 3	Select a file and click Open . (The file name that you selected appears in the box below the **Compare waveform** button. For example, **WF**YYMMDD_hhmm···.csv)

NOTE

- The color of the waveform matches the color shown on the display check mark, not the one used when you saved the data.
- The data read from the file is displayed in the Value1 column.
- Under the Waveform monitor tab, waveforms of most recent data and data read from the file are both displayed in one chart.
  The **Waveform Comparison** tab lets you compare waveform charts of two data sources side by side vertically.

2. Using Tabs in S-TUNE Ⅱ

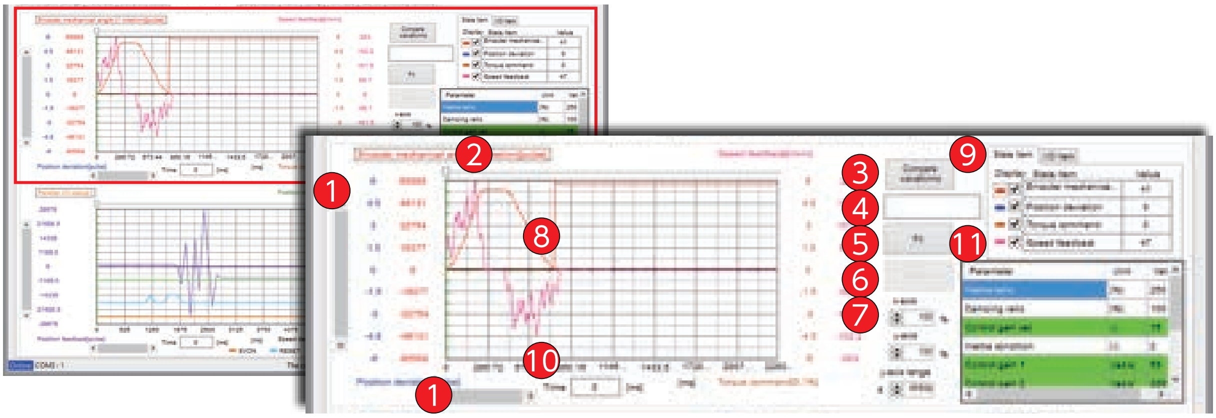
Procedure 4 Reading Waveform File



S-TUNE2_WAVEFORM_DATA						
Data Format Version	amplifier version	S-TUNE2 version				
2	X.X.X.X	X.X.X.X				
--- Condition ---						
Date	Sampling Period[msec]					
YYYY/MM/DD	hh:mm:ss					
--- Gain Parameteters ---						
Name	Item	Main No.	Sub No.	Unit	Value	
MP_RPP1_GRATE	Inertia ratio	102	0	[%]	250	
MP_RPP1_DRATE	Damping ratio	103	0	[%]	100	
PCL_RPP1_CONTROL_LEVEL_ALL	Control gain set	113	0	[-]	15	
PCL_RPP1_CONTROL_LEVEL_ALL	Inertia condition	113	1	[-]	2	
PCL_RPP1_W1	Control gain 1	115	0	[rad/s]	50	
PCL_RPP1_W2	Control gain 2	116	0	[rad/s]	200	
PCL_RPP1_FF1	Gain FF compensation 1	117	0	[0.01%]	10000	
PCL_RPP1_WQ	Integral gain	119	0	[rad/s]	160	
PVCC_POS_FILTER_FIR_DIM_1	Position command smoothing filter 1 Moving average order	80	0	[-]	25	
PVCC_POS_FILTER_FIR_DIM_2	smoothig 2 moving average order	81	0	[-]	10	
--- Waveform Data ---						
Channel No.		CH0	CH1	CH2	CH3	
		TRUE	TRUE	TRUE	TRUE	
Unit		[pulse]	[pulse]	[0.1%]	[r/min]	
State Value Name	Sampling Number	EIO_ENC_MA	PCL_POS_ERROR	TCC_TORQUE_COMMAND	VCL_SPEED_FEEDBACK	
State Value Item	Sampling Number	Encoder mechanical angle (1 rotation)	Position deviation	Torque command	Speed feedback	
	0	297	0	0	75	
	1	693	0	0	84	
	2	1128	0	0	90	
	3	1596	0	0	97	
	4	2083	0	0	100	
--- I/O Bit Assign ---						
Bit Name List	SVON	RESET/PCLR	PCSTART1	PCSEL1	PCSEL2	PCSEL3
I/O State Value	4097	6937	7452	5406	0	3081
Select Bit Name	SVON	RESET/PCLR	PCSTART1	PCSEL1		
--- Parameteters ---						
Name	Item	Main No.	Sub No.	Unit	Value	
SC_CONTROL_MODE	Control mode	2	0	[-]	0	
SC_COMMAND_MODE	Command mode	3	0	[-]	3	
PSCI_PRESCALER	Pulse train command - Paired ratio (Numerator)	34	0	[-]	1000	
PSCI_PRESCALER_DIV	Pulse train command - Paired ratio (Denominator)	36	0	[-]	1000	
PVCC_POS_IIR_NOTCH_1_FREQ	Position command filter 1 - Notch Frequency	74	0	[0.1Hz]	10	
PVCC_POS_IIR_NOTCH_1_WIDTH	Position command filter 1 - Width	75	0	[-]	512	
PVCC_POS_IIR_NOTCH_1_HF_GAIN	Position command filter 1 - High frequency gain constant	76	0	[-]	100	
PVCC_SPEED_FILTER_FIR_DIM_1	Moving average time for Speed command smoothing filter	78	0	[ms]	100	
PVCC_POS_IIR_NOTCH_1_DEPTH	Position command filter 1 - Depth	79	0	[-]	0	

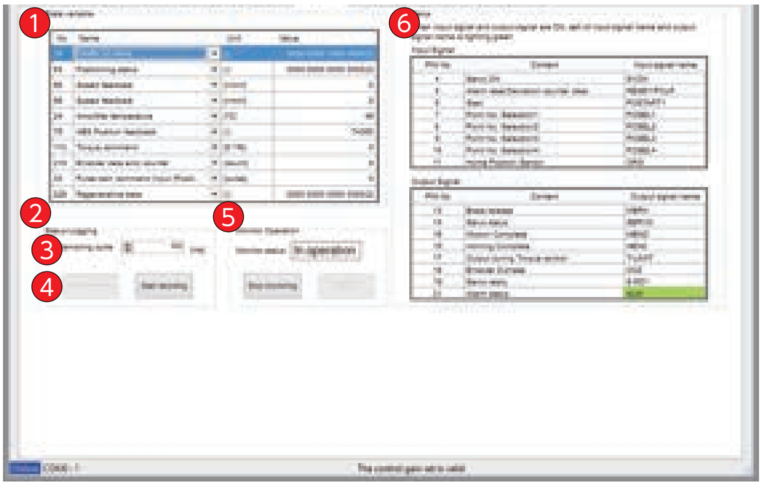
--- Condition ---		
①	Date	Data timestamp for saving a file
②	Sampling Period [msec]	Sampling cycle
--- Gain Parameters ---		
③	Item	Tuning parameter names
④	Unit	Tuning parameter units
⑤	Value	Tuning parameter values
--- Waveform Data---		
⑥	Unit	Measurement units of status items
⑦	State Value Item	Amplifier status variable names
⑧	Status data	Time series data of status variables
---I/O Bit Assign---		
⑨	I/O data	
---I/O Bit Assign---		
⑩	Information of related parameters	

4. Waveform Comparison



No.	Button/Function	Explanation
①	Scroll bars	Use the horizontal bar to scroll sideways. Use the vertical bar to scroll up and down.
②	Cursor	Move the cursor horizontally to display the x coordinate in ⑩ (Time [ms]).
③	Compare waveforms	Click to read the data created earlier.
④	WFYYMMDD_hhmm···.csv	The name of the file that the data was read from.
⑤	Fit	Click to fit the waveform chart to the chart display area such that the max value of the selected waveform will be the max y-coordinate..
⑥	Return	Click to go back to the previous waveform display (i.e. undo **Fit**.). You can go back up to the fifth one. Click Fit to reset the history.
⑦	x-axis zoom %	Enter a zoom percentage for x-axis.
	y-axis zoom %	Enter a zoom percentage for y-axis.
	y-axis range	Specify the display range of y-axis.
⑧	Chart Display Area	You can use the mouse in the Chart area. Drag to specify a rectangle area to zoom in. Right-click to copy the waveform. Use the scroll wheel in any input cell of x-axis zoom %, y-axis zoom %, or y-axis range where the cursor is blinking, to change the max value of the selected item to be included in the chart. Click on the cursor button ② and then use the scroll wheel to move the green cursor.
⑨	State Item	Click the checkbox of the item that you want to see its waveform for. You can select up to four items.
⑩	Time	The measured value at the x-axis cursor position.
⑪	Parameter	Displays the parameter values at the time when waveform data was obtained.

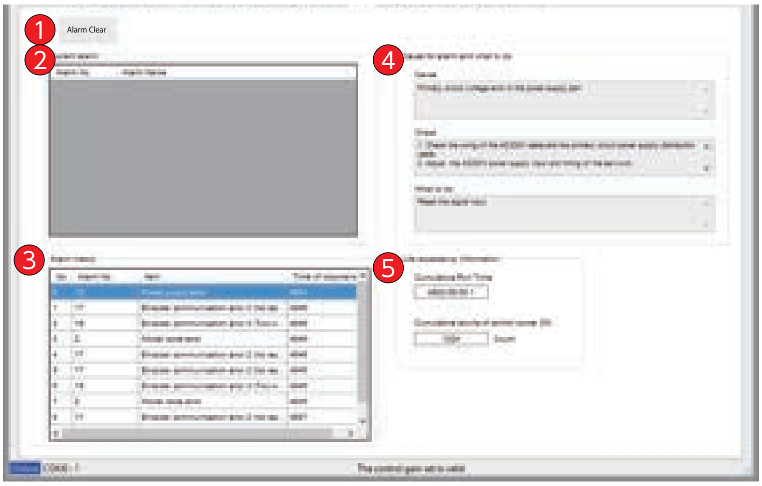
5. Status Monitor



No.	Button/Function	Explanation
①	State variable	Select up to ten status variables that you want to monitor. The data is displayed at the same time. Display example: [0000 0000 0000 0000(2)] where (2) indicates binary. ☞ **Z- 2 Technical Information** Status Display
②	Status Logging	Lets you obtain status log.
③	Sampling cycle	Range: 500 to 100,000 [ms] Set in increments of: 500 [ms]
④	Stop recording Start recording	Click Start recording after setting the sampling cycle. Click Stop recording to stop logging. The data will be saved to a csv file. Default file name: **SV**YYMMDD_hhmm···.csv
⑤	Monitor Operation	Clicking the [Status monitor] tab starts monitoring. Use Stop monitoring or Restart to stop or resume monitoring.
⑥	I/O status	When an input or output signal turns on, its signal name cell turns green.

2. Using Tabs in S-TUNE Ⅱ

6. Alarm



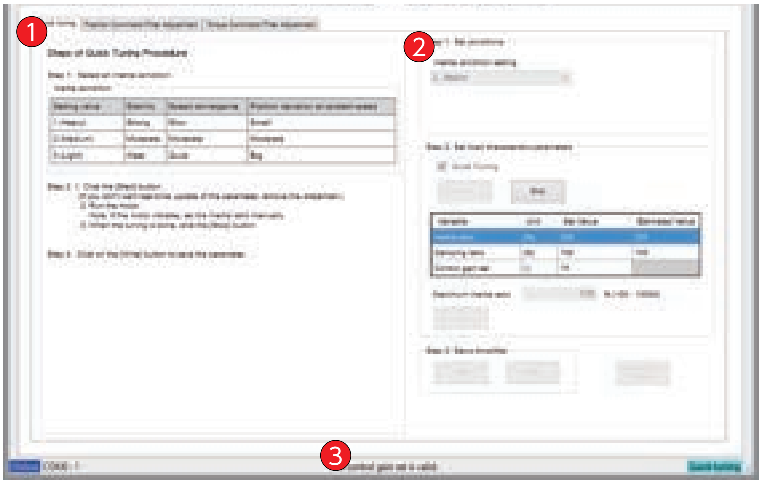
No.	Button/Function	Explanation
①	Alam Clear	Click to clear amplifier alarms. Clearing alarms 1. Remove the cause of the alarm(s). 2. Under the **Parameters** tab, set Operation Mode (No.9.0) to 1 (communication). 3. Click **Alarm Clear**.
②	Current alarm	Displays a list of current alarms.
③	Alarm history	Displays up to ten most recent alarms.
④	Cause for alarm and what to do	Shows possible causes of the alarm selected in ② and troubleshooting.
⑤	Life expectancy information	Shows guidelines for regular maintenance and product life. **Cumulative Run Time:** This item indicates the total amplifier runtime (in [hhhhhh:mm:ss.s]) since the control power was supplied to it for the first time. **Cumulative counts of control power ON:** This item indicates how many times the control power was turned on to the amplifier since the first time

☞ **Z- 1 Troubleshooting**

7. Tuning

Quick tuning

Position control mode only

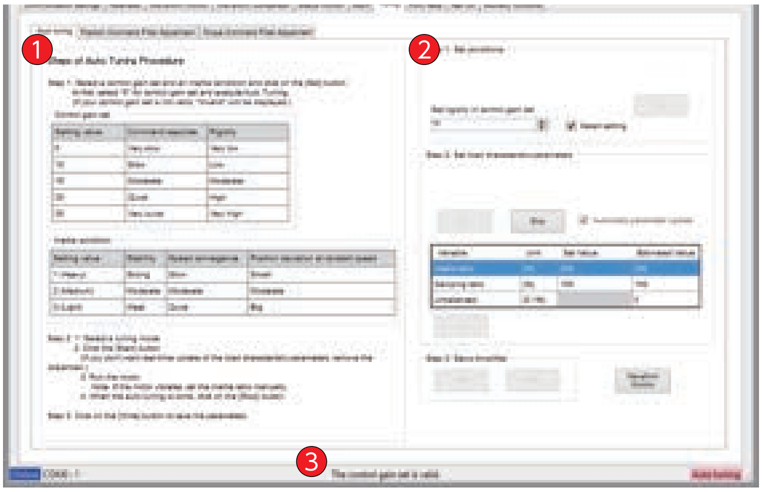


No.	Procedure/Button	Explanation
①	Operating Procedure	This is a guidance of the "Quick Tuning".
②	Conditions **Step 1**	Set a load related parameter of the motor. Set the appropriate inertia condition : Choose a inertia condition to machine system connecting to your motor.
	Step 2	Setting of the load related parameters : ☑ : Quick Tuning If you check "Quick Tuning", the inertia ratio value is estimated automatically, and then the value is set to the amplifier RAM one by one. Uncheck the check box if you need the inertia ratio estimation only. Click Start : to start a Quick Tuning Click Stop : to stop a Quick Tuning Inertia ratio upper bound If you try to enter the inertia ratio by manually, enter a value in the "Set value" cell. Set : Write the new parameter settings to the amplifier RAM.
	Step 3	Get : Pull the values of the parameters from the amplifier RAM Write : Write the new parameter settings to the amplifier EEPROM.
	Waveform Monitor	Jump to the Wave Monitor window.
③	Tuning status indicator	This indicator shows a tuning condition.

(7. Tuning)

Auto tuning

Velocity Control Mode only

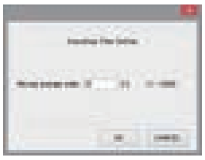
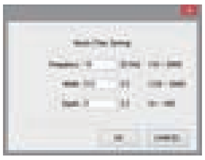
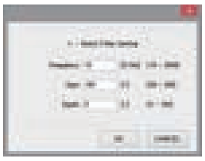


<table>
<tr><th>No.</th><th>Button/Function</th><th>Explanation</th></tr>
<tr><td>①</td><td>Step of Auto Tuning Procedure</td><td>Auto Tuning Operation</td></tr>
<tr><td rowspan="5">②</td><td>Conditions
Step 1</td><td>Adjust load characteristic parameters.
Setting rigidity (Control Gain Set):
Start with the lowest value 5, then gradually increase the value.
<table>
<tr><th></th><th>Range</th><th>Increment by</th></tr>
<tr><td>☐ Detail setting</td><td>5 to 30</td><td>5</td></tr>
<tr><td>☑ Detail setting</td><td>1 to 46</td><td>1</td></tr>
</table>
Inertia ratio upper bound
If you try to enter the inertia ratio by manually, enter a value in the "Set value" cell.
Set : Write the new parameter settings to the amplifier RAM.</td></tr>
<tr><td>Step 2</td><td>Estimating the inertia ratio automatically:
Click Start : to start Auto-tuning
Click Stop : to end Auto-tuning
☑ : Automatic parameter update
The parameter value will be estimated and set to the amplifier RAM.
Manually enter the inertia ratio:
Enter a value in the "Set Value" column.
Set : to set data to the amplifier RAM.</td></tr>
<tr><td>Step 3</td><td>Click Get : to read data from the amplifier RAM.
Click Write : to write data to the amplifier EEPROM.</td></tr>
<tr><td>Waveform Monitor</td><td>Click this button to jump to the Waveform tab.</td></tr>
<tr><td>③</td><td>Status display</td><td>Tuning status is displayed here.</td></tr>
</table>

2. Using Tabs in S-TUNE Ⅱ

(7. Tuning)

Adjusting Position command filter

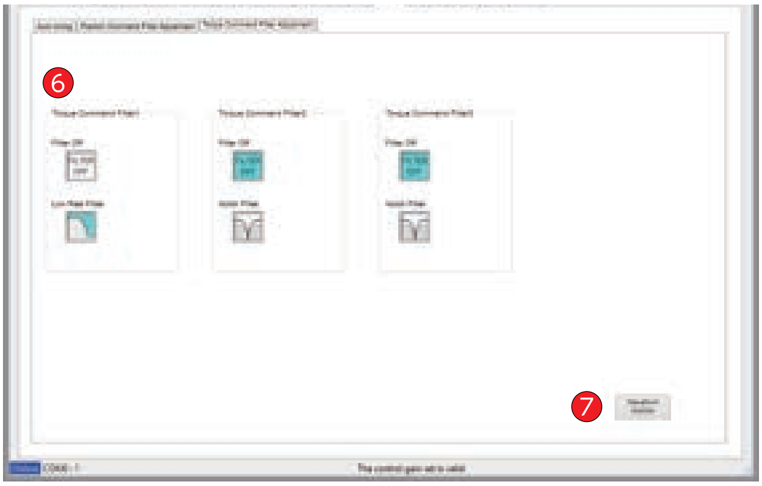
No.	Button/Function	Explanation
④	Position Command Filter 1-4	For each filter, select whether use it or not. If selected, a pop-up box opens. Enter the specific value you want. The selected icon turns blue.
	Filter Off	Select this if you are not setting up any filters. Click the icon to toggle between disable FILTER OFF (no filter) and enable FILTER OFF (use filter).
	Smoothing Filter 	Set the moving average count. Click on the icon to toggle between enable ⎍ and disable ⎍ .
	Notch Filter 	Set frequency [0.1 Hz], width, and depth. Click on the icon to toggle between enable ⋎ and disable ⋎ .
	γ -Notch filter 	Set frequency [0.1 Hz], gain, and depth. Click on the icon to toggle between enable √ and disable √ .
⑤	Waveform monitor	Click to jump to the **Waveform Monitor** tab.

☞ C- 3 Tuning

2. Using Tabs in S-TUNE Ⅱ

(7. Tuning)

Adjusting Torque Command Filter



No.	Button/Function	Explanation
⑥	Torque Command Filter 1-3	For each filter, select whether use it or not. If selected, a dialog box opens. Enter the specific value you want. The selected icon turns blue.
	Filter Off	Select this if you are not setting up any filters. Click the icon to toggle between disable FILTER OFF (no filter) or enable FILTER OFF (use filter).
	Low Pass Filter 	Set the time constant [0.01ms]. Click on the icon to toggle between enable and disable .
	Notch Filter 	Set frequency [Hz], width, and depth. Click on the icon to toggle between enable and disable .
⑦	Waveform monitor	Click this button to jump to the **Waveform Monitor** tab.

☞ **C- 3 Tuning**

8. Z-Tuning

Z-tuning is an auto-tuning function that uses S-TUNE II to perform motor operation.

⚠ DANGER

⊘	DO NOT apply Z-tuning to vertical axes or axes that are loaded with a constant load, such as spring mechanisms.	⚠ ⚠ ⚠
	DO NOT touch the setting panel while S-TUNE II is running tuning.	
❗	Be sure to take hazard prevention methods, immediate stopping methods, and shock mitigation etc. before tuning.	

Z-Tuning is an auto-tuning function that is performed by operating the motor from S-TUNE II.

Supported Models and Versions

Supported Models		Supported Versions
Software S-TUNE Ⅱ		**2.1.0.0** or later
Servo Amplifier S-FLAG Ⅱ series	Standard model (Pulse-train command type) **DB6**11** series	**5.0.3.0** or later
	EtherCAT model **DB6**41** series **DB6**42** series	**6.0.3.0** or later **6.1.0.0** or later
Servo Amplifier S-FLAG series	**DA2**23** series	**4.2.5.0** or later

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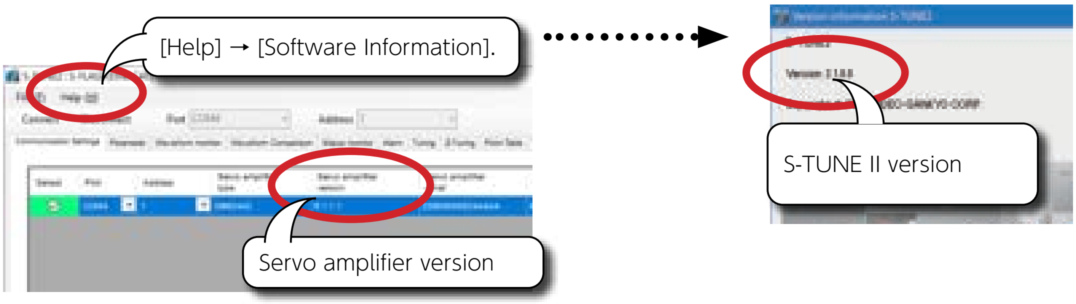
How to check the version

You can check the version information in S-TUNE II.



[Help] → [Software Information].

Servo amplifier version

S-TUNE II version

(8. Z-Tuning)

Outline of Z-Tuning

Z-tuning is for Position control mode.
It is not available in the Velocity control mode and Torque control mode.

Z-tuning is only applicable to horizontal axis motions.
It is not applicable to the axis that is under a permanent load such as vertical axis and spring mechanism.

Z-Tuning automatically searches for the load inertia ratio, gain set, torque notch filter, and position command smoothing filter to fulfill the set positioning completion range and settling time targets.

To start Z-tuning, the user sets the operating range for tuning and some tuning conditions.

Once Z-Tuning starts, the motor will be run while changing tuning parameters from S-TUNE II, and the trials are repeated until the tuning parameters become optimal.
During Z-Tuning, the maximum motor speed is 1,000 r/min and the acceleration time is 100ms.

The tuning process ends after the set positioning completion range and settling time conditions are reached.
To ensure servo stability, depending on the customer's equipment, the tuning may be completed before the conditions are reached, but this is not an abnormality.

The motion control parameters(*) required for Z-tuning operation are changed automatically and return to the previous settings automatically after Z-tuning is finished.

*) These are the control mode, command mode, and other parameters.

The result of Z-tuning can be saved in a data file. Saved data files can be read and displayed even when the connection between S-TUNE II and the amplifier is offline.

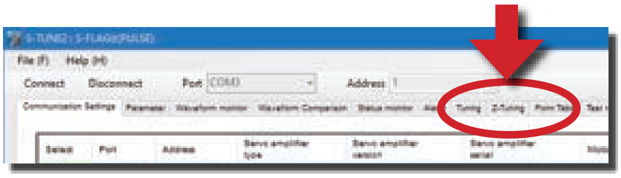
Any of the following may interrupt proper performance of Z-Tuning.
The inertia ratio is less than 1 or above 30. (*1)
The load inertia is fluctuating.
Machine rigidity is extremely low.
Non-linear characteristics such as backlash exist.
The torque is extremely large or small.

*1) If an extremely large load with an inertia ratio greater than 100 times is connected, parameter No. 102.0 (the value of the inertia ratio) will be clamped at 10,000.

Overall flow of Z-tuning

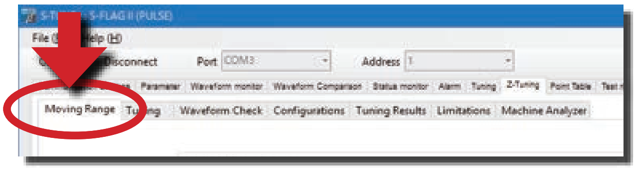
Start tuning. Start Z-tuning.

1 Connect the S-TUNE II to the amplifier and select the **[Z-Tuning]** tab.



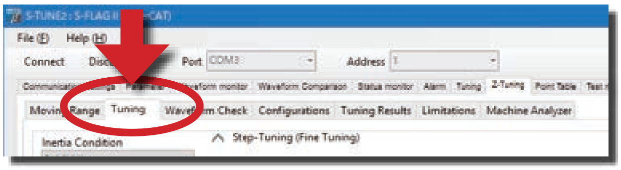
2 Sets up the range where you want to perform Z-tuning.

This is carried out
in the **[Moving Range]** tab.



3 Start tuning.

This is carried out
in the **[Adjustment]** tab.



Tuning complete Z-Tuning is complete.

Tip !

Limitations of "Z-Tuning"

There are some Limitations on Z-tuning.
Please be sure to fully understand the Limitations before tuning.

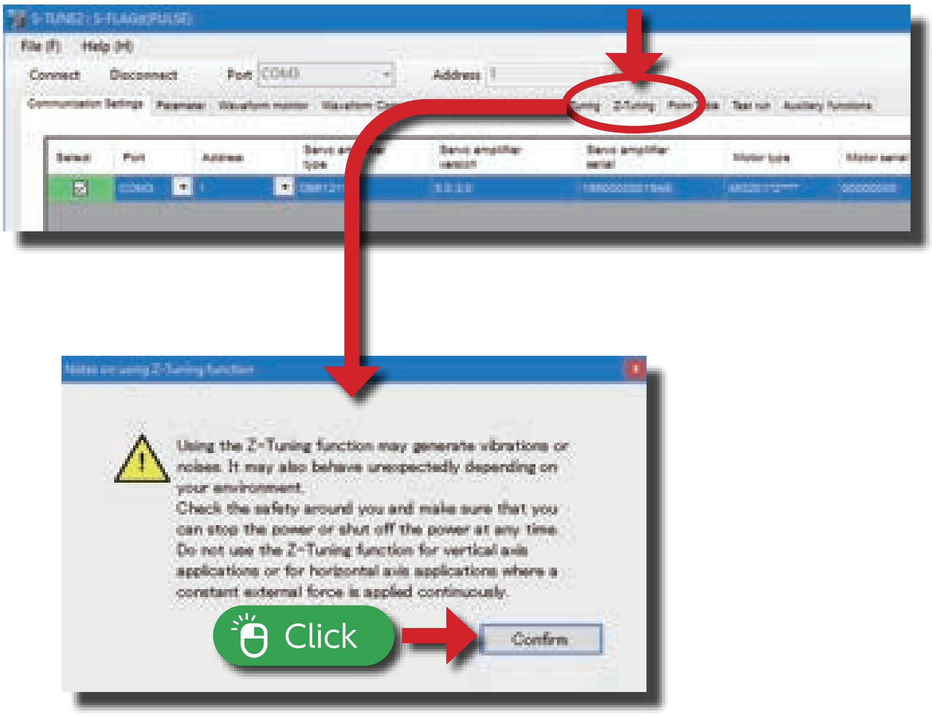
☞ P. 40

2. Using Tabs in S-TUNE Ⅱ

(8. Z-Tuning)

1 Connect the S-TUNE II to the amplifier and select the **[Z-Tuning]** tab.

When Z-Tuning is started for the first time, a warning message pops up.
Please click the **[Confirm]** button after you have fully understood the notes.



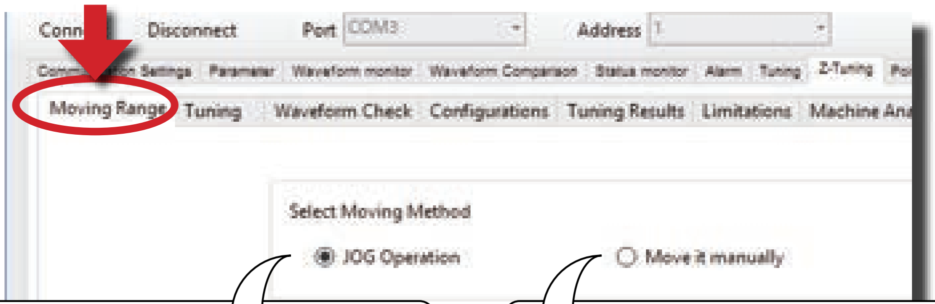
Using the Z-Tuning function may generate vibrations or noises. It may also behave unexpectedly depending on your environment.
Check the safety around you and make sure that you can stop the power or shut off the power at any time.
Do not use the Z-Tuning function for vertical axis applications or for horizontal axis applications where a constant external force is applied continuously.

NEXT 2 Sets up the range where you want to perform Z-tuning.

If an/some alarm(s) is/are present, you cannot move into the [Z-Tuning] tab. Check the contents of the "Alarm" tab and clear the alarm.

2 Sets up the range where you want to perform Z-tuning.

On the **[Moving Range]** tab, choose one way to move the motor.



Select Moving Method
◉ JOG Operation ○ Move it manually

Jog Operation ☞ P. 35

Use the jog operation buttons in the motion range setting frame.

(The motor turns into SERVO ON state.)

Move by hand ☞ P. 36

Manually move your device, which is connected to the motor, without turning on the servo.

(This operation is not supported for motors with brakes.)

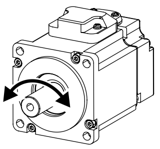
⚠ DANGER

🚫	DO NOT use "Move by hand" if your machine is a device with a blade or a press, or something like that.
❗	BE EXTREMELY CAREFUL not to roll or collide with the equipment while moving by "Move by hand".
	MAKE SURE there are no one(s) or obstacles in/around the moving area before you start.
	RESET the operating range setting if it collides with an obstacle while setting the operating range. Please set the motion range again.

Tip !

In case the motor movable range is less than 180° .

Z-tuning cannot be executed.



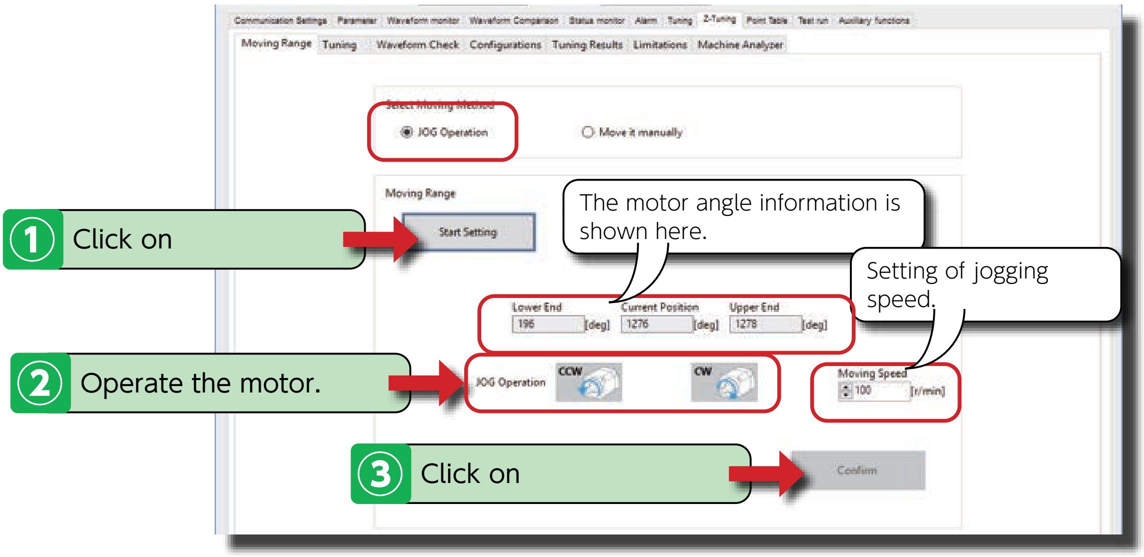
Working range of the device
Motor shaft rotation is less than 180° .

For safety reasons, the jog operation will stop after three rotations (1080°) of movement, even if the CW/CCW button is held down.

(8. Z-Tuning)

2 Sets up the range where you want to perform Z-tuning.

Jog Operation



● JOG Operation ○ Move it manually

Lower End 196 [deg] Current Position 1276 [deg] Upper End 1278 [deg]

Moving Speed 100 [r/min]

① Click on

② Operate the motor.

③ Click on

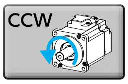
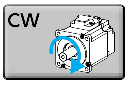
The motor angle information is shown here.

Setting of jogging speed.

① Click on it. The motor turns into "servo on".

② Press the jog operation buttons to get the motor running.

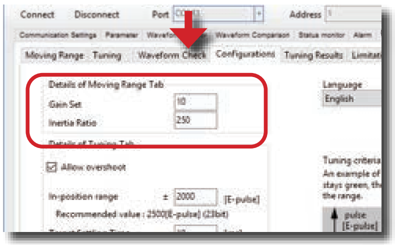
The motor operates while the button is being pushed.

Jog motion buttons	Action
	Move in the **CCW** direction.
	Move in the **CW** direction.

Changing the **[Moving speed]** value will change the jogging speed. The jogging speed should be set to a value that allows you to operate your device safely. The jogging speed can be set from 1 r/min to 100 r/min.

③ Click the "Set Moving Range" button to complete the configuration.

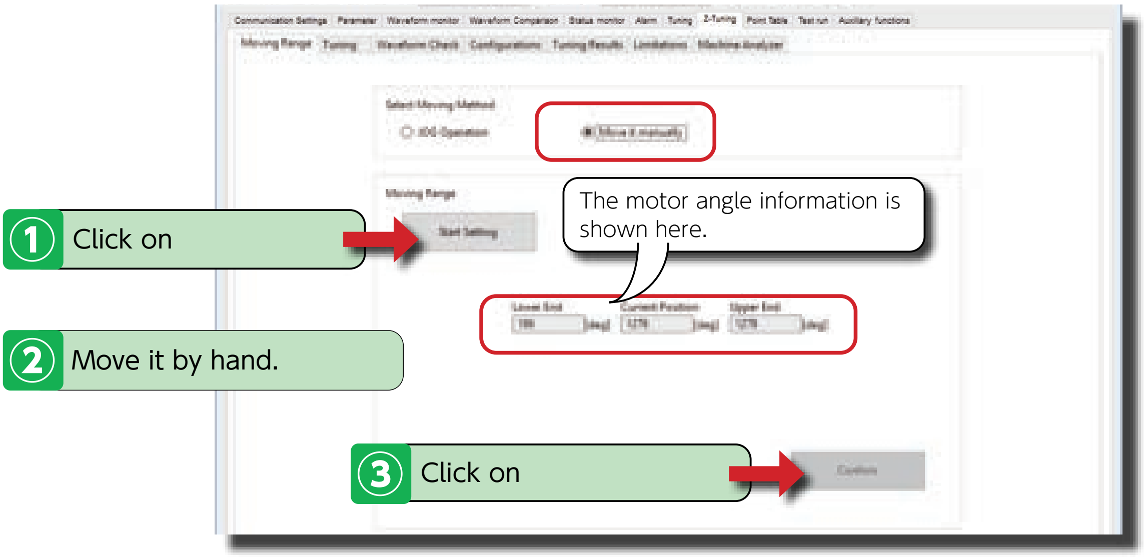
If the load connected to the motor is extremely high, it may cause some oscillation, noise or abnormal vibration during jogging. These problems may be solved by modifying the "Details of Moving Range" in the **[Settings Details]** tab.
To change the settings, click the "Reset" button.



Gain Set 10
Inertia Ratio 250
☑ Allow overshoot
In-position range ± 2000 [E-pulse]
Recommended value : 2500[E-pulse] (23bit)
Language English

2 Sets up the range where you want to perform Z-tuning.

Move by hand (A motor with a built-in brake is not supported.)



The motor angle information is shown here.

① Click on it.

② Move it by hand.

③ Click the "Set Moving Range" button to complete the configuration.

Note: If your S-TUNE II or amplifier is one of the following versions, see the following table.

Products and Versions	S-TUNE Ⅱ : 2.1.0.0 DB6**11: 5.0.3.0 , DB6**41: 6.0.3.0 DA2**23: 4.2.5.0

Go to next page

NEXT 3 Get the tuning started.

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2 Sets up the range where you want to perform Z-tuning.

Tip !

Specify the ranges to be tuned.

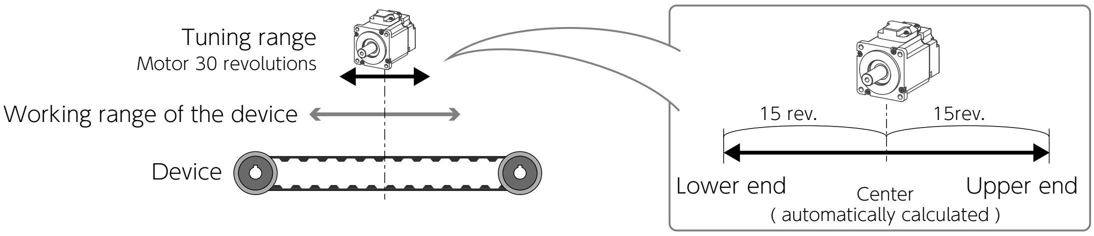
Please refer to this section if your S-TUNE II or amplifier version corresponds to ANY of the following.

Products and Versions	S-TUNE Ⅱ : 2.1.0.0 DB6**11: 5.0.3.0 , DB6**41: 6.0.3.0 DA2**23: 4.2.5.0

Z-tuning is executed in a range of 30 motor shaft revolutions.
The tuning range should be set to the range actually used in your device.
In [Moving range] tab, set the lower and upper end positions for tuning.
The median value is automatically calculated from the set lower and upper end positions.
The range for tuning is the range of 15 motor revolutions from the median value to the lower and upper ends, respectively.

In case of ... Operating range of your device > Range to be tuned .

The range to be tuned should be set near the center of the operating range of your device.

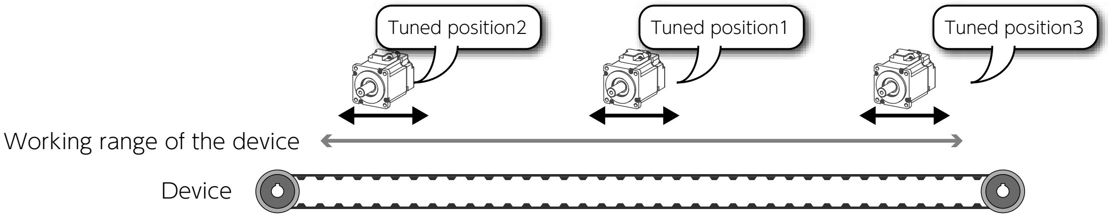


In case of ... Operating range of your device >> Range to be tuned .

In case the actual working range is excessively larger than the range where the Z-tuning is executed.

Perform Z-tuning in at least three locations (*) in the center and both ends of the operating range of the device. Of the tuning results obtained, set the result with the smallest value.

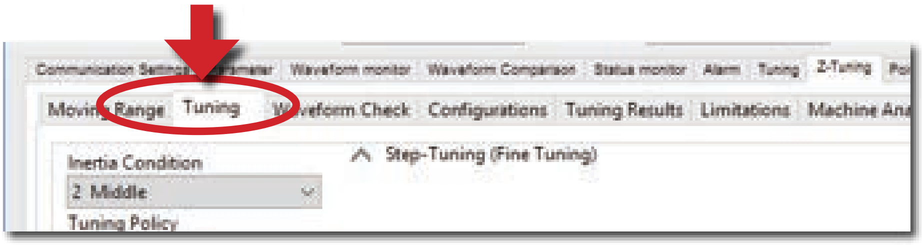
Untuned positions may cause vibration, noise, oscillation, etc. while the device is working.



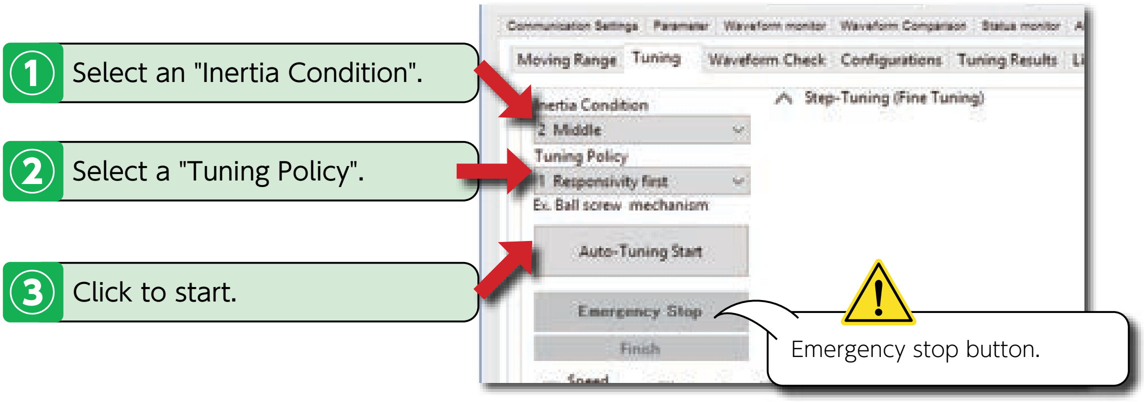
*) In addition, it is recommended that tuning should be executed at characteristic locations within the operating range. (For example, locations where there is a possibility of rattling due to device connections, or where there are local friction load fluctuations due to deflection.

3 Start tuning.

Tuning is handled in the "Tuning" tab.



Inertia Condition: 2 Middle



Inertia Condition: 2 Middle

Tuning Policy: 1 Responsivity first

Ex. Ball screw mechanism

① Select an "Inertia Condition".

② Select a "Tuning Policy".

③ Click to start.

Emergency stop button.

① Select an "Inertia Condition".

Inertia Condition	Intended Use
1 Heavy	- Heavy-load, high fluctuation equipment, low-rigid equipment - For robot arms etc.
2 Middle	- General transport machines
3 Light	- Light-load equipment - Equipment that demands high-speed operation or settling-required

② Select a "Tuning Policy".

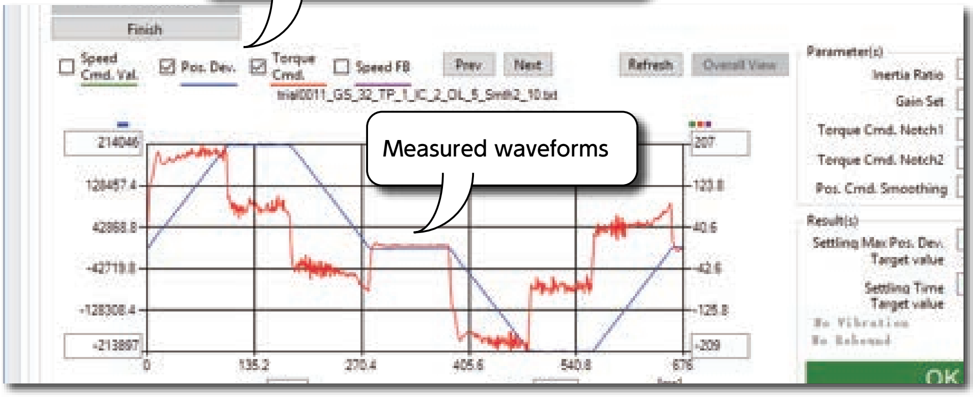
Tuning Policy	Intended Use
0 Stability first	**Suitable for tuning the Belt Mechanism.** This tuning policy will not cause noise or oscillation. The position command smoothing filter is automatically applied, therefore the response becomes mild. In some cases, the torque command notch filter is also set automatically.
1 Responsibility first	**Suitable for tuning the ball screw mechanism.** This tuning policy is for devices with light or low load variation. In some cases, the torque command notch filter is also set automatically.

(8. Z-Tuning)

3 Start tuning.

③ Click the "Auto-Tuning Start" button to start tuning.

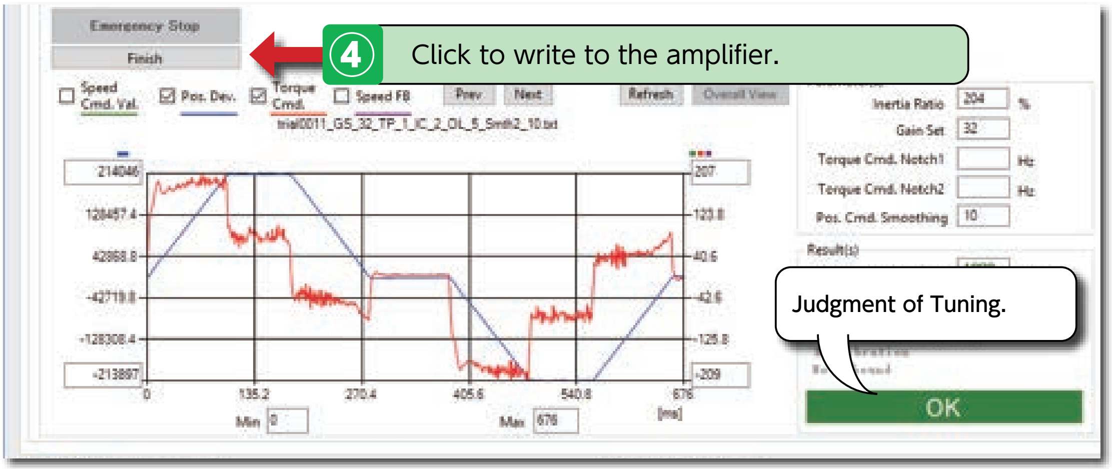
Waveform data is displayed during tuning, and the waveform is updated at the end of each trial.



You can select the kind of signal to be displayed on the chart.

Measured waveforms

If you can accept the settling time and positioning range in the waveform at the end of tuning, the tuning is complete.



④ Click to write to the amplifier.

Judgment of Tuning.

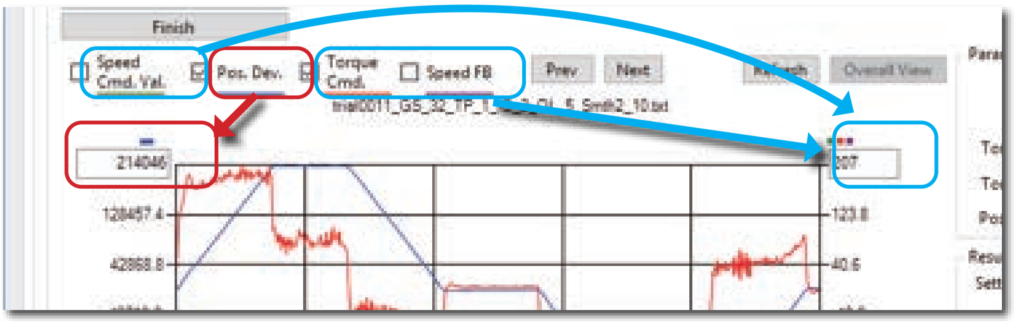
④ Click the **[Write to Amp.]** button to write the tuning parameters to the amplifier.

Completion Z-Tuning is complete.

Tip !

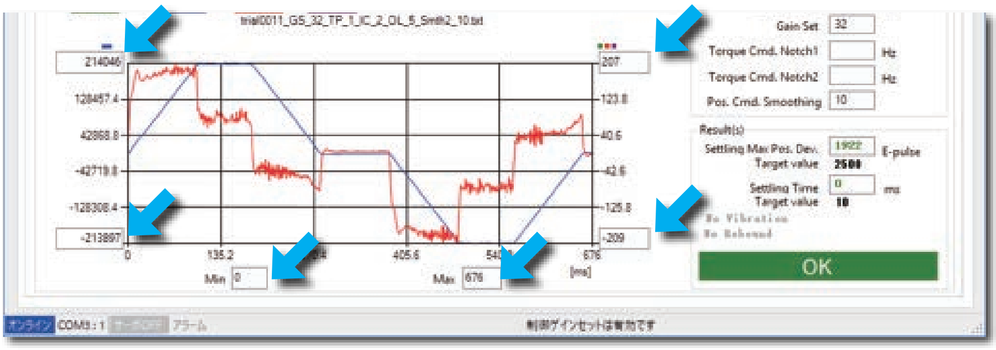
About the Vertical Axis and its Displayed Items in Waveform Chart

The vertical axis of the waveform graph is identified by the underlined color of the displayed item.



About zooming in on waveform graphs

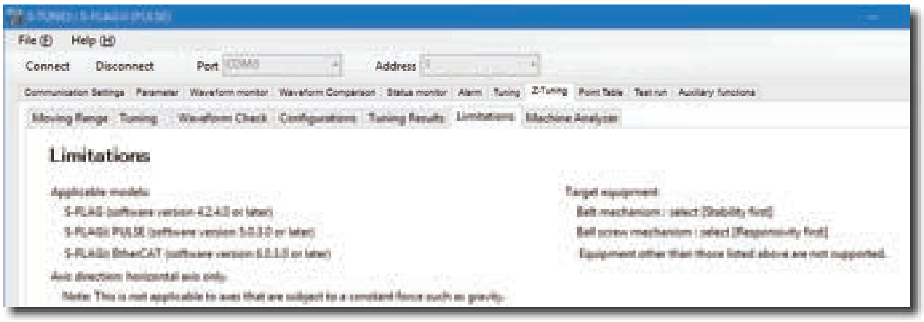
To enlarge the waveform graph, enter values in the maximum/minimum values surrounded by the squares (blue arrows in the figure below) and click the **[Refresh]** button. To turn the display back to whole view, click the **[Overall View]** button.



Gain Set 32
Torque Cmd. Notch1 Hz
Torque Cmd. Notch2 Hz
Pos. Cmd. Smoothing 10
Result(s)
Settling Max Pos. Dev. 1922 E-pulse
Target value 2500
Settling Time 0 ms
Target value 10
No Vibration
No Rebound

The Limitations on Tuning

You can check the conditions and Limitations of Z-tuning in the Limitations tab.



Limitations

Applicable models
S-FLAG (software version 4.2.4.0 or later)
S-FLAGII PULSE (software version 5.0.3.0 or later)
S-FLAGII EtherCAT (software version 6.3.3.0 or later)
Axis direction: horizontal axis only
Note: This is not applicable to axes that are subject to a constant force such as gravity.

Target equipment
Belt mechanism : select [Stability first]
Ball screw mechanism : select [Responsivity first]
Equipment other than those listed above are not supported.

This screen shows an example of connecting a motor with a 23-bit encoder.

2. Using Tabs in S-TUNE Ⅱ

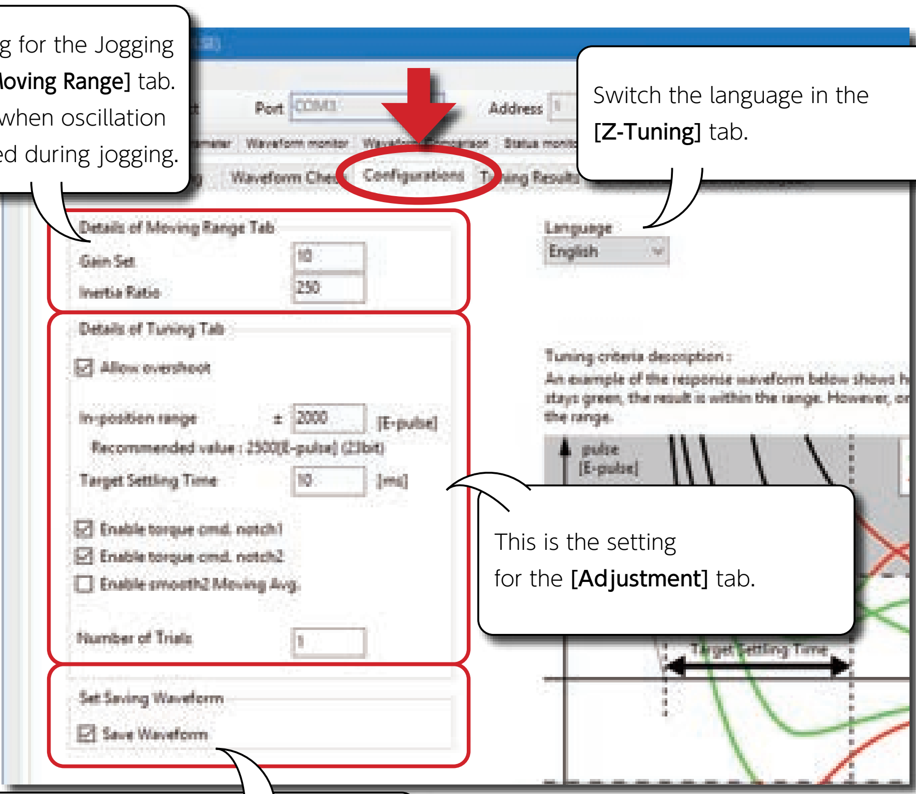
(8. Z-Tuning)

Changing tuning settings / saving results

"Z-Tuning" tuning can be configured in the **[Setting Details]** tab.

This is the setting for the Jogging motion on the **[Moving Range]** tab. Use this setting when oscillation or noise is caused during jogging.

Switch the language in the **[Z-Tuning]** tab.



Port COM3

Details of Moving Range Tab

Gain Set 10

Inertia Ratio 250

Details of Tuning Tab

☑ Allow overshoot

In-position range ± 2000 [E-pulse]

Recommended value : 2500[E-pulse] (23bit)

Target Settling Time 10 [ms]

☑ Enable torque cmd. notch1

☑ Enable torque cmd. notch2

☐ Enable smooth2 Moving Avg.

Number of Trials 1

Set Saving Waveform

☑ Save Waveform

Language English

Tuning criteria description :

An example of the response waveform below shows h

stays green, the result is within the range. However, o

the range.

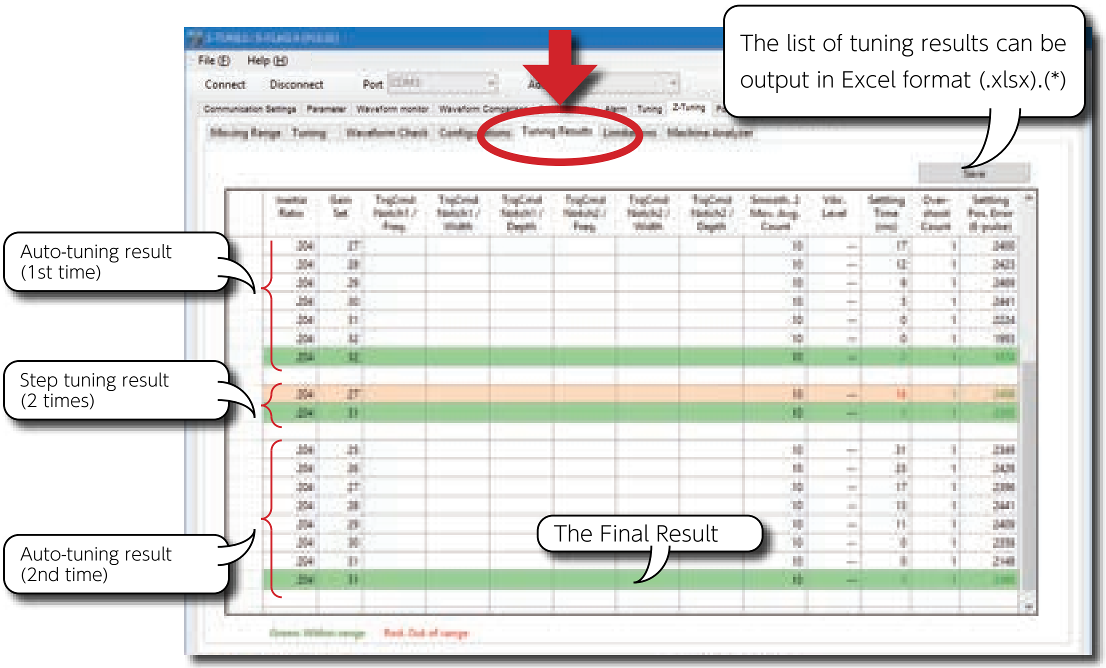
This is the setting for the **[Adjustment]** tab.

When you CHECK in this box, the waveform data of all tuning results are automatically saved.

Show the list of tuning results

All the tuning results are listed in the "Tuning Result" tab.

The results where the vibration level, settling time and number of overshoots are within the target range are highlighted in **GREEN**.
The results that are out of the target range are highlighted in **RED**.



The list of tuning results can be output in Excel format (.xlsx).(*)

Auto-tuning result (1st time)

Step tuning result (2 times)

Auto-tuning result (2nd time)

The Final Result

The examples shown in the figure above shows a series of results from the first auto-tuning executed, then the step tuning is executed twice, and then the second auto-tuning is executed.
This list remains on display until you exit S-TUNE II. when you restart S-TUNE II, the list will be cleared.

When adopting the <u>FINAL RESULT</u>:

Go to the other tabs from the Z-Tuning tab.
When you click on the other tabs, a dialog appears asking you to confirm the saving of tuning parameters.

When adopting a result <u>OTHER THAN</u> the final result:

Back to the [Adjustments] tab, and then set each parameter in Step Tuning (Detailed Adjustment).

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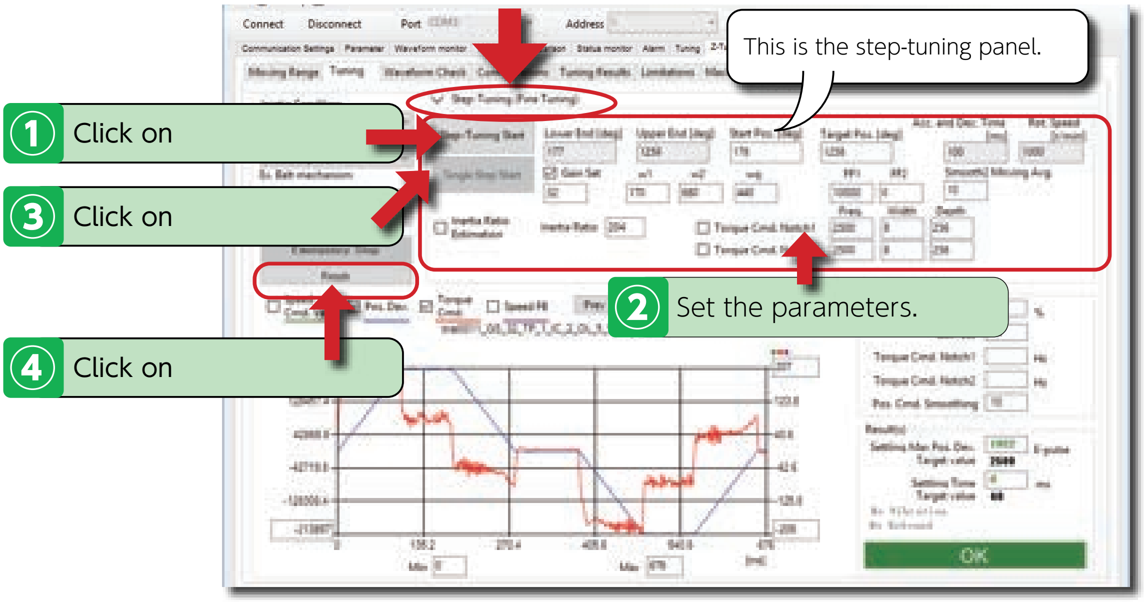
*) The file name is "TuningResult_(Acquisition date yymmdd)_Acquisition time hhmmss).xlsx".
Example : TuningResult_200123_153055.xlsx
Excel is a registered trademark or trademark of Microsoft Corporation in the United States and other countries.

For more fine tuning: "Step Tuning".

You can adjust the tuning parameters individually for detailed tuning (step-tuning).
This step-tuning is for the advanced users who are experienced in tuning parameters.

DANGER

Only those with expert knowledge of tuning should operate it.



This is the step-tuning panel.

① Click on

② Set the parameters.

③ Click on

④ Click on

① Click the [Step-Tuning Start] button to turn the motor to servo-on status.

② Adjust the parameters on the step tuning screen.

③ Click the **[Single Step Start]** button to start tuning.

-The waveform is updated after each tuning sequence.

-When the amplifier detects vibration or oscillation, a dialog box will pop up.
Try to set the notch filter or change the gain set, and then click the **[Single Step Start]** button again.

④ Click the **[Write to Amp.]** button to write the parameters to the amplifier.

Machine Analyzer: Investigate mechanical properties.

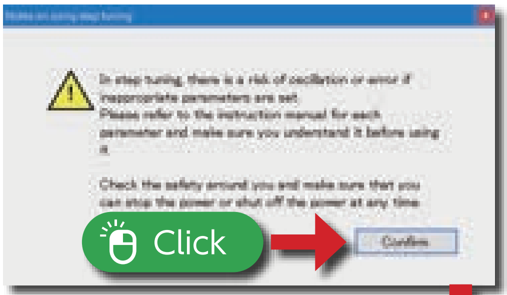
"Machine Analyzer" allows you to automatically investigate the mechanical properties (resonance point/anti-resonance point) of a mechanical part.

(Results are for reference.)

⚠ DANGER

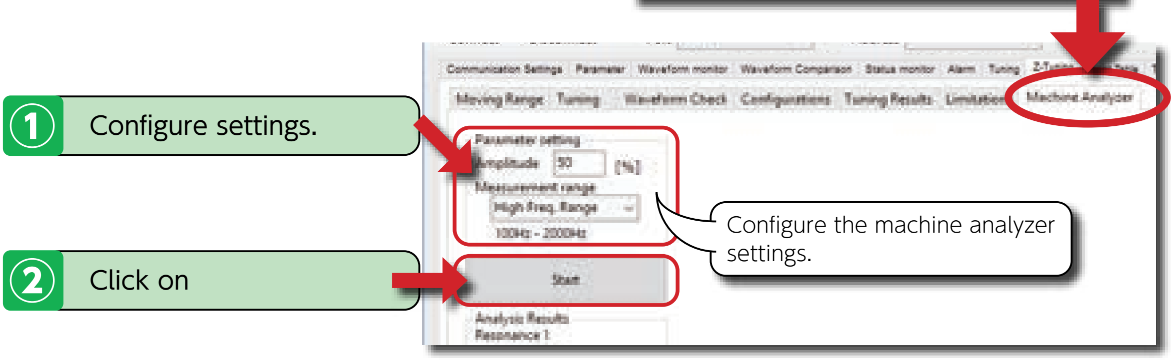
🚫	DO NOT apply to vertical axes, or even horizontal axes that have constant loads such as springs.	⚠

Once the machine analyzer is started, a note will pop up. After fully understanding the precautions, click the [Confirm] button.



In step tuning, there is a risk of oscillation or error if inappropriate parameters are set.
Please refer to the instruction manual for each parameter and make sure you understand it before using it.

Check the safety around you and make sure that you can stop the power or shut off the power at any time.



Parameter setting
Amplitude 50 [%]
Measurement range
High Freq. Range
100Hz - 2000Hz

Configure the machine analyzer settings.

① Configure the machine analyzer settings.

Items	Setting value
Amplitude	5–100% (Recommended value：50%)
Measurement range	Low frequency range(10–400 Hz) High frequency range(100–2,000 Hz)

② Click the Start button to start the investigation.

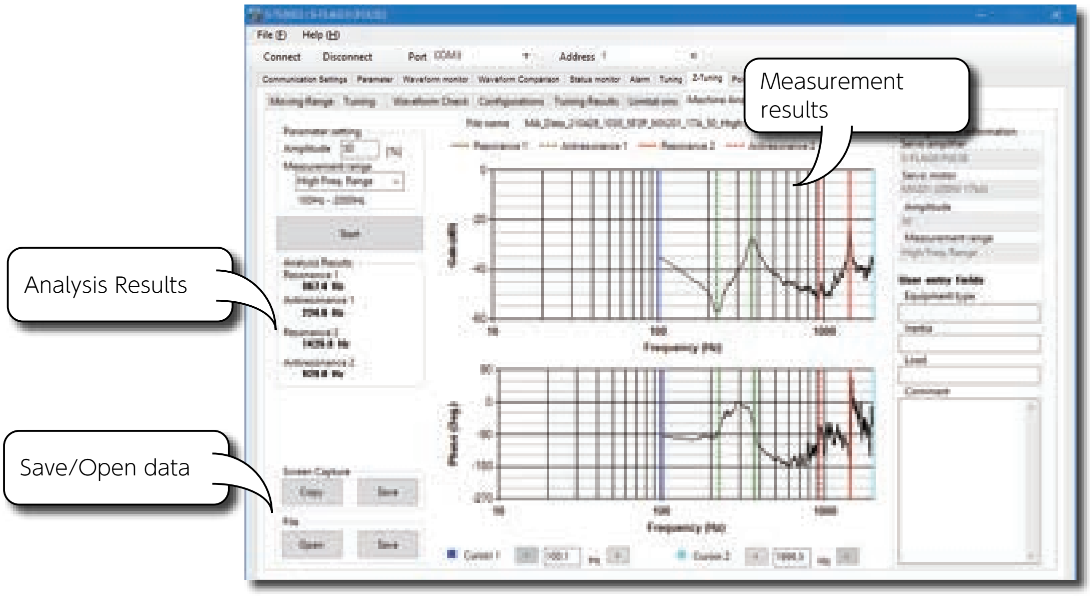
Tip !

Note on Amplitude

The recommended amplitude setting is 50%. Look at the investigation results, and if the device characteristics are not clear, try again with a larger amplitude setting.
If the amplitude setting is set too high, a loud noise may be caused during investigation.

(8. Z-Tuning)

(Machine Analyzer: Investigate mechanical properties.)



Investigation result (Bode plot)

Displays a combination of a gain(=magnitude) plot, expressing the gain of the frequency response, and a phase plot, expressing the phase shift.

Analysis Results

Detects the frequency of the resonance point and anti-resonance point of the graph displayed in the measurement result automatically. (Automatically detects up to two resonance points and two anti-resonance points respectively.)

Save/Open data

Screen Capture

The graph of the displayed measurement result is handled an image data.

Copy	Copy to clipboard.
Save	Save the file in ".png" format.

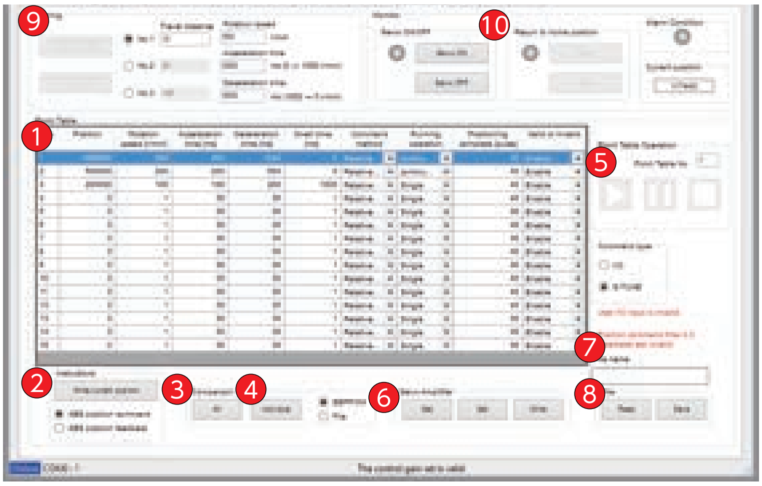
File

The graph of the displayed measurement result is handled as numerical data.

Save	Saves the numerical data of the displayed measurement result in text format.
Open	Open the saved measurement data.

The measurement results of this machine analyzer may not match the notch frequency of the torque command notch filter that is automatically set upon execution of Z-tuning. This is due to the characteristics of servo control and is not an anomaly.

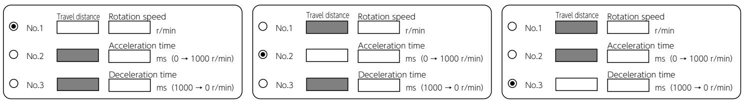
9. Point Table



No.	Button/Function	Explanation
①	Point Table	Enter point table data for up to 32-point numbers.(Varies by amplifier model.)
②	Instructions	Writes the current position to the cell in the [Position] column of the selected Point No.
③	Comparison All	Click to compare the following two versions for all point numbers. a) data currently being edited in the table b) data from the **EEPROM** or **File** that you select. Wherever two versions are not identical, the cell in the table will turn red. Click Complete to return to the main window.
④	Comparison Individual	Click to compare the two versions (a and b above) for the selected point numbers. Click Edit to return to the main window.
⑤	Point Table Operation	Operate test-run according to the point table. Point table No. ☐ : Enter the point number you want to start with. ▶ : Start ⏸ : Pause ☐ : Stop
⑥	Servo Amplifier	Click Get to read data from the amplifier RAM. Click Set to write data to the amplifier RAM. Click Write to write data to the amplifier EEPROM.

2. Using Tabs in S-TUNE Ⅱ

(9. Point Table)

No.	Button/Function	Explanation
⑦	File name	Name of the file read by PTYYMMDD_hhmm···.xml .
⑧	File	Click Read to open the point table parameter file created earlier. Click Save to save the point table parameters to a file.
⑨	Inching	Fine tuning with specified parameter values. You can set three motion patterns (No.1 to 3). Range Travel distance (amount of movement): 0 to 1,073,741,823 [E-pulse] Rotational speed: 0 to maximum rotational speed of motor [r/min] Acceleration/deceleration time: 0 to 5,000 [ms] Counterclockwise rotation (CCW) Clockwise rotation (CW) : One clicking per one pattern motion 
⑩	Return to home position	Start : The lamp to the left will turn green when homing is complete; the box below Current Position will show the post-homing position. Click Stop to stop homing

Procedure

Step	Description
Step 1	Set the following under the **Parameter** tab.
Step 2	Create a point table; set and write it to the amplifier. ☞ F- 1 Operations
Step 3	Work with the point table operation buttons (⑤).

Parameter Name	No.	Setting	Description	Standard	EtherCAT
Control Mode	2.0	0 :	Position Control Mode	Yes	Yes
Command Mode	3.0	3 :	Internal Command	Yes	Yes
Internal Position -Operation Mode	642.0	0 :	Point Table	Yes	–

Additional ; Inching (⑨) and Homing (⑩) can be done under the **Point Table** tab.

2. Using Tabs in S-TUNE Ⅱ

10. Test Run

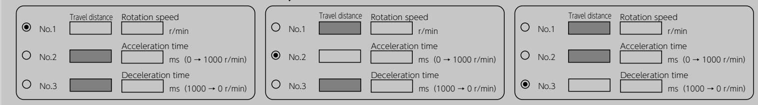
DANGER

Testing operation involves actual motor motion and could be dangerous.
Secure safety in surrounding areas and take safety measures such as emergency stop.

Test run is a motion control feature of S-TUNE Ⅱ that you can use without the host controller.
Use this feature to check motor motions or perform tuning.

No.	Button/Function	Explanation
①	Operation conditions Travel distance :	Range: 0 to 1,073,741,823 [E-pulse]
	Motor rotation speed :	Range: 1 to Maximum rotational speed [r/min]
	Acceleration time :	Time for the rotational speed to change from 0 to 1,000 rpm. Range: 0 to 5,000 [ms]
	Deceleration time :	Time for the rotational speed to change from 1,000 to 0 rpm. Range: 0 to 5,000 [ms]
	Motion pattern :	Click [CCW rotation ∨] for a CCW motion only. Click [CCW rotation -> CW rotation ∨] for a CCW motion and then a CW motion. Click [CW rotation -> CCW rotation ∨] for a CW motion and then a CCW motion. Click [CW rotation ∨] for a CW motion only.
	Dwell time :	Wait time between rotations. The wait time setting may not work when other applications are running on your computer.
	Repeat count :	Set how many times the specified motion pattern should be repeated. Range: 1 to 1,000 times

(10. Test Run)

No.	Button/Function	Explanation
②	☑ Aging function	Check the checkbox to disable the repeat count setting so that the motor will keep running. Click ⏸ to pause, and ☐ to stop.
③	Test run operation	▶ : Start ⏸ : Pause ☐ : Stop
④	Repeat count	Displays how many times the specified motion was repeated.
⑤	Inching	Fine tuning with specified parameter values. You can set three motion patterns (No.1 to 3).  Range Travel amount: 0 to 1,073,741,823 [E-pulse] Rotational speed: 0 to Maximum rotational speed [r/min] Acceleration/deceleration time: 0 to 5,000 [ms] Counterclockwise rotation (CCW) Clockwise rotation (CW) : one clicking per one pattern motion
⑥	Return to home position	When Homing finishes, the indicator to the left of Start button will turn green and Current position cell will show the current position resulting from homing. Click Stop to stop homing

Procedure

<table>
<tr><th>Step</th><th>Operation</th></tr>
<tr><td>Step 1</td><td>Set the following under the Parameter tab.
<table>
<tr><th>Parameter Name</th><th>No.</th><th colspan="2">Setting</th><th>Standard</th><th>EtherCAT</th></tr>
<tr><td>Control Mode</td><td>2.0</td><td>0 :</td><td>Position Control Mode</td><td>Yes</td><td>Yes</td></tr>
<tr><td>Command Mode</td><td>3.0</td><td>3 :</td><td>Internal Command</td><td>Yes</td><td>Yes</td></tr>
<tr><td>Internal Position -Operation Mode</td><td>642.0</td><td>1 :</td><td>Communication motion</td><td>Yes</td><td>–</td></tr>
</table></td></tr>
<tr><td>Step 2</td><td>Set the Operating conditions in the Test run area.</td></tr>
<tr><td>Step 3</td><td>Click on the Start button below Test run operation.</td></tr>
</table>

Additional

1. Inching (⑤) and Homing (⑥) can be performed as well.
2. Under the following operating conditions, an alarm will occur and test run will stop when the number of repetitions exceeds the Repeat count setting.
   The **Motion pattern** setting is CCW rotation or CW rotation and the aging function checkbox (☑) is check-marked.
   If you want non-stop test runs, set the following in addition to the above parameters.
   Internal Position: Overflow detection (No.643.0) = 0 (disable)
3. If the communication with the amplifier becomes disconnected, the test run will stop.
   To resume, reconnect to the amplifier and restart the test run.

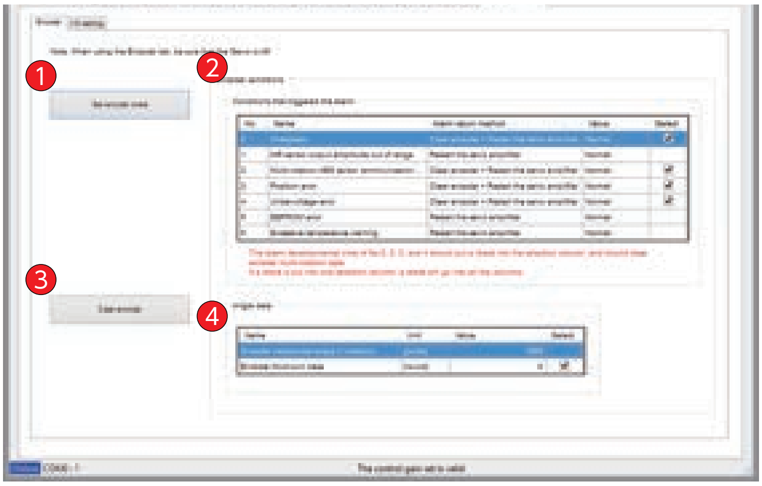
⚠ DANGER

To prevent fire and injuries in case of earthquake, ensure secure installation. After earthquake, be sure to confirm safety before resuming operation.

11. Auxiliary Functions

Encoder tab

⚠ CAUTION	
! Use the Encoder tab only in a Servo OFF state.	⚠ ⚠



No.	Button/Function	Explanation
①	Get encoder state	Click this to obtain encoder status and display in the ②.
②	Encoder conditions	This area displays encoder status. If there is any abnormity (i.e. the Value column shows "abnormal"), fix the problem and clear the alarm.
③	Clear encoder	This clears encoder alarms and multi-turn data all at once. Click this button only after clicking on one of the box ☑ in ② or ④.
④	Angle data	This area displays current encoder angle data. Click on Clear encoder to clear encoder multi-turn data.

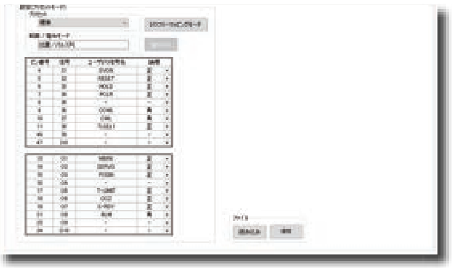
2. Using Tabs in S-TUNE Ⅱ

(11. Auxilary Functions ／ I/O Configuration)

I/O Setting tab

I/O settings can be made using "presets" already set for each control mode or "free mapping (*)" that allows I/O pin functions to be freely assigned.

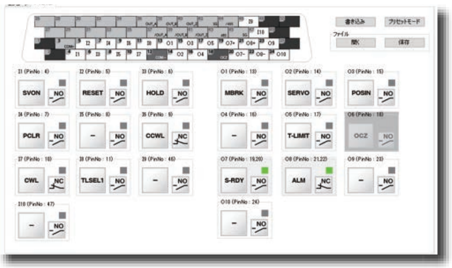
Preset



Go to NEXT page

Select the I/O assignment from the presets.

I/O free mapping (*)



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I/O assignments can be set individually.

If you use the "COL (collision)" output, assign the function to the output pin by free mapping.

Once the amplifier is switched to free mapping mode, it will start up in free mapping mode even if the amplifier is restarted.
The I/O setting tab of S-TUNE II also starts up in free mapping mode.

Supported Models and Versions

Supported Models		Supported Versions
Software S-TUNE Ⅱ		**2.3.0.0** or later
Servo Amplifier S-FLAG Ⅱ Series	Standard model (Pulse train command input type) **DB6**11** Series	**5.0.4.0** or later
	EtherCAT Communication model **DB6**41** Series **DB6**42** Series	**6.0.5.1** or later **6.1.0.1** or later

Make sure to assign functions by I/O free mapping after completing tuning and test operation with S-TUNE II.

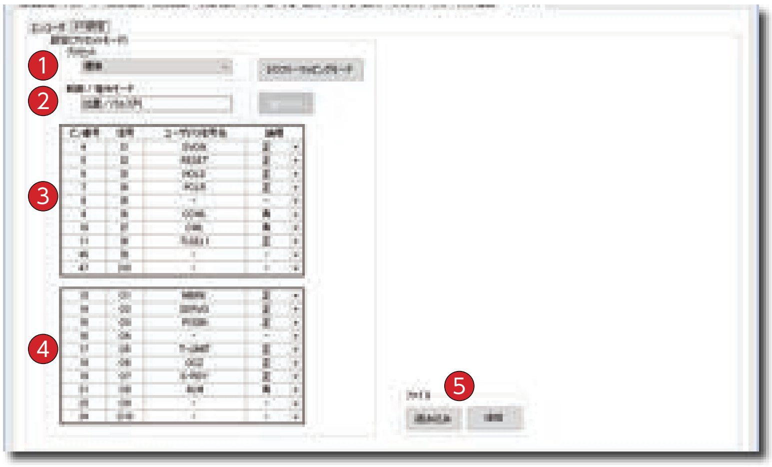
After changing the I/O function assignment, amplifier operation cannot be performed from S-TUNE II. (*)

*) When the I/O function assignment is changed, the internal processing of S-TUNE II results in a mismatch with the I/O commands sent to the amplifier.
Note that this is a design specification and is not a product abnormality.

(11. Auxilary Functions ／ I/O Configuration)

Preset mode

Select from the **Preset** pull down menu.



No.	Button/Function	Explanation
①	Preset	Check the box under Control/Command Mode. Select from the **Preset** pull down menu.
②	Pinout - Input signals	Verify I/O input settings. When the presetting is changed, a changed signal name will be green indication.
③	Pinout - Output signals	Verify I/O output settings. When the presetting is changed, a changed signal name will be green indication.
④	Write	Click to write the parameters to the amplifier EEPROM
⑤	File	Read : Click to read and display the saved I/O pinout data. Save : Click to save I/O pinout data in the XML format.

☞ **B- 2 Mounting and Wiring**

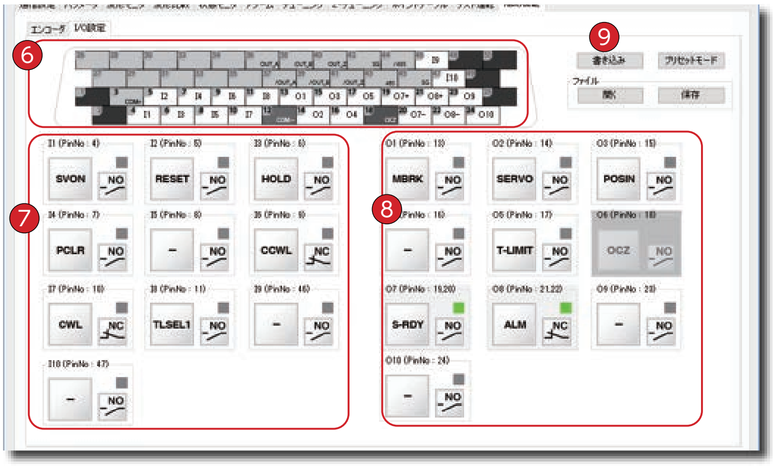
Only "Standard model" amplifiers can change I/O pin assignments in "Preset" mode.

(11. Auxilary Functions ／ I/O Configuration)

I/O free mapping mode

Click the "function button" of the pin number to be changed to set the I/O function assignment.

Example of mapping screen

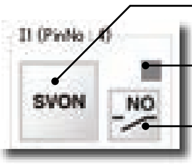


About "OCZ" output

"OCZ" (O6 pin No. 18) is a fixed assignment pin.
The output logic is also fixed.

☞ **B- 2 Mounting and Wiring**

Input/output setting panel



Function button

I/O status indicator

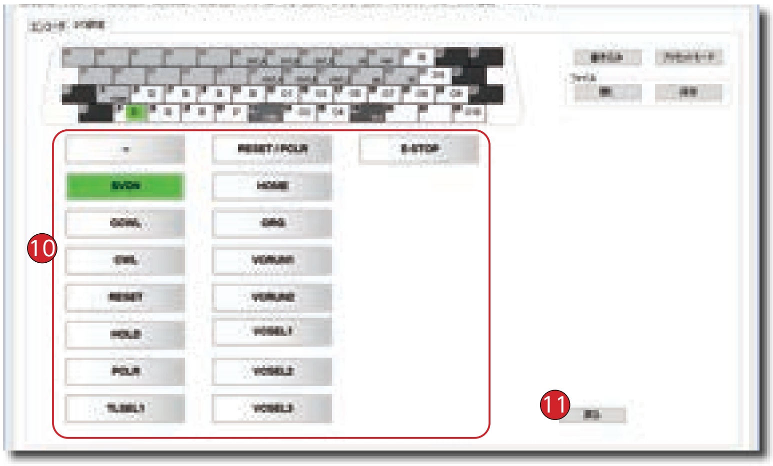
Logic switching button

About outputting a pairing signal

Outputs O7 and O8 (model: DB6**11) are 2-wire outputs. They are wired differently from the common outputs O1 to O5.

☞ **B- 2 Mounting and Wiring**

Function selection screen



Duplicate Assignment of Functions

Duplicate assignments are possible.

No exclusivity processing.
No warnings or errors.

Connector layout and assignable functions differ for each amplifier model.
The example on this screen is for S-FLAG Ⅱ (general-purpose output type: DB6**11).
It is different from EtherCAT type: DB6**41, DB6**42.
"NO" : Normally Open (= contact A), "NC" : Normally Closed (= contact B).

(11. Auxilalry Functions ／ I/O Configuration)

No.	Name	Descriptions	
⑥	Connector Layout	View of I/O connector from soldering side. This is a reference display of pin assignments.	
⑦ ⑧	Input Output -configuration	I/O input/output configuration section. It consists of "function buttons," "logic buttons," and "status display.	
		Function button SVON	The current allocation is displayed. Click on the button corresponding to each pin to switch to the function selection screen.
		Logic switching button NO , NC	Choose "Positive Logic (=NO, contact A)" or "Negative Logic (=NC, contact B)" for input/output.
		I/O status indicator 🟩 , ■	Displays input/output status. 🟩 Green : ON state. ■ OFF state.
⑨	File	Write	Writes the I/O assignment set in free mapping mode to the amplifier.
		Preset	Exit Free Mapping Mode and change to "Preset Mode". (*)
		Open	Click to read and display the saved I/O pinout data.
		Save	Click to save I/O pinout data in the XML format.
⑩	Function button	Choose the function to be assigned. After choosing a function, the display returns to the mapping screen. (The change is reflected in the display of the function buttons on the mapping screen.) The currently set function is displayed in green.	
⑪	Return	Returns to the "Mapping Screen". (No changes are made to the assignments.)	

*) About Preset button

Clicking the "Preset" button exits the free mapping mode and switches to the preset mode. When switching to the preset mode, the I/O settings made in the free mapping mode are cleared.

When switching between "Preset Mode" and "Free Mapping Mode," the amplifier must be restarted.

S-FLAG Ⅱ　Instruction Manual
- EtherCAT -

E

COMMUNICATIONS

AMO-NP-35475-42
SF2-E-E
APR. 2023
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MEMO

1

System Overview

1. Introduction to EtherCAT

EtherCAT is the open real-time Ethernet network originally developed by Beckhoff Automation Gmbh, Germany. All rights for EtherCAT are reserved by Beckhoff Automation Gmbh.

Trademarks and Patents

EtherCAT® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany. Other designations used in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owners.

2. Introduction to EtherCAT

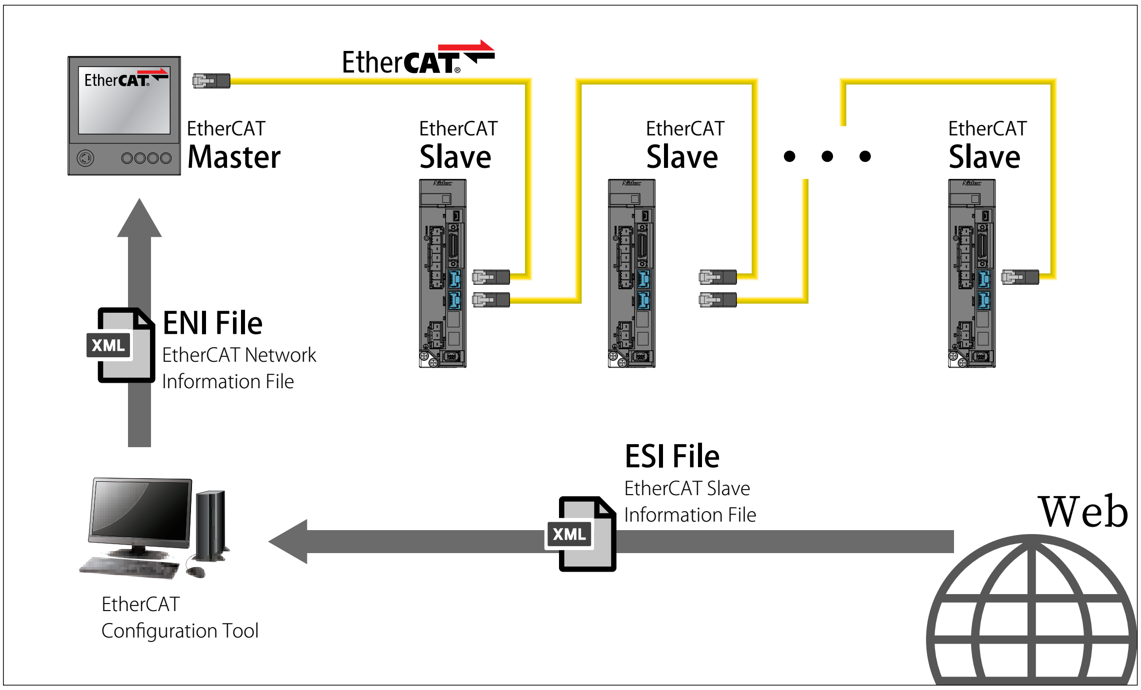
This document refers to the following documents and focuses on the parts that apply to this product.

No. Document	Version	Date
ETG. 1000.2 EtherCAT Specifications — Part2 Physical Layer service definition and protocol specification	1.0.2	Mar 30, 2010
ETG. 1000.3 EtherCAT Specifications — Part3 Data Link Layer service definition	1.0.2	Mar 30, 2010
ETG. 1000.4 EtherCAT Specifications — Part4 Data Link Layer protocol specification	1.0.2	Mar 30, 2010
ETG. 1000.5 EtherCAT Specifications — Part5 Application Layer service definition	1.0.2	Mar 30, 2010
ETG. 1000.6 EtherCAT Specifications — Part6 Application Layer protocol specification	1.0.2	Mar 30, 2010
ETG. 1020 EtherCAT Protocol Enhancements	1.2.0	Dec 01, 2015
ETG. 1300 Indeicator and Labeling	1.1.1	Jul 03, 2015
ETG. 2000 Slave Information	1.0.7	May 26, 2020
ETG. 6010 Implemantation Directive for CiA402 Drive Profile	1.1.0	Nov 19, 2014

3. System Configuration (master-slave configuration)

Configuration of the EtherCAT network

An EtherCAT master requires a standard Ethernet port and an ENI file (= EtherCAT network configuration information).
The **ENI (= EtherCAT slave information) file** is automatically created by the EtherCAT configuration tool based on the **ESI file** which is provided by us.
The slaves are connected at the Ethernet physical layer.



Configuration Tool:

This is a configuration tool for EtehrCAT. The EtherCAT configuration tool automatically generates the network configuration information called "ENI file".

ENI File: EtherCAT Network Information FIle

The ENI file contains information about the network topology, initialization commands for each device, cyclic commands, and so on. The ENI file is generated from either an "ESI file" or online information read from EEPROM or object dictionary in the slave device.
The ENI file is installed to the master.
The master sends commands to the slave based on the ENI file.

ESI File: EtherCAT Slave Information File

The ESI file contains the EtherCAT slave information (device functions and settings).
The file format of the ESI file is XML format.All ESI files for S-FLAG servo amplifiers are the same.Please download the ESI file of the S-FLAG servo amplifier from our website.

3. System Configuration (master-slave configuration)

Structure of EtherCAT slave devices

A slave device consists of three components.

- **Application layer**: Device application
  - Host controller(*)

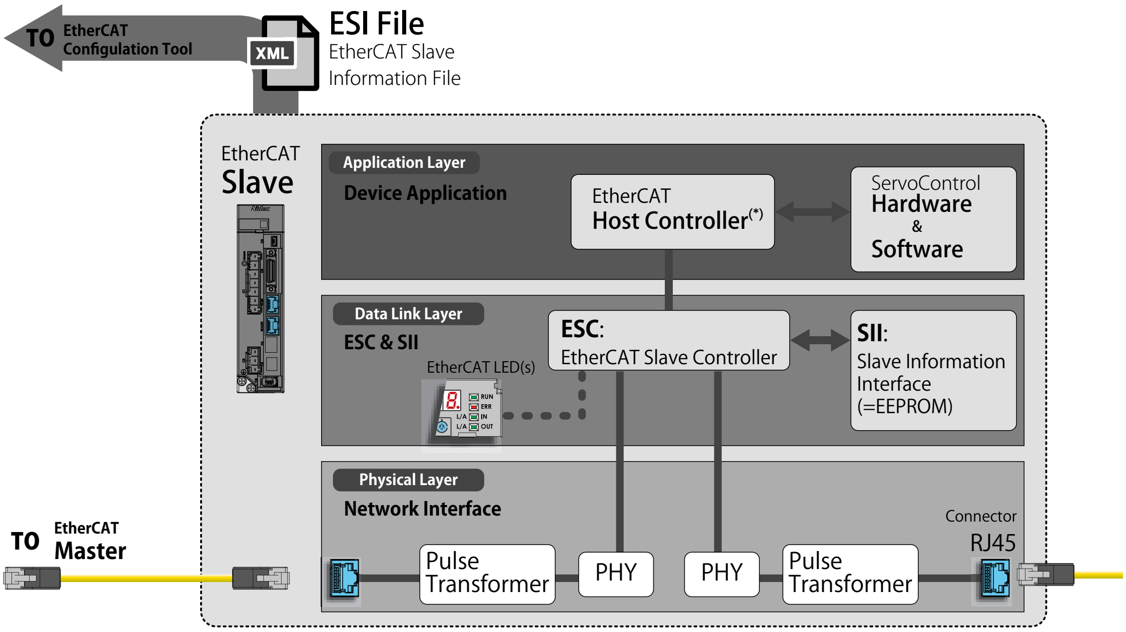
    The host controller performs EtherCAT communication.
  - Hardware & Software

    Hardware and software perform servo control.
- **Data link layer**: ESC and SII
  - **ESC**: EtherCAT Slave Controller and Communication Module)
  - **SII**: Slave Information Interface

    The SII contains the essential information for EtherCAT communication (slave identification and I/O PDO configuration) and is used to configure the slave devices. This information is used for the configuration of the slave device: it is a binary file stored in EEPROM in the EtherCAT slave device.
- **Physical layer**: Network interface
  - Connector

    Connector type is RJ45, the same as for Ethernet.
  - Cable

    <u>A shielded twisted pair cable (CAT 5e STP) of category 5 or higher</u> is recommended.
    Use a cable that is compatible with the environment in which the equipment will be used.



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*) The host controller may sometimes be named "application controller" or "microcontroller" (μC).

4. Specifications

Items	Specifications
Communication standards	IEC 61158 Type12, IEC 61800-7, CiA 402 Drive Profile
Physical Layer	100BASE-TX (IEEE802.3)
Communication speed	100Mbps (Full duplex)
Connector	RJ45 2pcs (Shielded) **ECIN** : EtherCAT Input, **ECOUT** : EtherCAT Output
Communication media	A shielded twisted pair cable (CAT 5e STP) of category 5 or higher (Shielded cable with double shielding by aluminum tape and braid is recommended.)
Communication range	Distance between nodes is less than 100 m.
Number of connected slaves	65,535 Max.
Station Alias (ID)	Setting Range: 0-65,535 Configuration Methods 1 Lower 8bit：Two rotary switches on the front of the amplifier Upper 8bit：Fixed at "00h" OR Configuration Methods 2 Stored value in SII
Wiring Topology	LINE
Process Data	PDO mapping
Mail Box (CoE)	EMERGENCY MESSAGE, SDO Request, SDO Response, SDO Information
Distributed Clocks (DC)	Synchronization by DC mode (250 μs, 500 μs, 1 ms, 2 ms, and 4 ms)
LED indicators	・L/A IN (Link/Activity IN) 1pcs ・L/A OUT (Link/Activity OUT) 1 pcs ・RUN 1 pcs ・ERR 1 pcs
CiA402 Drive Profile (OP-mode)	・**PP(1):** Profile position mode ・**CSP(8)** : Cyclic synchronous position mode ・**CSV(9)** : Cyclic synchronous velocity mode ・**CST(10)** : Cyclic synchronous torque mode ・**HM(6):** Homing mode
Device Profile	CoE (CANopen over EtherCAT)
SyncManager	4

4. Specifications

Items	Specifications
Explicit Device ID	Available
FMMU (*)	3
Communication Object	SDO (Service Data Object), PDO (Process Data Object)
SDOmessage	**Available:** SDO Request, SDO Response, SDO information, Emaergency message **Not supported:** Complete Access
Maximum PDO assignments	RxPDO : 1 [Table], TxPDO : 1 [Table]
Maximum PDO data length	RxPDO : 12-object, TxPDO : 12-object
Diagnosis Object	Only "Diagnosis message" is supported.
Command Object	Not supported
Shift time	Only Input (response) is supported in 250 μs time intervals.
Compensation of csp position command (During Communication error)	Available

(*) FMMU: Fieldbus Memory Management Unit

MEMO

2

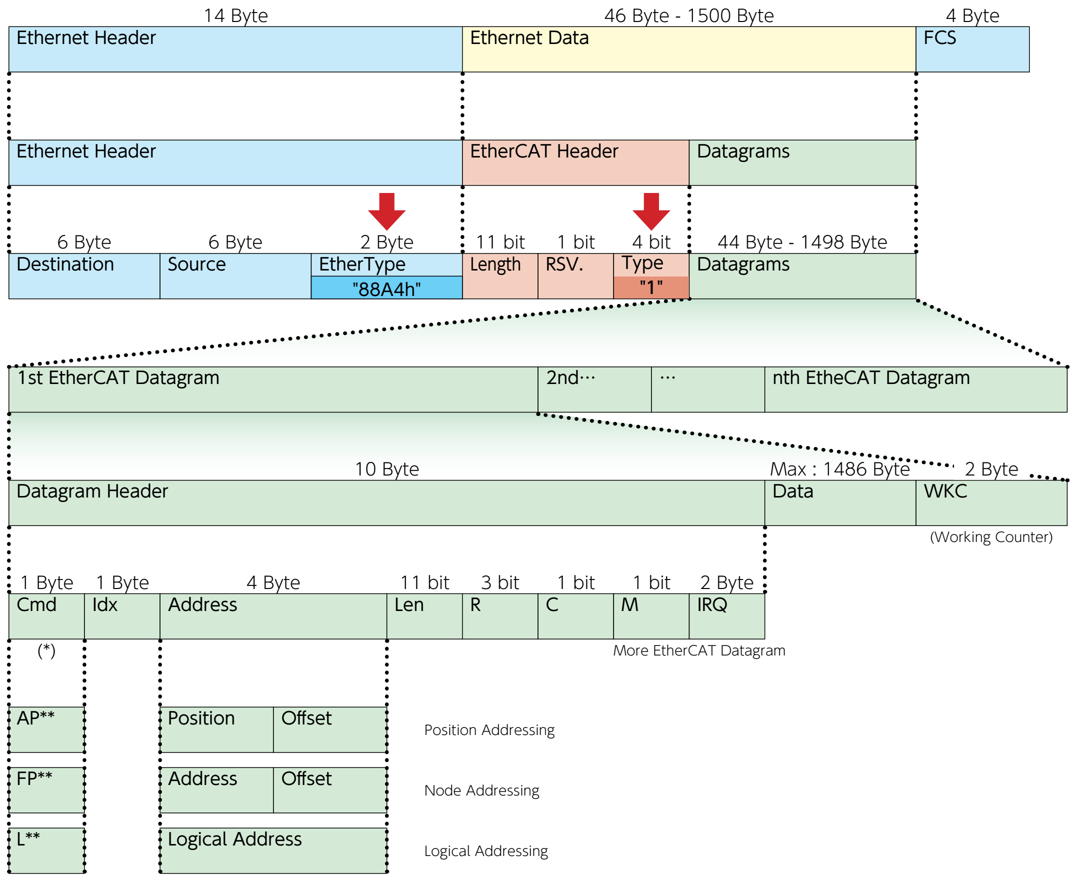
Communications Specifications

1. EtherCAT Frame Structure

Since the EtherCAT is built on standard IEEE 802.3 Ethernet frames, any standard network controller can be used.
EtherCAT data can coexist with other Ethernet protocols. By setting the **"Ether Type"** of the **"Ethernet Header"** to **"88A4h"**, Ethernet Data can be handled as an EtherCAT frame.
It is distinguished from the Ethernet frame.

Only EtherCAT frames for which the "Type" of the EtherCAT Header is set to "1" are processed by the ESC.
The Datagram following the EtherCAT Header is used as one or more EtherCAT Datagram(s).

EtherCAT Frame Structure



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*) See the commands on the next page.

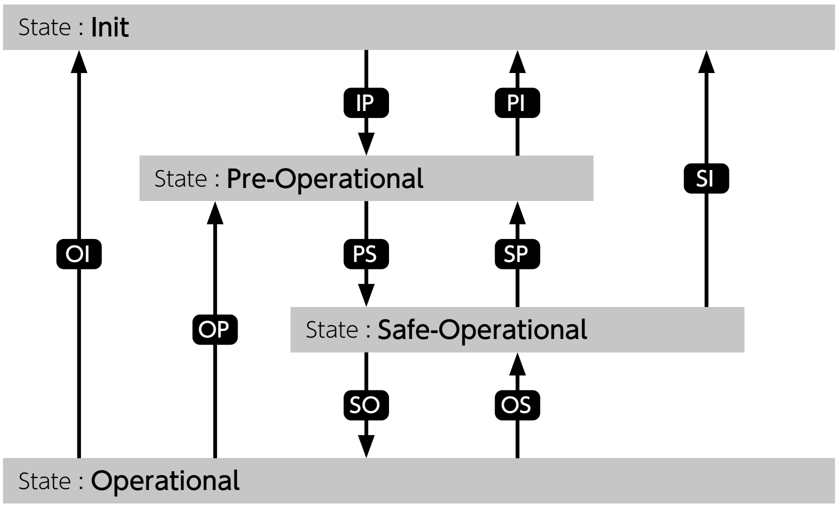
1. Frame Structure

Cmd	Symbol Name	Descriptions
00h	**NOP** No operation	No operation.
01h	**APRD** Auto increment physical read	Each slave device increments the " **Address** ". When the slave receives a frame with **"Address"** = 0, it executes "read" as requested by the command.
02h	**APWR** Auto increment physical write	Each slave device increments the " **Address** ". When the slave receives a frame with **"Address"** = 0, it executes "write" as requested by the command.
03h	**ADRW** Auto increment physical read write	Each slave device increments the " **Address** ". When the slave receives a frame with **"Address"** = 0, it executes "read" and "write" as requested by the command.
04h	**FPRD** Configured address physical read	Each slave device executes the requested "read" when the value of **"Address"** matches the station address.
05h	**FPWR** Configured address physical write	Each slave device executes the requested "write" when the value of **"Address"** matches the station address.
06h	**FPRW** Configured address physical read write	Each slave device executes the requested "read" and "write" when the value of "Address" matches the station address.
07h	**BRD** Broadcast read	All slave devices execute the "read" as requested by the command.
08h	**BWR** Broadcast write	All slave devices execute the "write" as requested by the command.
09h	**BRW** Broadcast read write	All slave devices execute the "read" and "write" as requested by the command.
0Ah	**LRD** Logical read	Each slave device executes the "read" requested by the command when the **"Logical Address"** value matches the logical memory area specified by the FMMU(*) request.
0Bh	**LWR** Logical write	Each slave device executes the "write" requested by the command when the **"Logical Address"** value matches the logical memory area specified by the FMMU(*) request.
0Ch	**LRW** Logical read write	Each slave device executes the "read" and "write" requested by the command when the **"Logical Address"** value matches the logical memory area specified by the FMMU(*) request.
0Dh	**ARMW** Positional physical read / multiple write	Each slave device increments the " **Address** ". When the slave receives a frame with **"Address"** = 0, it executes "read" as requested by the command. The other slaves execute the "write".
0Eh	**FRMW** Configured address physical read / multiple write	Each slave device compares the "Address" with the "Station Address". The slave(s) with matching values will execute the requested "read" operation, and the slave(s) with unmatching values will execute the "write" operation.
0Fh ～ FFh	― (Reserved)	―

(*) FMMU: Fieldbus Memory Management Unit

2. ESM (EtherCAT State Machine)

State Diagram of EtherCAT Application Layer



Symbols such as **IP** in the state transition diagram indicate the short names of the state transitions.

eg.) **IP** : Transition from "Init" to "Pre-Operational"

ESM State	Behavior in each state	Communication		
		SDO (Mailbox) Sending/ receiving	PDO sending (S to M)	PDO receiving (M to S)
Init	The communication is being initialized. SDO (Mailbox) sending/receiving and PDO sending/receiving are **NOT** enabled.	—	—	—
Pre-Operational (= PreOP)	SDO (Mailbox) sending/receiving is enabled.	○	—	—
Safe-Operational (= SafeOP)	SDO (Mailbox) sending/receiving and PDO sending (from slave to master) are enabled.	○	○	—
Operational (= OP)	SDO (Mailbox) sending/receiving and PDO sending/receiving are all enabled.	○	○	○

3. ESC Address Space

The physical address space has 12 kBytes.
The first 4 kByte (0000h-0FFFh) is used for register space, and the following 8 kByte is used for the process data RAM area.

Please refer to the datasheet of the IP core (ET1815/ET1817) for register details and registers not listed in the table below.

ESC Register Byte Address	Length (Byte)	Descriptions	Default (*)
■ **ESC Information**			
0000h	1	Type	04h
0001h	1	Revision	02h
0002h-0003h	2	Build	0040h
0004h	1	FMMUs supported	03h
0005h	1	SyncManagers supported	04h
0006h	1	RAM Size	08h
0007h	1	Port Descriptor	0Fh
0008h-0009h	2	ESC Features supported	0184h
■ **Station Address**			
0010h-0011h	2	Configured Station Address	-
0012h-0013h	2	Configured Station Alias	-
		...	
■ **Data Link Layer**			
		...	
0100h-0103h	4	ESC DL Control	-
		...	
0110h-0111h	2	ESC DL Status	-
■ **Application Layer**			
0120h-0121h	2	AL Control	-
0130h-0131h	2	AL Status	-
0134h-0135h	2	AL Status Code	-
		...	
■ **PDI**			
0140h		PDI Control	08h
0141h		ESC Configuration	0Ch
0150h		PDI Configuration	-
0151h		SYNC/LATCH PDI Configuration	66h
0152h-0153h		Extended PDI Configuration	-
		...	

*) The default value is the value at ESC startup.These values may be modified by loading the CPU firmware or other values after startup.

3. ESC Address Space

ESC Register Byte Address	Length (Byte)	Descriptions	Default (*)
■ **Watchdogs**			
0400h-0401h	2	Watchdog Divider	-
0410h-0411h	2	Watchdog Time PDI	-
0420h-0421h	2	Watchdog Time Process Data	-
0440h-0441h	2	Watchdog Status Process Data	-
0442h	1	Watchdog Counter Process Data	-
0443h	1	Watchdog Counter PDI	-
…			
■ **FMMU**			
066h-062Fh	3x16	FMMU[2 : 0]	-
+0h-3h	4	Logical Start Address	-
+04h-5h	2	Length	-
+6h	**1**	**Logical Start Bit**	**-**
+7h	1	Logical Stop Bit	-
+8h-9h	2	Physical Start Address	-
+Ah	1	Physical Start Bit	-
+Bh	1	Type	-
+Ch	**1**	**Activate**	**-**
+Dh-Fh	3	Rsv.	-
…			
■ **Distributed Clock (DC) — SYNC Out Unit**			
0981h	1	Acvitation	-
…			
0984h	1	Activation Status	-
098Eh	1	SYNC0 Status	-
…			
0990h-0993h	4	Start Time Cyclic Operation/Next SYNC0 Pulse	-
…			
09A0h-09A3h	4	SYNC0 Cycle Time	-
…			

*) The default value is the value at ESC startup.These values may be modified by loading the CPU firmware or other values after startup.

4. SII

The details of SII (Slave Information Interface) are as follows.

Structure of SII (EEPROM)

SII EEPROM Word Address	+0H	+1h	+2h	+3h	+4h	+5h	+6h	+7h
0000h	EtherCAT Slave Controller Configuration Area							
0008h	Vender ID		Product Code		Revision Number		Serial Number	
0010h	Hardware Delays				Bootstrap Maibox Config			
0018h	Mailbox Sync Man Config					Rsv.		
0020h … **0030h**	Rsv.							
0038h	Rsv.						Size	Version
0040h	Additional Information (Subdivided in Categories)							
	Category Strubgs							
	Category Generals							
	Category FMMU							
	Category SyncManager							
	Category TxPDO / RxPDO for each PDO							

SII area (0000h-003Fh)

In the ESC configuration area (EEPROM word address 0000h-0007h), the Configured Station Alias is automatically read by the ESC after power-on and written to the ESC register.
To apply the changed SII EEPROM value to the ESC register, reboot the device. Otherwise, the default value will be set to the value of the IP core (ET1815/ET1817).

DO NOT modify any values other than 0004h (Configured Station Alias) and 0007h (Checksum).

Note that 0004h and 0007h need to be changed together. For more information, please refer to the datasheet of the IP core (ET1815/ET1817).

Outline of SII EEPROM

SII EEPROM Word Address	Name	Descriptions	ESC Register Word Address	Data type	Initial Value
0000h	**PDI Control**	Initial value for PDI control register	0140h 0141h	U16	0C08h
0001h	**PDI Configuration**	Initial values for PDI configuration registers	0150h 0151h	U16	6600h
0002h	**Pulse Length of SYNC Signals**	SYNC 信号のパルス長に対する初期値	0982h 0983h	U16	0064h
0003h	**Extended PDI Configuration**	Initial value for the pulse length of the SYNC signal	0152h 0153h	U16	0000h
0004h	**Configured Station Alias**	Initial value for Station Alias (ID) (See P.18 for details.)	0012h 0013h	U16	0000h
0005h -0006h	**Rsv.**	Rsv.	-	4Byte	-
0007h	**Checksum**	Checksum of the ESC configuration area	-	U16	-

What is the data type?

In this document, the data types are illustrated using the following icons.

Data Type	Size (Bytes)	Description	Range
U8	1	Unsigned Short Integer	0 to 255
I8	1	Signed Short Integer	−128 to 127
U16	2	Unsigned Integer	0 to 65,525
I16	2	Signed Integer	−32,768 to 32,767
U32	4	Unsigned Double Integer	0 to 2^{32} (0 to 4,294,967,295)
I32	4	Signed Double Integer	-2^{31} to $2^{31}-1$ (−2,147,483,648 to 2,147,483,647)
**Byte	**	Byte	—

SII EEPROM Word Address	Name	Descriptions	ESC Register Word Address	Data type	Initial value
0008h 0009h	**Vender ID**	Vendor ID	—	U32	066Fh
000Ah 000Bh	**Product Code**	Product Code	—	U32	Product Specific
000Ch 000Dh	**Revision Number**	Revision number	—	U32	Product Specific
000Eh 000Fh	**Serial Number**	Serial number	—	U32	Product Specific
0010h	**Execution Delay**	Execution delay	—	U32	0000h
0011h	**Port0 Delay**	Port 0 Delay	—	I16	0000h
0012h	**Port1 Delay**	Port 1 Delay	—	I16	0000h
0013h	**Rsv.**	Rsv.	—	2Byte	-
0014h	**Bootstrap Receive Mailbox Offset**	Receiving mailbox offset in Bootstrap state (master -> slave) (Not supported)	—	U16	0000h
0015h	**Bootstrap Receive Mailbox Size**	Receiving mailbox size in Bootstrap state (master -> slave) (Not supported)	—	U16	0000h
0016h	**Bootstrap Send Mailbox Offset**	Sending mailbox offset in Bootstrap state (slave -> master) (Not supported)	—	U16	0000h
0017h	**Bootstrap Receive Mailbox Size**	Sending mailbox size in Bootstrap state (slave -> master) (Not supported)	—	U16	0000h
0018h	**Standard Receive Mailbox Offset**	Receiving mailbox offset in the standard state (master -> slave)	—	U16	1000h
0019h	**Standerd Receive Mailbox Size**	Receiving mailbox size in the standard state (master -> slave)	—	U16	0100h
001Ah	**Standard Send Mailbox Offset**	Sending mailbox offset in the standard state (slave -> master)	—	U16	1200h
001Bh	**Standard Send Mailbox Size**	Sending mailbox seize in the standard state (slave -> master)	—	U16	0100h
001Ch	**Mailbox Protocol**	Supported mailbox protocols	—	U16	0004h
001Dh ... 003Dh	**Rsv.**	Rsv.	—	66Byte	-
003Eh	**Size**	EEPROM size (The EEPROM size of this product is 16kbit.)	—	U16	000Fh
003Fh	**Version**	Version (Value is fixed at 1.)	—	U16	0001h
0040h ...	(Data for each category.)				

5. Synchronization modes

The following synchronization modes are available.

Mode	Description	Synchronous method	Features
DC (Distributed Clock)	Synchronize with SYNC0 event	The time information of the second and subsequent slave axes is synchronized based on the time information of the first axis.	**Advantages** - High precision **Disadvantages** - Correction is required by the master.
FreeRun	Asynchronous	Asynchronous.	**Advantages** -Simple to use. **Disadvantages** - Real-time is not guaranteed.

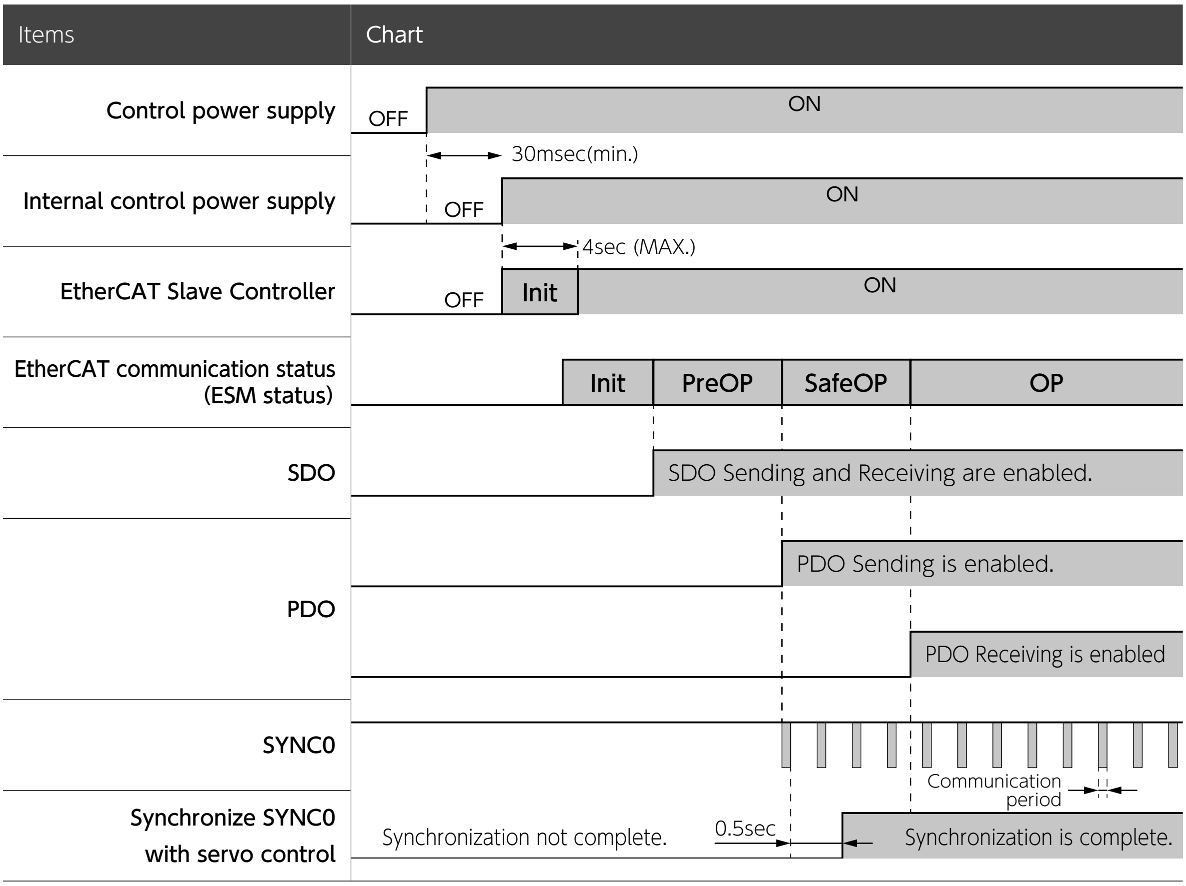
5. Synchronization modes

DC (Synchronize with SYNC0 event)

In DC mode, the master device runs in synchronization with the slave device. This synchronization is performed by a "Distributed Clock" (DC), where the master and slaves share the same clock.
The slave closest to the master provides the master clock.
This slave device then corrects the delay time between each slave to within 1μsec of jitter.
DC mode should be used when multiple slaves are to perform cooperative motions.

Timing Chart

The following chart shows the steps from the time the control power is turned on until the SYNC0 event and the slave process, i.e. the servo process, are synchronized.

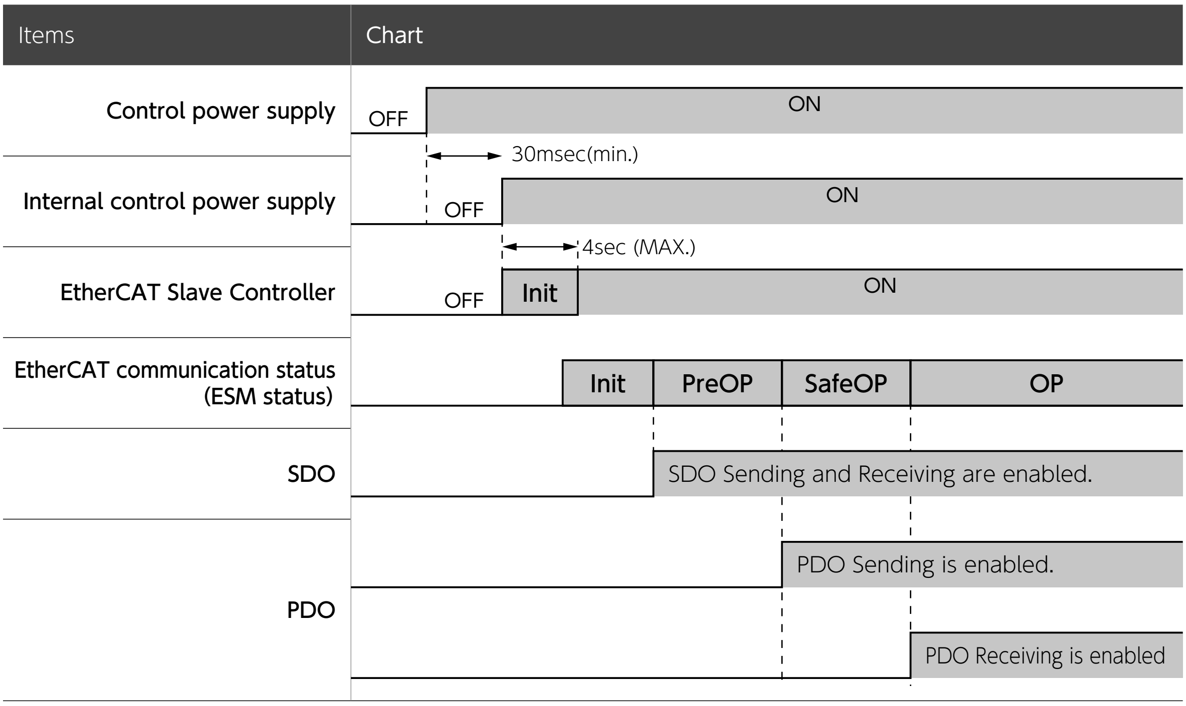


5. Synchronization modes

FreeRun

In Free Run mode, the slave devices run asynchronously, independent of the communication cycle of the EtherCAT master device.

Timing Chart



6. SDO (Service Data Object)

SDO data is handled by Mailbox communication.
This is the communication procedure to carry out parameter data, diagnostic data, and process data settings for PDO communication.

It is available in the Pre-Operational state or higher. (Cannot be used in Init).

Tip !

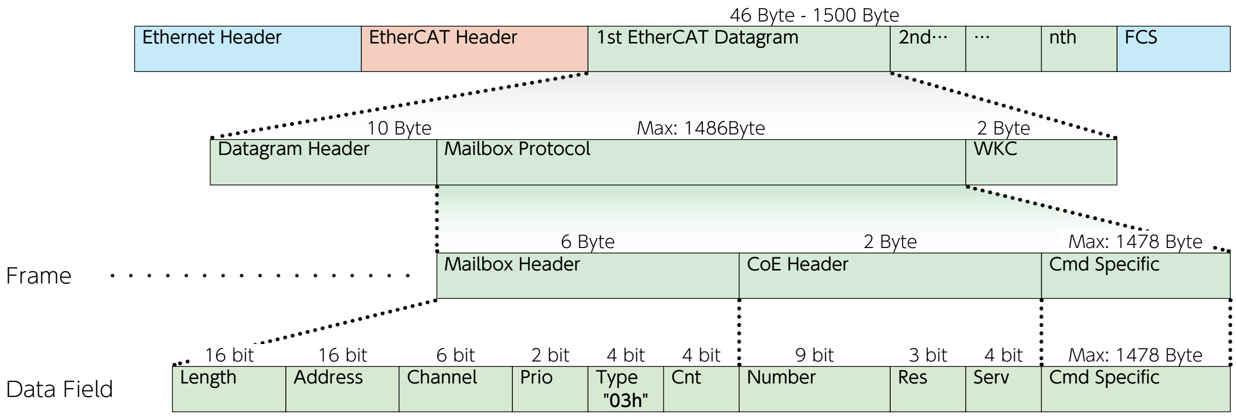
Furthermore…

The response of read/write operations in SDO may take some time.

DO NOT update objects in SDO that are updated in PDO.
It will be overwritten by the value in PDO.

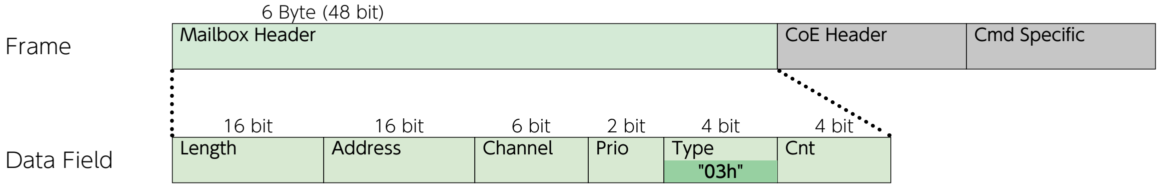
Mailbox Frame Structure

For details, please refer to the ETG specifications (ETG1000-5, ETG1000-6).



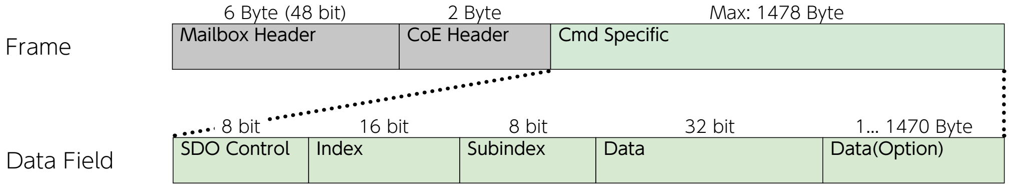
6. SDO (Service Data Object)

Mailbox Header Frame



Data Field	Functions
Length	Data length of Mailbox (Byte)
Address	When the slave sends to the master -Fixed address of the sender slave (i.e., the slave's own address). When the master sends to the slave -Fixed address of the destination slave.
Channel	Rsv.
Priority	Rsv.
Type	Mailbox type, protocol identifier 00h : Error 01h : Rsv. 02h : EoE(not supported) 03h : CoE 04h : FoE(not supported) 05h : SoE(not supported) 06h-0Eh : Rsv. 0Fh : VoE(not supported)
Cnt	Sequences number This will be incremented for each new mailbox service. The increments are 1,2,...,7 in cycles.

Cmd Specific Frame



Data Field	Functions
SDO Control	Standard CANopen* SDO Service
Index	Object addressing by index
Subindex	Sub-index of the above index
Data	SDO service data
Data (optional)	It is possible to send more than 4Byte of data in a one frame. (Optional) Mailbox size can be used.

7. PDO (Process Data Object)

Real-time data transfer in EtherCAT is carried out by exchanging PDO (Process Data Object) data. There are two types of PDO: RxPDO, which transfers data from the master to the slave, and TxPDO, which transfers data from the slave to the master.

	Transmitter	Receiver
RxPDO	Master	Slave
TxPDO	Slave	Master

PDO mapping object

"PDO mapping object" is an object that stores the application objects built from the object dictionary.

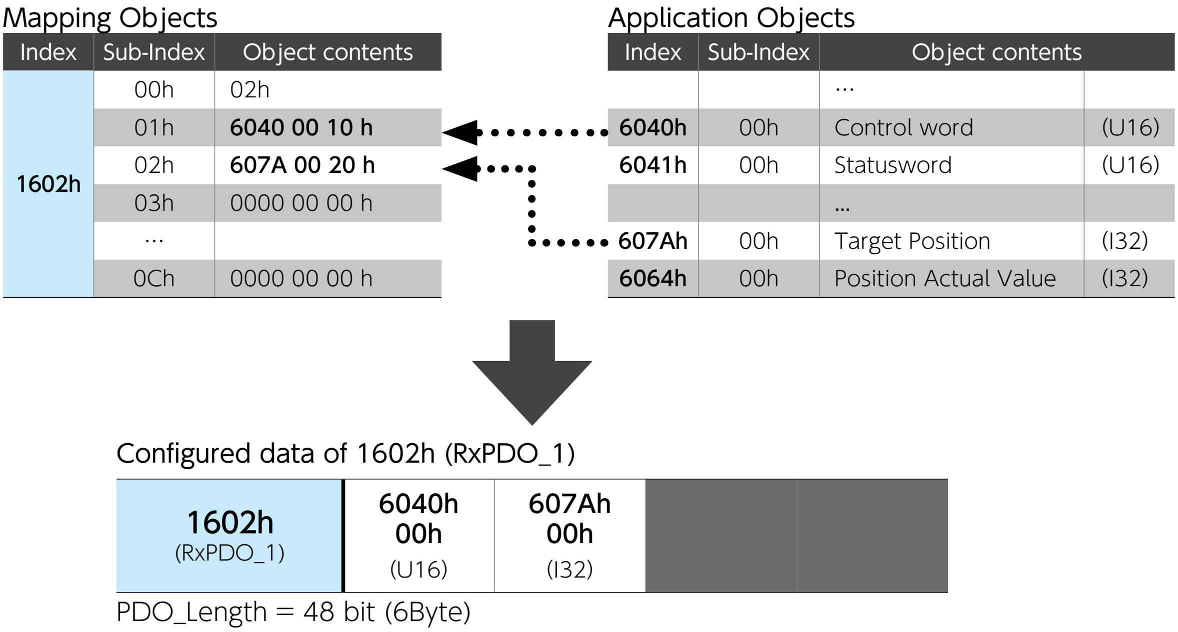
The PDO mapping of this product offers 1600h-1603h mapping objects for RxPDO and 1A00h-1A03h mapping objects for TxPDO.

The maximum number of application objects that can be mapped to a single mapping object is as follows.

Maximum PDO data length	RxPDO : 12-object TxPDO : 12-object

PDO mapping configuration example

To assign application objects 6040h and 607Ah to mapping object 1602h (Receive PDO mapping 1 : RxPDO_1)



Mapping Objects

Index	Sub-Index	Object contents
1602h	00h	02h
	01h	**6040 00 10 h**
	02h	**607A 00 20 h**
	03h	0000 00 00 h
	…	
	0Ch	0000 00 00 h

Application Objects

Index	Sub-Index	Object contents	
		…	
6040h	00h	Control word	(U16)
6041h	00h	Statusword	(U16)
		…	
607Ah	00h	Target Position	(I32)
6064h	00h	Position Actual Value	(I32)

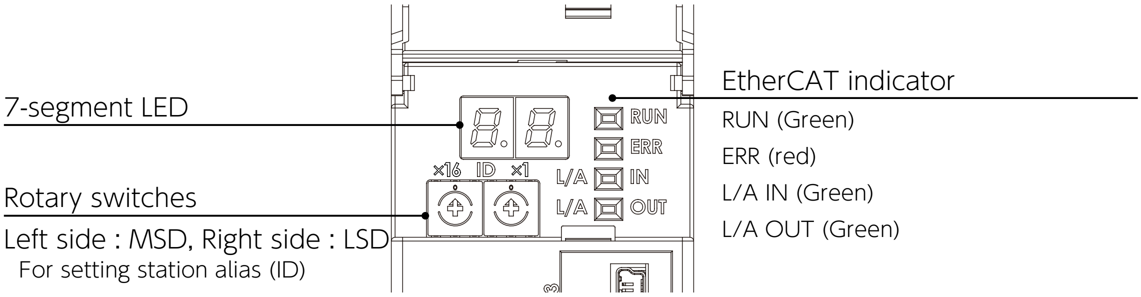
Configured data of 1602h (RxPDO_1)

1602h (RxPDO_1)	**6040h** **00h** (U16)	**607Ah** **00h** (I32)		

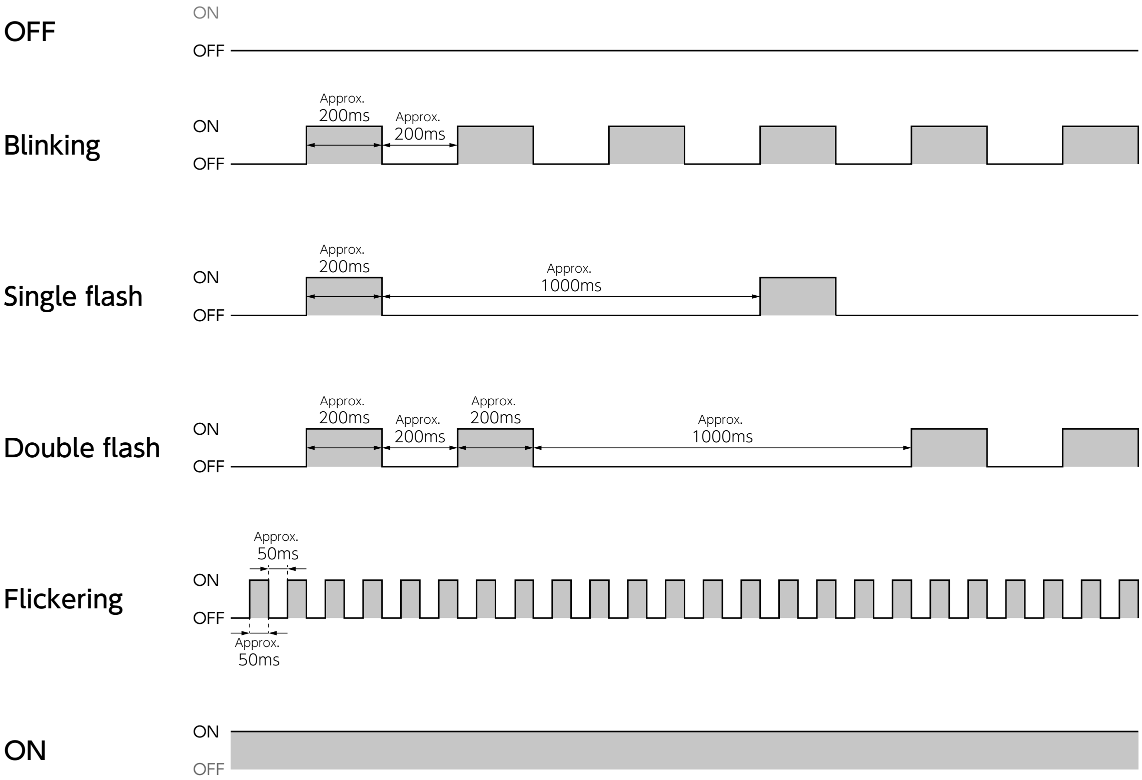
PDO_Length = 48 bit (6Byte)

8. Front Panel of the Servo Amplifier

Names of the parts of the front panel



LED status of the "EtherCAT indicator"



"RUN"

The RUN indicator shows the status of the ESM (EtherCAT State Machine).

LED	Descriptions
OFF	ESM : in the "INIT" state
Blinking	ESM : in the "Pre-Operational" state
Single flash	ESM : in the "Safe-Operational" state
ON	ESM : in the "Operational" state

"ERR"

The ERR indicator shows the status of the alarm(*) defined by the AL status code.

LED	Descriptions
OFF	No alarms defined in the AL status code are detected.
Blinking	Communication setting error
Single flash	Synchronization event error
Double flash	Application watchdog timeout
Flickering	Initialization error
ON	PDI error

*) In this servo amplifier, Err03 will be indicated when an alarm occurs.

"L/A IN", "L/A OUT"

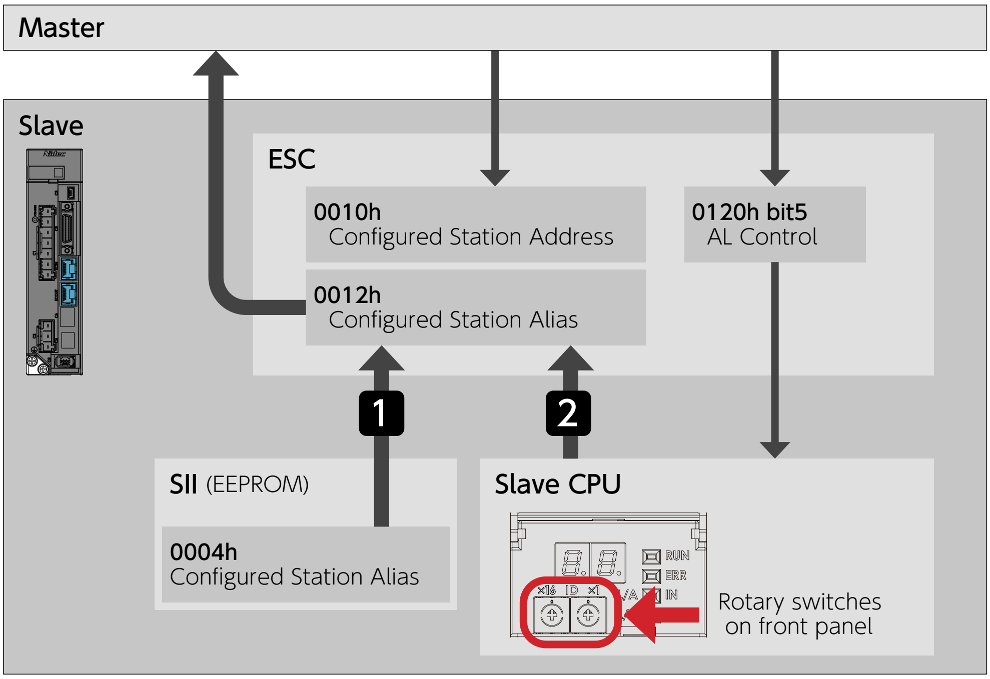
The L/A IN and L/A OUT indicators show the LINK status of the physical layer of each port and the operating status.

LED	Descriptions
OFF	LINK not established.
Flickering	LINK established. Data is being sent and received.
ON	LINK established. No data is sending or receiving.

Node addressing (Station alias setting)

Node addressing is the configuration of a unique node ID (station alias) by the master to identify the slave. There are two ways to set this up.

First, the master reads the Configured Station Alias (0012h) setting in the ESC register, and then sets it to the Configured Station Address (0010h). As a result, the address of the FPRD command used in the Mailbox will be set.



1 **Read SII value via Configured Station Alias**

How to read the value of 0004h (Configured Station Alias) in SII from 0012h (Configured Station Alias) in ESC register

2 **Read rotary switches value via Configured Station Alias**

How to read the value set by the rotary switches on the front panel from the ESC register 0012h (Configured Statin Alias)

3

Object Dictionary

1. List of Object Dictionary

In this document, the data types are illustrated using the following icons.

Data Type	Size (bytes)	Description	Range
U8	1	Unsigned Short Integer	0 to 255
I8	1	Signed Short Integer	−128 to 127
U16	2	Unsigned Integer	0 to 65,525
I16	2	Signed Integer	−32,768 to 32,767
U32	4	Unsigned Double Integer	0 to 2^{32} (0 to 4,294,967,295)
I32	4	Signed Double Integer	-2^{31} to $2^{31}-1$ (−2,147,483,648 to 2,147,483,647)

Access	Description
RO	Read Only
RW	Read / Write

1. List of Object Dictionary

1. CoE Communication Profile Area (1000h–1FFFh)

1000h–1602h

Index	Sub-Index	Name	Units	Type	Access	Range	PDO Mapping	Op-mode	Remarks
1000h	**00h**	Device Type	–	U32	RO	0 to 4,294,967,295	No	ALL	
1001h	**00h**	Error Register	–	U8	RO	0 to 255	No	ALL	
1018h	–	Identity Object	–	–	–	–	–	ALL	–
	00h	Number of Entries	–	U8	RO	0 to 12	No	ALL	
	01h	Vendor ID	–	U32	RO	0 to 4,294,967,295	No	ALL	
	02h	Product Code	–	U32	RO	0 to 4,294,967,295	No	ALL	
	03h	Revision Number	–	U32	RO	0 to 4,294,967,295	No	ALL	
	04h	Serial Number	–	U32	RO	0 to 4,294,967,295	No	ALL	
1600h	–	Receive PDO Mapping 1	–	–	–	–	–	–	
	00h	Number of Entries	–	U8	RW	0 to 12	No	ALL	
	01h	1st mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	02h	2nd mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	...								
	0Ch	12th mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
1601h	–	Receive PDO Mapping 2	–	–	–	–	–		
	00h	Number of Entries	–	U8	RW	0 to 12	No	ALL	
	01h	1st mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	02h	2nd mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	...								
	0Ch	12th mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
1602h	–	Receive PDO Mapping 3	–	–	–	–	–		
	00h	Number of Entries	–	U8	RW	0 to 12	No	ALL	
	01h	1st mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	02h	2nd mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	…								
	0Ch	12th mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	

1. List of Object Dictionary

1604h–1A02h

CoE Communication profile area

Index	Sub-Index	Name	Units	Type	Access	Range	PDO Mapping	Op-mode	Remarks
1604h	–	Receive PDO Mapping 5	–	–	–	–	–		
	00h	Number of Entries	–	U8	RW	0 to 12	No	ALL	
	01h	1st mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	02h	2nd mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	...								
	0Ch	12th mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
1605h	–	Receive PDO Mapping 6	–	–	–	–	–		
	00h	Number of Entries	–	U8	RW	0 to 12	No	ALL	
	01h	1st mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	02h	2nd mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	...								
	0Ch	12th mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
1A00h	–	Transmit PDO Mapping 1	–	–	–	–	–		
	00h	Number of Entries	–	U8	RW	0 to 12	No	ALL	
	01h	1st mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	02h	2nd mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	...								
	0Ch	12th mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
1A01h	–	Transmit PDO Mapping 2	–	–	–	–	–		
	00h	Number of Entries	–	U8	RW	0 to 12	No	ALL	
	01h	1st mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	02h	2nd mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	...								
	0Ch	12th mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
1A02h	–	Transmit PDO Mapping 3	–	–	–	–	–		
	00h	Number of Entries	–	U8	RW	0 to 12	No	ALL	
	01h	1st mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	02h	2nd mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	...								
	0Ch	12th mapped object	–	U32	RW	0 to 4294967295	No	ALL	

1. List of Object Dictionary

1A04h–1C15h

CoE Communication profile area

Index	Sub-Index	Name	Units	Type	Access	Range	PDO Mapping	Op-mode	Remarks
1A04h	–	Transmit PDO Mapping 5	–	–	–	–	–		
	00h	Number of Entries	–	U8	RW	0 to 12	No	ALL	
	01h	1st mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	02h	2nd mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	...								
	0Ch	12th mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
1A05h	–	Transmit PDO Mapping 6	–	–	–	–	–		
	00h	Number of Entries	–	U8	RW	0 to 12	No	ALL	
	01h	1st mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	02h	2nd mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
	...								
	0Ch	12th mapped object	–	U32	RW	0 to 4,294,967,295	No	ALL	
1C00h	–	Sync Manager Communication Type	–	–	–	–	–		
	00h	Number of Used Sync Manager Channels	–	U8	RO	0 to 255	No	ALL	
	01h	Sync Manager Communication Type 0	–	U8	RO	0 to 4	No	ALL	
	02h	Sync Manager Communication Type 1	–	U8	RO	0 to 4	No	ALL	
	03h	Sync Manager Communication Type 2	–	U8	RO	0 to 4	No	ALL	
	04h	Sync Manager Communication Type 3	–	U8	RO	0 to 4	No	ALL	
	05h	Sync Manager Communication Type 4	–	U8	RO	0 to 4	No	ALL	
	06h	Sync Manager Communication Type 5	–	U8	RO	0 to 4	No	ALL	
1C10h	**00h**	Sync Manager 0 PDO Assignment	–	U8	RO	0	No	ALL	
1C11h	**00h**	Sync Manager 1 PDO Assignment	–	U8	RO	0	No	ALL	
1C12h	–	Sync Manager 2 PDO Assignment	–	–	–	–	–		
	00h	Number of Assigned PDOs	–	U8	RW	0 to 1	No	ALL	
	01h	PDO Mapping Object Index of Assigned RxPDO	–	U16	RW	1600h to 1605h	No	ALL	
1C13h	–	Sync Manager 3 PDO Assignment	–	–	–	–	–		
	00h	Number of Assigned PDOs	–	U8	RW	0 to 1	No	ALL	
	01h	PDO Mapping Object Index of Assigned TxPDO	–	U16	RW	1A00h to 1A05h	No	ALL	
1C14h	**00h**	Sync Manager 4 PDO Assignment	–	U8	RO	0	No	ALL	
1C15h	**00h**	Sync Manager 5 PDO Assignment	–	U8	RO	0	No	ALL	

1C32h–1C33h

CoE Communication profile area

Index	Sub-Index	Name	Units	Type	Access	Range	PDO Mapping	Op-mode	Remarks
1C32h	–	Sync Manager 2 synchronization	–	–	–	–	–	–	
	00h	Sync Manager 2 synchronization Number of Entries	–	U8	RO	0 to 255	No	ALL	
	01h	Sync Manager 2 synchronization Sync mode	–	U16	RO	0 to 65,535	No	ALL	
	02h	Sync Manager 2 synchronization Cycle time	–	U32	RO	0 to 4,294,967,295	No	ALL	
	03h	(Not supported)	–	–	–	–	–	–	
	04h	Sync Manager 2 synchronization Sync modes supported	–	U16	RO	0 to 65,535	No	ALL	
	05h	Sync Manager 2 synchronization Minimum cycle time	ns	U32	RO	0 to 4,294,967,295	No	ALL	
	06h –09h	(Not supported)	–	–	–	–	–	–	
	0Ah	Sync Manager 2 synchronization Sync0 cycle time	ns	U32	RO	0 to 4,294,967,295	No	ALL	
	0Bh –0Ch	(Not supported)	–	–	–	–	–	–	
1C33h	–	Sync Manager 3 synchronization	–	–	–	–	–	–	
	00h	Sync Manager 3 synchronization Number of Entries	–	U8	RO	0 to 255	No	ALL	
	01h	Sync Manager 3 synchronization Sync mode	–	U16	RO	0 to 65,535	No	ALL	
	02h	Sync Manager 3 synchronization Cycle time	–	U32	RO	0 to 4,294,967,295	No	ALL	
	03h	(Not supported)	–	–	–	–	–	–	
	04h	Sync Manager 3 synchronization Sync modes supported	–	U16	RO	0 to 65,535	No	ALL	
	05h	Sync Manager 3 synchronization Minimum cycle time	ns	U32	RO	0 to 4,294,967,295	No	ALL	
	06h –09h	(Not supported)	–	–	–	–	–	–	
	0Ah	Sync Manager 3 synchronization Sync0 cycle time	ns	U32	RO	0 to 4,294,967,295	No	ALL	
	0Bh –0Ch	(Not supported)	–	–	–	–	–	–	

2. Manufacturer Specific Profile Area (2000h-4000h)

2000h-2077h

Index	Sub-Index	Name	Units	Type	Access	Range	PDO Mapping	Op-mode	Remarks
200Ch	00h	Warning Latch Time	50ms	U16	RW	0 to 200	No	ALL	No.12.0
200Dh	00h	Timing for Alarm Output	–	U16	RW	0 to 1	No	ALL	No.13.0
2020h	00h	Position Control Mode Setting 1	–	U16	RW	0 to 65,535	No	ALL	No.32.1
2021h	00h	Position Control Mode Setting 2	–	U16	RW	0 to 65,535	No	ALL	No.33.1
203Eh	00h	Velocity Control Mode Setting	–	U16	RW	0 to 65,535	No	ALL	No.62.0
2041h	00h	Deviation Error Detection Setting	–	U16	RW	0 to 65,535	No	ALL	No.65.0, No.65.1
2042h	00h	Position Control Mode Setting 2	–	U16	RW	0 to 65,535	No	ALL	No.66.0, No.66.3
2043h	00h	Drive Restriction Input	–	U16	RW	0 to 65,535	No	ALL	No.67.0 to No.67.3
204Ah	00h	Position Command Filter 1 Notch Frequency	0.1Hz	U16	RW	10 to 2,000	No	ALL	No.74.0
204Bh	00h	Position Command Filter 1 Notch Width	–	U16	RW	128 to 2,048	No	ALL	No.75.0
204Ch	00h	Position Command Filter 1 High Frequency Gain	–	U16	RW	50 to 200	No	ALL	No.76.0
204Fh	00h	Position Command Filter 1 Notch Depth	–	U16	RW	0 to 100	No	ALL	No.79.0
2050h	00h	Position Command Smoothing Filter 1 Moving Average Order	–	U16	RW	1 to 6,250	No	ALL	No.80.0
2052h	00h	Position Command Filter 2 Type	–	U16	RW	0 to 65,535	No	ALL	No.82.0, No.82.1
2053h	00h	Position Command Filter 2 Notch Frequency	0.1Hz	U16	RW	10 to 2,000	No	ALL	No.83.0
2054h	00h	Position Command Filter 2 Notch Width	–	U16	RW	128 to 2,048	No	ALL	No.84.0
2055h	00h	Position Command Filter 2 High Frequency Gain	–	U16	RW	50 to 200	No	ALL	No.85.0
2056h	00h	Position Command Filter 2 Notch Depth	–	U16	RW	0 to 100	No	ALL	No.86.0
205Ah	00h	Speed Deviation Error Detection Value	pulse /100μs	U16	RW	0 to 32,767	No	ALL	No.90.0
205Bh	00h	Speed Deviation Error Detection Delay Time	100μs	U16	RW	0 to 32,767	No	ALL	No.91.0
2066h	00h	Inertia Ratio	%	U16	RW	100 to 10,000	No	ALL	No.102.0
2067h	00h	Damping Ratio	%	U16	RW	10 to 5,000	No	ALL	No.103.0
206Ah	00h	Tuning Inertia Ratio Upper Limit	%	U16	RW	100 to 10,000	No	ALL	No.106.0
206Eh	00h	Tuning Setting 1	–	U16	RW	0 to 65,535	No	ALL	No.110.0, No.110.1
2071h	00h	Tuning Setting 2	–	U16	RW	0 to 65,535	No	ALL	No.113.0, No.113.1
2072h	00h	Position Control Mode Control level	–	U16	RW	5 to 45	No	ALL	No.114.0
2073h	00h	Position Control Mode Control Gain 1	rad/s	U16	RW	5 to 1,000	No	ALL	No.115.0
2074h	00h	Position Control Mode Control Gain 2	rad/s	U16	RW	80 to 5,000	No	ALL	No.116.0
2075h	00h	Position Control Mode Gain FF Compensation 1	0.01%	U16	RW	0 to 15,000	No	ALL	No.117.0
2076h	00h	Position Control Mode Gain FF Compensation 2	0.01%	U16	RW	0 to 15,000	No	ALL	No.118.0
2077h	00h	Position Control Mode Integral Gain	rad/s	U16	RW	45 to 5,000	No	ALL	No.119.0

1. List of Object Dictionary

2078h-20EFh Manufacturer Specific Profile Area

Index	Sub-Index	Name	Units	Type	Access	Range	PDO Mapping	Op-mode	Remarks
2078h	00h	Tuning Control Gain Set Upper limit	–	U16	RW	5 to 45	No	ALL	No.120.1
2079h	00h	Tuning Tuning Constant	–	U16	RW	1 to 200	No	ALL	No.121.0
2081h	00h	Velocity Control Mode Control Gain Set	–	U16	RW	1 to 46	No	ALL	No.129.0
2082h	00h	Velocity Control Mode Control Level	–	U16	RW	1 to 46	No	ALL	No.130.0
2083h	00h	Velocity Control Mode Control Gain 1	rad/s	U16	RW	100 to 6,000	No	ALL	No.131.0
2084h	00h	Velocity Control Mode Gain FF Compensation 1	0.01%	U16	RW	0 to 15,000	No	ALL	No.132.0
2085h	00h	Velocity Control Mode Integral Gain	rad/s	U16	RW	45 to 5,000	No	ALL	No.133.0
2092h	00h	Torque Command Offset	0.1%	I16	RW	−1,000 to 1,000	No	ALL	No.146.0
20A0h	00h	Torque Command Filter Setting	–	U16	RW	0 to 65,535	No	ALL	No.160.0 to No.160.3
20A2h	00h	Torque Command Filter Low-pass Filter Time Constant	0.01ms /rad	U16	RW	0 to 65,535	No	ALL	No.162.0
20A8h	00h	Torque Command Filter Notch Filter Frequency	Hz	U16	RW	0 to 2,500	No	ALL	No.168.0
20A9h	00h	Torque Command Filter Notch Filter Width	–	U16	RW	1 to 16	No	ALL	No.169.0
20AAh	00h	Torque Command Filter Notch Filter Depth	–	U16	RW	0 to 256	No	ALL	No.170.0
20ABh	00h	Torque Command Filter Notch Filter 2 Frequency	0.1Hz	U16	RW	0 to 2,500	No	ALL	No.171.0
20ACh	00h	Torque Command Filter Notch Filter 2 Width	–	U16	RW	1 to 16	No	ALL	No.172.0
20ADh	00h	Torque Command Filter Notch Filter 2 Depth	–	U16	RW	0 to 256	No	ALL	No.173.0
20C1h	00h	Tuning Current Control Gain	–	U16	RW	0 to 1	No	ALL	No.193.0
20E0h	00h	Deceleration and Stop Setting	–	U16	RW	0 to 65,535	No	ALL	No.224.0 to No.224.3
20E1h	00h	Emergency Stop Setting	–	U16	RW	0 to 65,535	No	ALL	No.225.0 to No.225.2
20E2h	00h	Deceleration Stop Working Time	100μs	U16	RW	0 to 16,383	No	ALL	No.226.0
20E3h	00h	Deceleration Stop Rotational Speed to End Deceleration Stop	pulse /100μs	U16	RW	0 to 32,767	No	ALL	No.227.0
20E4h	00h	Deceleration Stop Working Time ()	100μs	U16	RW	0 to 16,383	No	ALL	No.228.0
20E5h	00h	Immediate Stop Average Counter for Smoothing Filter	–	U16	RW	0 to 1,000	No	ALL	No.229.0
20E8h	00h	Deceleration and Stop Setting 2	–	U16	RW	0 to 65,535	No	ALL	No.232.1 to No.232.3
20E9h	00h	Deceleration and Stop Setting 3	–	U16	RW	0 to 65,535	No	ALL	No.233.0, No.233.3
20EAh	00h	Deceleration Stop Delay Time for Braking	100μs	U16	RW	0 to 16,383	No	ALL	No.234.0
20EBh	00h	Deceleration Stop Rotational Speed on Braking	pulse /100μs	U16	RW	0 to 32,767	No	ALL	No.235.0
20ECh	00h	Immediate Stop Time Extension	100μs	U16	RW	0 to 3,125	No	ALL	No.236.0
20EDh	00h	Delay Time for Servo Off	100μs	U16	RW	0 to 3,125	No	ALL	No.237.0
20EEh	00h	Delay Time for Mechanical Brake Release	100μs	U16	RW	0 to 3,125	No	ALL	No.238.0
20EFh	00h	Immediate Stop Decelerating Time	ms	U16	RW	0 to 100	No	ALL	No.239.0

1. List of Object Dictionary

2101h–2FFFh

Manufacturer Specific Profile Area

Index	Sub-Index	Name	Units	Type	Access	Range	PDO Mapping	Op-mode	Remarks
2101h	00h	Absolute System	–	U16	RW	0 to 2	No	ALL	No.257.0
2103h	00h	Encoder Error Detection Output Switch	–	U16	RW	0 to 65,535	No	ALL	No.259.0, No.259.1
210Bh	00h	Encoder Temperature to Detect Overheat	℃	U16	RW	0 to 127	No	ALL	No.267.0
210Ch	00h	Encoder Voltage to Detect low Battery Voltage	0.1V	U16	RW	0 to 100	No	ALL	No.268.0
212Eh	00h	Torque Control Mode Setting	–	U16	RW	0 to 65,535	No	ALL	No.302.0 to No.302.2
2130h	00h	Basic Setting Main Circuit Power	–	U16	RW	0 to 65,535	No	ALL	No.304.0, No.304.1
2131h	00h	Voltage Drop Detection Delay Time	ms	U16	RW	25 to 50,000	No	ALL	No.305.0
2152h	00h	Logical Input Masking Configuration	–	U32	RW	0 to 4,294,967,295	No	ALL	–
2165h	00h	Position Command Filter 3 Notch Frequency	0.1Hz	U16	RW	10 to 2,000	No	ALL	No.357.0
2166h	00h	Position Command Filter 3 Notch Width	–	U16	RW	128 to 2,048	No	ALL	No.358.0
2167h	00h	Position Command Filter 3 High Frequency Gain	–	U16	RW	50 to 200	No	ALL	No.359.0
2168h	00h	Position Command Filter3 Notch Depth	–	U16	RW	0 to 100	No	ALL	No.360.0
216Bh	00h	Following Error Warning Window (Position deviation waning detection value)	pulse	U32	RW	0 to 2,147,483,647	No	ALL	No.363.0
216Dh	00h	Following Error Warning Time Out (Position deviation waning detection delay time)	100μs	U16	RW	0 to 65,535	No	ALL	No.365.0
2178h	00h	Motor Rotating Position at Encoder Error Holding Method	–	U16	RW	0 to 2	No	ALL	No.376.0
2179h	00h	Motor Rotating Position at Encoder Error Holding Time	ms	U16	RW	0 to 200	No	ALL	No.377.0
21D8h	00h	Multi-turn limit Value	–	U16	RW	0 to 65,535	No	ALL	No.472.0
21D9h	00h	Multi-turn limit Notification to Encoder	–	U16	RW	0 to 1	No	ALL	No.473.0
21DAh	00h	EtherCAT Communication Setting	–	U16	RW	0 to 65,535	No	ALL	No.474.0
21DCh	00h	Logical IO Polarity	–	U32	RW	0 to 4,294,967,295	No	ALL	–
21DEh	00h	Logical Input Mask with Monitor	–	U32	RW	0 to 4,294,967,295	No	ALL	–
2FFFh	00h	Access to Servo Parameters	–	U16	RW	0 to 65,535	No	ALL	(*1)

*1) **Bit0-7**: Control parameter
1: Amp → Object Dictionary
2: Object Dictionary → Amp and Save all parameter

Bit8: Busy bit (Read only)
Bit9-15: RSV.

4000h–

Manufacturer Specific Profile Area

Index	Sub-Index	Name	Units	Type	Access	Range	PDO Mapping	Op-mode	Remarks
4000h	00h	Special Function	–	U16	R	0 to 65,535	No	ALL	(*2)
4100h	00h	Mechanical Angle	–	U32	R	(*3)	No	ALL	
4101h	00h	Multi-turn Data	–	U16	R	0 to 65,535	No	ALL	

*2) **Bit0:** Clear multi turn data, **Bit1-15**: RSV.

*3) 0 to 131,071(17Bit) / 0 to 8,388,607(23Bit)

3. Drive Profile Area (6000h-6FFFh)

603Fh-6091h

Index	Sub-Index	Name	Units	Type	Access	Range	PDO Mapping	Op-mode	Remarks
603Fh	00h	Error Code	–	U16	RO	0 to 65,535	TxPDO	ALL	
6040h	00h	Controlword	–	U16	RW	0 to 65,535	RxPDO	ALL	
6041h	00h	Statusword	–	U16	RO	0 to 65,535	TxPDO	ALL	
605Ah	00h	Quick Stop Option Code	–	I16	RW	2, 6	No	ALL	
6060h	00h	Modes of Operation	–	I8	RW	0 to 10	RxPDO	ALL	
6061h	00h	Modes of Operation Display	–	I8	RO	0 to 10	TxPDO	ALL	
6062h	00h	Position Demand Value	Command Unit	I32	RO	−2,147,483,648 to 2,147,483,647	TxPDO	CSP	
6064h	00h	Position Actual Value	Command Unit	I32	RO	−2,147,483,648 to 2,147,483,647	TxPDO	ALL	
6065h	00h	Following Error Window	Command Unit	U32	RW	0 to 4,294,967,295	No	CSP	
6067h	00h	Position Window	Command Unit	U32	RW	0 to 4,294,967,295	No	CSP	
606Ch	00h	Velocity Actual Value	Command Unit/s	I32	RO	−2,147,483,648 to 2,147,483,647	TxPDO	ALL	
6071h	00h	Target Torque	0.1%	I16	RW	−32,768 to 32,767	RxPDO	CST	
6072h	00h	Max Torque	0.1%	U16	RW	0 to 65,535	RxPDO	ALL	
6074h	00h	Torque Demand	0.1%	I16	RO	−32,768 to 32,767	TxPDO	ALL	
6077h	00h	Torque Actual Value	0.1%	I16	RO	−32,768 to 32,767	TxPDO	ALL	
607Ah	00h	Target Position	Command Unit	I32	RW	−2,147,483,648 to 2,147,483,647	RxPDO	CSP, PP	
607Bh	–	Position Range Limit	–	–	–	–	–	ALL	
	00h	Number of Entries		U8	RO	2	No		
	01h	Min Position Range Limit	Command Unit	I32	RW	−2,147,483,648 to 0	No		
	02h	Max Position Range Limit	Command Unit	I32	RW	1 to 2,147,483,647	No		
607Ch	00h	Home Offset	Command Unit	I32	RW	−2,147,483,648 to 2,147,483,647	RxPDO	HM	
607Fh	00h	Max Profile Velocity	Command Unit/s	U32	RW	0 to 4,294,967,295	RxPDO	CSP, PP	
6080h	00h	Max Motor Speed	rpm	U32	RW	0 to 4,294,967,295	RxPDO	ALL	
6081h	00h	Profile Velicity	Command Unit/s	U32	RW	0 to 4,294,967,295	RxPDO	PP	
6083h	00h	Profile Acceleration	Command Unit/s^2	U32	RW	0 to 4,294,967,295	RxPDO	PP	
6084h	00h	Profile Deceleration	Command Unit/s^2	U32	RW	0 to 4,294,967,295	RxPDO	PP	
6085h	00h	Quick Stop Deceleration	Command Unit/s^2	U32	RW	0 to 4,294,967,295	No	ALL	
6091h	–	Gear Ratio	–	–	–	–	–	ALL	
	00h	Number of Entries		U8	RO		No		
	01h	Motor Revolutions	–	U32	RW	1 to 4,294,967,295	No		
	02h	Shaft Revolutions	–	U32	RW	1 to 4,294,967,295	No		

6098h–6502h

Drive profile area

Index	Sub-Index	Name	Units	Type	Access	Range	PDO Mapping	Op-mode	Remarks
6098	00 h	Homing Method	–	I8	RW	0 to 37	No	HM	
6099h	–	Homing Speeds	–	–	–	–	–	HM	
	00h	Number of Entries		U8	RO	2	No		
	01h	Speed During Search for Switch	Command Unit/s	U32	RW	1 to 4,294,967,295	No		
	02h	Speed During Search for Zero	Command Unit/s	U32	RW	1 to 4,294,967,295	No		
609Ah	00h	Homing Acceleration	Command Unit/s^2	U32	RW	0 to 4,294,967,295	No	HM	
60B0h	00h	Position Offset	Command Unit	I32	RW	−2,147,483,648 to 2,147,483,647	RxPDO	CSP	
60B1h	00h	Velocity Offset	Command Unit/s	I32	RW	−2,147,483,648 to 2,147,483,647	RxPDO	CSV	
60B2h	00h	Torque Offset	0.1%	I16	RW	−32,768 to 32,767	RxPDO	CSP, CSV, CST	
60B8h	00h	Touch Probe Function	–	U16	RW	0 to 65,535	RxPDO	ALL	
60B9h	00h	Touch Probe Status	–	U16	RO	0 to 65,535	TxPDO	ALL	
60BAh	00h	Touch Probe 1 Positive Edge	Command Unit	I32	RO	−2,147,483,648 to 2,147,483,647	TxPDO	ALL	
60BBh	00h	Touch Probe 1 Negative Edge	Command Unit	I32	RO	−2,147,483,648 to 2,147,483,647	TxPDO	ALL	
60BCh	00h	Touch Probe 2 Positive Edge	Command Unit	I32	RO	−2,147,483,648 to 2,147,483,647	TxPDO	ALL	
60BDh	00h	Touch Probe 2 Negative Edge	Command Unit	I32	RO	−2,147,483,648 to 2,147,483,647	TxPDO	ALL	
60F4h	00h	Following Error Actual Value	Command Unit	I32	RO	−2,147,483,648 to 2,147,483,647	TxPDO	CSP, HM, PP	
60FDh	00h	Digital Inputs	–	U32	RO	0 to 4,294,967,295	TxPDO	ALL	
60FFh	00h	Target Velocity	Command Units/s	I32	RW	−2,147,483,648 to 2,147,483,647	RxPDO	CSV	
6502h	00h	Supported Drive Modes	–	U32	RO	0 to 4,294,967,295	No	ALL	(*)

*) Product spec: CSP, CSV, CST, HM, PP
Currently: CSP, CSV, CST, HM, PP

2. Details of Object Dictionary

1. CoE Communication Profile Area (1000h-1FFFFh)

1000h	**Device Type**							
Sub-Index **00h**	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RO
	Default	–	OP-mode	ALL	PDO mapping	No		
	Description	This object is used to indicate the information of device type. The return value will be **0002 0192h** (fixed).						

1001h	**Error Register**							
Sub-Index **00h**	Range	0 to 255	Unit	–	Type	U8	Access	RO
	Default	–	OP-mode	ALL	PDO mapping	No		
	Description	This object is used to indicate the error status of the servo amplifier. **00h**: No Error **80h**: Some error has occurred.						

1018h	**Identity Object**							
	Description	This object is used to indicate the device-specific information.						
Sub-Index **00h**	**Number of Entries**							
	Range	0 to 255	Unit	–	Type	U8	Access	RO
	Default	4	OP-mode	ALL	PDO mapping	No		
	Description	Number of entries (Fixed value **4**)						
Sub-Index **01h**	**Vendor ID**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RO
	Default	–	OP-mode	ALL	PDO mapping	No		
	Description	Returns the Vendor ID of EtherCAT (Fixed value **0000 083Ch**)						
Sub-Index **02h**	**Product Code**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RO
	Default	–	OP-mode	ALL	PDO mapping	No		
	Description	Returns the product code (Fixed value **0000 0020h**)						
Sub-Index **03h**	**Revision Number**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RO
	Default	–	OP-mode	ALL	PDO mapping	No		
	Description	Returns the product revision number (Format: "**Major**"."**Minor**"."**Version**"."**Build**")						
Sub-Index **04h**	**Serial Number**							
	Range	0 to 4,294,967,295	Unit	–	Type	U8	Access	RO
	Default	–	OP-mode	ALL	PDO mapping	No		
	Description	(Fixed value **0**)						

1600h	**Receive PDO Mapping 1**							
	Description	This object is used to configure the "RxPDO mapping 1".						
Sub−Index **00h**	**Number of Entries**							
	Range	0 to 12	Unit	–	Type	U8	Access	RW
	Default	1	OP−mode	ALL	PDO mapping	No		
	Description	Number of entries in PDO mapping 1						
Sub−Index **01h**	**1st mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0x60400010 CiA402 control word (0x6040)	OP−mode	ALL	PDO mapping	No		
	Description	Specifies the first object to be mapped.						

bit functions

bit	31 ··· 16	15 ··· 8	7 ··· 0
	Index number	Sub-index number	Bit length

Sub−Index **02h**	**2nd mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0	OP−mode	ALL	PDO mapping	No		
	Description	Specifies the second object to be mapped. (The setting method is the same as for subindex 01h.)						
⋮		⋮						
Sub−Index **0Ch**	**12th mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0	OP−mode	ALL	PDO mapping	No		
	Description	Specifies the 12th object to be mapped. (The setting method is the same as for subindex 01h.)						

1601h	**Receive PDO Mapping 2**							
	Description	This object is used to configure the "RxPDO mapping 2".						
Sub−Index **00h**	**Number of Entries**							
	Range	0 to 12	Unit	−	Type	U8	Access	RW
	Default	2	OP−mode	ALL	PDO mapping	No		
	Description	Number of entries in PDO mapping 2						
Sub−Index **01h**	**1st mapped object**							
	Range	0 to 4,294,967,295	Unit	−	Type	U32	Access	RW
	Default	0x60400010 CiA402 control word (0x6040)	OP−mode	ALL	PDO mapping	No		
	Description	Specifies the first object to be mapped.						
Sub−Index **02h**	**2nd mapped object**							
	Range	0 to 4,294,967,295	Unit	−	Type	U32	Access	RW
	Default	0x60600008 CiA402 mode of operation (0x6060)	OP−mode	ALL	PDO mapping	No		
	Description	Specifies the second object to be mapped. (The setting method is the same as for subindex 01h.)						
⋮		⋮						
Sub−Index **0Ch**	**12th mapped object**							
	Range	0 to 4,294,967,295	Unit	−	Type	U32	Access	RW
	Default	0	OP−mode	ALL	PDO mapping	No		
	Description	Specifies the 12th object to be mapped. (The setting method is the same as for subindex 01h.)						

bit functions (Sub-Index 01h)

bit	31 ··· 16	15 ··· 8	7 ··· 0
	Index number	Sub-index number	Bit length

1602h	**Receive PDO Mapping 3**							
	Description	This object is used to configure the "RxPDO mapping 3".						
Sub−Index **00h**	**Number of Entries**							
	Range	0 to 12	Unit	–	Type	U8	Access	RW
	Default	2	OP−mode	ALL	PDO mapping	No		
	Description	Number of entries in PDO mapping 3						
Sub−Index **01h**	**1st mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0x60400010 CiA402 control word (0x6040)	OP−mode	ALL	PDO mapping	No		
	Description	Specifies the first object to be mapped.						

bit functions

bit	31 ··· 16	15 ··· 8	7 ··· 0
	Index number	Sub-index number	Bit length

Sub−Index **02h**	**2nd mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0x607A0020 CiA402 target position (0x607A)	OP−mode	ALL	PDO mapping	No		
	Description	Specifies the second object to be mapped. (The setting method is the same as for subindex 01h.)						
⋮		⋮						
Sub−Index **0Ch**	**12th mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0	OP−mode	ALL	PDO mapping	No		
	Description	Specifies the 12th object to be mapped. (The setting method is the same as for subindex 01h.)						

1604h	**Receive PDO Mapping 5**							
	Description	This object is used to configure the "RxPDO mapping 5".						
Sub−Index **00h**	**Number of Entries**							
	Range	0 to 12	Unit	–	Type	U8	Access	RW
	Default	2	OP−mode	ALL	PDO mapping	No		
	Description	Number of entries in PDO mapping 5						
Sub−Index **01h**	**1st mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0x60400010 CiA402 control word (0x6040)	OP−mode	ALL	PDO mapping	No		
	Description	Set the first object to be mapped. bit functions						

bit	31	···	16	15	···	8	7	···	0
	Index number			Sub-index number			Bit length		

Sub−Index **02h**	**2nd mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0x60710010 CiA402 target position (0x6071)	OP−mode	ALL	PDO mapping	No		
	Description	Set the second object to be mapped. (The setting method is the same as for subindex 01h.)						
⋮		⋮						
Sub−Index **0Ch**	**12th mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0	OP−mode	ALL	PDO mapping	No		
	Description	Set the 12th object to be mapped. (The setting method is the same as for subindex 01h.)						

1605h	Receive PDO Mapping 6							
	Description	This object is used to configure the "RxPDO mapping 6".						
Sub−Index 00h	Number of Entries							
	Range	0 to 12	Unit	–	Type	U8	Access	RW
	Default	2	OP−mode	ALL	PDO mapping	No		
	Description	Number of entries in PDO mapping 6						
Sub−Index 01h	1st mapped object							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0x60400010 CiA402 control word (0x6040)	OP−mode	ALL	PDO mapping	No		
	Description	Set the first object to be mapped.						

bit functions

bit	31 ··· 16	15 ··· 8	7 ··· 0
	Index number	Sub-index number	Bit length

Sub−Index 02h	2nd mapped object							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0x60FF0010 CiA402 target position (0x60FF)	OP−mode	ALL	PDO mapping	No		
	Description	Set the second object to be mapped. (The setting method is the same as for subindex 01h.)						
⋮		⋮						
Sub−Index 0Ch	12th mapped object							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0	OP−mode	ALL	PDO mapping	No		
	Description	Set the 12th object to be mapped. (The setting method is the same as for subindex 01h.)						

1A00h	**Transmit PDO Mapping 1**							
	Description	This object is used to configure the "TxPDO mapping 1".						
Sub−Index **00h**	**Number of Entries**							
	Range	0 to 12	Unit	–	Type	U8	Access	RW
	Default	1	OP−mode	ALL	PDO mapping	No		
	Description	Number of entries in PDO mapping 1						
Sub−Index **01h**	**1st mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0x60410010 CiA402 control word (0x6041)	OP−mode	ALL	PDO mapping	No		
	Description	Set the first object to be mapped.						

bit functions

bit	31 ··· 16	15 ··· 8	7 ··· 0
	Index number	Sub-index number	Bit length

Sub−Index **02h**	**2nd mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0	OP−mode	ALL	PDO mapping	No		
	Description	Set the second object to be mapped. (The setting method is the same as for subindex 01h.)						
⋮		⋮						
Sub−Index **0Ch**	**12th mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0	OP−mode	ALL	PDO mapping	No		
	Description	Set the 12th object to be mapped. (The setting method is the same as for subindex 01h.)						

1A01h	**Transmit PDO Mapping 2**							
	Description	This object is used to configure the "TxPDO mapping 2".						
Sub−Index 00h	**Number of Entries**							
	Range	0 to 12	Unit	–	Type	U8	Access	RW
	Default	2	OP−mode	ALL	PDO mapping	No		
	Description	Number of entries in PDO mapping 2						
Sub−Index 01h	**1st mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0x60410010 CiA402 control word (0x6041)	OP−mode	ALL	PDO mapping	No		
	Description	Set the first object to be mapped. bit functions						

bit	31	···	16	15	···	8	7	···	0
	Index number			Sub-index number			Bit length		

Sub−Index 02h	**2nd mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0x60610008 CiA402 mode of operation display(0x6061)	OP−mode	ALL	PDO mapping	No		
	Description	Set the second object to be mapped. (The setting method is the same as for subindex 01h.)						
⋮		⋮						
Sub−Index 0Ch	**12th mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0	OP−mode	ALL	PDO mapping	No		
	Description	Set the 12th object to be mapped. (The setting method is the same as for subindex 01h.)						

1A02h	**Transmit PDO Mapping 3**							
	Description	This object is used to configure the "TxPDO mapping 3".						
Sub−Index **00h**	**Number of Entries**							
	Range	0 to 12	Unit	–	Type	U8	Access	RW
	Default	2	OP−mode	ALL	PDO mapping	No		
	Description	Number of entries in PDO mapping 3						
Sub−Index **01h**	**1st mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0x60410010 CiA402 control word (0x6041)	OP−mode	ALL	PDO mapping	No		
	Description	Set the first object to be mapped.						

bit functions

bit	31	⋯	16	15	⋯	8	7	⋯	0
	Index number			Sub-index number			Bit length		

Sub−Index **02h**	**2nd mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0x60640020 CiA402 mode of operation display(0x6064)	OP−mode	ALL	PDO mapping	No		
	Description	Set the second object to be mapped. (The setting method is the same as for subindex 01h.)						
⋮		⋮						
Sub−Index **0Ch**	**12th mapped object**							
	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	0	OP−mode	ALL	PDO mapping	No		
	Description	Set the 12th object to be mapped. (The setting method is the same as for subindex 01h.)						

1A04h	**Transmit PDO Mapping 5**							
	Description	This object is used to configure the "TxPDO mapping 5".						
Sub−Index **00h**	**Number of Entries**							
	Range	0 to 12	Unit	−	Type	U8	Access	RW
	Default	2	OP−mode	ALL	PDO mapping	No		
	Description	Number of entries in PDO mapping 5						
Sub−Index **01h**	**1st mapped object**							
	Range	0 to 4,294,967,295	Unit	−	Type	U32	Access	RW
	Default	0x60410010 CiA402 control word (0x6041)	OP−mode	ALL	PDO mapping	No		
	Description	Set the first object to be mapped.						

bit functions

bit	31 ··· 16	15 ··· 8	7 ··· 0
	Index number	Sub-index number	Bit length

Sub−Index **02h**	**2nd mapped object**							
	Range	0 to 4,294,967,295	Unit	−	Type	U32	Access	RW
	Default	0x60770010 CiA402 mode of operation display(0x6077)	OP−mode	ALL	PDO mapping	No		
	Description	Set the second object to be mapped. (The setting method is the same as for subindex 01h.)						
⋮		⋮						
Sub−Index **0Ch**	**12th mapped object**							
	Range	0 to 4,294,967,295	Unit	−	Type	U32	Access	RW
	Default	0	OP−mode	ALL	PDO mapping	No		
	Description	Set the 12th object to be mapped. (The setting method is the same as for subindex 01h.)						

1A05h	**Transmit PDO Mapping 6**							
	Description	This object is used to configure the "TxPDO mapping 6".						
Sub−Index **00h**	**Number of Entries**							
	Range	0 to 12	Unit	−	Type	U8	Access	RW
	Default	2	OP−mode	ALL	PDO mapping	No		
	Description	Number of entries in PDO mapping 6						
Sub−Index **01h**	**1st mapped object**							
	Range	0 to 4,294,967,295	Unit	−	Type	U32	Access	RW
	Default	0x60410010 CiA402 control word (0x6041)	OP−mode	ALL	PDO mapping	No		
	Description	Set the first object to be mapped.						

bit functions

bit	31 ··· 16	15 ··· 8	7 ··· 0
	Index number	Sub-index number	Bit length

Sub−Index **02h**	**2nd mapped object**							
	Range	0 to 4,294,967,295	Unit	−	Type	U32	Access	RW
	Default	0x606C0010 CiA402 mode of operation display(0x606C)	OP−mode	ALL	PDO mapping	No		
	Description	Set the second object to be mapped. (The setting method is the same as for subindex 01h.)						
⋮		⋮						
Sub−Index **0Ch**	**12th mapped object**							
	Range	0 to 4,294,967,295	Unit	−	Type	U32	Access	RW
	Default	0	OP−mode	ALL	PDO mapping	No		
	Description	Set the 12th object to be mapped. (The setting method is the same as for subindex 01h.)						

1C00h	**Sync Manager Communication Type**							
	Description	This object is used to configure the mode to which each Sync Manager is to be assigned.						
Sub−Index **00h**	**Number of Used Sync Manager Channels**							
	Range	0 to 255	Unit	–	Type	U8	Access	RO
	Default	6	OP−mode	ALL	PDO mapping		No	
	Description	Number of objects used (Fixed value **6**)						
Sub−Index **01h**	**Sync Manager Communication Type 0**							
	Range	0 to 4	Unit	–	Type	U8	Access	RO
	Default	1	OP−mode	ALL	PDO mapping		No	
	Description	Sync Manager 0 is assigned to "Receiving mailbox".						
Sub−Index **02h**	**Sync Manager Communication Type 1**							
	Range	0 to 4	Unit	–	Type	U8	Access	RO
	Default	2	OP−mode	ALL	PDO mapping		No	
	Description	Sync Manager 1 is assigned to "Sending mailbox".						
Sub−Index **03h**	**Sync Manager Communication Type 2**							
	Range	0 to 4	Unit	–	Type	U8	Access	RO
	Default	3	OP−mode	ALL	PDO mapping		No	
	Description	Sync Manager 2 is assigned to "Process data output (RxPDOx - master to slave)".						
Sub−Index **04h**	**Sync Manager Communication Type 3**							
	Range	0 to 4	Unit	–	Type	U8	Access	RO
	Default	4	OP−mode	ALL	PDO mapping		No	
	Description	Sync Manager 3 is assigned to "Process data input (TxPDOx - slave to master)".						
Sub−Index **05h**	**Sync Manager Communication Type 4**							
	Range	0 to 4	Unit	–	Type	U8	Access	RO
	Default	3	OP−mode	ALL	PDO mapping		No	
	Description	Sync Manager 4 is assigned to "Process data output (RxPDOx - master to slave)."						
Sub−Index **06h**	**Sync Manager Communication Type 5**							
	Range	0 to 4	Unit	–	Type	U8	Access	RO
	Default	4	OP−mode	ALL	PDO mapping		No	
	Description	Sync Manager 5 is assigned to "Process data input (TxPDOx - slave to master)".						

1C10h	**Sync Manager 0 PDO Assignment**							
Sub-Index **00h**	Range	0	Unit	–	Type	U8	Access	RO
	Default	0	OP-mode	ALL	PDO mapping	No		
	Description	The Sync Manager 0 is used to synchronize the receiving of mailboxes, therefore unable to assign PDOs.						

1C11h	**Sync Manager 1 PDO Assignment**							
Sub-Index **00h**	Range	0	Unit	–	Type	U8	Access	RO
	Default	0	OP-mode	ALL	PDO mapping	No		
	Description	The Sync Manager 1 is used to synchronize the sending of mailboxes, therefore unable to assign PDOs.						

1C12h	**Sync Manager 2 PDO Assignment**							
	Description	This object is used to configure the object to be assigned to Sync Manager2.						
Sub-Index **00h**	**Number of Assigned PDOs**							
	Range	0 to 1	Unit	–	Type	U8	Access	RW
	Default	1	OP-mode	ALL	PDO mapping	No		
	Description	Number of object assigned (Fixed value **1**)						
Sub-Index **01h**	**PDO Mapping Object Index of Assigned RxPDO**							
	Range	1600h to 1605h	Unit	–	Type	U8	Access	RW
	Default	1602h	OP-mode	ALL	PDO mapping	No		
	Description	An object to be assigned to Sync Manager 2.						

1C13h	**Sync Manager 3 PDO Assignment**							
	Description	This object is used to configure the object to be assigned to Sync Manager3.						
Sub-Index **00h**	**Number of Assigned PDOs**							
	Range	0	Unit	–	Type	U8	Access	RW
	Default	0	OP-mode	ALL	PDO mapping	No		
	Description	Number of object assigned (Fixed value **1**)						
Sub-Index **01h**	**PDO Mapping Object Index of Assigned TxPDO**							
	Range	1A00h to 1A05h	Unit	–	Type	U8	Access	RW
	Default	1A02h	OP-mode	ALL	PDO mapping	No		
	Description	An object to be assigned to Sync Manager 3.						

1C14h	**Sync Manager 4 PDO Assignment**						
Sub-Index **00h**	Range	0 to 1	Unit	–	Type	U8	Access RO
	Default	0	OP-mode	ALL	PDO mapping	No	
	Description	Unable to assign PDO to Sync Manager 4.					

1C15h	**Sync Manager 5 PDO Assignment**						
Sub-Index **00h**	Range	0	Unit	–	Type	U8	Access RO
	Default	0	OP-mode	ALL	PDO mapping	No	
	Description	Unable to assign PDO to Sync Manager 5.					

1C32h	**Sync Manager 2 synchronization**							
	Description	This object is used to monitor the configuration of Sync Manager 2.						
Sub-Index **00h**	**Number of Entries**							
	Range	0 to 255	Unit	–	Type	U8	Access	RO
	Default	0Ch	OP-mode	ALL	PDO mapping	No		
	Description	Number of entries (Fixed value **0Ch**)						
Sub-Index **01h**	**Sync Mode**							
	Range	0 to 65,535	Unit	–	Type	U16	Access	RO
	Default	–	OP-mode	ALL	PDO mapping	No		
	Description	Indicates the sync mode of Sync Manager 2. **00h**: Free Run **02h**: DC SYNC0						
Sub-Index **02h**	**Cycle Time**							
	Range	0 to 4,294,967,295	Unit	ns	Type	U32	Access	RO
	Default	–	OP-mode	ALL	PDO mapping	No		
	Description	Indicates the control period of the Sync Manager 2. **250,000**(250μs), **500,000**(500μs), **1,000,000**(1ms), **2,000,000**(2ms), or **4,000,000**(4ms)						
Sub-Index **03h**	**–**							
	Range	–	Unit	–	Type	–	Access	–
	Default	–	OP-mode	–	PDO mapping	–		
	Description	(Not supported)						
Sub-Index **04h**	**Sync Mode Supported**							
	Range	0 to 65,535	Unit	–	Type	U16	Access	RO
	Default	5	OP-mode	ALL	PDO mapping	No		
	Description	Indicates the supported synchronization type. In this servo amplifier, each setting is underlined in the table below.						

bit	Supported sync modes	Value and Description
0	**FreeRun**	0: Not supported 1: FreeRun mode
1	**SM Sync Mode**	0: Not supported 1: SM2 Event Sync
2-4	**DC Sync**	000b: Not supported 001b: DC sync0 event
5,6	**Output shift**	00b:Not supported 01b: Shift to local timer
7-15	**Not Use**	(Rsv.)

1C32h	**Sync Manager 2 synchronization**							
	Description	(Continued from previous page)						
Sub−Index **05h**	**Minimum Cycle Time**							
	Range	0 to 4,294,967,295	Unit	ns	Type	U32	Access	RO
	Default	250,000	OP−mode	ALL	PDO mapping	No		
	Description	This is the minimum value until the writing is completed. (Fixed at 250,000)						
Sub−Index **06h-09h**	**−**							
	Range	−	Unit	−	Type	−	Access	−
	Default	−	OP−mode	−	PDO mapping	−		
	Description	(Not supported)						
Sub−Index **0Ah**	**Sync0 Cycle Time**							
	Range	0 to 4,294,967,295	Unit	ns	Type	U32	Access	RO
	Default	−	OP−mode	ALL	PDO mapping	No		
	Description	Indicates the value of ESC register 09A0h when DC SYNC0 (installation value of 1C32h-01h is 02h) is set.						
Sub−Index **0Bh-0Ch**	**−**							
	Range	−	Unit	−	Type	−	Access	−
	Default	−	OP−mode	−	PDO mapping	−		
	Description	(Not supported)						

1C33h	Sync Manager 3 synchronization							
	Description	This object is used to monitor the configuration of Sync Manager 3.						
Sub−Index 00h	Number of Entries							
	Range	0 to 255	Unit	−	Type	U8	Access	RO
	Default	0Ch	OP−mode	ALL	PDO mapping	No		
	Description	Number of entries (Fixed value **0Ch**)						
Sub−Index 01h	Sync Mode							
	Range	0 to 65,535	Unit	−	Type	U16	Access	RO
	Default	−	OP−mode	ALL	PDO mapping	No		
	Description	Indicates the sync mode of Sync Manager 3. **00h**: Free Run **02h**: DC SYNC0						
Sub−Index 02h	Cycle Time							
	Range	0 to 4,294,967,295	Unit	ns	Type	U32	Access	RO
	Default	−	OP−mode	ALL	PDO mapping	No		
	Description	Indicates the control period of the Sync Manager 3. **250,000**(250μs), **500,000**(500μs), **1,000,000**(1ms), **2,000,000**(2ms), or **4,000,000**(4ms)						
Sub−Index 03h	−							
	Range	−	Unit	−	Type	−	Access	−
	Default	−	OP−mode	−	PDO mapping	−		
	Description	(Not supported)						
Sub−Index 04h	Sync Mode Supported							
	Range	0 to 65,535	Unit	−	Type	U16	Access	RO
	Default	5	OP−mode	ALL	PDO mapping	No		
	Description	Indicates the supported synchronization type. In this servo amplifier, each setting is underlined in the table below.						

bit	Supported sync modes	Value and Description
0	FreeRun	0: Not supported **1: FreeRun mode**
1	SM Sync Mode	**0: Not supported** 1: SM2 Event Sync
2-4	DC Sync	000b: Not supported **001b: DC sync0 event**
5,6	Input shift	**00b:Not supported** 01b: Shift to local timer
7-15	Not Use	(Rsv.)

1C33h	**Sync Manager 3 synchronization**							
	Description	(Continued from previous page)						
Sub−Index **05h**	**Minimum Cycle Time**							
	Range	0 to 4,294,967,295	Unit	ns	Type	U32	Access	RO
	Default	250,000	OP−mode	ALL	PDO mapping		No	
	Description	This is the minimum value until the writing is completed. (Fixed at 250,000)						
Sub−Index **06h-09h**	**−**							
	Range	−	Unit	−	Type	−	Access	−
	Default	−	OP−mode	−	PDO mapping		−	
	Description	(Not supported)						
Sub−Index **0Ah**	**Sync0 Cycle Time**							
	Range	0 to 4,294,967,295	Unit	ns	Type	U32	Access	RO
	Default	−	OP−mode	ALL	PDO mapping		No	
	Description	Indicates the value of ESC register 09A0h when DC SYNC0 (installation value of 1C33h-01h is 02h) is set.						
Sub−Index **0Bh-0Ch**	**−**							
	Range	−	Unit	−	Type	−	Access	−
	Default	−	OP−mode	−	PDO mapping		−	
	Description	(Not supported)						

2. Manufacturer Specific Profile Area (2000h-4000h)

200Ch Warning Latch Time

Sub-Index								
00h	Range	0 to 200	Unit	50ms	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		

Description

This object is used to specify the length of latch time for warning output.

Corresponding amplifier parameters... No.12.0

No.12.0 : Warning latch time

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

200Dh Timing for Alarm Output

Sub-Index								
00h	Range	0 to 1	Unit	–	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		

Description

This object is used to specify when to output an alarm.

Corresponding amplifier parameters... No.13.0

No.13.0 : Timing for alarm output

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

2020h Position Control Mode Setting 1

Sub-Index								
00h	Range	0 to 65,535	Unit	–	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		

Description

This object is used to configure the parameters for the Position control mode.

Corresponding amplifier parameters... No.32.1 and No.32.2

bit functions

bit	15 … 12	11 … 8	7 … 4	3 … 0
	Not Use	No.32.2	No.32.1	Not Use

No.32.1 : Position command - Rotational direction

Settings	Rotational direction
0	CW rotation by incrementing the position command
1	CCW rotation by incrementing the position command

No.32.2 : Position command - Auto interpolations for paired ratio

Settings	Interpolation with pulse ratio
0	Disable
1	Enable

2021h Position Control Mode Setting 2

Sub−Index **00h**

Range	0 to 65,535	Unit	−	Type	U16	Access	RW
Default	N/A	OP−mode	ALL	PDO mapping	No		

Description

This object is used to configure the parameters for the Position control mode.

Corresponding amplifier parameters… No.33.1

bit functions

bit	15 ··· 12	11 ··· 8	7 ··· 4	3 ··· 0
	Not Use	Not Use	No.33.1	Not Use

No.32.1 : Wraparound Switch

Settings	Wraparound function
0	Disable
1	Enable

203Eh Velocity Control Mode Setting

Sub−Index **00h**

Range	0 to 65,535	Unit	−	Type	U16	Access	RW
Default	N/A	OP−mode	ALL	PDO mapping	No		

Description

This object is used to configure the parameters for the Velocity control mode.

Corresponding amplifier parameters… No.62.0

bit functions

bit	15 ··· 12	11 ··· 8	7 ··· 4	3 ··· 0
	Not Use			No.62.0

No.62.0 : **Velocity command - Rotational direction**

Settings	Rotational direction (at a Forward speed command input)
0	CW Rotation
1	CCW Rotation

2041h Deviation Error Detection Setting

Range	0 to 65,535	Unit	–	Type	U16	Access	RW
Default	N/A	OP-mode	ALL	PDO mapping	No		

Sub-Index
00h

Description

This object is used to configure the parameters for the position deviation detection.

Corresponding amplifier parameters… No.65.0 and No.65.1

bit functions

bit	15 ··· 12	11 ··· 8	7 ··· 4	3 ··· 0
	Not Use		No.65.1	No.65.0

No.65.0 : Position deviation excess detection - Switch

Settings	Behavior when detecting the error.
0	No detection (no output)
1	Output an alarm
2	Output a warning
3	Output both alarm and warning

No.65.1 : Speed deviation error detection - Switch

Settings	Speed deviation error detection
0	Disable
1	Enable

2042h Position Control Mode Setting 2

Range	0 to 65,535	Unit	–	Type	U16	Access	RW
Default	N/A	OP-mode	ALL	PDO mapping	No		

Sub-Index
00h

Description

This object is used to configure the parameters for the position control mode.

Corresponding amplifier parameters… No.66.0 , No.66.3

bit functions

bit	15 ··· 12	11 ··· 8	7 ··· 4	3 ··· 0
	No.66.3	Not Use		No.66.0

No.66.0 : Position command filter 1 - Type

Settings	Filter type to be applied
0	No filter
1	Smoothing Filter 1
2	Notch filter
3	γ -Notch Filter

No.66.3 : Feedforward delay compensation

Settings	Feed forward delay compensation
0	Disable
1	Enable

2043h Drive Restriction Input

Range	0 to 65,535	Unit	–	Type	U16	Access	RW
Default	N/A	OP–mode	ALL	PDO mapping	No		

Sub–Index **00h**

Description

This object is used to configure the parameter for the Drive restriction input.

Corresponding amplifier parameters... No.67.0 to No.67.3

bit functions

bit	15 ··· 12	11 ··· 8	7 ··· 4	3 ··· 0
	No.67.3	No.67.2	No.67.1	No.67.0

No.67.0 : **Drive restriction input - Setup**

Settings	CW Drive restriction	CCW Drive restriction
0	Disable	Disable
1	Enable	Disable
2	Disable	Enable
3	Enable	Enable

No.67.1 : **Drive restriction input - Deceleration method**

No.67.2 : **Drive restriction input - Standstill sate**

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: Immediate Stop	1: Zero Clamp
4		0: Free Run

No.67.3 : **Drive restriction input - Keep position deviation counter**

Settings	Position Deviation Counter
0	Holding
1	Clearing

204Ah	Position Command Filter 1 **Notch Frequency**						
Sub−Index 00h	Range	10 to 3,000	Unit	0.1Hz	Type	U16	Access RW
	Default	N/A	OP−mode	ALL	PDO mapping	No	
	Description	This object is used to set the notch frequency of the position command filter 1. Corresponding amplifier parameters... No.74.0					

204Bh	Position Command Filter 1 **Notch Width**						
Sub−Index 00h	Range	128 to 2,048	Unit	−	Type	U16	Access RW
	Default	N/A	OP−mode	ALL	PDO mapping	No	
	Description	This object is used to set the width of the notch frequency of the position command filter 1. Corresponding amplifier parameters... No.75.0					

204Ch	Position Command Filter 1 **High Frequency Gain**						
Sub−Index 00h	Range	10 to 2,000	Unit	−	Type	U16	Access RW
	Default	N/A	OP−mode	ALL	PDO mapping	No	
	Description	This object is used to set the high-frequency gain of the position command filter 1. Corresponding amplifier parameters... No.76.0					

204Fh	Position Command Filter 1 **Notch Depth**						
Sub−Index 00h	Range	0 to 100	Unit	−	Type	U16	Access RW
	Default	N/A	OP−mode	ALL	PDO mapping	No	
	Description	This object is used to set the notch depth of the position command filter 1. Corresponding amplifier parameters... No.79.0					

2050h Position Command Smoothing Filter 1
Moving Average Order

Sub-Index 00h	Range	1 to 6,250	Unit	–	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		

Description

This object is used to set the moving average count for position command filter 1 "Smoothing 1.

Corresponding amplifier parameters... No.80.0

2052h Position Command Filter 2
Type

Sub-Index 00h	Range	0 to 65,535	Unit	–	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		

Description

This object is used to configure the position command filters.

Corresponding amplifier parameters... No.82.0 , No.82.1

bit functions

bit	15 ··· 12	11 ··· 8	7 ··· 4	3 ··· 0
	Not use		No.82.1	No.82.0

No.82.0 : Position command filter 2 - Type

No.82.1 : Position command filter 3 - Type

Settings	Filter type to be applied
0	No filter
1	Reserved (Do not use)
2	Notch filter
3	γ -Notch Filter

2053h Position Command Filter 2
Notch Frequency

Sub-Index 00h	Range	10 to 3,000	Unit	0.1Hz	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		

Description

This object is used to set the notch frequency of the position command filter 2.

Corresponding amplifier parameters... No.83.0

2054h	Position Command Filter 2 **Notch Width**							
Sub−Index 00h	Range	128 to 2,048	Unit	–	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the width of the notch frequency of the position command filter 2. Corresponding amplifier parameters... No.84.0						

2055h	Position Command Filter 2 **High Frequency Gain**							
Sub−Index 00h	Range	50 to 200	Unit	–	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the high-frequency gain of the position command filter 2. Corresponding amplifier parameters... No.85.0						

2056h	Position Command Filter 2 **Notch Depth**							
Sub−Index 00h	Range	0 to 100	Unit	–	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the notch depth of the position command filter 2. Corresponding amplifier parameters... No.86.0						

205Ah	Speed Deviation Error Detection **Value**							
Sub−Index 00h	Range	0 to 32,767	Unit	pulse/100μs	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the speed deviation error detection value. Corresponding amplifier parameters... No.90.0						

205Bh Speed Deviation Error Detection Delay Time

Sub−Index 00h	Range	0 to 32,767	Unit	100μs	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the speed deviation error detection time. Corresponding amplifier parameters... No.91.0						

2066h Inertia Ratio

Sub−Index 00h	Range	100 to 10,000	Unit	%	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the inertia ratio. Corresponding amplifier parameters... No.102.0						

2067h Damping Ratio

Sub−Index 00h	Range	10 to 5,000	Unit	%	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the damper ratio. Corresponding amplifier parameters... No.103.0						

206Ah Tuning Inertia Ratio Upper Limit

Sub−Index 00h	Range	100 to 10,000	Unit	%	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the upper limit of the inertia ratio. Corresponding amplifier parameters... No.106.0						

206Eh Tuning Setting 1

Range	0 to 65,535	Unit	–	Type	U16	Access	RW
Default	N/A	OP-mode	ALL	PDO mapping	No		

Sub-Index **00h**

Description

This object is used to configure the settings for the tuning.

Corresponding amplifier parameters... No.110.0 , No.110.1

bit functions

bit	15 ··· 12	11 ··· 8	7 ··· 4	3 ··· 0
	Not use		No.110.1	No.110.0

No.110.0 : **Tuning - Mode switch**

Settings	Modes	Motion direction of the device connected to the motor
1	Standard	Horizontal
2	Offset Load	Non-horizontal

Use the Offset Load mode even in horizontal operation without offset load.

No.110.1 : **Tuning - Tuning option**

Settings (Tuning status)	Items to be estimated	
	Inertia ratio	Damping ratio
0 (Stop)	No estimate.	No estimate.
1 (Start)	Estimating.	
2 (Start)		Estimating.

2071h Position mode setting3 (Tuning Setting 2)

Range	0 to 65,535	Unit	–	Type	U16	Access	RW
Default	N/A	OP-mode	ALL	PDO mapping	No		

Sub-Index **00h**

Description

This object is used to configure the settings for the tuning.

Corresponding amplifier parameters... No.113.0

bit functions

bit	15 ··· 12	11 ··· 8	7 ··· 4	3 ··· 0
	Not use		No.113.0	

No.113.0 : **Position control - Control gain set**

Specifies the control gain set in the position control mode.

Settings	Command Response	Rigidity	Settling Time	Possibility of Noise
5	Slower	Lower	Longer	Lower
↕	↕	↕	↕	↕
45	Faster	Higher	Shorter	Higher

2072h Position Control Mode
Control Level

Sub−Index								
00h	Range	5 to 45	Unit	–	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the control level in the position control mode. Corresponding amplifier parameters… No.114.0						

2073h Position Control Mode
Control Gain 1

Sub−Index								
00h	Range	5 to 1,000	Unit	rad/s	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the "Control Gain 1" in the position control mode. Corresponding amplifier parameters… No.115.0						

2074h Position Control Mode
Control Gain 2

Sub−Index								
00h	Range	80 to 5,000	Unit	rad/s	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the "Control Gain 2" in the position control mode. Corresponding amplifier parameters… No.116.0						

2075h Position Control Mode
Gain FF Compensation1

Sub−Index								
00h	Range	0 to 15,000	Unit	0.01%	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the "Gain FF Compensation 1" in the position control mode. Corresponding amplifier parameters… No.117.0						

2076h Position Control Mode
Gain FF Compensation2

Sub−Index 00h	Range	0 to 15,000	Unit	0.01%	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the "Gain FF Compensation 2" in the position control mode. Corresponding amplifier parameters… No.118.0						

2077h Position Control Mode
Integral Gain

Sub−Index 00h	Range	45 to 5,000	Unit	rad/s	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the "Integral gain" in the position control mode. Corresponding amplifier parameters… No.119.0						

2078h Tuning
Control Gain Set Upper Limit

Sub−Index 00h	Range	5 to 45	Unit	–	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the settings for the tuning. Corresponding amplifier parameters… No.120.1						

bit functions

bit	15 … 12	11 … 8	7 … 4	3 … 0
	Not use	No.120.1		Not use

No.120.1 : Tuning - Control gain set upper limit

Specifies the control gain set upper limit value for auto-tuning.

This parameter is used in amplifier version 6.0.3.0 or earlier.
It is not used in versions 6.0.3.1 and later.

2079h

Tuning

Tuning Constant

Sub-Index **00h**	Range	1 to 200	Unit	–	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		
	Description	This object is used to set the "Tuning Constant" for the control gain set. Corresponding amplifier parameters... **No.121.0**						

2081h

Velocity Control Mode

Control Gain Set

Sub-Index **00h**	Range	1 to 46	Unit	–	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		
	Description	This object is used to set the "Control Gain Set" for the velocity control mode. Corresponding amplifier parameters... **No.129.0**						

2082h

Velocity Control Mode

Control Level

Sub-Index **00h**	Range	1 to 46	Unit	–	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		
	Description	This object is used to set the "Control Level" in the velocity control mode. Corresponding amplifier parameters... **No.130.0**						

2083h

Velocity Control Mode

Control Gain 1

Sub-Index **00h**	Range	100 to 6,000	Unit	rad/s	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		
	Description	This object is used to set the "Control Gain 1" in the velocity control mode. Corresponding amplifier parameters... **No.131.0**						

2084h Velocity Control Mode

Gain FF Compensation 1

Sub−Index								
00h	Range	0 to 15,000	Unit	0.01%	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the "Gain FF compensation 1" in the velocity control mode. Corresponding amplifier parameters… No.132.0						

2085h Velocity Control Mode

Integral Gain

Sub−Index								
00h	Range	45 to 5,000	Unit	rad/s	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the "Integral gain" in the velocity control mode. Corresponding amplifier parameters… No.133.0						

2092h

Torque command offset

Sub−Index								
00h	Range	−1,000 to 1,000	Unit	0.1%	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the torque command offset value. Corresponding amplifier parameters… No.146.0						

20A0h Torque command filter setting

Range	0 to 65,535	Unit	–	Type	U16	Access	RW
Default	N/A	OP–mode	ALL	PDO mapping	No		

Sub–Index **00h**

Description

This object is used to configure the torque command filter.

Corresponding amplifier parameters... No.160.0 to No.160.3

bit functions

bit	15 ··· 12	11 ··· 8	7 ··· 4	3 ··· 0
	No.160.3	No.160.2	No.160.1	No.160.0

No.160.0 : Torque command filter - Low-pass filter switch

Sets the low-pass filter (first-order IIR filter).

Settings	Low-pass filter
0	Disable
1	Enable

No.160.1 : Torque command filter - Notch filter switch

Sets the notch filter.

Settings	Notch filter
0	Disable
1	Enable

No.160.2 : Torque command filter - Auto setting

Sets the Auto setting for the time constant of the low-pass filter.

Settings	Auto setting
0	Auto setting OFF
1	Auto setting ON

No.160.3 : Torque command filter 2 - Notch filter switch

Sets the notch filter 2.

Settings	Torque command- Notch filter 2
0	Disable
1	Enable

20A2h Torque Command Filter Low-pass Filter Time Constant

Range	0 to 65,535	Unit	0.01ms/rad	Type	U16	Access	RW
Default	N/A	OP–mode	ALL	PDO mapping	No		

Sub–Index **00h**

Description

This object is used to set the time constant of the torque command low-pass filter.

Corresponding amplifier parameters... No.162.0

20A8h	Torque Command Filter **Notch Filter Frequency**							
Sub−Index 00h	Range	0 to 2,500	Unit	Hz	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the notch frequency of the torque command notch filter. Corresponding amplifier parameters… No.168.0						

20A9h	Torque Command Filter **Notch Filter Width**							
Sub−Index 00h	Range	1 to 16	Unit	−	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the width of the torque command notch filter. Corresponding amplifier parameters… No.169.0						

20AAh	Torque Command Filter **Notch Filter Depth**							
Sub−Index 00h	Range	0 to 256	Unit	−	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the depth of the torque command notch filter. Corresponding amplifier parameters… No.170.0						

20ABh	Torque Command Filter **Notch Filter2 Frequency**							
Sub−Index 00h	Range	0 to 2,500	Unit	Hz	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the notch frequency of the torque command notch filter 2. Corresponding amplifier parameters… No.171.0						

20ACh Torque Command Filter
Notch Filter2 Width

Sub−Index 00h	Range	1 to 16	Unit	−	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the width of the torque command notch filter 2. Corresponding amplifier parameters… No.172.0						

20ADh Torque Command Filter
Notch Filter2 Depth

Sub−Index 00h	Range	0 to 256	Unit	−	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the depth of the torque command notch filter 2. Corresponding amplifier parameters… No.173.0						

20C1h Tuning
Current Control Gain

Sub−Index 00h	Range	0 to 1	Unit	−	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the gain level of the current controller. Corresponding amplifier parameters… No.193.0						

Settings	Level	Noise	Response
0	Standard	More	Faster
1	Low	Less	Slower

20E0h Deceleration and Stop Setting

Range	0 to 65,535	Unit	–	Type	U16	Access	RW
Default	N/A	OP–mode	ALL	PDO mapping	No		

Sub–Index 00h

Description

This object is used to configure the Deceleration Stop setting.

Corresponding amplifier parameters... No.224.0 to No.224.3

bit functions

bit	15 … 12	11 … 8	7 … 4	3 … 0
	No.224.3	No.224.2	No.224.1	No.224.0

No.224.0 : Deceleration stop - Method (at Servo Off)

Specifies the deceleration stop method when the servo is turned off during the motor operation.

Settings	Descriptions
0	F RUN Free run
1	S STOP Short brake
2	P STOP Immediate stop
3	D STOP Dynamic brake

No.224.1 : Deceleration stop - Release condition

When an alarm occurs or the servo-ON signal turns OFF, sets the cause to release the "deceleration stop" state of the motor that is being decelerated by the stop method set in the deceleration stop method (No.224.0).

Settings	Working time No.226.0	Rotational speed to end deceleration stop No.227.0
0	○	–
1	○	○

In case of set value = 1, the decelerating stop condition is released when either condition is satisfied earlier.

No.224.2 : Deceleration stop - Switch (in case of control power error)

Selects Enable/Disable of deceleration stop when a Power supply error (Error32) occurs.

Settings	Deceleration stop
0	Disable
1	Enable

No.224.3 : Deceleration stop - DBRK output after deceleration stop (at Servo Off)

Specifies the "stop state" during servo-off.

Settings	Descriptions
0	F RUN Free run
1	D STOP Dynamic brake

20E1h Emergency stop setting

Range	0 to 65,535	Unit	–	Type	U16	Access	RW
Default	N/A	OP−mode	ALL	PDO mapping	No		

Sub−Index **00h**

Description

This object is used to configure the emergency stop settings.

Corresponding amplifier parameters... No.225.0 to No.225.2

bit functions

bit	15 ··· 12	11 ··· 8	7 ··· 4	3 ··· 0
	Not use	No.225.2	No.225.1	No.225.0

No.225.0 : **Emergency stop - Warning output switch**

Selects whether or not to output a warning when an E-STOP (emergency stop) signal is input.

Settings	Warning output
0	Disable
1	Enable

No.225.1 : **Emergency stop - Timing for alarm output**

Selects the timing for warning output when the E-STOP (emergency stop) signal is input.

Settings	Warning output timing
0	After the motor makes a deceleration stop
1	Immediately after the warning occurs

No.225.2 : **Immediate stop - Smoothing filter switch**

Selects whether or not to use the velocity command smoothing filter during the execution of an immediate stop.

Settings	Velocity Command smoothing filter
0	Disable
1	Enable

20E2h

Deceleration stop

Working time

Sub−Index 00h	Range	0 to 16,383	Unit	100μs	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the execution time of "deceleration stop" for the motor in deceleration. Corresponding amplifier parameters… No.226.0						

20E3h

Deceleration stop

Rotational speed to end

Sub−Index 00h	Range	0 to 32,767	Unit	pulse/100μs	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the rotational speed of the motor to release the "deceleration stop state" during deceleration. Corresponding amplifier parameters… No.227.0						

20E4h

Deceleration stop

Working time (in case of control power error)

Sub−Index 00h	Range	0 to 16,383	Unit	100μs	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the execution time of "deceleration stop" when a control power failure alarm occurs. Corresponding amplifier parameters… No.228.0						

20E5h

Immediate stop

Average Counter for Smoothing Filter

Sub−Index 00h	Range	1 to 1,000	Unit	−	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the number of moving average times of the speed command smoothing filter during "Immediate stop" execution. Corresponding amplifier parameters… No.229.0						

20E8h Deceleration and Stop Setting 2

Range	0 to 65,535	Unit	–	Type	U16	Access	RW
Default	N/A	OP–mode	ALL	PDO mapping		No	

Sub–Index **00h**

Description

This object is used to configure the deceleration stop setting.

Corresponding amplifier parameters... No.232.1 to No.232.3

bit functions

bit	15 ··· 12	11 ··· 8	7 ··· 4	3 ··· 0
	No.232.3	No.232.2	No.232.1	Not use

No.232.1 : Deceleration stop - Deceleration stop state during free-run

Switches on/off the "deceleration stop" state during free-run.

Settings	Handling of the "deceleration stop" state
0	OFF (not consider as deceleration stop) NOT Recommended
1	ON (consider as deceleration stop)

No.232.2 : Immediate stop - Short brake after the stop

Sets whether or not to use the short brake even after an immediate stop.

Settings	Short braking
0	Enable
1	Disable

No.232.3 : Deceleration stop - Timing for braking

For motors with a brake, sets the timing at which the brake is engaged.

(Set the timing at which MBRK (brake release) is opened.)

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).

20E9h Deceleration and Stop Setting 3

Sub-Index 00h

Range	0 to 65,535	Unit	–	Type	U16	Access	RW
Default	N/A	OP-mode	ALL	PDO mapping	No		

Description

This object is used to configure the deceleration stop setting.

Corresponding amplifier parameters... No.233.0 and No.233.3

bit functions

bit	15 ··· 12	11 ··· 8	7 ··· 4	3 ··· 0
	No.233.3	Not use		No.233.0

No.233.0 : Deceleration stop - Method (in case of alarm)

Selects the deceleration stop method when an alarm occurs during motor rotation.

☞ C–2 Parameter

No.233.3 : Deceleration stop - DBRK output after the stop (in case of alarm)

Specify the stopped state in the case of alarming.

Settings	Stopped state
0	F RUN Free run
1	D STOP Dynamic brake

20EAh Deceleration Stop Delay Time for Braking

Sub-Index 00h

Range	0 to 65,535	Unit	100µs	Type	U16	Access	RW
Default	N/A	OP-mode	ALL	PDO mapping	No		

Description

This object is used to set the delay time for brake actuating for a deceleration stop.

Corresponding amplifier parameters... No.234.0

20EBh Deceleration stop Rotational Speed on Braking

Sub-Index 00h

Range	0 to 32,767	Unit	pulse/100µs	Type	U16	Access	RW
Default	N/A	OP-mode	ALL	PDO mapping	No		

Description

This object is used to set the motor rotational speed at which the brake is activated for a deceleration stop.

Corresponding amplifier parameters... No.235.0

20ECh Immediate Stop Time Extension

Sub−Index 00h	Range	0 to 3,125	Unit	100µs	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the holding time of the "immediate stop state" after deceleration stop. Corresponding amplifier parameters… No.236.0						

20EDh Delay Time for Servo Off

Sub−Index 00h	Range	0 to 3,125	Unit	100µs	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the delay time until servo-off. Corresponding amplifier parameters… No.237.0						

20EEh Delay Time for Mechanical Brake Release

Sub−Index 00h	Range	0 to 3,125	Unit	100µs	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the delay time until the brake is released. Corresponding amplifier parameters… No.238.0						

20EFh Immediate stop − Decelerating time

Sub−Index 00h	Range	0 to 100	Unit	ms	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the deceleration time for immediate stop. Corresponding amplifier parameters… No.239.0						

2101h	Absolute System							
Sub−Index 00h	Range	0 to 2	Unit	−	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to select either Absolute system or Incremental system. Corresponding amplifier parameters… No.257.0						

2103h	Encoder Error Detection Output Switch							
Sub−Index 00h	Range	0 to 65,535	Unit	−	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description							

This object is used to configure the encoder error detection.

Corresponding amplifier parameters… No.259.0 and No.259.1

bit functions

bit	15 … 12	11 … 8	7 … 4	3 … 0
	Not use		No.259.1	No.259.0

No.259.0 : Encoder - Overheat detection output switch

Specifies the signal to be output when the encoder over temperature is detected.

Settings	Behavior when detecting encoder overtemperature
0	No alarms or warnings are output.
1	Output a warning
2	Output an alarm

No.259.1 : Encoder - Low battery voltage detection output switch

Sets the output signal when the encoder battery voltage drop is detected.

Settings	Behavior when detecting encoder battery voltage drop
0	No warning output.
1	Output a warning

210Bh Encoder Temperature to Detect Overheat

Sub-Index								
00h	Range	0 to 127	Unit	℃	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		
	Description	This object is used to set the threshold for detecting encoder overtemperature. Corresponding amplifier parameters… No.267.0						

210Ch Encoder Voltage to Detect Low Battery Voltage

Sub-Index								
00h	Range	0 to 100	Unit	0.1V	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		
	Description	This object is used to set the threshold for detecting encoder battery voltage drop. Corresponding amplifier parameters… No.268.0						

212Eh Torque Control Mode setting

Sub-Index								
00h	Range	0 to 65,535	Unit	–	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		
	Description	This object is used to configure the torque control mode settings. Corresponding amplifier parameters… No.302.0						

bit functions

bit	15 … 12	11 … 8	7 … 4	3 … 0
	Not use			No.302.0

No.302.0 : EtherCAT Communication Torque command - Rotation direction

Settings	Forward command	Backward command
0	CW Rotation	CCW Rotation
1	CCW Rotation	CW Rotation

2130h

Basic Setting

Main Circuit Power

Sub−Index **00h**

Range	0 to 65,535	Unit	−	Type	U16	Access	RW
Default	N/A	OP−mode	ALL	PDO mapping	No		

Description

This object is used to configure the main circuit power input.

Corresponding amplifier parameters... No.304.0 .

bit functions

bit	15 ··· 12	11 ··· 8	7 ··· 4	3 ··· 0
	Not use			No.304.0

No.304.0 : AC ／ DC

Select the main circuit power to be input to the amplifier.

Settings	Input Power Supply
0	AC power supply
1	DC power supply
2-5	DO NOT set it.

2131h

Voltage Sag Detection

Delay time

Sub−Index **00h**

Range	20 to 50,000	Unit	ms	Type	U16	Access	RW
Default	N/A	OP−mode	ALL	PDO mapping	No		

Description

This object is used to set the delay time to voltage sag of the primary circuit power supply.

Corresponding amplifier parameters... No.305.0

2152h Logical Input Masking Configuration

Range	0 to 4,294,697,295	Unit	ms	Type	U32	Access	RW
Default	N/A	OP−mode	ALL	PDO mapping	No		

Sub−Index **00h**

Description

This object is used to set the enable/disable of the signal input to I/O.

(If configured as disabled, monitoring with 60FDh is also disabled.)

bit functions

bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
	N/A															
bit	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
	N/A								I8	I7	I6	I5	I4	I3	I2	N/A

bit	I/O pin name & functions	
1	I2	Positive limit switch
2	I3	Negative limit switch
3	I4	Home switch
4	I5	External latch1
5	I6	External latch2
6	I7	Reset alarm
7	I8	Emergency stop

Settings	Enable/Disable for the "input I/O"
0	Disable (masked)
1	Enable (Un masked)

2165h Position command filter3
Notch Frequency

Sub−Index 00h	Range	10 to 3,000	Unit	0.1Hz	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the notch frequency of the position command filter 3. Corresponding amplifier parameters… No.357.0						

2166h Position command filter3
Notch Width

Sub−Index 00h	Range	128 to 2,048	Unit	−	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the width of the notch frequency of the position command filter 3. Corresponding amplifier parameters… No.358.0						

2167h Position command filter3
High Frequency Gain

Sub−Index 00h	Range	50 to 200	Unit	−	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the high-frequency gain of the position command filter 3. Corresponding amplifier parameters… No.359.0						

2168h Position command filter3
Notch Depth

Sub−Index 00h	Range	0 to 100	Unit	−	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to set the notch depth of the position command filter 3. Corresponding amplifier parameters… No.360.0						

216Bh Following error warning window (Position deviation warning detection: Value)

Sub-Index 00h	Range	0 to 2,147,483,647	Unit	pulse	Type	U32	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		
	Description	This object is used to set the threshold for position deviation warning detection. Corresponding amplifier parameters... No.363.0						

216Dh Following error warning time out (Position deviation warning detection:Delay time)

Sub-Index 00h	Range	0 to 65,535	Unit	100μs	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		
	Description	This object is used to set the time until the position deviation warning is detected. Corresponding amplifier parameters... No.365.0						

2178h Motor Rotating Position at Encoder Error Holding Method

Sub-Index 00h	Range	0, 2	Unit	–	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		
	Description	This object is used to set the item to hold the motor shaft position when an encoder error occurs. Corresponding amplifier parameters... No.376.0						

Settings	Holding items
0	Disable
2	Continue to hold the torque command value.

2179h Motor Rotating Position at Encoder Error Holding Time

Sub-Index 00h	Range	0 to 200	Unit	ms	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		
	Description	This object is used to set the time to hold the motor shaft position when an alarm occurs. Corresponding amplifier parameters... No.377.0						

21D8h Multi-turn limit Value

Range	0 to 65,535	Unit	–	Type	U16	Access	RW
Default	N/A	OP–mode	ALL	PDO mapping	No		

Sub–Index **00h**

Description

This object is used to set the multi-turn limit value.

Corresponding amplifier parameters... No.472.0

Settings	Description
0	Disable the function
1-65,535	Value

21D9h Multi-turn limit Notification to Encoder

Range	0 to 1	Unit	–	Type	U16	Access	RW
Default	N/A	OP–mode	ALL	PDO mapping	No		

Sub–Index **00h**

Description

This object is used to set Enable/Disable notification to encoder after changing the multi-turn limit value.

Corresponding amplifier parameters... No.473.0

Settings	Disable/Enable
0	Disable
1	Enable

21DAh EtherCAT Communication Setting

Range	0 to 65,535	Unit	–	Type	U16	Access	RW
Default	N/A	OP–mode	ALL	PDO mapping	No		

Sub–Index **00h**

Description

This object is used to configure EtherCAT communication settings.

Corresponding amplifier parameters... No.474.0 , No.474.3

bit functions

bit	15	···	12	11	···	8	7	···	4	3	···	0
	No.474.3			Not use						No.474.0		

No.474.0 : Error detection setting

Settings	Alarm No.3
0	NOT detecting
1	Detecting

No.474.3 : "Digital inputs" mapping

Settings	Mapping mode
0	Standard mapping
1	Custom mapping1

Note: Use this parameter as "0". Changing this setting may cause the master device to not recognize the I/O correctly.

21DCh Logical IO Polarity

Range	0 to 4,294,697,295	Unit	ms	Type	U32	Access	RW
Default	N/A	OP–mode	ALL	PDO mapping		No	

Sub–Index **00h**

Description

This object is used to configure the polarity of the I/O port.

bit functions

bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
	N/A													**O3**	**O2**	**O1**
bit	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
	N/A								**I8**	**I7**	**I6**	**I5**	**I4**	**I3**	**I2**	N/A

bit	I/O pin name & functions	
1	**I2**	Positive limit switch
2	**I3**	Negative limit switch
3	**I4**	Home switch
4	**I5**	External latch1
5	**I6**	External latch2
6	**I7**	Reset alarm
7	**I8**	Emergency stop
16	**O1**	Break
17	**O2**	Servo ready
18	**O3**	Alarm

Settings	Polarity of "Input I/O" port.
0	Positive logic (High-active)
1	Negative logic (Low-active)

21DEh Logical Input Mask with Monitor

Range	0 to 4,294,697,295	Unit	ms	Type	U32	Access	RW
Default	N/A	OP-mode	ALL	PDO mapping	No		

Sub-Index **00h**

Description

This object is used to configure the enable/disable of the signal input to I/O.

(The status of I/O inputs can be monitored with 60FDh.)

bit functions

bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
	N/A															
bit	**15**	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
	N/A								I8	I7	I6	I5	I4	I3	I2	N/A

bit	I/O pin name & functions	
1	**I2**	Positive limit switch
2	**I3**	Negative limit switch
3	**I4**	Home switch
4	**I5**	External latch1
5	**I6**	External latch2
6	**I7**	Reset alarm
7	**I8**	Emergency stop

Settings	Enable/Disable for the "input I/O"
0	Disable (masked)
1	Enable (Un masked)

Tip !

Difference between object "2152h" and "21DEh

Functions	2152h Logical Input Masking Configuration	21DEh Logical Input Mask with Monitor
Input I/O port masking	**YES**	**YES**
Input /O port status monitoring with **60FDh**	**NO**	**YES**

"21DEh" object is suitable for applications where the master controls the entire system.

Signals input to the amplifier's I/O ports can be monitored at 60 FDh, for example, if an "Emergency Stop signal" is input to the amplifier's I8 port, the master can recognize the status.

2FFFh Access to Servo Parameters

Range	0 to 65,535	Unit	–	Type	U16	Access	RW
Default	N/A	OP–mode	ALL	PDO mapping	No		

Sub–Index **00h**

Description

This object is used to access the amplifier parameters assigned to the 2000h series of the object dictionary.

bit functions

bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	N/A							busy (RO)	N/A				control command			

Control command	State
0001 (b)	Read the value from the servo amplifier to the object dictionary (0x2000-0x2FFE).
0010 (b)	Transfers and stores the values from the object dictionary (0x2000-0x2FFE) to the servo amplifier.

How to access amplifier parameters

The amplifier parameters are assigned to the object dictionary (2000h series).

Object Index equivalent to the amplifier parameter No.

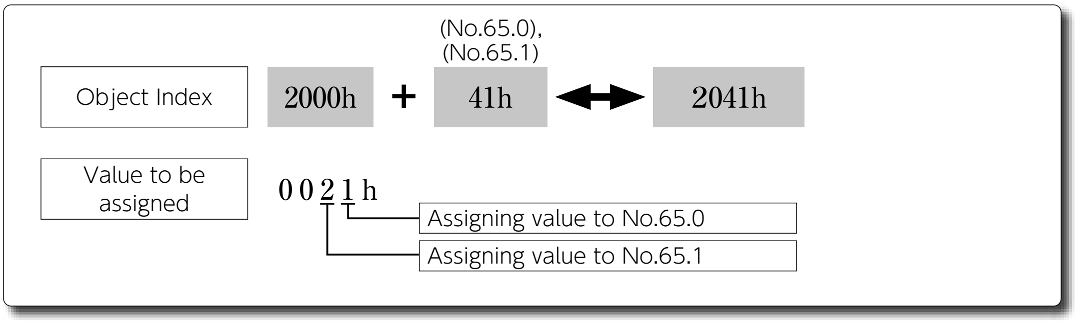
2000h + HEX value of integer part of each parameter No. of the amplifier ⟷ Index of the equivalent object

Example1: Amplifier parameter No. 474.0

Object Index 2000h + 1DAh (No.474.0) ⟷ 21DAh

Example 2: Subparameters which are separated by 4 bits

The object indexes are grouped into a single object.
To assign "1" to No.65.0 and "2" to No.65.1, set them all at once.



How to change the amplifier parameters stored in 2000h-2FFFh

When the amplifier is booted up, the parameters 2000h-2FFFh are automatically loaded into the object dictionary from the amplifier. The busy flag of 2FFFh is set to "1" while loading.
To change the parameters, make sure that the Busy flag is set to "0", and then follow the procedure below.

1 Check the bit8(busy bit) in object 2FFFh.

Parameter access is inhibited until bit8 is turned to "0".

bit8	Status	Parameter access
0	**Not Busy**	Permitted
1	**Busy**	NOT Permitted

2 Write a value to each object to be changed.

3 Set "2 (=0010(b))" to the control command of object 2FFFh.

Transfers and stores the values from the object dictionary (0x2000-0x2FFE) to the servo amplifier.

Tip !

NOTE for changing amplifier parameters

After the amplifier is started and EtherCAT communication is established, it may take some time before parameter access is permitted. (about 5 seconds)

Parameter access with object 2FFFh is permitted only when the servo is OFF.
(This means that the CiA402 status is "Ready To SwitchON" or lower.)

The object 2FFFh accesses only objects in the 2000h series, and 6091h.

After writing data to the amplifier, restart the amplifier.

4000h Special Function

Sub−Index 00h	Range	0 to 65,535	Unit	–	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object is used to command the execution of special functions.						

bit functions

bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	N/A															SP1

bit	Function	
0	**SP1**	Clearing multi-turn data

Settings	Behavior
0	NOP
1	Execute multi-turn data clear. (*)

*)After clearing is completed, this bit is automatically Returned to "0".

4100h Mechanical Angle

Sub−Index 00h	Range	0 to 131,071(17Bit)/0 to 8,388,607(23Bit)	Unit	–	Type	U32	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object displays the machine angle information of the motor.						

4101h Multi-turn Data

Sub−Index 00h	Range	0 to 65,535	Unit	–	Type	U16	Access	RW
	Default	N/A	OP−mode	ALL	PDO mapping	No		
	Description	This object displays multi-turn information for an absolute motor. Fixed to "0" when incremental mode is set.						

3. Drive Profile Area (6000h-6FFFFh)

603Fh Error code

Range	0 to 65,535 (0xFF00 to 0xFFFF)	Unit	–	Type	U16	Access	RO
Default	N/A	OP-mode	ALL	PDO mapping	TxPDO		

Sub-Index **00h**

Description

If the value is other than "0", the following error information is displayed.

Alarm/Warning	Error code	Descriptions
Alarm	0xFF00	System error
	0xFF01	EEPROM data error
	0xFF02	Product code error (Mismatching code)
	0xFF03	EtherCAT communication error
	0xFF04	Overspeed error
	0xFF05	Velocity deviation error
	0xFF06	Position deviation error
	0xFF07	Overload error
	0xFF08	Command overspeed error
	0xFF0A	Positioning command overflow error / Homing failure
	0xFF0B	Multi-turn counter error
	0xFF0C	Overheat error
	0xFF0E	Overvoltage error
	0xFF0F	Power supply error (Primary circuit AC power)
	0xFF10	Encoder error (Received data)
	0xFF11	Encoder error (No response)
	0xFF12	Encoder error (Hardware)
	0xFF13	Encoder error (Communication)
	0xFF14	Encoder error (Multi-turn data)
	0xFF15	Encoder error (Voltage drop)
	0xFF16	Voltage error (Internal control power DC24V)
	0xFF17	Switch circuitry error
	0xFF18	Overcurrent error
	0xFF19	Inverter error 1
	0xFF1A	Inverter error 2
	0xFF1B	Current sensor error
	0xFF1C	Encoder error (Overheat)
	0xFF1D	Voltage error (Internal control power DC5V)
	0xFF20	Power supply error (Control circuit AC power)
	0xFF22	Product code error (Undefined model code)
	0xFF28	Vibration prediction
Warning	0xFF80	Encoder overheat detection
	0xFF81	Encoder battery voltage drop error detection
	0xFF82	Emergency stop
	0xFF83	Encoder communication warning
	0xFF84	Excessive position deviation
	0xFF85	Vibration prediction warning1
	0xFF86	SRDY Warning
	0xFF87	Vibration prediction warning2

6040h Controlword

Range	0x0000 to 0xFFFF	Unit	–	Type	U16	Access	RW
Default	N/A	OP–mode	ALL	PDO mapping	RxPDO		

Sub–Index **00h**

Description

This object is used to command the amplifier, such as PDS state transition.

bit functions

bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	R						OMS	H	FR	OMS			EO	QS	EV	SO

SO . . .Switch on
EV . . .Enable voltage
QS . . .Quick stop
EO . . .Enable operation

OMS .Operation mode specific (Depending on control mode)
FR . . .Fault reset
H . . . .Halt
R . . . .Rsv.

bit 7, 3–0: Controls PDS commands.

Command	bit 7 Fault reset	bit 3 Enable operation	bit 2 Quick stop	bit 1 Enable voltage	bit 0 Switch on	6040h value (0x_ _ _☐)
Shutdown	0	X	1	1	0	☐ = 6h or Ah
Switch on	0	0	1	1	1	☐ = 7h
Switch on + Enable operation	0	1	1	1	1	☐ = Fh
Disable voltage	0	X	X	0	X	☐ = 0h, 1h, 4h, 5h, 8h, 9h, Ch, Dh
Quick stop	0	X	0 (*1)	1	X	☐ = 2h, 3h, Ah, Eh
Disable operation	0	0	1	1	1	☐ = 7h
Enable operation	0	1	1	1	1	☐ = Fh
Fault reset	↑	X	X	X	X	(Undefined)

*1) The "Quick stop" command is activated by "0". This bit is inverted from the other bits.

bit 9, 6–4: These are controlled by osm bit which depends on the control mode.
In this amplifier, it is used only in HM mode.

OP–mode	Bits of the controlword			
	bit 9	bit 6	bit 5	bit 4
HM	–	–	–	Start homing
CSP	–	–	–	–
CSV	–	–	–	–
CST	–	–	–	–
PP	–	absolute/ relative	–	new set-point

6041h Statusword

Sub-Index								
00h	Range	0 to 0xFFFF	Unit	–	Type	U16	Access	RO
	Default	N/A	OP-mode	ALL	PDO mapping	TxPDO		

Description

This object is used to indicate the status of the amplifier.

bit functions

bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	R		OMS		ILA	OMS	RM	R	W	SOD	QS	VE	F	OE	SO	RTSO

RTSO . Ready to Switch on
SO . . . Switched on
OE . . . Operation enabled
F . . . . Fault
VE . . . Voltage enabled
QS . . . Quick stop

SOD. . Switch on disabled
W. . . . Warning
RM. . . Remote
ILA. . . Internal limit active
OMS . Operation mode specific (Depending on control mode)
R . . . . Rsv. (Not supported)

bit 6, 5, 3–0: Shows the PDS status.

Statusword	PDS state	
xxxx xxxx x0xx 0000 (b)	Not ready to switch on	Initialization is not complete
xxxx xxxx x1xx 0000 (b)	Switch on disabled	Initialization is complete
xxxx xxxx x01x 0001 (b)	Ready to switch on	Main circuit power is OFF
xxxx xxxx x01x 0011 (b)	Switched on	Servo-off / Servo-ready
xxxx xxxx x01x 0111 (b)	Operation enabled	Servo-on
xxxx xxxx x00x 0111 (b)	Quick stop active	Immediate stop
xxxx xxxx x0xx 1111 (b)	Fault reaction active	Alarm detected (Executing Quick Stop)
xxxx xxxx x0xx 1000 (b)	Fault	In alarming state

bit 4 (Voltage enabled):

1: The main circuit power supply voltage is applied to the PDS.

bit 5 (Quick stop):

0: Indicates that the PDS has received a quick stop request.
The "Quick stop" command is activated by "0". This bit is inverted from the other bits.

bit 7 (Warning):

1: A warning has occurred. While a warning is occurring, the PDS status will not change.
Motor operation is ongoing.

605Ah Quick Stop Option Code

Sub-Index								
00h	Range	2, 6	Unit	–	Type	I16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	No		

Description

Sets the state after the motor is stopped by Quick Stop.

Value	Setting
2	Transition to "Switch on Disabled"
6	Transition to "Quick Stop Active"

*) PDO mapping is not possible. Set up in SDO.

6060h Modes of Operation

Range	0 to 10	Unit	–	Type	I8	Access	RW
Default	N/A	OP–mode	ALL	PDO mapping	RxPDO		

Sub–Index 00h

Description

This object is used to configure the control mode of the amplifier.

Value	Mode of operation	Name	Available (*)
−128 to −1	Rsv.	–	–
0	No mode change / No mode assigned	–	●
1	Profile Position	pp	●
2	Velocity mode	vl	×
3	Profile Velocity	pv	×
4	Profile Torque	tq	×
5	Rsv.	–	–
6	Homing	hm	●
7	Interpolated Position	ip	×
8	Cyclic Synchronous Position	csp	●
9	Cyclic Synchronous Velocity	csv	●
10	Cyclic Synchronous Torque	cst	●
11 to 127	Rsv.	–	–

*) It depends on the software version.

6061h Modes of Operation Display

Range	0 to 10	Unit	–	Type	I8	Access	RO
Default	N/A	OP–mode	ALL	PDO mapping	TxPDO		

Sub–Index 00h

Description

This object is used to indicate the current control mode of the amplifier.

Value	Mode of operation	Name	Available (*)
−128 to −1	Rsv.	–	–
0	No mode change / No mode assigned	–	●
1	Profile Position	pp	●
2	Velocity mode	vl	×
3	Profile Velocity	pv	×
4	Profile Torque	tq	×
5	Rsv.	–	–
6	Homing	hm	●
7	Interpolated Position	ip	×
8	Cyclic Synchronous Position	csp	●
9	Cyclic Synchronous Velocity	csv	●
10	Cyclic Synchronous Torque	cst	●
11–127	Rsv.	–	–

*) It depends on the software version.

6062h Position Demand Value

Sub−Index 00h	Range	−2,147,483,648 to 2,147,483,647	Unit	Command Unit	Type	I32	Access	RO
	Default	N/A	OP−mode	CSP	PDO mapping	TxPDO		
	Description	This object is used to indicate the demanded position value. This is equal to a value of 607Ah (Target Position) + 60B0h (Position Offset).						

6064h Position Actual Value

Sub−Index 00h	Range	−2,147,483,648 to 2,147,483,647	Unit	Command Unit	Type	I32	Access	RO
	Default	N/A	OP−mode	ALL	PDO mapping	TxPDO		
	Description	This object is used to indicate the actual position of the motor shaft.						

6065h Following Error Window

Sub−Index 00h	Range	0 to 4,294,967,295	Unit	Command Unit	Type	U32	Access	RW
	Default	2,147,483,647	OP−mode	CSP	PDO mapping	No		
	Description	If 60F4h (Following error actual value) is exceeded by the set value of this parameter, the amplifier causes a "position deviation error".						

6067h Position Window

Sub−Index 00h	Range	0 to 4,294,967,295	Unit	Command Unit	Type	U32	Access	RW
	Default	2,147,483,647	OP−mode	CSP	PDO mapping	RxPDO		
	Description	The value specified by this parameter is compared with the value of [6062h (Position demand value) - 6064h (Position actual value)]. Bit 10 (target reached) of 6041h (Statusword) is determined by the comparison result.						

Comparison				bit10 in 6041h
[6067h]	>	([6062h] − [6064h])	for ···	1
[6067h]	<	([6062h] − [6064h])	for ···	0

606Ch Velocity Actual Value

Sub−Index 00h	Range	−2,147,483,648 to 2,147,483,647	Unit	Command Unit/s	Type	I32	Access	RO
	Default	N/A	OP−mode	ALL	PDO mapping	TxPDO		
	Description	This object is used to indicate the actual motor velocity.						

6071h Target Torque

Sub−Index 00h	Range	−32,768 to 32,767	Unit	0.1%	Type	I16	Access	RW
	Default	0	OP−mode	CST	PDO mapping	RxPDO		
	Description	This object is used to set the torque command value.						

6072h Max Torque

Sub−Index 00h	Range	0 to 65,535	Unit	0.1%	Type	U16	Access	RW
	Default	65,535	OP−mode	ALL	PDO mapping	RxPDO		
	Description	This object is used to set the maximum torque value.						

6074h Torque Demand

Sub−Index 00h	Range	−32,768 to 32,767	Unit	0.1%	Type	I16	Access	RO
	Default	N/A	OP−mode	ALL	PDO mapping	TxPDO		
	Description	This object is used to indicate the torque value of the internal command.						

6077h Torque Actual Value

Sub−Index 00h	Range	−32,768 to 32,767	Unit	0.1%	Type	I16	Access	RO
	Default	N/A	OP−mode	ALL	PDO mapping	TxPDO		
	Description	This object is used to indicate the actual torque value.						

607Ah Target Position

Sub−Index 00h	Range	−2,147,483,648 to 2,147,483,647	Unit	Command Unit	Type	I32	Access	RW
	Default	0	OP−mode	CSP, PP	PDO mapping	RxPDO		
	Description	This object is used to set the position command value.						

607Bh Position Range Limit

	Description	This object is used to configure the upper / lower limit of the position command. (*)						
	Number of Entries							
Sub−Index 00h	Range	0 to 255	Unit	−	Type	U8	Access	RO
	Default	2	OP−mode	ALL	PDO mapping	No		
	Description	Number of entries (Fixed value **2**)						
	Min Position Range Limit							
Sub−Index 01h	Range	−2,147,483,648 to 0	Unit	Command Unit	Type	I32	Access	RW
	Default	−2,147,483,648	OP−mode	ALL	PDO mapping	No		
	Description	Specifies the minimum value (lower limit) of the position command limit.						
	Max Position Range Limit							
Sub−Index 02h	Range	1 to 2,147,483,647	Unit	Command Unit	Type	I32	Access	RW
	Default	2,147,483,647	OP−mode	ALL	PDO mapping	No		
	Description	Specifies the maximum value (upper limit) of the position command limit.						

(*) Wrap-around operation will be performed at the set upper limit.

607Ch Home Offset

Sub−Index 00h	Range	−2,147,483,648 to 2,147,483,647	Unit	Command Unit	Type	I32	Access	RW
	Default	N/A	OP−mode	HM	PDO mapping	RxPDO		
	Description	This object is used to indicate the configured difference between the zero position for the application and the machine home position (found during homing). During homing the machine home position is found and once the homing is completed, the zero position is offset from the home position by adding the home offset to the home position.						

607Fh Max Profile Velocity

Sub−Index 00h	Range	0 to 4,294,967,295	Unit	Command Unit/s	Type	U32	Access	RW
	Default	N/A	OP−mode	CSP, PP	PDO mapping		RxPDO	
	Description	This object is used to set the maximum motor velocity.						

6080h Max Motor Speed

Sub−Index 00h	Range	0 to 4,294,967,295	Unit	rpm	Type	U32	Access	RW
	Default	6,000	OP−mode	ALL	PDO mapping		RxPDO	
	Description	This object is used to set the maximum motor velocity. In CST mode, the motor velocity is limited by this setting value.						

6081h Profile Velocity

Sub−Index 00h	Range	0 to 4,294,967,295	Unit	Command Unit/s	Type	U32	Access	RW
	Default	N/A	OP−mode	PP	PDO mapping		RxPDO	
	Description	This object is used to set the motor velocity.						

6083h Profile Acceleration

Sub−Index 00h	Range	0 to 4,294,967,295	Unit	Command Unit/s^2	Type	U32	Access	RW
	Default	65,536	OP−mode	PP	PDO mapping		RxPDO	
	Description	This object is used to set the motor acceleration.						

6084h Profile Deceleration

Sub-Index								
00h	Range	0 to 4,294,967,295	Unit	Command Unit/s^2	Type	U32	Access	RW
	Default	65,536	OP-mode	PP	PDO mapping			RxPDO
	Description	This object is used to set the motor deceleration.						

6085h Quick Stop Deceleration

Sub-Index								
00h	Range	0 to 4,294,967,295	Unit	Command Unit/s^2	Type	U32	Access	RW
	Default	0	OP-mode	PP	PDO mapping			RxPDO
	Description	Sets the deceleration for Quick Stop.						

Value	Descriptions
0	Decelerates at the maximum deceleration rate. (Sudden stop)
1 to 4,294,967,295	Decelerates at the set deceleration rate.

6091h Gear Ratio

Description: This object is used to set the gear ratio.

Number of Entries

Sub-Index								
00h	Range	0 to 255	Unit	–	Type	U8	Access	RO
	Default	2	OP-mode	ALL	PDO mapping			No
	Description	Number of entries (Fixed value **2**)						

Motor Revolutions

Sub-Index								
01h	Range	0 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	1,000	OP-mode	ALL	PDO mapping			No
	Description	Specifies the motor revolutions (numerator).						

Shaft Revolutions

Sub-Index								
02h	Range	1 to 4,294,967,295	Unit	–	Type	U32	Access	RW
	Default	1,000	OP-mode	ALL	PDO mapping			No
	Description	Specifies the shaft revolutions (denominator).						

6098h Homing Method

Sub-Index								
00h	Range	0 to 37	Unit	–	Type	I8	Access	RW
	Default	N/A	OP-mode	HM	PDO mapping	No		

Description

This object is used to configure the homing method.

Method	Homing modes	Available
1	Homing on **negative limit sensor** and **index pulse**	●
2	Homing on **positive limit sensor** and **index pulse**	●
3, 4	Homing on **positive home sensor** and **index pulse**	●
5, 6	Homing on **negative home sensor** and **index pulse**	●
7–16	–	×
17	Homing on **negative limit sensor**	●
18	Homing on **positive limit sensor**	●
19, 20	Homing on **positive home sensor**	●
21, 22	Homing on **negative home sensor**	●
23-26	Homing on home sensor and positive limit - positive initial motion	●
27-30	Homing on home sensor and negative limit - negaitive initial motion	●
33, 34	Homing on **index pulse**	●
35, 37	Homing on **current position**	●

This information is dated February 2023.

6099h Homing Speeds

Description: This object is used to set the Homing speed.

Number of Entries

Sub-Index								
00h	Range	0 to 255	Unit	–	Type	U8	Access	RO
	Default	2	OP-mode	HM	PDO mapping	No		
	Description	Number of entries (Fixed value **2**)						

Speed During Search for Switch

Sub-Index								
01h	Range	1 to 4,294,967,295	Unit	Command Unit/s	Type	U32	Access	RW
	Default	1,000	OP-mode	HM	PDO mapping	No		
	Description	Specifies the moving speed until the switch is detected.						

Speed During Search for Zero

Sub-Index								
02h	Range	1 to 4,294,967,295	Unit	Command Unit/s	Type	U32	Access	RW
	Default	1,000	OP-mode	HM	PDO mapping	No		
	Description	Specifies the moving speed until the home position is detected.						

609Ah Homing Acceleration

Sub-Index								
00h	Range	0 to 4,294,967,295	Unit	Command Unit/s^2	Type	U32	Access	RW
	Default	72817766	OP-mode	HM	PDO mapping	No		
	Description	This object is used to set the acceleration and deceleration for homing.						

60B0h Position Offset

Sub-Index								
00h	Range	−2,147,483,648 to 2,147,483,647	Unit	Command Unit	Type	I32	Access	RW
	Default	0	OP-mode	CSP	PDO mapping	RxPDO		
	Description	This object is used to set the offset value for the position command.						

60B1h Velocity Offset

Sub-Index								
00h	Range	−2,147,483,648 to 2,147,483,647	Unit	Command Unit/s	Type	I32	Access	RW
	Default	0	OP-mode	CSV	PDO mapping	RxPDO		
	Description	This object is used to set the offset value for the velocity command.						

60B2h Torque Offset

Sub-Index								
00h	Range	−32,768 to 32,767	Unit	0.1%	Type	I16	Access	RW
	Default	0	OP-mode	CSP, CSV, CST	PDO mapping	RxPDO		
	Description	This object is used to set the offset value for the torque command.						

60B8h Touch Probe Function

Sub-Index								
00h	Range	0 to 65,535	Unit	–	Type	U16	Access	RW
	Default	N/A	OP-mode	ALL	PDO mapping	RxPDO		
	Description	This object is used to configure the Touch probe function.						

bit functions

bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Touch probe2								Touch probe1							

bit7-0: Configures the Touch probe 1 settings.

bit	value	Note	
0	0	Disable touch probe1	Touch probe1 Enable / Disable
	1	Enable touch probe1	
1	0	Trigger first event	Touch probe1 Event mode selection
	1	Continuous event	
2	0	Trigger with EXT1 input	Touch probe1 Trigger selection (EXT or Z pulse)
	1	Trigger with zero impulse signal from encoder	
3	–	N/A	N/A
4	0	Disable sampling at positive edge of Touch probe1	Touch probe1 Positive edge selection
	1	Enable sampling at positive edge of Touch probe1	
5	0	Disable sampling at negative edge of Touch probe1	Touch probe1 Negative edge selection
	1	Enable sampling at negative edge of Touch probe1	
6, 7	–	N/A	N/A

bit15-8: Configures the Touch probe 2 settings.

bit	value	Note	
8	0	Disable touch probe2	Touch probe2 Enable / Disable
	1	Enable touch probe2	
9	0	Trigger first event	Touch probe2 Event mode selection
	1	Continuous event	
10	0	Trigger with EXT2 input	Touch probe2 Trigger selection (EXT or Z pulse)
	1	Trigger with zero impulse signal from encoder	
11	–	N/A	N/A
12	0	Disable sampling at positive edge of Touch probe2	Touch probe2 Positive edge selection
	1	Enable sampling at positive edge of Touch probe2	
13	0	Disable sampling at negative edge of Touch probe2	Touch probe2 Negative edge selection
	1	Enable sampling at negative edge of Touch probe2	
14, 15	–	N/A	N/A

60B9h Touch Probe Status

Sub−Index 00h	Range	0 to 65,535	Unit	−	Type	U16	Access	RO
	Default	N/A	OP−mode	ALL	PDO mapping	TxPDO		
	Description	This object is used to indicate the status of the Touch probe.						

bit functions

bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	Touch probe2								Touch probe1							

bit7–0: Indicates the status of the Touch probe 1.

bit	value	Note	
0	0	Touch probe1 is disabled	Touch probe1 stopping / running
	1	Touch probe1 is enabled	
1	0	Touch probe1 no positive edge value stored	Touch probe1 positive edge not stored / stored
	1	Touch probe1 positive edge value stored	
2	0	Touch probe1 no negative edge value stored	Touch probe1 negative edge not stored / stored
	1	Touch probe1 negative edge value stored	
3–7	−	N/A	N/A

bit15–8: Indicates the status of the Touch probe 2.

bit	value	Note	
8	0	Touch probe2 is disabled	Touch probe2 stopping / running
	1	Touch probe2 is enabled	
9	0	Touch probe2 no positive edge value stored	Touch probe2 positive edge not stored / stored
	1	Touch probe2 positive edge value stored	
10	0	Touch probe2 no negative edge value stored	Touch probe2 negative edge not stored / stored
	1	Touch probe2 negative edge value stored	
11–15	−	N/A	N/A

60BAh Touch Probe 1 Positive Edge

Sub−Index 00h	Range	−2,147,483,648 to 2,147,483,647	Unit	Command Unit	Type	I32	Access	RO
	Default	N/A	OP−mode	ALL	PDO mapping	TxPDO		
	Description	This object is used to indicate the latch position at the rising edge of Touch probe1.						

60BBh Touch Probe 1 Negative Edge

Sub−Index 00h	Range	−2,147,483,648 to 2,147,483,647	Unit	Command Unit	Type	I32	Access	RO
	Default	N/A	OP−mode	ALL	PDO mapping	TxPDO		
	Description	This object is used to indicate the latch position at the falling edge of Touch probe1.						

60BCh Touch Probe 2 Positive Edge

Sub−Index 00h	Range	−2,147,483,648 to 2,147,483,647	Unit	Command Unit	Type	I32	Access	RO
	Default	N/A	OP−mode	ALL	PDO mapping	TxPDO		
	Description	This object is used to indicate the latch position at the rising edge of Touch probe2.						

60BDh Touch Probe 2 Negative Edge

Sub−Index 00h	Range	−2,147,483,648 to 2,147,483,647	Unit	Command Unit	Type	I32	Access	RO
	Default	N/A	OP−mode	ALL	PDO mapping	TxPDO		
	Description	This object is used to indicate the latch position at the falling edge of Touch probe2.						

60F4h Following Error Actual Value

Sub−Index 00h	Range	−2,147,483,648 to 2,147,483,647	Unit	Command Unit	Type	I32	Access	RO
	Default	N/A	OP−mode	CSP, HM, PP	PDO mapping	TxPDO		
	Description	This object is used to indicate the position error value.						

60FDh Digital Inputs

Sub−Index 00h	Range	0 to 4,294,967,295	Unit	−	Type	U32	Access	RO
	Default	N/A	OP−mode	ALL	PDO mapping	TxPDO		
	Description	This object is used to indicate the logical input state of the input signal.						

bit functions

bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
	N/A							Z	I8	I7	I6	I5	I4	I3	I2	N/A
bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	N/A															

bit	I/O pin name & functions	
17	I2	**POT:** Positive limit switch
18	I3	**NOT:** Negative limit switch
19	I4	**HOME:** Home switch
20	I5	**EXT1:** External latch 1
21	I6	**EXT2:** External latch 2
22	I7	**RESET:** Reset alarm
23	I8	**E−STOP:** Emergency stop
24	Z	Z-index pulse input

60FFh Target Velocity

Sub−Index 00h	Range	−2,147,483,648 to 2,147,483,647	Unit	Command Unit/s	Type	I32	Access	RW
	Default	0	OP−mode	CSV	PDO mapping		RxPDO	
	Description	This object is used to set the velocity command.						

6502h Supported Drive Modes

Sub−Index 00h	Range	0 to 4,294,967,295	Unit	−	Type	U32	Access	RO
	Default	N/A	OP−mode	ALL	PDO mapping		No	
	Description	This object is used to indicate the supported control modes. (Mode of operation)						

bit	Modes of Operations	Name	Available(*)
0	Profile Position	pp	●
1	Velocity mode	vl	×
2	Profile Velocity	pv	×
3	Profile Torque	tq	×
4	Rsv.	−	−
5	Homing	hm	●
6	Interpolated Position	ip	×
7	Cyclic Synchronous Position	csp	●
8	Cyclic Synchronous Velocity	csv	●
9	Cyclic Synchronous Torque	cst	●
10 to 31	Rsv.	−	−

*) It depends on the software version.

MEMO

4

EtherCAT Communication Monitor

1. Introduction

Debugging and trouble shooting can be smoothed out by directly monitoring the EtherCAT communication packets between master and slave.

In order to monitor communication packets, the followings are required.

Items	Descriptions
PC (for monitoring)	Operating System: 32Bit version Windows 7/8/8.1/10 64Bit version Windows 7/8/8.1/10 Processor:. 1 Gigahertz (GHz) or faster processor RAM: 1 GB for the 32-bit version, 2 GB for the 64-bit version Free Hard Drive Space: 16 GB for 32-bit OS, 32 GB for 64-bit OS Display: 1024 x 768 or higher Internet Connection Port: Capable of connecting a LAN cable (CAT5e or higher recommended)
Software "Wireshark"	This is a network protocol analyzer (packet capture tool). You can download the software from the following sites on the Internet and install it on your computer. URL: **https://www.wireshark.org/** Download Site: **https://ja.osdn.net/projects/wireshark/** Note: Confirmed to work with Version 2.6.6 or later
Switching hub	Connect the switching hub to the EtherCAT communication line between master and slave, and also to the monitoring PC. Required LAN port : IEEE802.3u (100BASE-TX)、IEEE802.3 (10BASE-T)

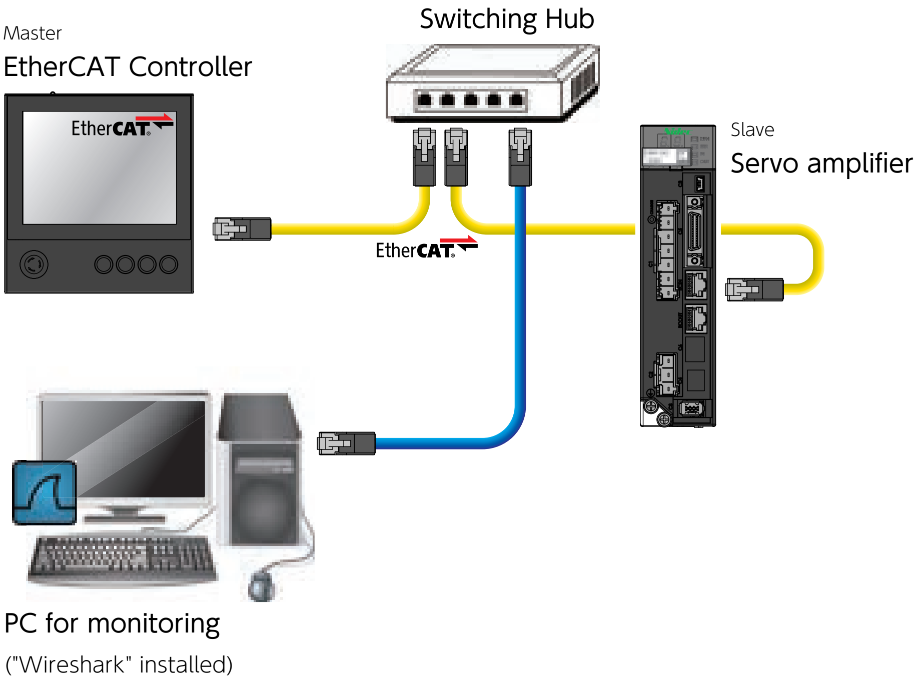
⚠ CAUTION

During packet monitoring with Wireshark, real-time EtherCAT communication is not guaranteed.

1. Introduction

1. Wiring images

Follow the diagram below for wiring.



Make sure to use a switching hub.
Even though the "EOUT" connector of the amplifier is wired directly to the monitoring PC, the EtherCAT communication cannot be monitored by Wireshark.

2. Monitoring EtherCAT communication

1. Procedures

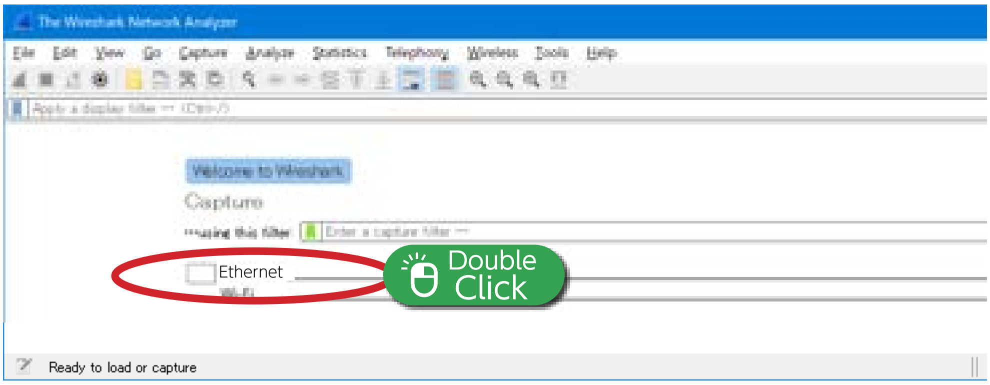
1 Begin monitoring.

Launching Wireshark

After the wiring is complete, turn on the power to the amplifier.
Launch "Wireshark".

Select the network port to which the device to be monitored is connected, and Double-click it.

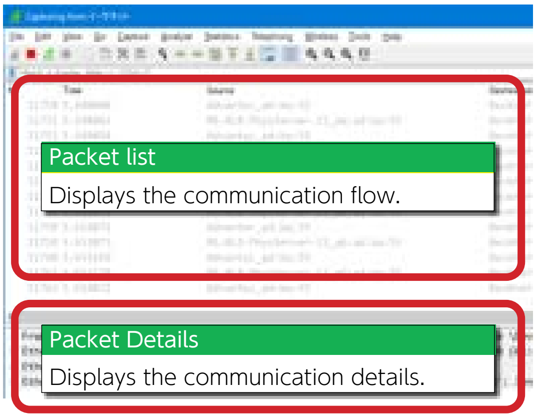
Packet monitoring will start immediately upon double-clicking a network port.



This screen shot shows an example of an "Ethernet" connection.

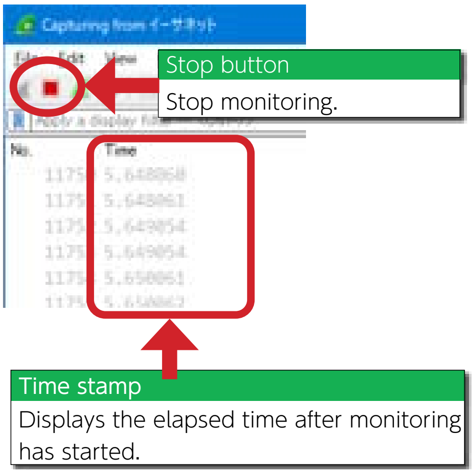
Tip

Understanding the Wireshark screen



Packet list
Displays the communication flow.

Packet Details
Displays the communication details.

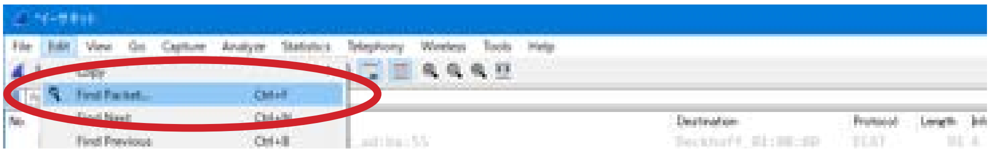


Stop button
Stop monitoring.

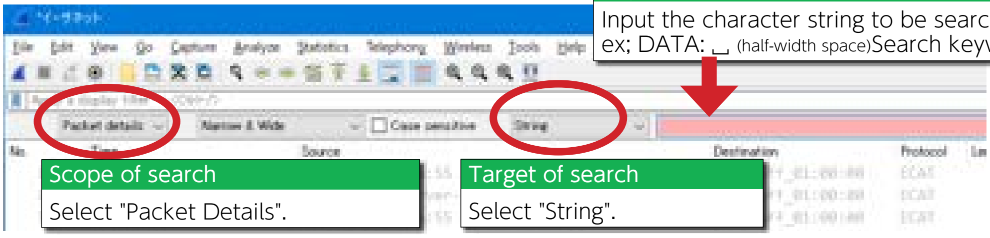
Time stamp
Displays the elapsed time after monitoring has started.

2 Finding the objective packet.

Select " Find Packet" from the "Edit" menu.



Start searching upon entering the search terms.



Keywords to search

Input the character string to be searched.
ex; DATA: ␣ (half-width space)Search keyword

Scope of search

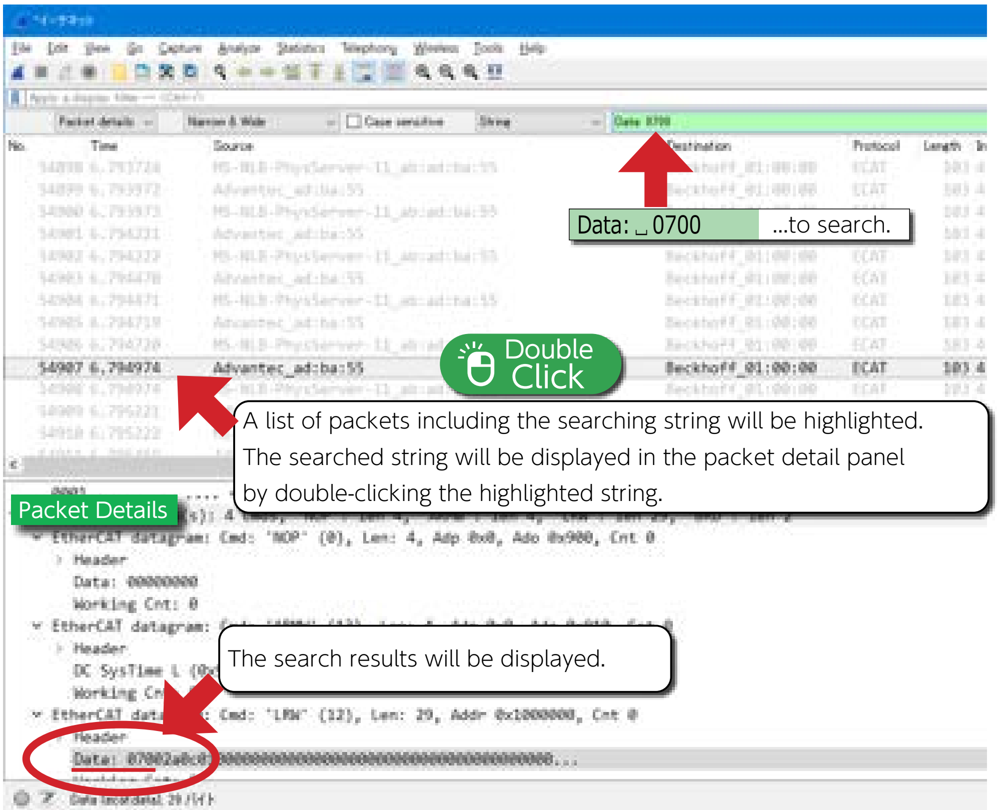
Select "Packet Details".

Target of search

Select "String".

Your search results will be displayed.

Example : searching for "Data: 0700"



```
EtherCAT datagram: Cmd: 'NOP' (0), Len: 4, Adp 0x0, Ado 0x900, Cnt 0
  Header
  Data: 00000000
  Working Cnt: 0
EtherCAT datagram:
  Header
  DC SysTime L
  Working Cn
EtherCAT data: Cmd: 'LRW' (12), Len: 29, Addr 0x1000000, Cnt 0
  Header
  Data: 07002a0c0000000000000000000000000000000000000000...
```

Data: ␣0700 ...to search.

A list of packets including the searching string will be highlighted.
The searched string will be displayed in the packet detail panel by double-clicking the highlighted string.

The search results will be displayed.

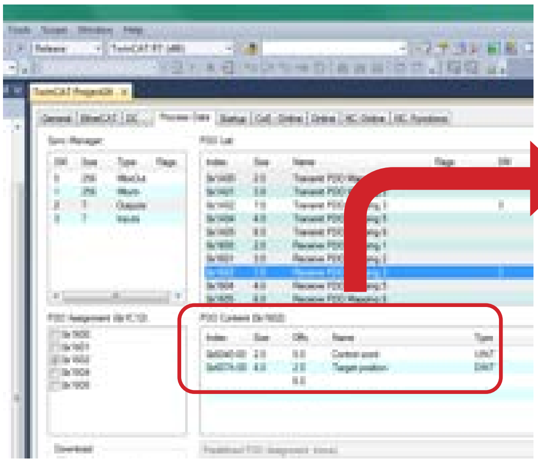
2. Understanding packets

CASE 1: Monitoring Transitions to Servo On and Position Command

This section describes how to monitor the transition to the "Servo On" state and the "Position Command".

This example shows the case where the following are assigned to the PDO.
The transition to servo-on is stored in "Controlword" and the position command is stored in "TargetPosition".
Here is an example of reading these data.

Configure and Check PDO mapping.



Example of PDO screen in TwinCAT

PDO mapping can be configured and checked from a master device such as "TwinCAT".

Data mapped in this example

Data:	Controlword 0x6040	TargetPosition 0x607A
	2 Byte	4 Byte

The "TwinCAT" is an automatic control software developed by Beckhoff Automation GmbH.

PDO mapping can be freely configured to suit the user's application.

Bit Assignments of Controlword and PDS State Transition

Assinging bit0, bit1, and bit2 of the Controlword (0x6040) to "1" (= 0x0007) will turn the servo on state.

Command	Bits of the controlword				
	bit7 Fault reset	bit3 Enable operation	bit2 Quick stop	bit1 Enable voltage	bit0 Switch on
Shutdown	0	X	1	1	0
Switch on	0	0	1	1	1
Switch on + Enable operation	0	1	"Servo On"		1
Disable voltage	0	X	X	0	X
Quick stop	0	X	0	1	X
Disable operation	0	0	1	1	1
Enable operation	0	1	1	1	1
Fault reset	↑	X	X	X	X

State transition to "Servo On"

Controlword 0x6040 = 00 07

2 Byte

(Go to the next page.)

For more details on the Controlword bit assignment and PDS state transitions, please refer to the E-3 Object Dictionary.

2. Monitoring EtherCAT communication

Continue from CASE 1 Monitoring Transitions to Servo On and Position Command

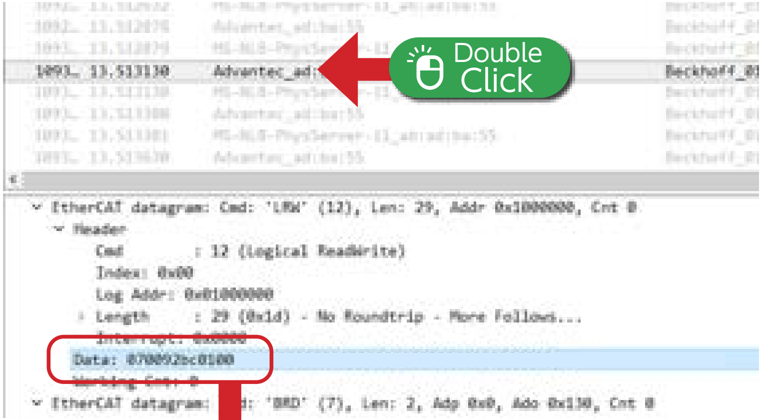
Search for packets of "Transition to Servo On (0x0007)" with Wireshark.

Data: ⎵ 0700 ...to search.

Note that the search string must be entered in little endian.

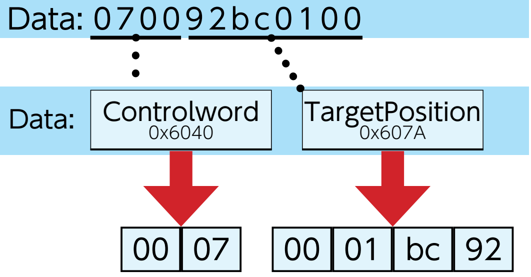
(Search results)

The packets including "Data: ⎵ 0700" will be highlighted.



```
1093… 13.513130   Advantec_ad:                Beckhoff_01
˅ EtherCAT datagram: Cmd: 'LRW' (12), Len: 29, Addr 0x1000000, Cnt 0
  ˅ Header
      Cmd          : 12 (Logical ReadWrite)
      Index: 0x00
      Log Addr: 0x01000000
    › Length       : 29 (0x1d) - No Roundtrip - More Follows...
      Interrupt: 0x0000
    Data: 070092bc0100
    Working Cnt: 0
˅ EtherCAT datagram: Cmd: 'BRD' (7), Len: 2, Adp 0x0, Ado 0x130, Cnt 0
```

Found data



(0x1bc92 = 113,810)

This is an example of "TargetPosition = 0x1bc92".

Finish

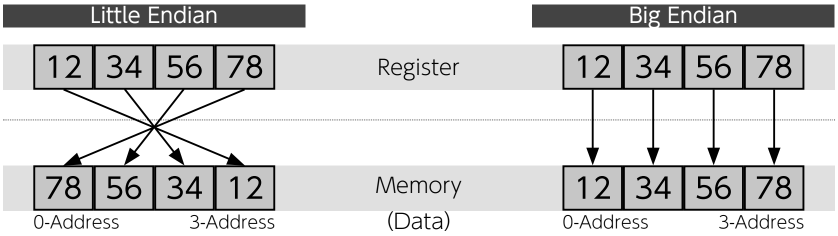
The state transition to Servo On and the position command value at that instant have been monitored.

Tip!

"Little Endian" or "Big Endian"

The memory access of this servo amplifier is "Little Endian".
Packet monitoring should be checked in "Little Endian".

Example: Data is "0x12345678".



CASE 2: Monitoring Position Feedback in Servo On state

This section describes how to monitor the "Position Feedback" in the "Servo On" state.

In this procedure, the Position Feedback data stored in "PositionActualValue" in the Servo On state (0x0233) is read our as an example.

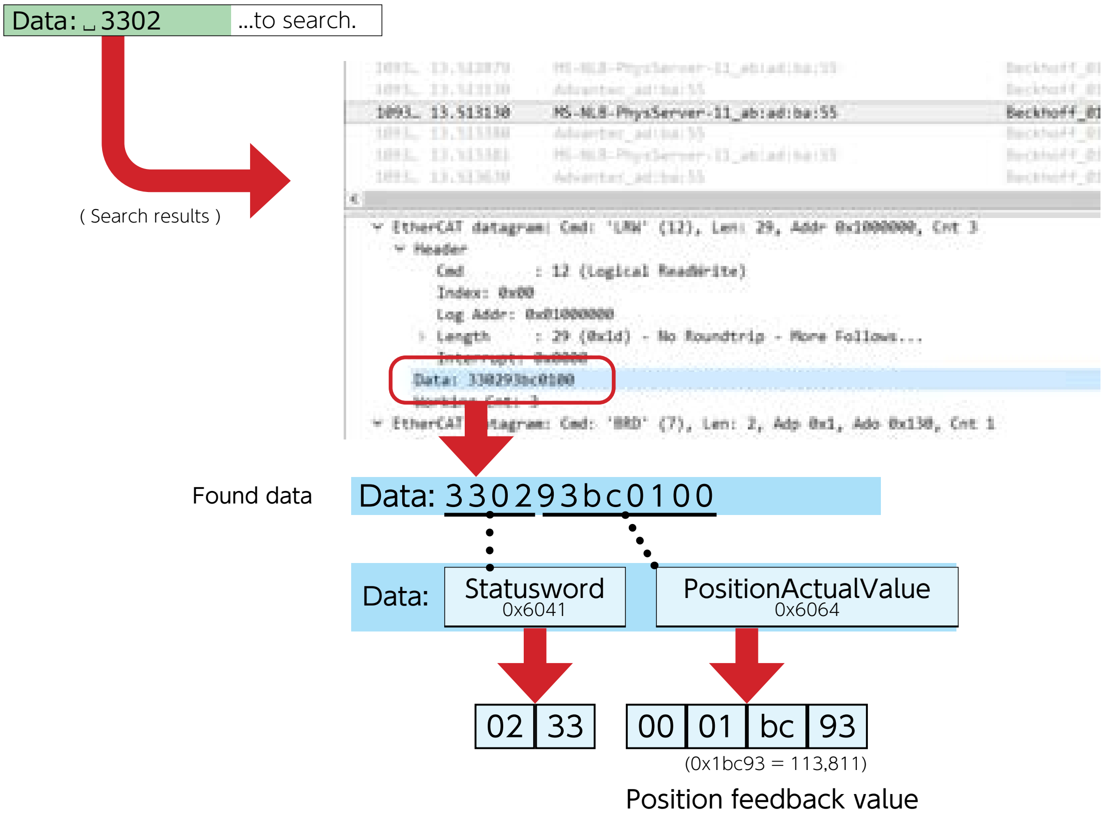
Find the Statusword to monitor.

Statusword	PDS state
xxxx xxxx x0xx 0000 (b)	Not ready to switch on
xxxx xxxx x1xx 0000 (b)	Switch on disabled
xxxx xxxx x01x 0001 (b)	Ready to switch on
xxxx xxxx x01x 0011 (b)	Switched on
xxxx xxxx x01x 0111 (b)	Operation enabled
xxxx xxxx x00x 0111 (b)	Quick stop active
xxxx xxxx x0xx 1111 (b)	Fault reaction active
xxxx xxxx x0xx 1000 (b)	Fault

Servo ON state

In this example, the status of 0x0233 is monitored.

Do searches for 0x0233 packets in Wireshark.



```
1093… 13.513130    MS-NLB-PhysServer-11_ab:ad:ba:55    Beckhoff_01
```

```
∨ EtherCAT datagram: Cmd: 'LRW' (12), Len: 29, Addr 0x1000000, Cnt 3
  ∨ Header
      Cmd        : 12 (Logical ReadWrite)
      Index: 0x00
      Log Addr: 0x01000000
    › Length     : 29 (0x1d) - No Roundtrip - More Follows...
      Interrupt: 0x0000
    Data: 330293bc0100
    Working Cnt: 3
∨ EtherCAT datagram: Cmd: 'BRD' (7), Len: 2, Adp 0x1, Ado 0x130, Cnt 1
```

(0x1bc93 = 113,811)

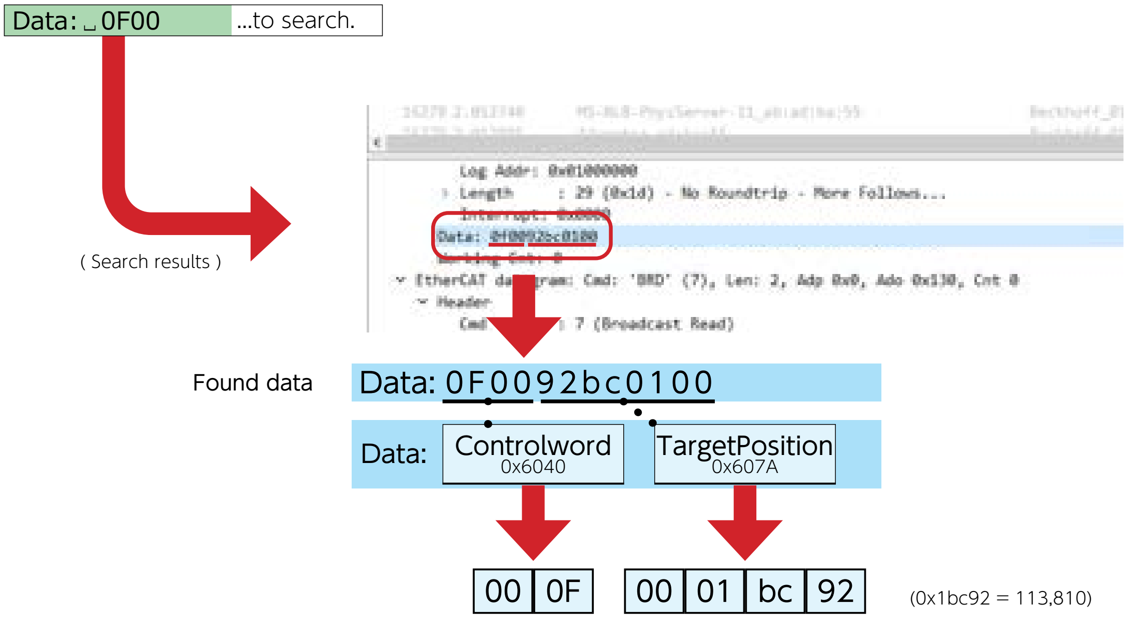
Position feedback value

CASE 2: A similar example-1

A similar example is given here to discribe how to monitor "Transition to EnableOperation" and "Position Command" from SDO.

This is an example of data with the following assignments to the PDO. The transition to EnableOperation is stored in "Controlword" and the position command is stored in TargetPosition" respectively.
Then read out these data.

Do searches for packets of "Transition to EnableOperation (0x000F)" with Wireshark.



```
Log Addr: 0x01000000
> Length     : 29 (0x1d) - No Roundtrip - More Follows...
Interrupt: 0x0000
Data: 0f0092bc0100
Working Cnt: 0
v EtherCAT datagram: Cmd: 'BRD' (7), Len: 2, Adp 0x0, Ado 0x130, Cnt 0
 v Header
   Cmd      : 7 (Broadcast Read)
```

In this example, TargetPosition = 0x1bc92.

Finish

The transition to EnableOperation and the value of the position command at that time were monitored.

2. Monitoring EtherCAT communication

CASE 2: A similar example-2

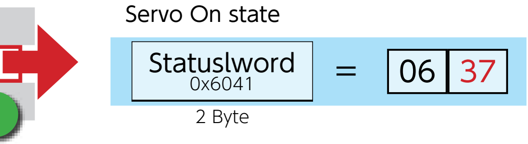
A similar example is given here to discribe how to monitor the "servo on state" and "position feedback" from SDO.

In this procedure, the position feedback data stored in "PositionActualValue" in the servo-on state (0x0637) is read out as an example.

Find the Statusword to monitor.

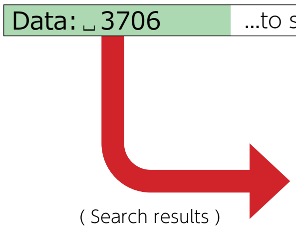
Statusword	PDS state
xxxx xxxx x0xx 0000 (b)	Not ready to switch on
xxxx xxxx x1xx 0000 (b)	Switch on disabled
xxxx xxxx x01x 0001 (b)	Ready to switch on
xxxx xxxx x01x 0011 (b)	Switched on
xxxx xxxx x01x 0111 (b)	Operation enabled
xxxx xxxx x00x 0111 (b)	Quic
xxxx xxxx x0xx 1111 (b)	Fault reaction active
xxxx xxxx x0xx 1000 (b)	Fault

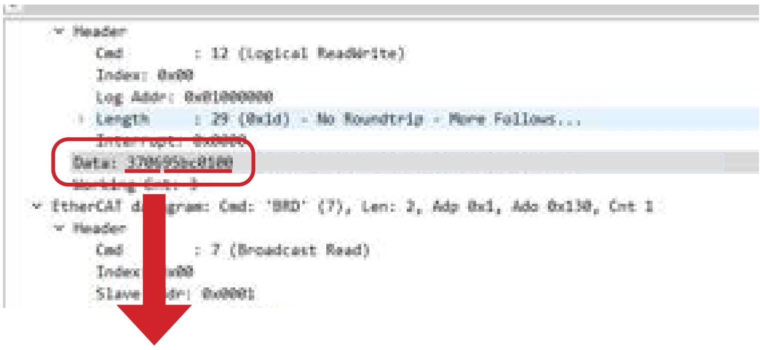
Servo ON state



In this example, the status of 0x0637 is monitored.

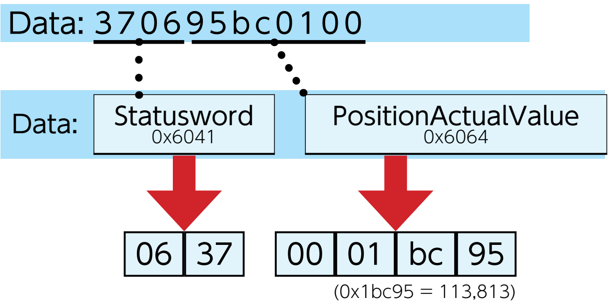
Do searches for 0x0637 packets in Wireshark.





```
  ˅ Header
      Cmd         : 12 (Logical ReadWrite)
      Index: 0x00
      Log Addr: 0x01000000
    › Length      : 29 (0x1d) - No Roundtrip - More Follows...
      Interrupt: 0x0000
    Data: 370695bc0100
    Working Cnt: 3
˅ EtherCAT datagram: Cmd: 'BRD' (7), Len: 2, Adp 0x1, Ado 0x130, Cnt 1
  ˅ Header
      Cmd         : 7 (Broadcast Read)
      Index: 0x00
      Slave Addr: 0x0001
```

Found data



(0x1bc95 = 113,813)

Position feedback value

2. Monitoring EtherCAT communication

CASE 3; Monitoring Operation Mode Configuration Packet with SDO

The current operation mode configuration is indicated by "Modes of Operation (0x6060)".

In this example, monitoring a command packet to configure the operation mode to "Cyclic Synchronous Position Mode".

Find the current setting of Modes of Operation.

The cyclic synchronous position mode setting is 0x08.

ModesofOperation = 08
0x6060
1 Byte

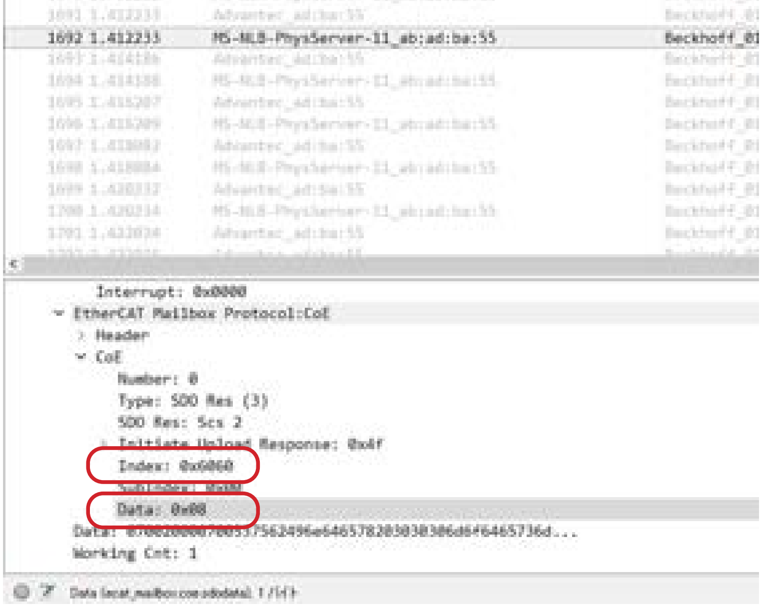
"ModesofOperation"(0x6060)

value	Modes of operation
0	No mode change / No mode assigned
1	Profile Position
2	Velocity mode
3	Profile Velocity
4	Profile Torque
5	Rsv.
6	Homing
7	Interpolated Position
8	Cyclic Synchronous Position
9	Cyclic Synchronous Velocity
10	Cyclic Synchronous Torque

Do searches for 0x08 packets in Wireshark.

Data: ␣0x08 ...to search.

(Search results)



```
1692 1.412233      MS-NLB-PhysServer-11_ab:ad:ba:55      Beckhoff_01

    Interrupt: 0x0000
  EtherCAT Mailbox Protocol:CoE
    Header
    CoE
      Number: 0
      Type: SDO Res (3)
      SDO Res: Scs 2
      Initiate Upload Response: 0x4f
      Index: 0x6060
      SubIndex: 0x00
      Data: 0x08
  Data: 070020000700537562496e646578203030306d6f6465736d...
  Working Cnt: 1
```

終了

The index: 0x6060 is now 0x08, so this packet is identified as the packet set to "Cyclic Synchronous Position Mode".

2. Monitoring EtherCAT communication

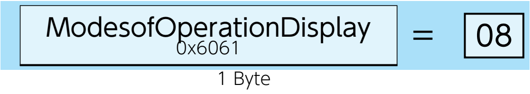
CASE 4: Monitoring Operation Mode Acknowledgement(ACK) Packet in SDO

The current operation mode monitors the "Modesof Operation Display (0x6061)".

In this example procedure, monitoring the command packet to confirm that "Cyclic Synchronous Position Mode" is set as the operation mode.

Find the current setting of Modes of Operation Display.

The cyclic synchronous position mode setting is 0x08.

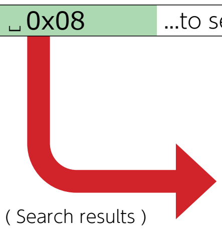


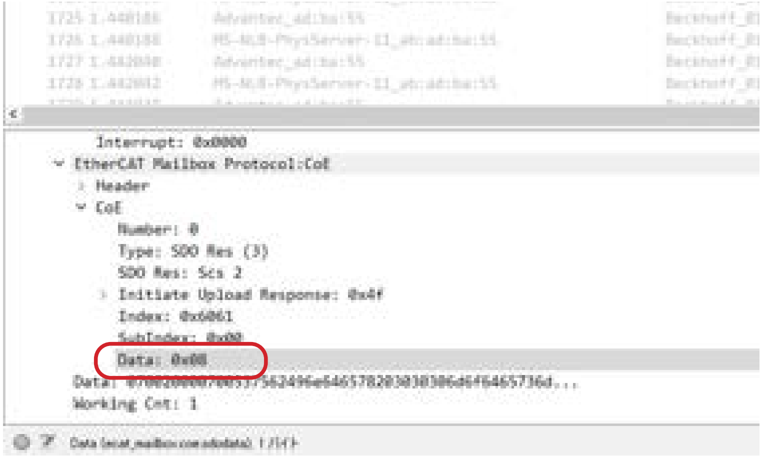
"ModesofOperationDisplay"(0x6061)

value	Mode of operation
0	No mode change / No mode assigned
1	Profile Position
2	Velocity mode
3	Profile Velocity
4	Profile Torque
5	Rsv.
6	Homing
7	Interpolated Position
8	Cyclic Synchronous Position
9	Cyclic Synchronous Velocity
10	Cyclic Synchronous Torque

Do searches for 0x08 packets in Wireshark.

Data: ␣0x08 ...to search.





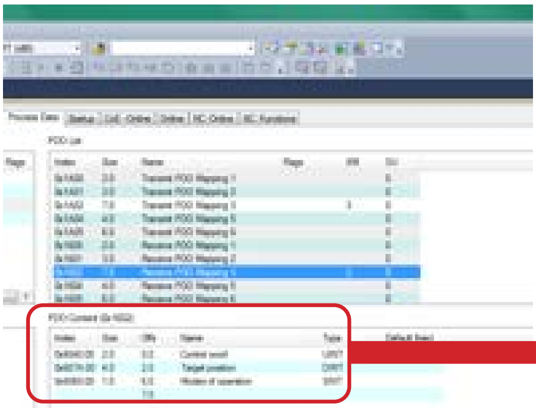
```
      Interrupt: 0x0000
  ˅ EtherCAT Mailbox Protocol:CoE
    › Header
    ˅ CoE
        Number: 0
        Type: SDO Res (3)
        SDO Res: Scs 2
      › Initiate Upload Response: 0x4f
        Index: 0x6061
        SubIndex: 0x00
        Data: 0x08
  Working Cnt: 1
```

終了

It was confirmed that "Cyclic synchronous position mode" is set by the data of "Index: 0x6061" being 0x08.

CASE 4: A similar example-1

Configure and verify PDO mapping.



Example of PDO screen in TwinCAT

PDO mapping can be configured and verified via a master such as TwinCAT.

In this example, it is verified that the operation mode is set to the cyclic synchronous position mode. The cyclic synchronous position mode is 0x08.

ModesofOperation 0x6060 = 08
1 Byte

Data mapped in this example

Data:	Controlword 0x6040	TargetPosition 0x607A	ModesofOperation 0x6060
	2 Byte	4 Byte	1 Byte

Offset = 6 Byte

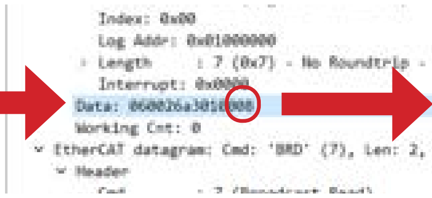
In this example, there is a 6 Byte data offset in front of the ModesofOperation data section.

In PDO, the mode setting is complete if ModeofOperation(0x6060)=ModeofOperation Display(0x6061).

Do search for packets of Controlword=0x0006 in Wireshark.

Data: ␣0x0600 ...to search.

(The PDS state transition in the Controlword 0x0006 is "Shutdown".)



```
    Index: 0x00
    Log Addr: 0x01000000
  › Length      : 7 (0x7) - No Roundtrip -
    Interrupt: 0x0000
   Data: 060026a3010008
   Working Cnt: 0
 ˅ EtherCAT datagram: Cmd: 'BRD' (7), Len: 2,
   ˅ Header
```

(Search results)

Found data

Data: 060026a3010008

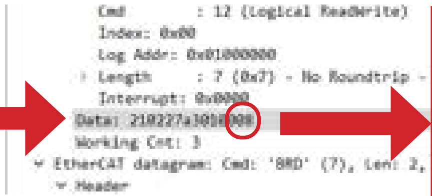
Offset = 6 Byte

ModesofOperation
0x6060

Similarly, do searches for "statusword = 0x0221" packets.

Data: ␣0x2102 ...to search.

(The status transition in the Statusword 0x0221 is "Ready to switch on".)



```
    Cmd         : 12 (Logical ReadWrite)
    Index: 0x00
    Log Addr: 0x01000000
  › Length      : 7 (0x7) - No Roundtrip -
    Interrupt: 0x0000
   Data: 210227a3010008
   Working Cnt: 3
 ˅ EtherCAT datagram: Cmd: 'BRD' (7), Len: 2,
   ˅ Header
```

(Search results)

Found data

Data: 210227a3010008

Offset = 6 Byte

ModesofOperationDisplay
0x6061

終了

In PDO, ModeofOperation(0x6060) = ModeofOperationDisplay(0x6061), which indicates that the mode setting has been completed.

2. Monitoring EtherCAT communication

CASE 5: Monitoring "Homing"

This section describes how to monitor packets that configure the homing operation. After that, monitoring the packet to start homing operation.

This example procedure describes the following operation configuration.

Example configuration	Homing method (0x6098)	: 22	(0x16)
	Homing Speed1 (0x6099:1)	: 218,454 $^{(*1)}$	(0x00035556)
	Homing Speed2 (0x6099:2)	: 21,846 $^{(*2)}$	(0x00005556)
	Homing acceleration (0x609A)	: 72,817,766 $^{(*3)}$	(0x4571C66)

*1) This stands for 218,454 pulse/s = 100 rpm.
*2) This stands for 21,846 pulse/s =10 rpm.
*3) This stands for 72,817,766 pulse/s2 = 20 ms.

Do search for homing-related packets in Wireshark

Homing method
(0x6098)

Data: ␣0x16 ...to search.

(Search results)

```
⌄ CoE
    Number: 0
    Type: SDO Res (3)
    SDO Res: Scs 2
  › Initiate Upload Response: 0x4f
    Index: 0x6098
    SubIndex: 0x00
    Data: 0x16
  Data: 0700020000070005375562496e646578203030306d6f6465736d...
  Working Cnt: 1
```

Homing speed1
(0x6099:1)

SubIndex: ␣0x01 ...to search.

(Search results)

```
⌄ CoE
    Number: 0
    Type: SDO Res (3)
    SDO Res: Scs 2
  › Initiate Upload Response: 0x43
    Index: 0x6099
    SubIndex: 0x01
    Data: 0x00035556
  Data: 0700020000070005375562496e646578203030306d6f6465736d...
  Working Cnt: 1
```

Homing speed2
(0x6099:2)

SubIndex: ␣0x02 ...to search.

(Search results)

```
⌄ CoE
    Number: 0
    Type: SDO Res (3)
    SDO Res: Scs 2
  › Initiate Upload Response: 0x43
    Index: 0x6099
    SubIndex: 0x02
    Data: 0x00005556
  Data: 0700020000070005375562496e646578203030306d6f6465736d...
  Working Cnt: 1
```

Homing acceleration
(0x609A)

Index: ␣0x609A ...to search.

(Search results)

```
⌄ CoE
    Number: 0
    Type: SDO Res (3)
    SDO Res: Scs 2
  › Initiate Upload Response: 0x43
    Index: 0x609a
    SubIndex: 0x00
    Data: 0x04571c66
  Data: 0700020000070005375562496e646578203030306d6f6465736d...
  Working Cnt: 1
```

(Go to the next page.)

2. Monitoring EtherCAT communication

Continue from CASE 5: Monitoring "Homing"

Confirm the "Homing operation start" command.

"Controlword"(0x6040)

bit	Name
0	Switch on
1	Enable voltage
2	Quick stop
3	Enable operation
4	Homing operation start
5	Rsv.
6	
7	Fault reset
8	Halt
9	Rsv.
10	
11	
12	
13	
14	
15	

Start homing.

For the Homing operatoin start command, set bit 4 of the "Controlword" to 1.

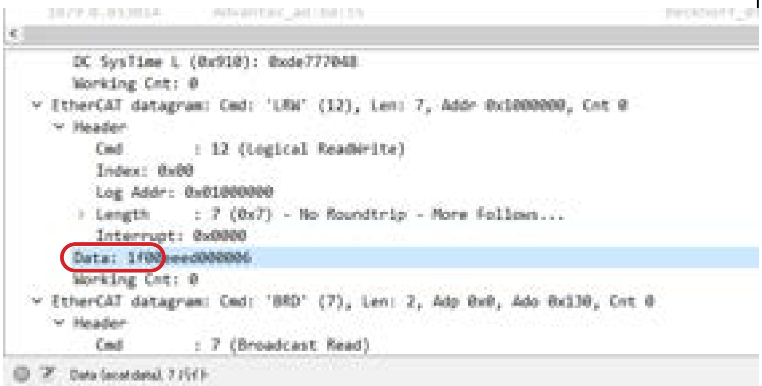
Controlword 0x6040 = 00 1F

2 Byte

Do search the "Homing operation start" command packet.

Data: ␣1f00 ...to search.

(Search results)



```
    DC SysTime L (0x910): 0xde777048
    Working Cnt: 0
v EtherCAT datagram: Cmd: 'LRW' (12), Len: 7, Addr 0x1000000, Cnt 0
  v Header
      Cmd        : 12 (Logical ReadWrite)
      Index: 0x00
      Log Addr: 0x01000000
    > Length     : 7 (0x7) - No Roundtrip - More Follows...
      Interrupt: 0x0000
    Data: 1f00eed0000006
    Working Cnt: 0
v EtherCAT datagram: Cmd: 'BRD' (7), Len: 2, Adp 0x0, Ado 0x130, Cnt 0
  v Header
      Cmd        : 7 (Broadcast Read)
```

(Go to the next page.)

2. Monitoring EtherCAT communication

Continue from CASE 5: Monitoring "Homing"

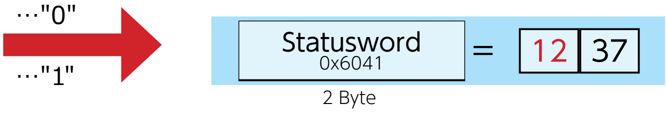
Check the "homing operation" status.

"Statusword"(0x6041)

bit	Name
0	Ready to switch on
1	Switch on
2	Operation enable
3	Fault
4	Voltage enable
5	Quick stop
6	Switch on disabled
7	Warning
8	Rsv.
9	Remote
10	Target reached
11	Internal limit active
12	Homing attained
13	Homing error
14	Rsv.
15	

During homing operation, the Statusword (0x6041) <u>bit10 is set to "0"</u> and <u>bit12 is set to "1"</u>.

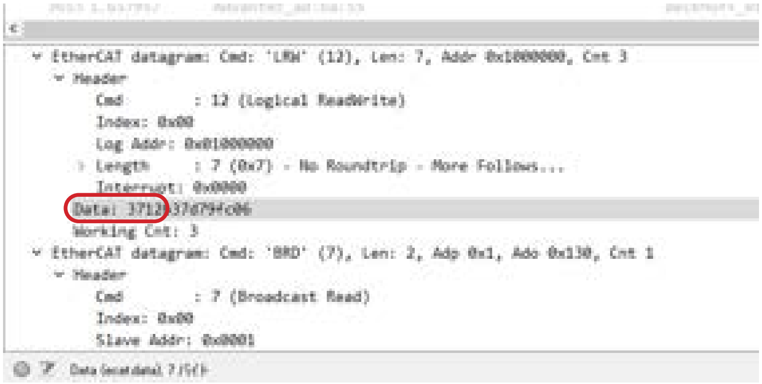
Homing is in progress.



Do search for "homing operation" packet.

Data:␣3712 ...to search.

(Search results)



```
∨ EtherCAT datagram: Cmd: 'LRW' (12), Len: 7, Addr 0x1000000, Cnt 3
  ∨ Header
      Cmd       : 12 (Logical ReadWrite)
      Index: 0x00
      Log Addr: 0x01000000
    > Length    : 7 (0x7) - No Roundtrip - More Follows...
      Interrupt: 0x0000
    Data: 371237d79fc06
    Working Cnt: 3
∨ EtherCAT datagram: Cmd: 'BRD' (7), Len: 2, Adp 0x1, Ado 0x130, Cnt 1
  ∨ Header
      Cmd       : 7 (Broadcast Read)
      Index: 0x00
      Slave Addr: 0x0001
```

(Go to the next page.)

Continue from CASE 5: Monitoring "Homing"

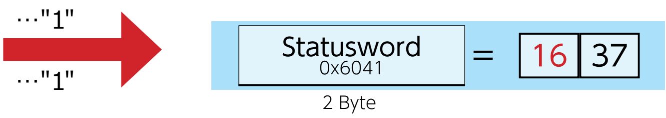
Check the "Homing completion" status.

"Statusword"(0x6041)

bit	Name
0	Ready to switch on
1	Switch on
2	Operation enable
3	Fault
4	Voltage enable
5	Quick stop
6	Switch on disabled
7	Warning
8	Rsv.
9	Remote
10	Target reached
11	Internal limit active
12	Homing attained
13	Homing error
14	Rsv.
15	

Upon completion of homing, the Statusword (0x6041) bit10 will be set to "1" and bit12 will be set to 1.

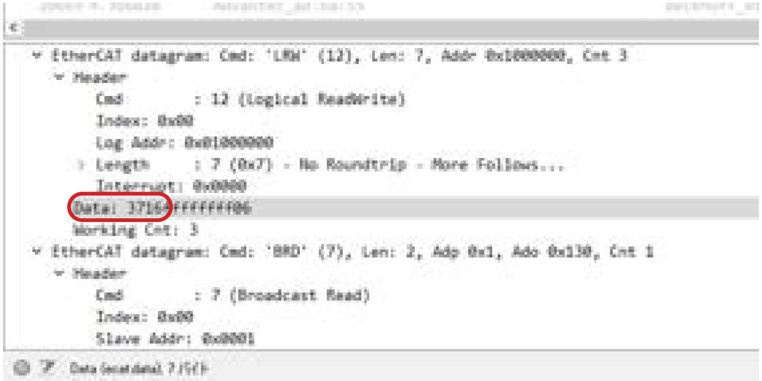
Homing completed.



Do search for the "Homing completion" packet.

Data: ␣3716 ...to search.

(Search results)



```
∨ EtherCAT datagram: Cmd: 'LRW' (12), Len: 7, Addr 0x1000000, Cnt 3
  ∨ Header
      Cmd        : 12 (Logical ReadWrite)
      Index: 0x00
      Log Addr: 0x01000000
    > Length     : 7 (0x7) - No Roundtrip - More Follows...
      Interrupt: 0x0000
    Data: 37164FFFFFFF06
    Working Cnt: 3
∨ EtherCAT datagram: Cmd: 'BRD' (7), Len: 2, Adp 0x1, Ado 0x130, Cnt 1
  ∨ Header
      Cmd        : 7 (Broadcast Read)
      Index: 0x00
      Slave Addr: 0x0001
```

終了

As the Statusword is assigned to 0x1637, homing has been finished.

MEMO

S-FLAG Ⅱ Instruction Manual
- EtherCAT -

F

OPERATIONS

AMO-NP-35475-42
SF2-E-F
APR. 2023

MEMO

1

Operations

1. Overview

Operation modes supported by the this product

The product supports the CiA 402 drive profile. The available operation modes are as follows.
The operation mode is set with the 6060 h (Modes of operation) object.
Some bits of the Control word and Status word differ for each mode of operation.
See the description of each operation mode for the different bits for each operation mode.

Operation modes	6060h value
Cyclic synchronous position mode (CSP)	**8**
Cyclic synchronous velocity mode (CSV)	**9**
Cyclic synchronous torque mode (CST)	**10**
Homing Mode (HM)	**6**
Profile position mode (PP)	**1**

1. Overview

1. Control mode setting

6502h Supported drive modes

6052 h indicates the control mode supported by this product.

6502h	Supported drive modes				
Sub-index:	**00h**	–			
Access:	RW	**Data Type:**	U32	**Unit:**	–
Default:	–			**Range:**	0 to 4,294,967,295

Description:

Indicates the supported control modes.

bit	Control mode	Abbreviation	Support*
0	Profile Position control mode	pp	●
1	Velocity control mode	vl	×
2	Profile Velocity control mode	pv	×
3	Profile Torque control mode	tq	×
4	Rsv.		-
5	Homing mode	hm	●
6	Interpolated Position mode	ip	×
7	Cyclic synchronous position mode	csp	●
8	Cyclic synchronous velocity mode	csv	●
9	Cyclic synchronous torque mode	cst	●
10-31	Rsv.	-	-

*) The supported modes depend on the software version.

6060h Modes of operation

6060h sets the servo amplifier control mode.

6060h	Modes of operation				
Sub-index:	**00h**	–			
Access:	RW	**Data Type:**	I8	**Unit:**	–
Default:	–			**Range:**	– 128 to 127

Description: Sets the control mode of the servo amplifier.

value	Mode of operation	Abbreviation	Support*
-128 to -1	Rsv.	-	-
0	Mode not changed/Mode not set	-	●
1	Profile position control mode	pp	●
2	Velocity control mode	vl	×
3	Profile Velocity control mode	pv	×
4	Profile Torque control mode	tq	×
5	Rsv.		-
6	Homing mode	hm	●
7	Interpolated Position mode	ip	×
8	Cyclic synchronous position mode	csp	●
9	Cyclic synchronous velocity mode	csv	●
10	Cyclic synchronous torque mode	cst	●
11-127	Rsv.	-	-

*) The supported modes depend on the software version.

6061h Modes of operation display

6061 h indicates the servo amplifier control mode.

6061h	Modes of operation display				
Sub-index:	**00h**	–			
Access:	RO	**Data Type:**	I8	**Unit:**	–
Default:	–			**Range:**	– 128 to 127

Description: Indicates the current control mode of the servo amplifier.

value	Mode of operation	Abbreviation	Support*
-128 to -1	Rsv.	-	-
0	Mode not changed/Mode not set	-	●
1	Profile position control mode	pp	●
2	Velocity control mode	vl	×
3	Profile Velocity control mode	pv	×
4	Profile Torque control mode	tq	×
5	Rsv.		-
6	Homing mode	hm	●
7	Interpolated Position mode	ip	×
8	Cyclic synchronous position mode	csp	●
9	Cyclic synchronous velocity mode	csv	●
10	Cyclic synchronous torque mode	cst	●
11-127	Rsv.	-	-

*) The supported modes depend on the software version.

2. Drive profile (CiA402)

6040h Controlword

6040h is a command to control slave devices such as PDS state transition.

6040h	Controlword				
Sub-index:	**00h**	–			
Access:	RW	**Data Type:**	U16	**Unit:**	–
Default:	–			**Range:**	0 to 65,535
Description:	Sets control commands to the servo amplifier such as PDS state transition.				

bit	Descriptions
0	Switch on
1	Enable voltage
2	Quick stop
3	Enable operation
4	**Operation mode specific**
5	
6	
7	Fault reset
8	halt
9	**Operation mode specific**
10	Rsv.
11	
12	
13	
14	
15	

Command coding

Command	bit 7 Fault reset	bit 3 Enable operation	bit 2 Quick stop	bit 1 Enable voltage	bit 0 Switch on	6040h value **(0x_ _ _☐)**
Shutdown	0	X	1	1	0	☐ = **6h** or **Ah**
Switch on	0	0	1	1	1	☐ = **7h**
Switch on + Enable operation	0	1	1	1	1	☐ = **Fh**
Disable voltage	0	X	X	0	X	☐ = **0h, 1h, 4h, 5h, 8h, 9h, Ch, Dh**
Quick stop	0	X	0 (*1)	1	X	☐ = **2h**, **3h**, **Ah**, **Eh**
Disable operation	0	0	1	1	1	☐ = **7h**
Enable operation	0	1	1	1	1	☐ = **Fh**
Fault reset	↑	X	X	X	X	(Undefined)

*1) The "Quick stop" command is activated by "0". This bit is inverted from the other bits.

6041h Statusword

6041h indicates the status of the slave device.

6041h	Statusword				
Sub-index:	00h	–			
Access:	RW	Data Type:	U16	Unit:	–
Default:	–			Range:	0 to 65,535
Description:	Indicates the status of the servo amplifier.				

bit	Descriptions
0	Ready to Switch on
1	Switch on
2	Operation enable
3	Fault
4	Voltage enable
5	Quick stop
6	Switch on disabled
7	Warning
8	Rsv.
9	Remote
10	Operation mode specific
11	Internal limit active
12	Operation mode specific
13	
14	
15	

The PDS state is indicated by Bit 6,5,3-0.

Statusword	PDS state	
xxxx xxxx x0xx 0000 (b)	Not ready to switch on	Initialization not complete
xxxx xxxx x1xx 0000 (b)	Switch on disabled	Initialization complete
xxxx xxxx x01x 0001 (b)	Ready to switch on	Main circuit power OFF
xxxx xxxx x01x 0011 (b)	Switched on	Servo Off/Servo Ready
xxxx xxxx x01x 0111 (b)	Operation enabled	Servo On
xxxx xxxx x00x 0111 (b)	Quick stop active	Quick stop
xxxx xxxx x0xx 1111 (b)	Fault reaction active	Error determination
xxxx xxxx x0xx 1000 (b)	Fault	Error state

bit 4 (Voltage enable):

1: The main circuit power supply voltage is applied to the PDS.

bit 5 (Quick stop):

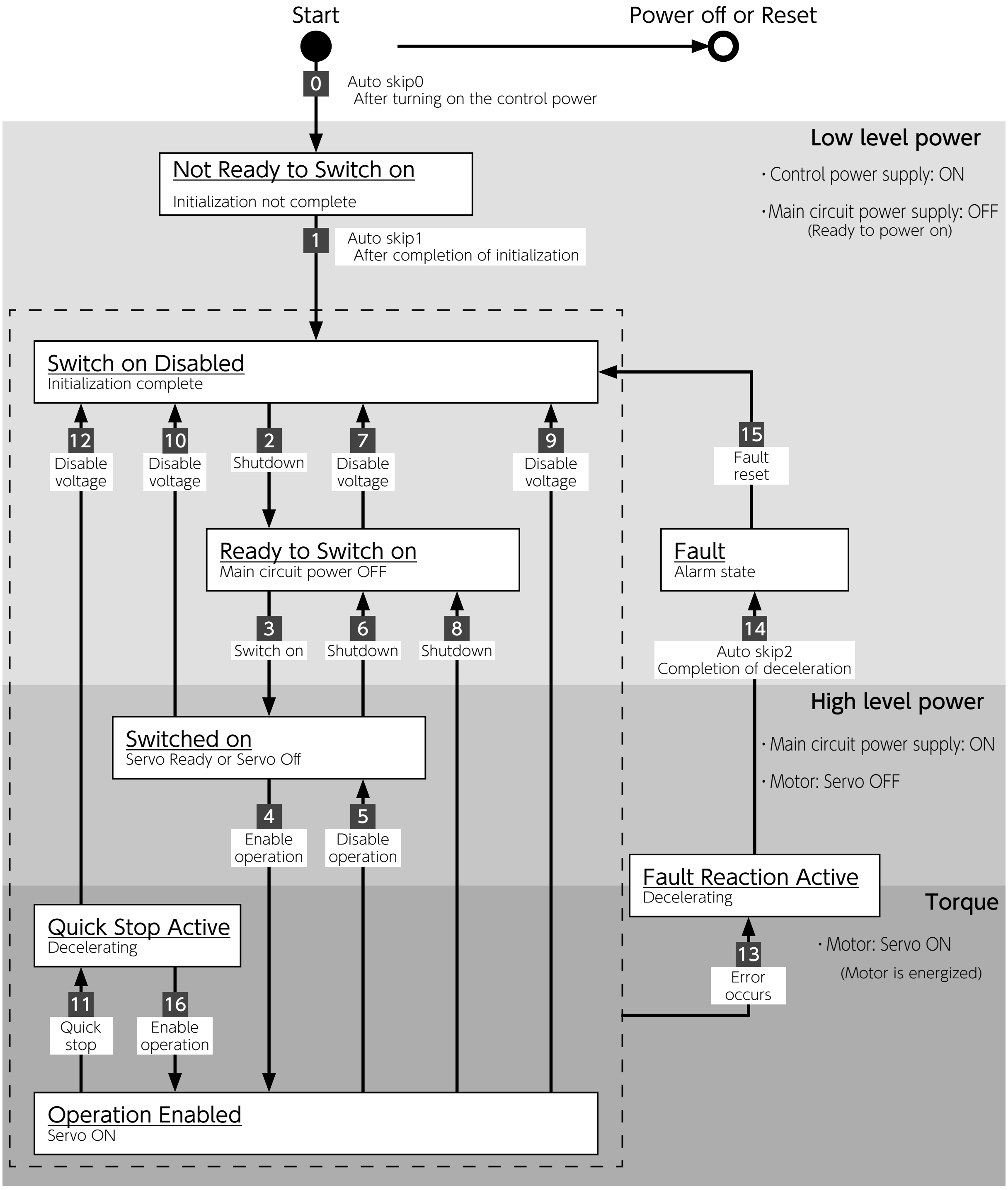
0: PDS receives "Quick stop" command.
"Quick stop" command is enabled with a value of "0". This is the opposite of other bit logic.

bit 7 (Warning):

1: A warning has occurred. The PDS state does not change when a warning occurs.
(The motor continues to operate.)

3. PDS (Power Drive System)

FSA (Finite State Automaton)



n is the PDS Transition number. (n: 0-16)

The FSA State

State	Descriptions
Not Ready to Switch on	Control power is supplied to the slave device and control power is established. The slave device is initializing or performing a self-test.
Switch on Disabled	The slave device is initialized and ready to set parameters. The main circuit power supply should not be turned on.
Ready to Switch on	The main circuit power supply is permitted to be turned on. The parameter is configurable, but the function is disabled.
Switched on	The main circuit power is supplied and ready to accept "Operation Enabled". The slave device can set parameters.
Operation Enabled	The drive function is enabled and the motor is energized. No alarms. The slave device can set parameters.
Quick Stop Active	"Quick stop" is executing. The drive function is enabled and the motor is energized.
Fault Reaction Active	An alarm has occurred on the slave device then "Quick stop" is executing. The motor is energized.
Fault	An alarm has been occurred on the slave device then "Fault reaction" is completed. The drive function is disabled. The main circuit power supply is turned on or off by an application.

2. Cyclic synchronous position mode (CSP)

In Cyclic synchronous position mode, the command position is generated by the master controller. The slave device operates by receiving the command position every interpolation period.

To use cyclic synchronization position mode, set the 6060 h (Modes of operation) object to "8".

Objects Used in Cyclic Synchronous Position Mode

Index	Sub-Index	Name	Units	Type	Access	PDO Mapping
603Fh	00h	Error code	–	U16	RO	TxPDO
6040h	00h	Controlword	–	U16	RW	RxPDO
6041h	00h	Statusword	–	U16	RO	TxPDO
6062h	00h	Position demand value	Command Unit	I32	RO	TxPDO
6064h	00h	Position actual value	Command Unit	I32	RO	TxPDO
6065h	00h	Following error window	Command Unit	U32	RW	No
6072h	00h	Max torque	0.1%	U16	RW	RxPDO
6077h	00h	Torque actual value	0.1%	I16	RO	TxPDO
607Ah	00h	Target position	Command Unit	I32	RW	RxPDO
6080h	00h	Max motor speed	r/min	U32	RW	RxPDO
60B0h	00h	Position offset	Command Unit	I32	RW	RxPDO
60B1h	00h	Velocity offset	Command Unit/s	I32	RW	RxPDO
60B2h	00h	Torque offset	0.1%	I16	RW	RxPDO
60F4h	00h	Following error actual value	Command Unit	I32	RO	TxPDO
60FDh	00h	Digital inputs	–	U32	RO	TxPDO

6040h Controlword on Cyclic synchronous position mode

6040h is a command to control slave devices such as PDS state transition.

6040h	Controlword				
Sub-index:	**00h**	–			
Access:	RW	Data Type:	U16	Unit:	–
Default:	–			Range:	0 to 65,535

Description: Sets control commands to the servo amplifier such as PDS state transition.

bit	Descriptions
0	Sensor on
1	Enable voltage
2	Quick stop
3	Enable operation
4 5 6	Rsv.
7	Fault reset
8	Halt
9 10 11 12 13 14 15	Rsv.

bit 8 (Halt):

0: Permits the cyclic synchronous position function.

1: Motor stop by 605Dh (Halt option code)

2. Cyclic synchronous position mode (CSP)

6041h Statusword on Cyclic synchronous position mode

6041h indicates the status of the slave device.

6041h	Statusword				
Sub-index:	**00h**	–			
Access:	RW	Data Type:	U16	Unit:	–
Default:	–			Range:	0 to 65,535
Description:	Indicates the status of the servo amplifier.				

bit	Descriptions
0	Ready to switch on
1	Switch on
2	Operation enable
3	Fault
4	Voltage enable
5	Quick stop
6	Switch on disabled
7	Warning
8	Rsv.
9	Remote
10	**Rsv.**
11	Internal limit active
12	**Drive follows command value**
13	**Following error**
14	Rsv.
15	

bit 12 (Drive follows command value):

0: Not following the command position

1: Following the command position

bit 13 (Following error):

If the value of 60F4h (Following error actual value) has exceeded the setting range of 6065h(Following error window) for a certain period of time, the 6041h value becomes "1".

0: No excessive position deviation

1: Position deviation excess alarm

3. Cyclic synchronous velocity mode (CSV)

In Cyclic synchronous velocity mode, the command velocity is generated by the master controller. The slave device operates by receiving the command velocity every interpolation period.

To use cyclic synchronization position mode, set the 6060 h (Modes of operation) object to "9".

Objects Used in Cyclic Synchronous Velocity Mode

Index	Sub-Index	Name	Units	Type	Access	PDO Mapping
603Fh	00h	Error code	–	U16	RO	TxPDO
6040h	00h	Controlword	–	U16	RW	RxPDO
6041h	00h	Statusword	–	U16	RO	TxPDO
6072h	00h	Max torque	0.1%	U16	RW	RxPDO
6080h	00h	Max motor speed	r/min	U32	RW	RxPDO
60B1h	00h	Velocity offset	Command Unit/s	I32	RW	RxPDO
60B2h	00h	Torque offset	0.1%	I16	RW	RxPDO
60FFh	00h	Target velocity	Command Unit/s	I32	RW	RxPDO

CSV

6040h Controlword on Cyclic synchronous velocity mode

6040h is a command to control slave devices such as PDS state transition.

6040h	Controlword				
Sub-index:	**00h**	–			
Access:	RW	**Data Type:**	U16	**Unit:**	–
Default:	–			**Range:**	0 to 65,535
Description:	Sets control commands to the servo amplifier such as PDS state transition.				

bit	Descriptions
0	Sensor on
1	Enable voltage
2	Quick stop
3	Enable operation
4	Rsv.
5	
6	
7	Fault reset
8	Halt
9	Rsv.
10	
11	
12	
13	
14	
15	

bit 8 (Halt):

0: Permits the cyclic synchronous velocity function.

1: Motor stop by 605Dh (Halt option code)

6041h Statusword on Cyclic synchronous velocity mode

6041h indicates the status of the slave device.

6041h	Statusword				
Sub-index:	**00h**	–			
Access:	RW	**Data Type:**	**U16**	**Unit:**	–
Default:	–			**Range:**	0 to 65,535
Description:	Indicates the status of the servo amplifier.				

bit	Descriptions
0	Ready to switch on
1	Switch on
2	Operation enable
3	Fault
4	Voltage enable
5	Quick stop
6	Switch on disabled
7	Warning
8	Rsv.
9	Remote
10	**Rsv.**
11	Internal limit active
12	**Drive follows command value**
13	**Rsv.**
14	Rsv.
15	

bit 12 (Drive follows command value):

- **0**: Not following the command velocity
- **1**: Following the command velocity

4. Cyclic synchronous torque mode (CST)

In Cyclic synchronous velocity mode, the command torque is generated by the master controller. The slave device operates by receiving the command torque every interpolation period.

To use cyclic synchronization position mode, set the 6060 h (Modes of operation) object to "10".

Objects Used in Cyclic Synchronous Torque Mode

Index	Sub-Index	Name	Units	Type	Access	PDO Mapping
603Fh	00h	Error code	–	U16	RO	TxPDO
6040h	00h	Controlword	–	U16	RW	RxPDO
6041h	00h	Statusword	–	U16	RO	TxPDO
6071h	00h	Target torque	0.1%	I16	RW	RxPDO
6072h	00h	Max torque	0.1%	U16	RW	RxPDO
6080h	00h	Max motor speed	r/min	U32	RW	RxPDO
60B2h	00h	Torque offset	0.1%	I16	RW	RxPDO

6040h Controlword on Cyclic synchronous torque mode

6040h is a command to control slave devices such as PDS state transition.

6040h	Controlword				
Sub-index:	**00h**	–			
Access:	RW	Data Type:	U16	Unit:	–
Default:	–			Range:	0 to 65,535
Description:	Sets control commands to the servo amplifier such as PDS state transition.				

bit	Descriptions
0	Sensor on
1	Enable voltage
2	Quick stop
3	Enable operation
4	Rsv.
5	
6	
7	Fault reset
8	Halt
9	Rsv.
10	
11	
12	
13	
14	
15	

bit 8 (Halt):

0: Permits the cyclic synchronous torque function.

1: Motor stop by 605Dh (Halt option code)

4. Cyclic synchronous torque mode (CST)

6041h Statusword on Cyclic synchronous torque mode

6041h indicates the status of the slave device.

6041h	Statusword				
Sub-index:	**00h**	–			
Access:	RW	**Data Type:**	U16	**Unit:**	–
Default:	–			**Range:**	0 to 65,535
Description:	Indicates the status of the servo amplifier.				

bit	Descriptions
0	Ready to switch on
1	Switch on
2	Operation enable
3	Fault
4	Voltage enable
5	Quick stop
6	Switch on disabled
7	Warning
8	Rsv.
9	Remote
10	**Rsv.**
11	Internal limit active
12	**Drive follows command value**
13	**Rsv.**
14	Rsv.
15	

bit 12 (Drive follows command value):

0: Not following the command torque

1: Following the command torque

5. Homing Mode (HM)

Homing mode is a position control mode in which homing is performed by setting the operating speed, acceleration and operating method.
For an incremental motor, always perform homing after turning on the power.

To set the homing mode, set the 6060 h (Modes of operation) object to "6".

Objects used for Homing

Index	Sub-Index	Name	Units	Type	Access	PDO Mapping
6040h	00h	Controlword	–	U16	RW	RxPDO
6041h	00h	Statusword	–	U16	RO	TxPDO
607Ch	00h	Home offset	Command Unit	I32	RW	RxPDO
6098h	00h	Homing method	–	I8	RW	RxPDO
6099h	–	Homing speeds	–	–	–	–
	00h	Highest sub-index supported	–	U8	RO	No
	01h	Speed during search for switch	Command Unit/s	U32	RW	RxPDO
	02h	Speed during search for zero	Command Unit/s	U32	RW	RxPDO
609Ah	00h	Homing acceleration	Command Unit/s^2	U32	RW	No

5. Homing Mode (HM)

6040h Controlword in Homing mode

6040h is a command to control slave devices such as PDS state transition.

6040h	Controlword				
Sub-index:	**00h**	–			
Access:	RW	**Data Type:**	**U16**	**Unit:**	–
Default:	–			**Range:**	0 to 65,535
Description:	Sets control commands to the servo amplifier such as PDS state transition.				

bit	Descriptions
0	Switch on
1	Enable voltage
2	Quick stop
3	Enable operation
4	**Homing operation start**
5	Rsv.
6	
7	Fault reset
8	Halt
9	Rsv.
10	
11	
12	
13	
14	
15	

When the set value of bit 4 (homing operation start) of 6040 h (Controlword) is changed from 0 to 1, the parameter used in the homing mode is loaded at the rising edge and the operation starts.

6041 h Statusword in homing mode

6041h indicates the status of the slave device.

6041h	Statusword				
Sub-index:	**00h**	–			
Access:	RW	Data Type:	U16	Unit:	–
Default:	–			Range:	0 to 65,535
Description:	Indicates the status of the servo amplifier.				

bit	Descriptions
0	Ready to switch on
1	Switch on
2	Operation enable
3	Fault
4	Voltage enable
5	Quick stop
6	Switch on disabled
7	Warning
8	Rsv.
9	Remote
10	**Target reached**
11	Internal limit active
12	**Homing attained**
13	**Homing error**
14	Rsv.
15	

bit 10 (Target reached):

- **0**: Executing
- **1**: Stop

bit 12 (Homing attained):

- **0**: Homing is not completed.
- **1**: Homing is completed.

bit 13 (Homing error):

- **0**: No Error
- **1**: There is an error related to Homing.

Bit 10, 12, and 13 indicate the homing status.

Statusword	Status of Homing mode
xx00 x0xx xxxx xxxx (b)	"Homing" is in progress
xx00 x1xx xxxx xxxx (b)	"Homing" is interrupted or not started.
xx01 x0xx xxxx xxxx (b)	"Homing" is completed, but the motor has not reached the target position.
xx01 x1xx xxxx xxxx (b)	"Homing" is completed.
xx10 x0xx xxxx xxxx (b)	An error related to "homing" was detected, but operation is continuing.
xx10 x1xx xxxx xxxx (b)	An error related to "homing" was detected, then the motor has stopped.

5. Homing Mode (HM)

List of Homing Methods

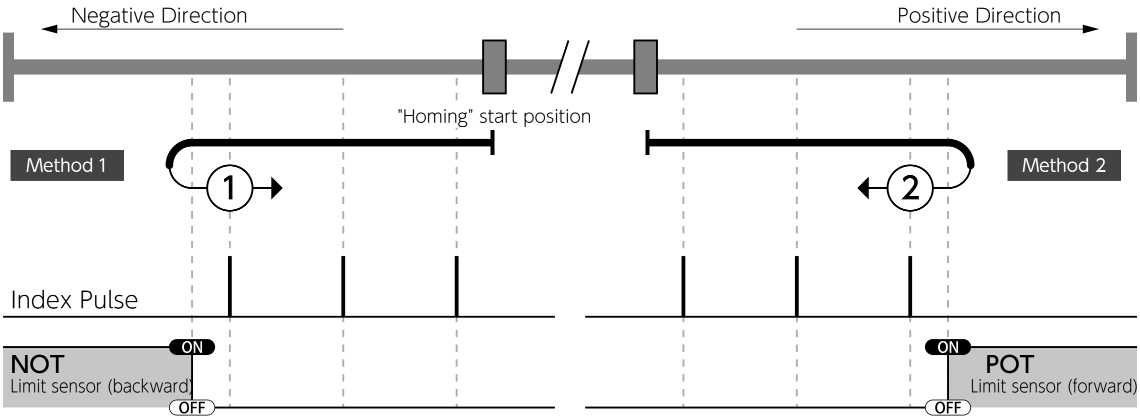
Method	Type of Homing mode	Support
1	Homing on **negative limit sensor** and **index pulse**	●
2	Homing on **positive limit sensor** and **index pulse**	●
3, 4	Homing on **positive home sensor** and **index pulse**	●
5, 6	Homing on **negative home sensor** and **index pulse**	●
7-16	–	×
17	Homing on **negative limit sensor**	●
18	Homing on **positive limit sensor**	●
19, 20	Homing on **positive home sensor**	●
21, 22	Homing on **negative home sensor**	●
23-26	Homing on home sensor and positive limit - **positive initial motion**	●
27-30	Homing on home sensor and negative limit - **negative initial motion**	●
33, 34	Homing on **index pulse**	●
35, 37	Homing on **current position**	●

As of February 2023.

Method 35 (Homing on current position) was discontinued in CiA402 Work Draft CANopen Drive and motion control device profile part2 Version : 3.0.1.13(26 April 2012). Use "Method 37" for new designs.

5. Homing Mode (HM)

Method 1	Homing on **negative limit sensor (NOT)** and **index pulse**
Method 2	Homing on **positive limit sensor (POT)** and **index pulse**



▬	**6099h 01h**	Speed during search for sensor
→	**6099h 02h**	Speed during search for zero

Method 1

- When the "**NOT** (backward direction limit sensor : pin No. 8 of I/O connector)" is OFF, the moving direction at the Homing start is to the left of this figure (The motor rotates CW.).

- When the "NOT" input is turned ON, the motor moves to the right (The motor is CCW.) at a low speed.

- Then, the position where the first index pulse is detected becomes the origin. ①

Method 2

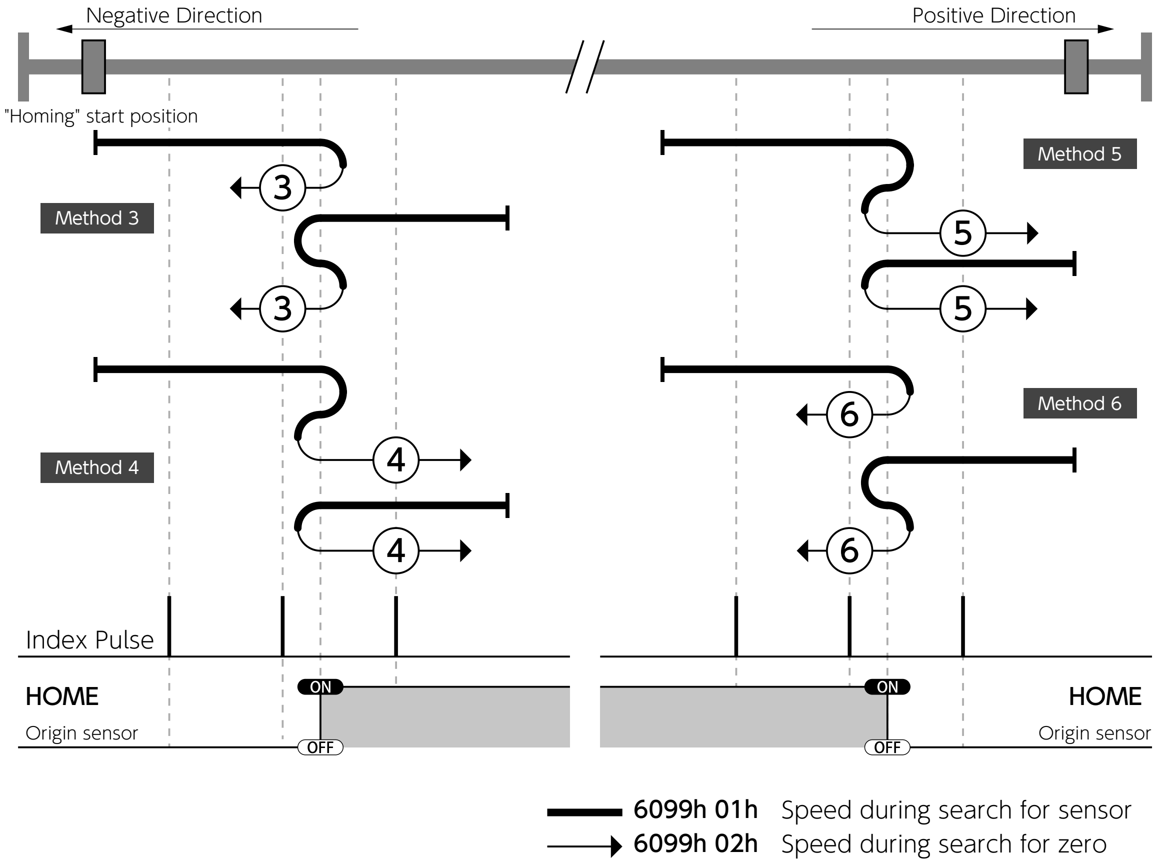
- When the "**POT** (forward direction limit sensor : pin No. 7 of I/O connector)" is OFF, the moving direction at the Homing start is to the right of this figure (The motor rotates CCW.).

- When the "POT" input is turned ON, the motor moves to the left (The motor is CW.) at a low speed.

- Then, the position where the first index pulse is detected becomes the origin. ②

5. Homing Mode (HM)

Method 3 Method 4	Homing on **positive home sensor** and **index pulse**
Method 5 Method 6	Homing on **negative home sensor** and **index pulse**

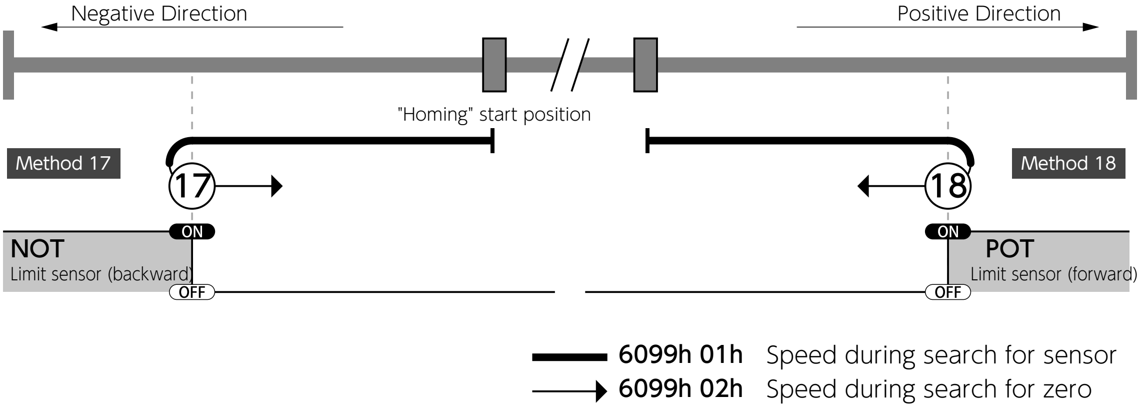


Method 3 **Method 4** **Method 5** **Method 6**

- The moving direction depends on the input state of "**HOME** (Origin sensor: pin No. 9 of I/O connector)" when "Homing" is started.
- When the Origin sensor is detected, the motor changes its moving direction and moves at low speed.
- After that, the position where the first Index pulse is found becomes Origin. ③④⑤⑥

5. Homing Mode (HM)

Method 17	Homing on **negative limit sensor (NOT)**
Method18	Homing on **positive limit sensor (POT)**



Method 17

- When the "**NOT** (backward direction limit sensor : pin No. 8 of I/O connector)" is OFF, the moving direction at the Homing start is to the left of this figure (The motor rotates CW.).
- The position where the "**NOT**" input signal turns ON is the origin. ⑰

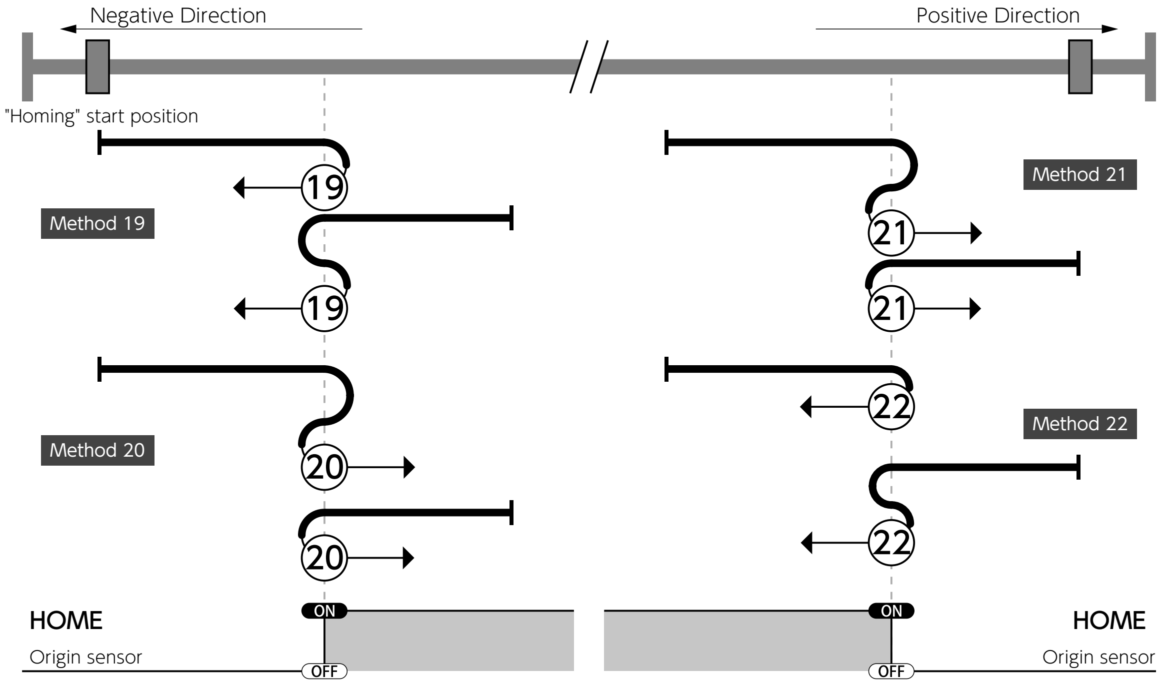
Method 18

- When the "**POT** (forward direction limit sensor : pin No. 7 of I/O connector)" is OFF, the moving direction at the Homing start is to the right of this figure (The motor rotates CCW.).
- The position where the "**POT**" input signal turns ON is the origin. ⑱

- These methods are the same as not using Index Pulse in "Method 1" and "Method 2", respectively.

5. Homing Mode (HM)

Method 19 Method 20	Homing on **positive home sensor**
Method 21 Method 22	Homing on **negative home sensor**



━ **6099h 01h** Speed during search for sensor
→ **6099h 02h** Speed during search for zero

Method 19 Method 20 Method 21 Method 22

- The moving direction depends on the input state of "**HOME** (Origin sensor: pin No. 9 of I/O connector)" when "Homing" is started.

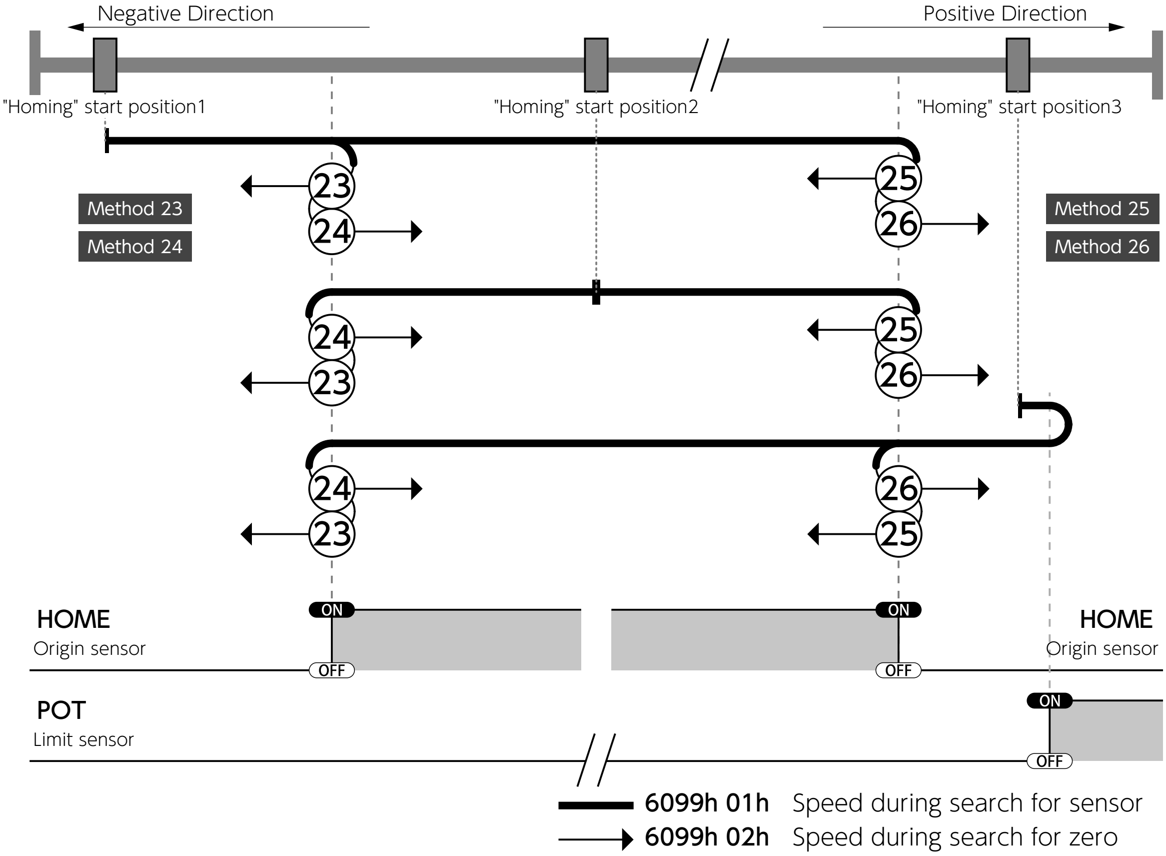
- The position where the first Index pulse is found becomes Origin. ⑲⑳㉑㉒

- These methods are the same as not using Index Pulse in "Method 3-6", respectively.

5. Homing Mode (HM)

Method 23
Method 24
Method 25
Method 26

Homing on home sensor and Positive limit(POT) - **positive initial motion**



Method 23 **Method 24**

- The moving direction depends on the input state of the home sensor input (HOME : I/O pin 9) at the time the homing operation is executed.

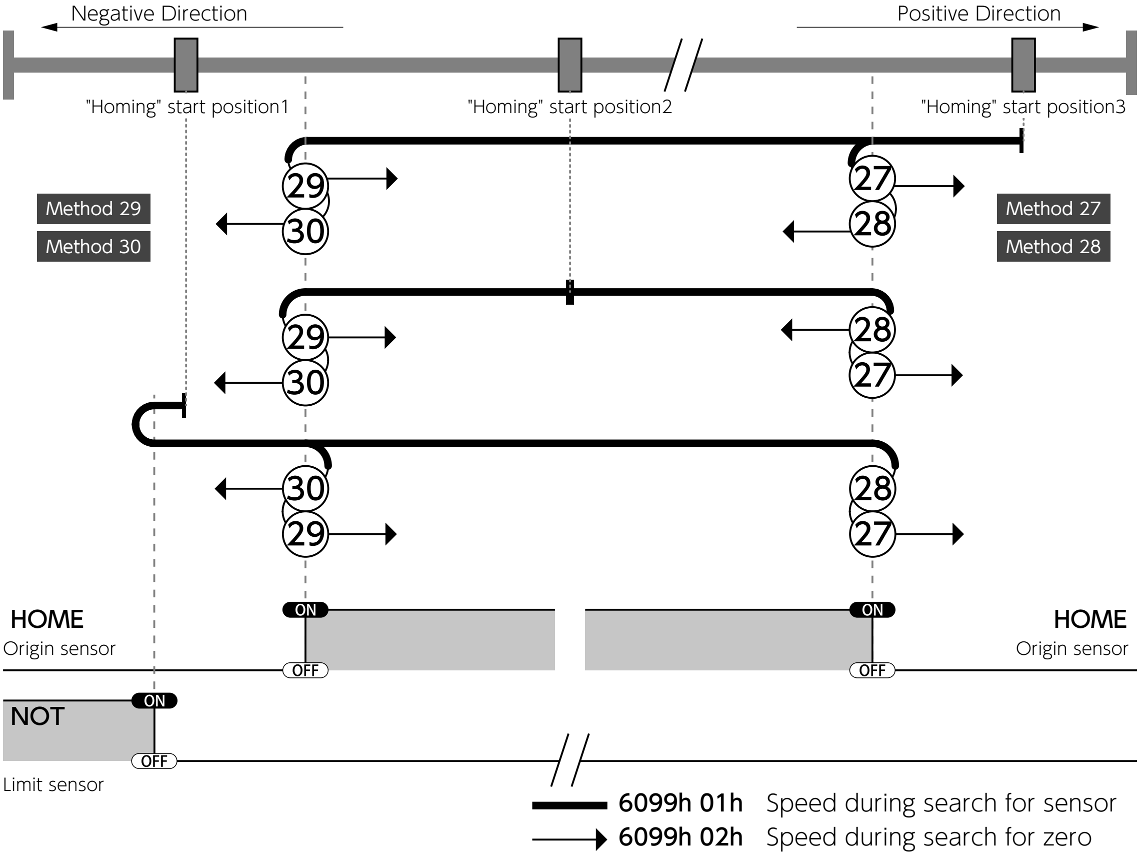
  When the input state of the HOME signal is OFF, it operates in the Positive direction.
  When the input state of the HOME signal is ON, it operates in the Negative direction.
- When the positive limit sensor (POT) is detected, it operates in the negative direction.
- Detects the rising edge of the home sensor (HOME) signal. ㉓㉔

Method 25 **Method 26**

- When the homing operation is started, it moves in the positive direction.
- When the positive limit sensor (POT) is detected, it moves in the negative direction.
- Detects the falling edge of the home input sensor (HOME) signal. ㉕㉖

5. Homing Mode (HM)

Method 27 Method 28 Method 29 Method 30	Homing on home sensor and negative limit(NOT) - **negative initial motion**



Method 27 **Method 28**

The moving direction depends on the input state of the home sensor input (HOME : I/O pin 9) at the time the homing operation is executed.

When the input state of the HOME signal is OFF, it operates in the Negative direction.

When the input state of the HOME signal is ON, it operates in the Positive direction.

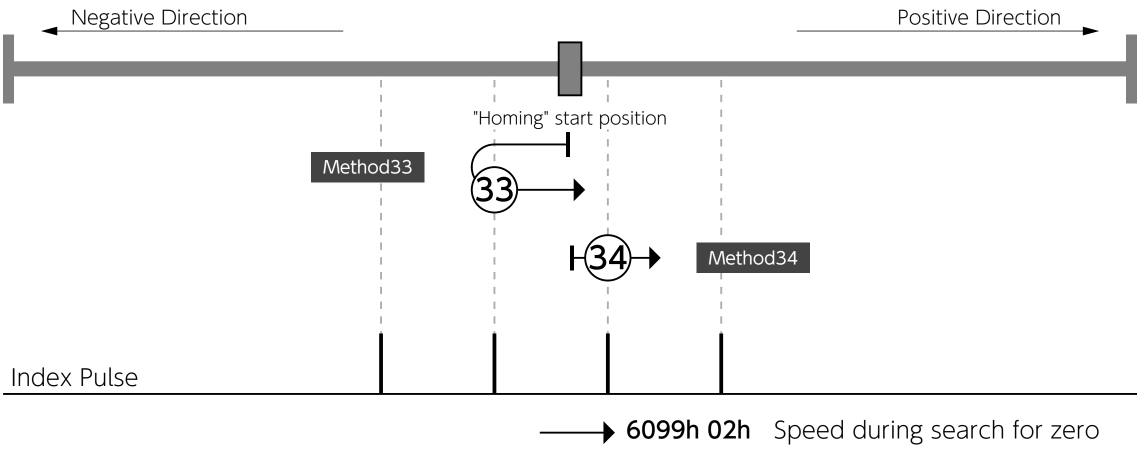
- When the negative limit sensor (NOT) is detected, it operates in the positive direction.
- Detects the falling edge of the home sensor (HOME) signal. ㉗㉘

Method 29 **Method 30**

- When the homing operation is started, it moves in the negative direction.
- When the negative limit sensor (NOT) is detected, it moves in the positive direction.
- Detects the rising edge of the home input sensor (HOME) signal. ㉙㉚

Method 33
Method 34

Homing on **index Pulse**

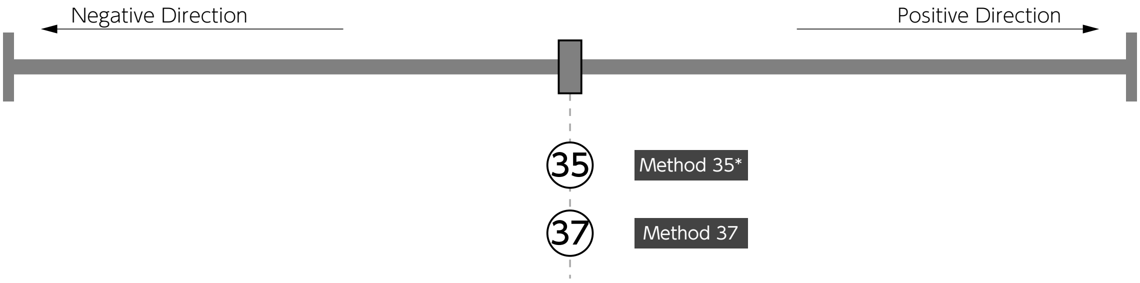


Method 33 **Method 34**

- The nearest index pulse position detected from "Homing" start position is the origin.
- The moving direction for Method 33 is to the left of the figure (The motor is CCW.). ㉝
- The moving direction for Method 34 is to the right of the figure (The motor is CW.). ㉞

5. Homing Mode (HM)

Method 35 **Method 37** Homing on **current position**



Start homing: **0→1**
6040h 04h : Homing operation

*) Method 35 (Homing on current position) was discontinued in CiA402 Work Draft CANopen Drive and motion control device profile part2 Version : 3.0.1.13(26 April 2012). Use "Method 37" for new designs.

Method 35 **Method 37**

- The starting point of Homing is the origin. ㉟㊲
- At the timing when the "Homing" has started, the following objects are initialized:.
  6062h (Position demand value) = **6064h** (Position actual value) = **607Ch** (Home offset)

- These Methods can execute even if the PDS state is not "Operation enable".

5. Homing Mode (HM)

Procedure for the Homing

STEP1 Object Settings

Set the parameters for the following objects:.

Object	Things to do
6098h	Select the Homing method (Choose from1-6, 17-22, or 33-37)
607Ch	Set the Home offset value.
6060h	Change the operation mode to "6 (Homing)"
6099h 01h	Set the motor speed to detect the Origin sensor.
6099h 02h	Set motor speed to detect index pulse.
609Ah	Set the motor acceleration

STEP2 Start "Homing"

Set bit 4 of 6040h (Controlword) to "1" after Servo ON.

Object	Things to do
6040h	Set 0010h

STEP3 Searching the Origin

Execute Homing with the method set to 6098h.

STEP4 Confirm

Check that bit 12 of 6041 h (Statusword) becomes "1".

STEP5 Exit "Homing"

Object	Things to do
6040h	Make the bit 4 to "0" (Exit Homing).
6060h	Change the operating mode to suit your own application.

6. Profile Position Mode (PP)

In the profile position control mode, the motor runs to the target position following the specified velocity profile. It is possible to monitor the velocity and position during operation, as well as the positioning completion.

To set this profile position control mode, set the 6060h (Modes of operation) object to "1".

Objects Used in Profile Position Mode

Index	Sub-Index	Name	Units	Type	Access	PDO Mapping
603Fh	00h	Error code	–	U16	RO	TxPDO
6040h	00h	Controlword	–	U16	RW	RxPDO
6041h	00h	Statusword	–	U16	RO	TxPDO
6064h	00h	Position actual value	Command Unit	I32	RO	TxPDO
606Ch	00h	Velocity actual value	r/min	I32	RO	TxPDO
6072h	00h	Max torque	0.1%	U16	RW	RxPDO
6074h	00h	Torque demand	0.1%	I16	RO	TxPDO
6077h	00h	Torque actual value	0.1%	I16	RO	TxPDO
607Ah	00h	Target position	Command Unit	I32	RW	RxPDO
607Fh	00h	Max profile velocity	Command Unit/s	U32	RW	RxPDO
6080h	00h	Max motor speed	r/min	U32	RW	RxPDO
6081h	00h	Profile velocity	Command Unit/s	I32	RW	RxPDO
6083h	00h	Profile acceleration	Command Unit/s^2	I32	RW	RxPDO
6084h	00h	Profile deceleration	Command Unit/s^2	I32	RW	RxPDO
60F4h	00h	Following error actual value	Command Unit	I32	RO	TxPDO
60FDh	00h	Digital inputs	–	U32	RO	TxPDO

6040h Controlword on Profile Position mode

6040h is a command to control slave devices such as PDS state transition.

6040h	Controlword				
Sub-index:	**00h**	–			
Access:	RW	Data Type:	**U16**	Unit:	–
Default:	–			Range:	0 to 65,535
Description:	Sets control commands to the servo amplifier such as PDS state transition.				

bit	Descriptions
0	Switch on
1	Enable voltage
2	Quick stop
3	Enable operation
4	(OMS) New set-point
5	(OMS) Change set immediately (*)
6	(OMS) Absolute/Relative
7	Fault reset
8	halt
9	(OMS) Change on set-point
10	Rsv.
11	
12	
13	
14	
15	

bit 6 (Absolute/Relative):

Selects the Absolute or Relative setting for 607Ah (Target position).

0: Absolute position

1: Relative position

bit 8 (Halt):

The profile positioning operation is temporarily stopped upon setting bit8(Halt) to 1.

The positioning operation is resumed upon setting bit8(Halt) to 0.

0: Motion permitted (Resume)

1: Temporary stop

Be sure to carry out the setting change of bit6 (Absolute/Relative) before setting bit4 (New set-point) to 1.

Note that if you change bit6 simultaneously with bit4, the setting will not be reflected.

---

*) This product does not support bit5 setting change.
(The product interrupts the current positioning operation and immediately starts the next positioning operation.)

5. Profile Position Mode (PP)

Example Motion 1 (Basic Set-Point Operation)

Relevant objects and settings

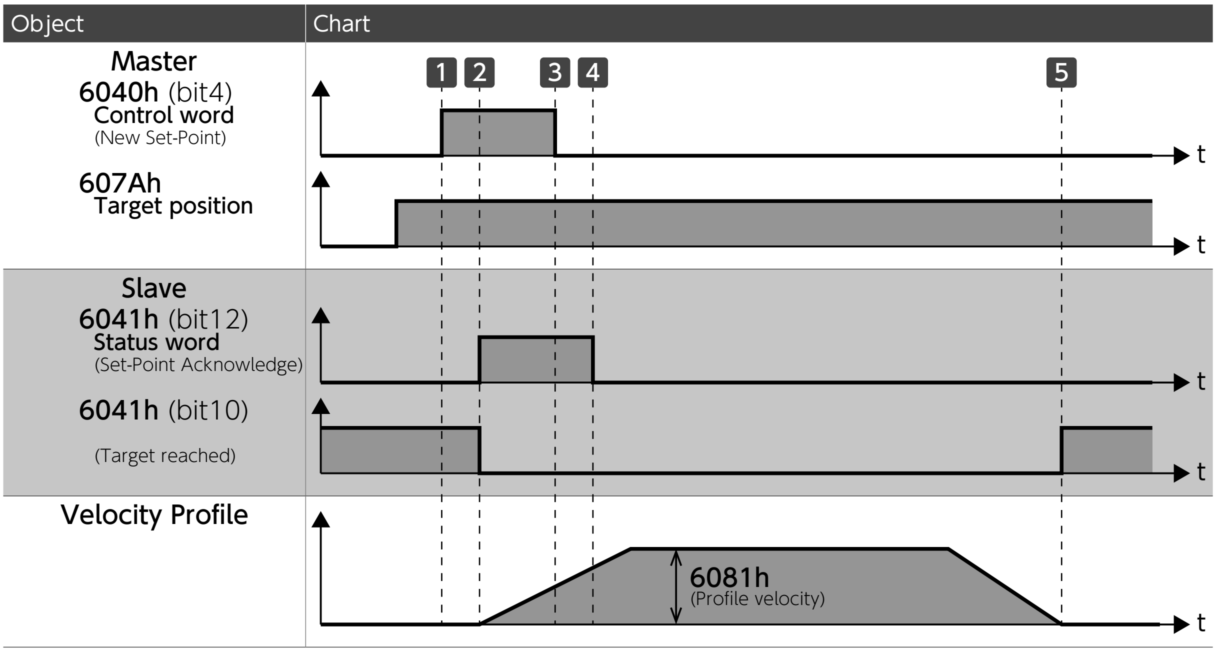
Before starting the motion, the master should be sure to specify the parameters.

Object	Required setups.
607Ah	Sets the "Target Position".
6081h	Sets the "Profile Velocity".
6083h	Sets the "Profile Acceleration".
6084h	Sets the "Profile Deceleration".

Note that if the value of 6081h is "0", the motor does not run.

STEP		Object	Setting
Motion start	1 **Master**	**6040h** (bit4) **Control word** (new set-point)	Change the setting from 0 to 1.
	2 **Slave**	**6041h** (bit12) **Statusword** (Set-Point Acknowledge)	Upon detection of the rising edge (0 → 1) of 6040h (bit4) Change the setting from 0 to 1.
	Starting motion on Profile velocity (6081h) to Target position (607Ah).		
	3 **Master**	**6040h** (bit4)	Upon confirming that the 6041h (bit12) setting has been switched from 0 to 1 Change the setting from 1 to 0.
	4 **Slave**	**6041h** (bit12)	Upon detecting the falling edge (1 → 0) of 6040h (bit4) Change the setting from 1 to 0.
		(In Motion)	
Motion end	5 **Slave**	**6041h** (bit10) (Target reached)	Change the setting from 0 to 1.

Timing Diagram



Example Motion 2 (Modifying the target position and target velocity during operation)

The target position and target velocity can be modified during motion. In this case, the current positioning is interrupted and the next positioning operation is started immediately.

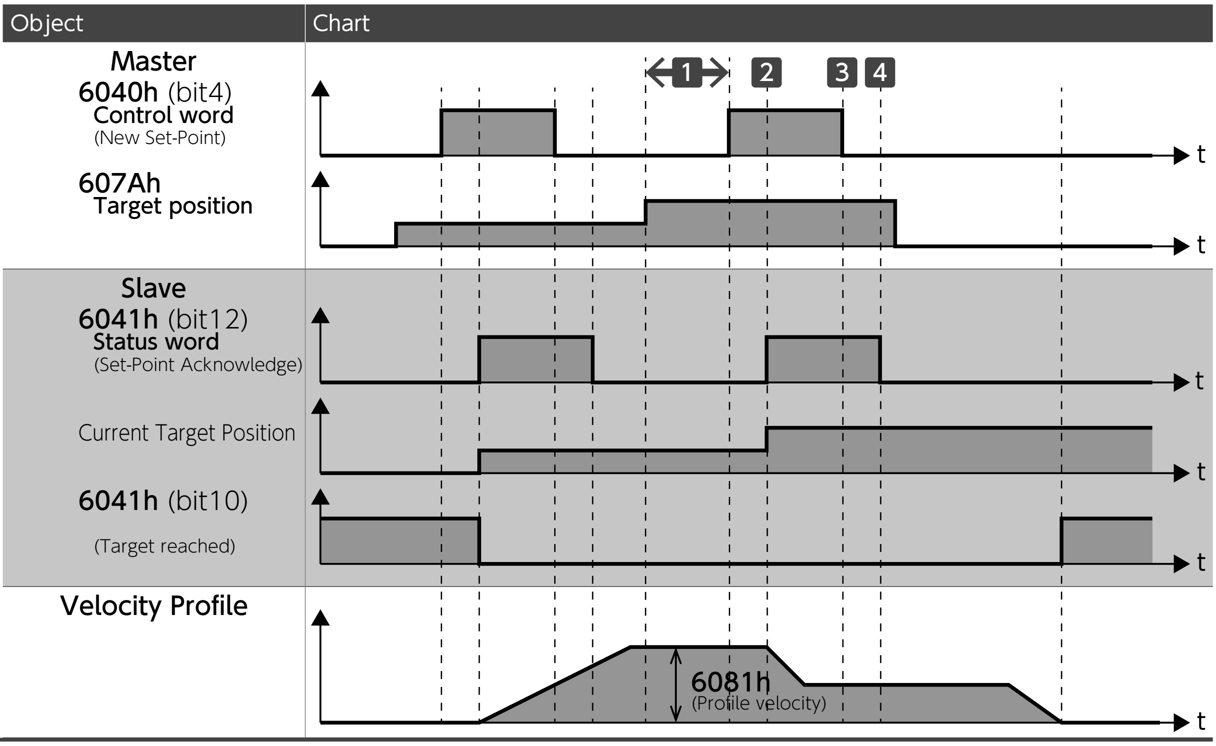
Relevant objects and settings

Example: Modifying the target position

STEP		Object	Setting
In Motion	1 **Master**	**607Ah** **Target position** **6040h** (bit4) **Control word** (new set-point)	After confirming that 6041h (bit12) is 0 Modify the target position. After modifying the target position Change the setting from 0 to 1.
	2 **Slave**	**6041h** (bit12) **Statusword** (Set-Point Acknowledge)	Upon detection of the rising edge (0 → 1) of 6040h (bit4), the value of 607Ah is updated to the value set in step 1 Change the setting from 0 to 1.
	Interrupt the current motion and immediately start the motion towards the new target position (607Ah) that has been changed.		
	3 **Master**	**6040h** (bit4)	Upon confirming that 6041h (bit12) has gone from 0 to 1 Change the setting from 1 to 0.
	4 **Slave**	**6041h** (bit12)	Upon detection of the falling edge (1 → 0) of 6040h (bit4) Change the setting from 1 to 0.

NOTE) The above example shows how to modify only the target position during motion. The target velocity can be modified in a similar procedure. Of course, you can change both the target position and the target velocity at the same time. To modify the target velocity, set the value to 6081h (Profile velocity).

Timing Diagram



2

Connecting to the Master Controller

1. Preface

Connecting to the Master Controller

This product can be driven by connecting it to a master controller made by another manufacturer. If you are using a master controller other than those listed below, please refer to the operation manual of the product.

List of the master controller

manufacturer	Name of the software
Beckhoff	TwinCAT® (TwinCAT XAE)

TwinCAT® is a software developed and licensed by Beckhoff Automation GmbH, Germany. for real-time control of industrial machinery.

2. Use Beckhoff's "TwinCAT"

1. Connect to the master controller

Open EtherCAT communication and prepare for operation

Start Connect the master controller and slave devices (servo amplifier) with the EtherCAT cable and turn on the power.

1 Save "ESI (*) files (.xml files)" to the appropriate folder on the master controller.

*) ESI : EtherCAT Slave Information.
The ESI file is an XML format file that describes the identification information such as the manufacturer name and model number of the EtherCAT slave device, as well as information necessary for setting and communication.

2 Start the software "TwinCAT XAE".

3 Create a new project.

4 The master controller scans the EtherCAT network.

5 Set the system clock.

6 Set the servo amplifier.

Finish Operation preparations are complete.

TIP !

You may need to enter a Security Code when starting TwinCAT 3.

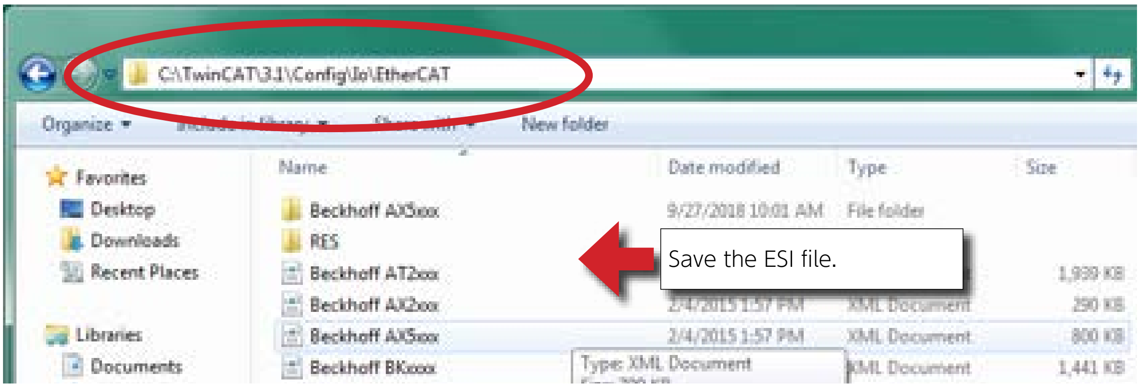
1. Make sure that the five characters displayed are correctly transcribed into the text box.
2. Click on OK button.

When an exact match is made, the text you type is green.

2. Use Beckhoff's "TwinCAT"

1 Save "ESI (*) files (.xml files)" to the appropriate folder on the master controller.

Folder pass : **"C:\TwinCAT\3.1\Config\Io\EtherCAT\"**

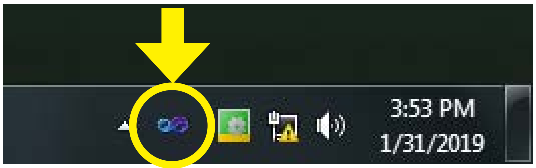


Save the ESI file.

The ESI file (.xml files) contains configuration information for the product.
The master controller must be restarted after the .xml file is downloaded to the master.

Be sure to use the ESI file for the device connected to the slave device.
Make sure the ESI file version matches the amplifier version.

2 Start the software "TwinCAT XAE".



The TwinCAT.XAE icon is in the task tray.

It is useful to create a shortcut on your desktop.

When the EtherCAT cable is connected correctly between the master and the slave (amplifier), the ECIN LED (green) of the amplifier lights up.
When multiple amplifiers are connected, the ECIN and ECOUT LEDs of the connected amplifiers light up.

TIP !

Operation modes in TwinCAT3

The icon color distinguishes the mode currently selected by the icon color.

Green

RUN

This mode allows real-time operation of PLC and C/C + + tasks.
You can set TwinCAT to automatically enable RUN mode at startup.

Blue

CONFIG

This mode is used to configure network, I/O, motion, and program development and configuration. When Free Run is enabled, network communication occurs in non-real-time. You can also check the operation of the I/O terminal.

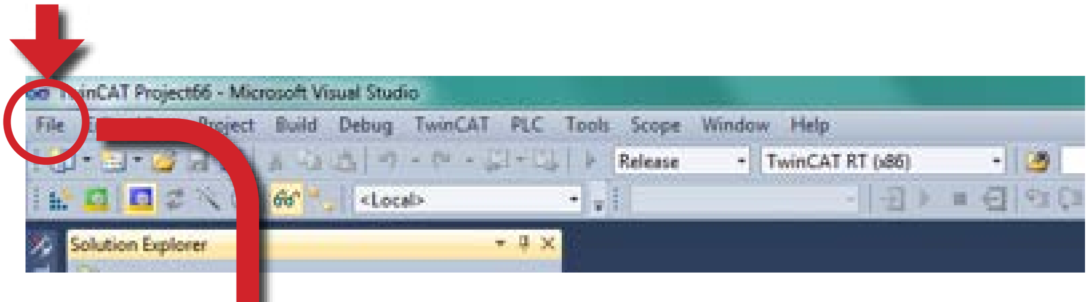
Red

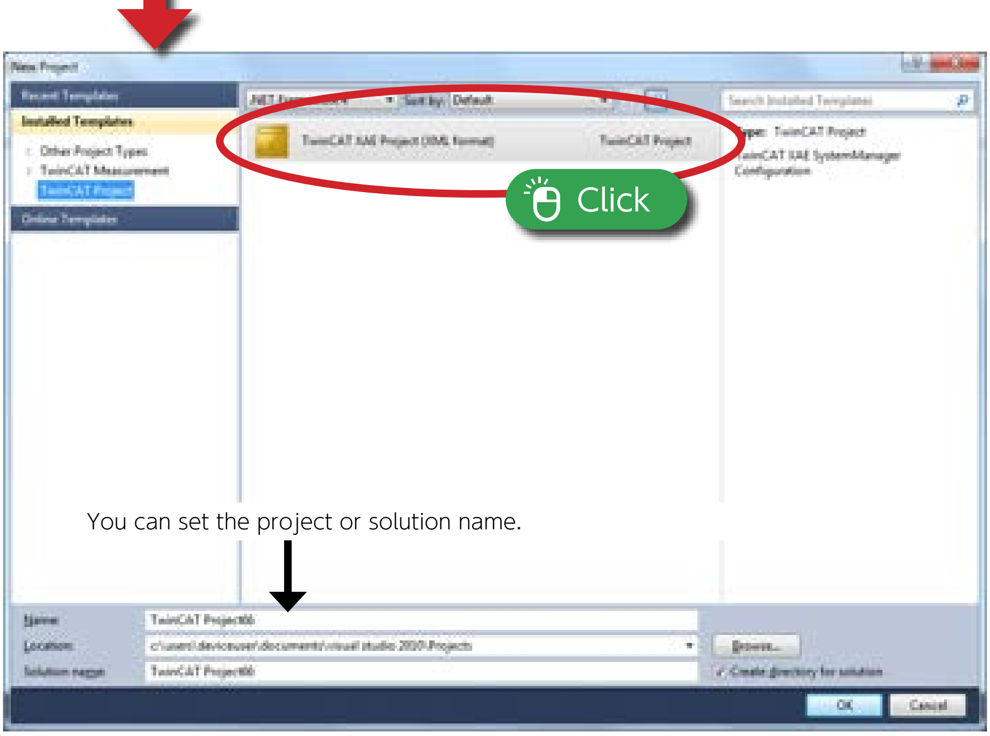
The red icon indicates "Mode is switching".

2. Use Beckhoff's "TwinCAT"

3 Create a new project.

Select "File" → "New" → "Project" from the menu to create a new project.

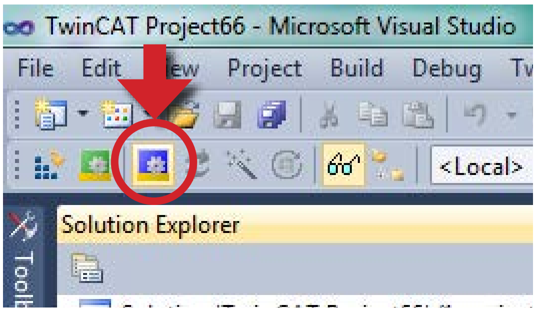




Name: TwinCAT Project66
Location: c:\users\deviceuser\documents\visual studio 2010\Projects
Solution name: TwinCAT Project66

You can set the project or solution name.

Switch TwinCAT operation mode to "CONFIG" mode after creating a project.



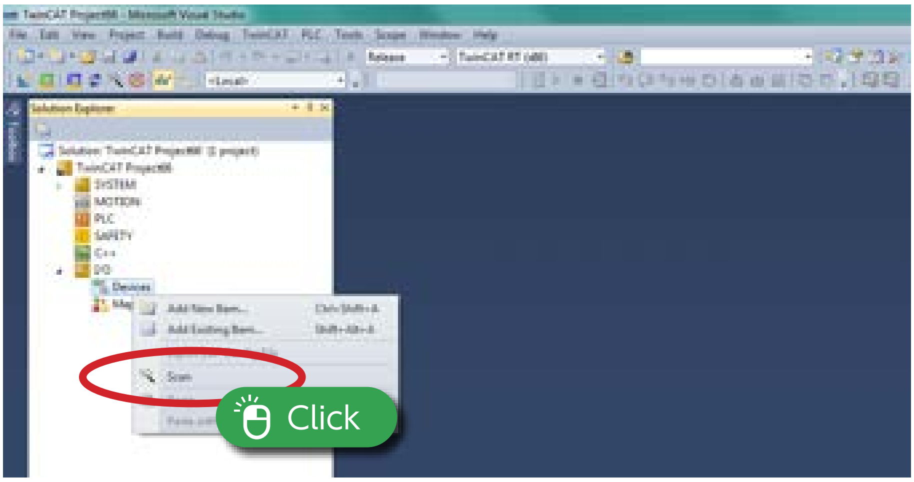
Saving the project file allows you to save the connection information with the amplifier, settings, and test operation conditions. Saved settings can be read when starting the software.

☞ P. 24 4. Save project
P. 25 5. Open project

2. Use Beckhoff's "TwinCAT"

4 The master controller scans the EtherCAT network.

Select "I/O" → "Device" in the TwinCAT System Manager navigation tree, right-click and select "Scan".



Before execute "Scan" verify the following:

1. EtherCAT cable must be connected between master and slave.
2. Power must be turned on for the master and the slave.
3. The "Link" LED of the master and slave must be on.

The screen shows the slave devices that are connected.

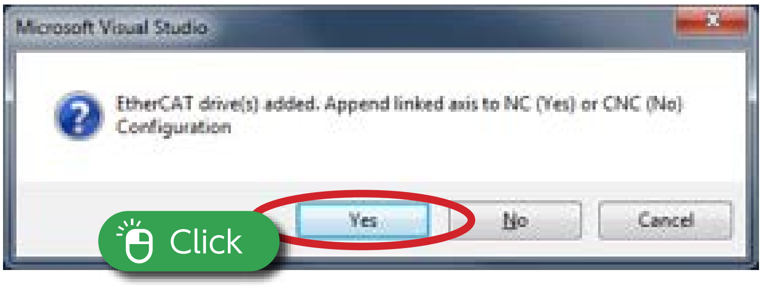
Make sure the checkbox has "check mark".

1 new I/O devices found

☑ Device 2 (EtherCAT) [LAN A (TwinCAT-Intel PCI Ethernet Adapter (Gigabit)]

When OK button is clicked, the dialog "Scan for Boxes" is displayed, so select Yes button.

Select "NC" or "CNC" according to the slave device whose connection has been confirmed.

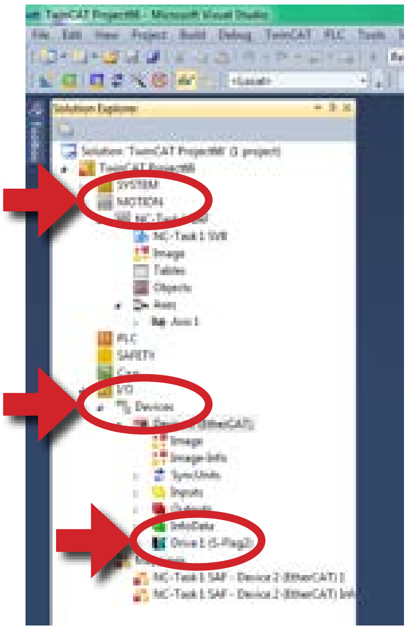


Microsoft Visual Studio

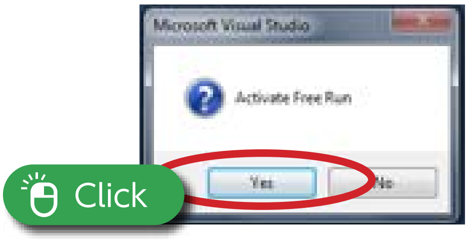
EtherCAT drive(s) added. Append linked axis to NC (Yes) or CNC (No) Configuration

If the slave device is a servo driver, select Yes .

After "Scan" completes, "MOTION" is added to the TwinCAT System Manager navigation tree and "Device" is added to "I/O".
" Drive (S-Flag2)" is added to the "Device" tree.



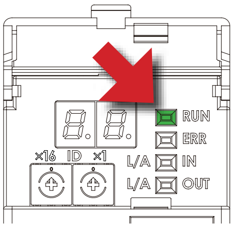
The Activate Free Run dialog will appear.
Click on Yes button.



TIP !

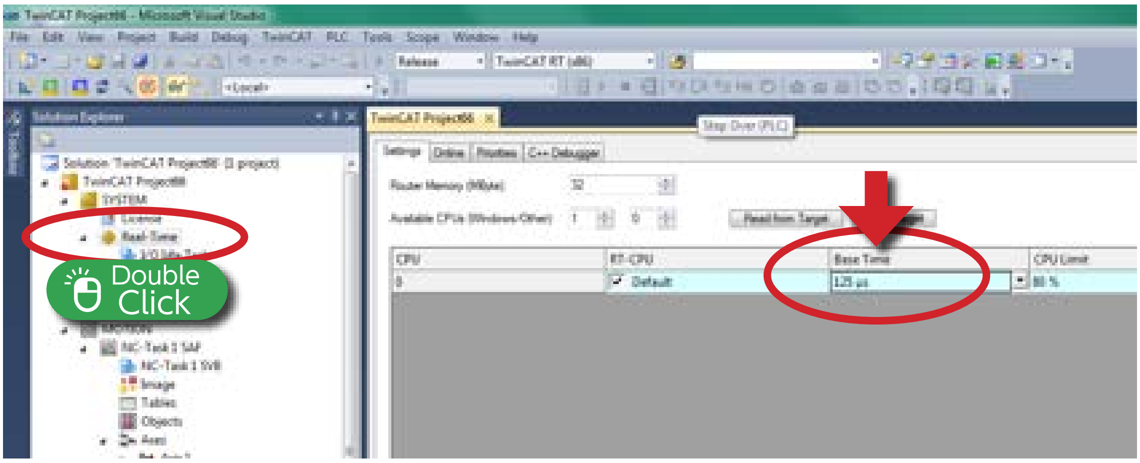
About Free Run

In Free Run mode, EtherCAT communication operation can be performed
in CONFIG mode. In Free Run status, "RUN LED" of the slave lights up.

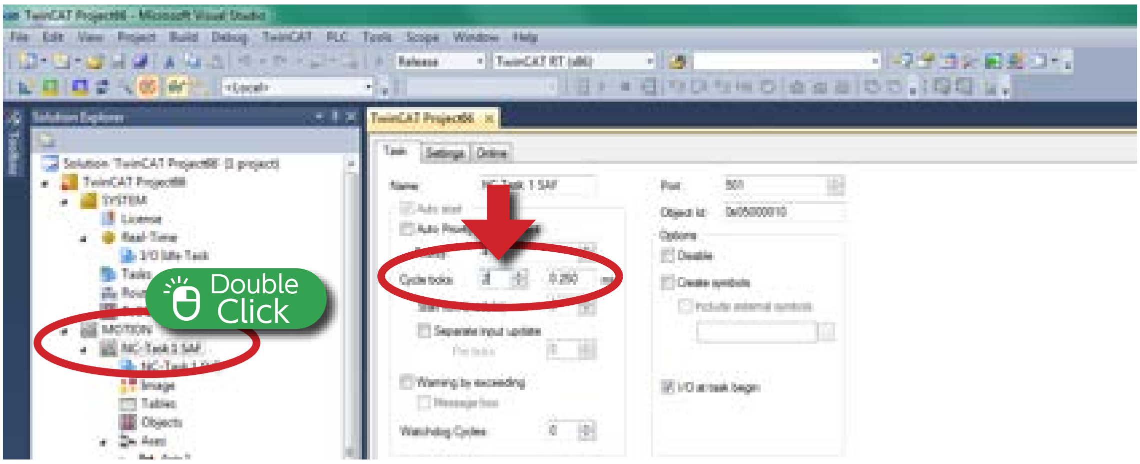


5 Set the system clock.

Set the "System clock (= Base Time)" to 125 µs by double-clicking "Real-Time" from the "SYSTEM" in the TwinCAT System Manager navigation tree.



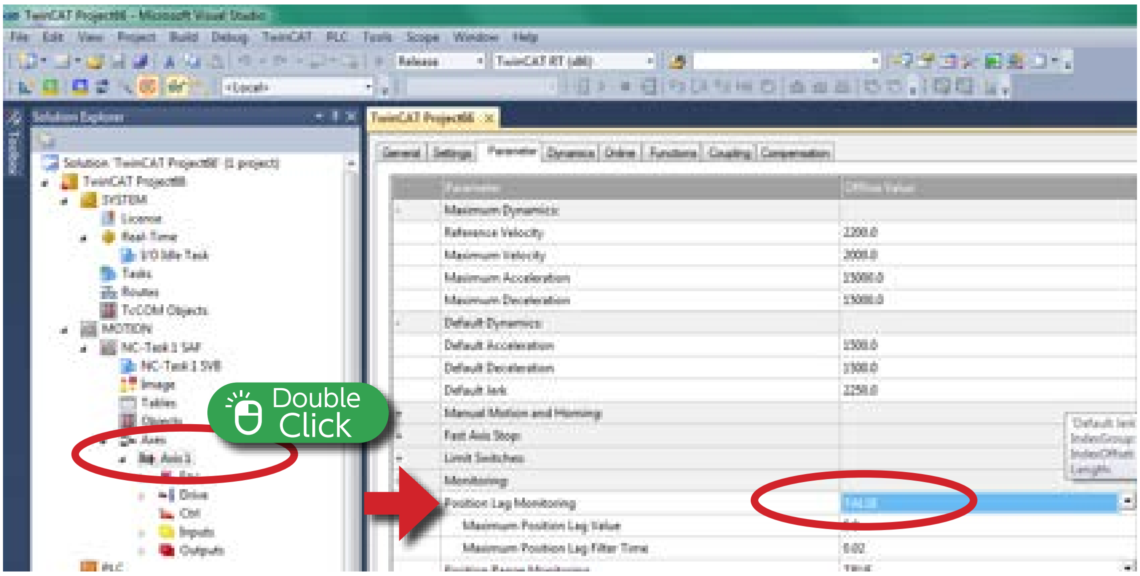
Double-click "NC-Task" in the "MOTION", and set Cycle ticks to "2".



2. Use Beckhoff's "TwinCAT"

6 Set the servo amplifier.

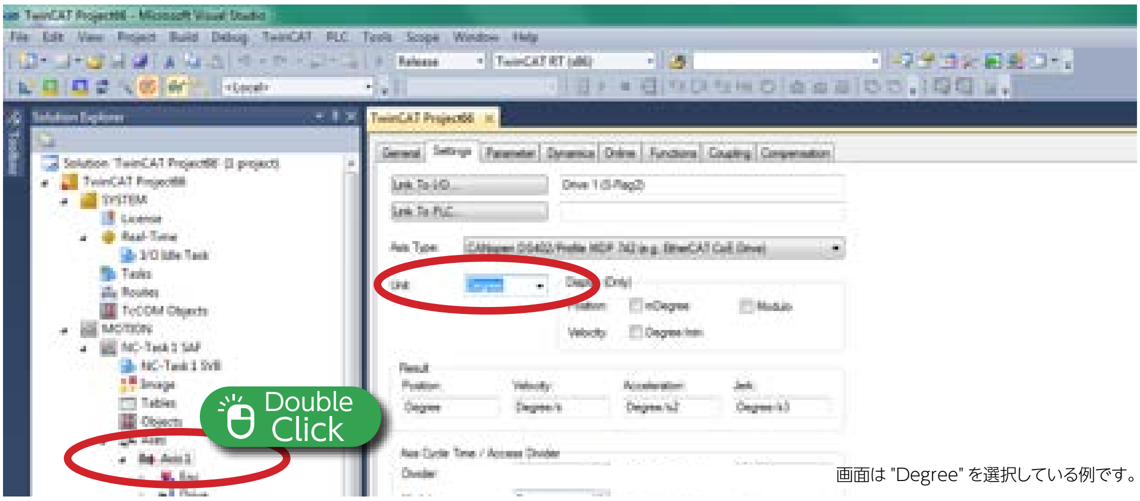
Double-click "Axis1" in "MOTION" → "NC-Task xxx" → "Axes", and set the Position Lag Monitoring setting in the Parameter tab to "FALSE" (*).



Parameter	Offline Value
Maximum Dynamics:	
Reference Velocity	2200.0
Maximum Velocity	2000.0
Maximum Acceleration	15000.0
Maximum Deceleration	15000.0
Default Dynamics:	
Default Acceleration	1500.0
Default Deceleration	1500.0
Default Jerk	2250.0
Manual Motion and Homing:	
Fast Axis Stop:	
Limit Switches:	
Monitoring:	
Position Lag Monitoring	FALSE
Maximum Position Lag Value	
Maximum Position Lag Filter Time	0.02

*)【暫定】この設定により、マスタによる「位置偏差過大」が誤検出されるのを防ぎます。

Double-click "Axis1" in "MOTION" → "NC-Task xxx" → "Axes" and select the Unit setting in the Setting tab.



Drive 1 (S-Flag2)

Unit: Degree

Result
Position: Degree
Velocity: Degree/s
Acceleration: Degree/s2
Jerk: Degree/s3

画面は "Degree" を選択している例です。

TIP !

About the "Unit"

Degree: The angle of the motor's mechanical axis.

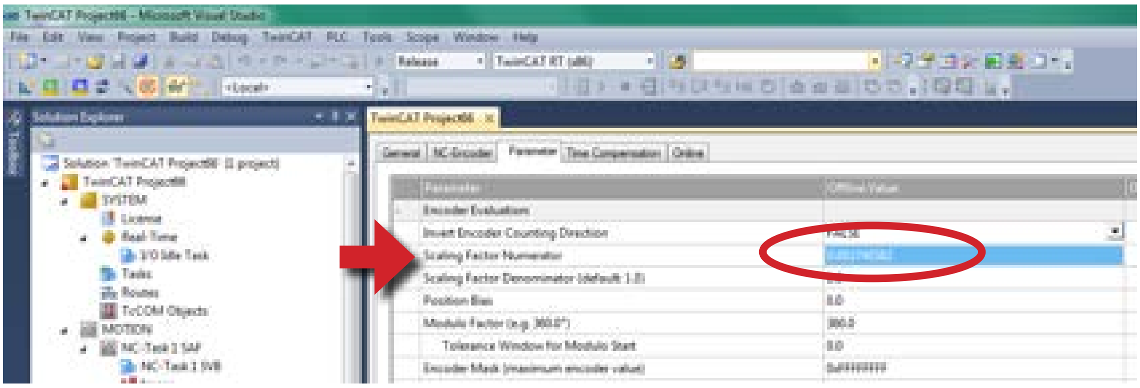
mm : The amount of mechanical movement such as the slider.

6 Set the servo amplifier.

Enter a value for the Scaling Factor Numerator in the Parameter tab,

(When "Degree" is selected in Unit)
"Scaling Factor Numerator" value = 0.002746582 deg/INC

This is an example of a 17 bit encoder.
360 (deg)/131,072 (INC) = 0.002746582



Be sure to enter the value in all digits that can be entered accurately.

If the number is rounded, the motor may not operate correctly.

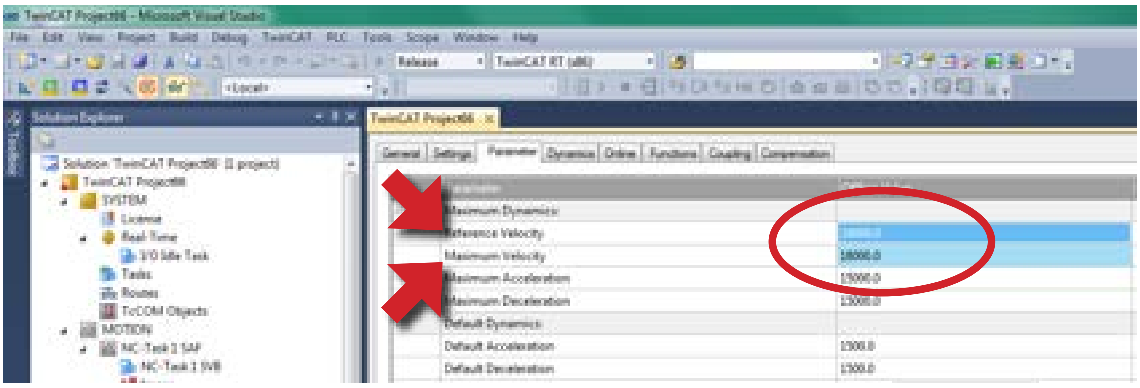
On the Parameter tab, set "Reference Velocity" and "Maximum Velocity" to 36,000.0 respectively.

Examples

"Reference Velocity" value = 36,000.0 Degree/s
"Maximum Velocity" value = 36,000.0 Degree/s

Set the maximum speed of the motor to be used.

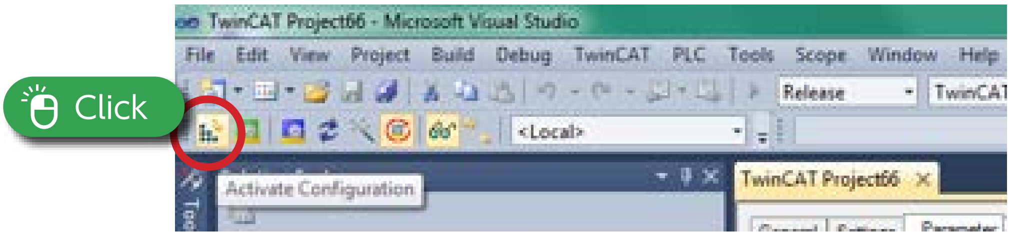
This is an example of a motor with a maximum speed of 6,000 rpm.
6,000 rpm × 360 (deg) / 60 (s) = 36,000 Degree/s



This is an example of setting 18,000.0 (= 3000 rpm).

6 Set the servo amplifier.

When you have completed all the settings, click Activate Configuration to accept the settings.

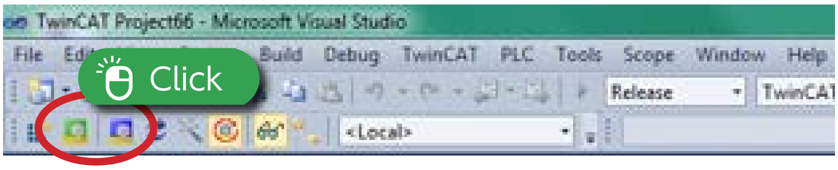


A confirmation dialog for switching to "RUN mode" is displayed.
Select Yes to go on.

Finish

Operation preparations are complete.

You can switch the TwinCAT 3 operation mode using the (RUN mode) or (CONFIG mode) button on the toolbar.



The operational mode of TwinCAT3 is displayed in the bottom right corner of the task tray or TwinCAT3 window.

2. Use "TwinCAT" to run the motor (test operation)

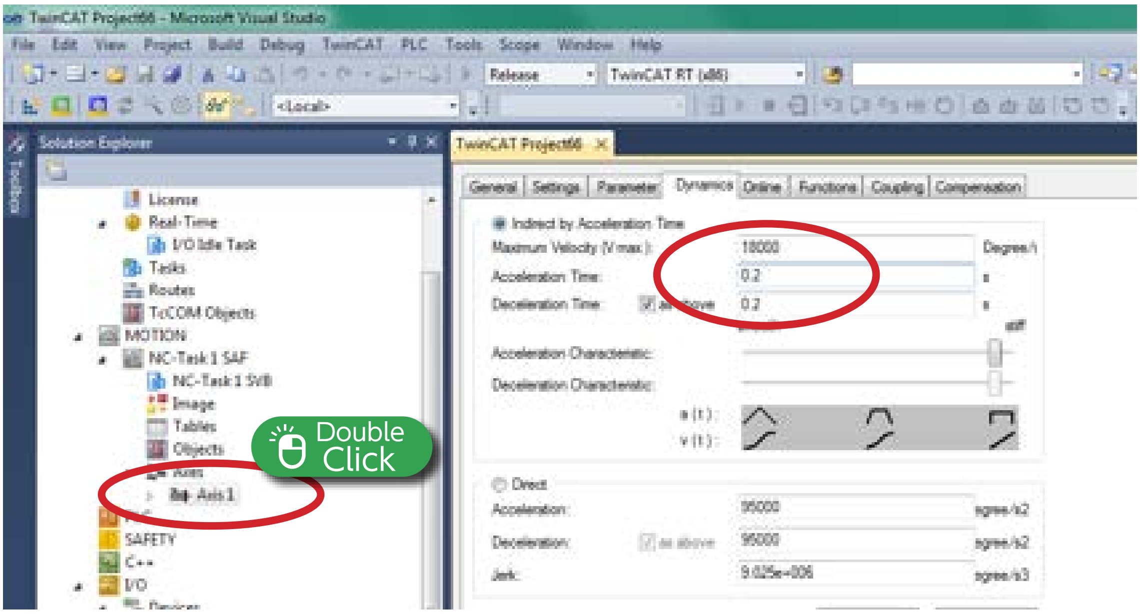
Setting operating conditions for test operation

Set the maximum speed, acceleration time and deceleration time of the motor.

Double-click "Axis1" in "MOTION" → "NC-Task xxx" → "Axes" to display the Dynamics tab.

Examples

"Maximum Velocity (V max)" value = 18,000 Degree/s
"Acceleration Time" value = 0.2 s
"Deceleration Time" value = 0.2 s



● Indirect by Acceleration Time
Maximum Velocity (V max): 18000 Degree/s
Acceleration Time: 0.2 s
Deceleration Time: ☑ as above 0.2 s

○ Direct
Acceleration: 95000 egree/s2
Deceleration: ☑ as above 95000 egree/s2
Jerk: 9.025e+006 egree/s3

This example sets the maximum speed to 3,000 rpm, the acceleration time to 0.2 s, and the deceleration time to 0.2 s.

In order to take the test operation safety,

- Set the maximum rotation speed to a small value.
- Set the acceleration/deceleration time to a larger value.

Adjust the value gradually after confirming safety.

TIP !

About Acceleration/Deceleration time

These settings specify the time from the current speed (Include the state of shutdown) to the target speed.

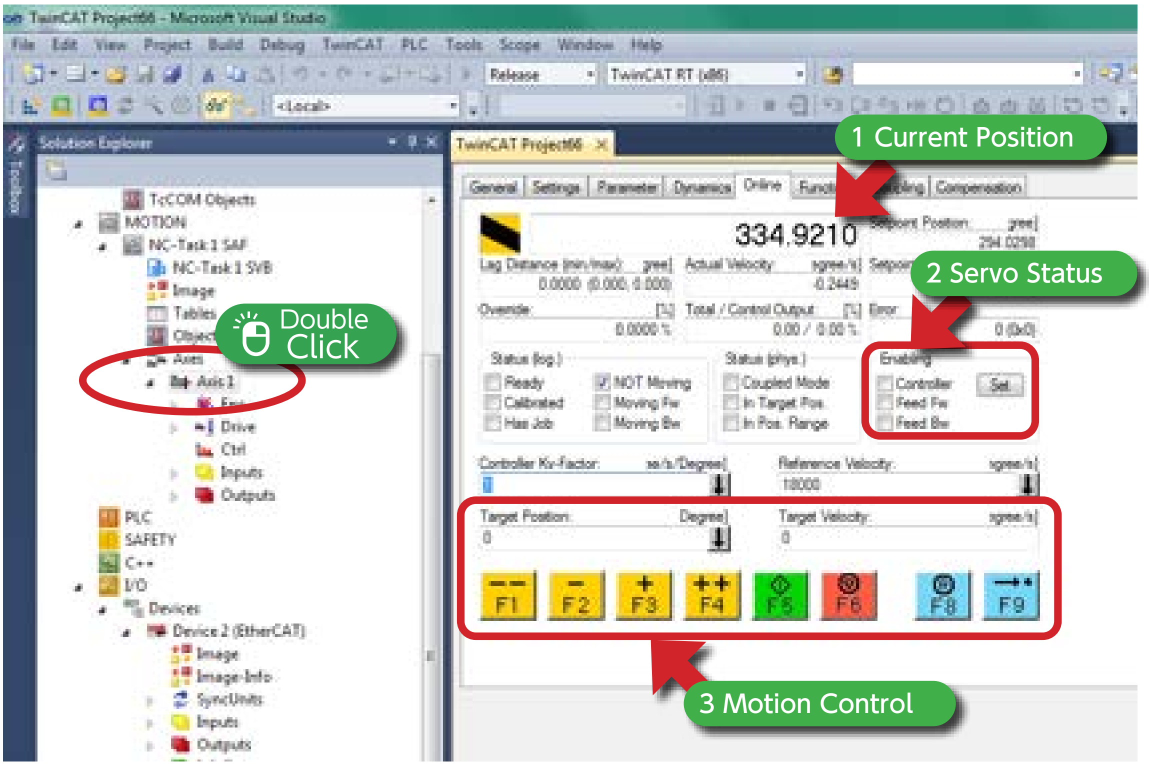
Setting a larger value makes gradual acceleration/deceleration.

Setting a lower value makes sudden acceleration/deceleration.

Test motion (Jog motion and single motion)

"Jog motion" moves the motor while the button is pressed.
"Single motion" moves the motor toward the set target position.

Double-click "Axis1" in "MOTION" → "NC-Task xxx" → "Axes" to display the Online tab.



1 Current Position

The current position is displayed in the unit set in "Unit" on the Setting tab.

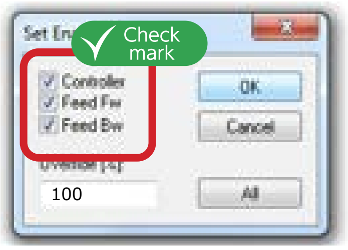
2 Servo Status

Displays the Servo status. To control the Servo status, click on the Set button and go to the configuration screen.

Servo on

To turn Servo on, click on the Set button and check the checkbox in the dialog below. The "Override " value must be 100%.

Click on the OK button to accept the settings.



☑ Controller
☑ Feed Fw
☑ Feed Bw
Override [%]
100

Controller : Check the box to turn it on "Servo On".
Feed Fw : Check the box to accept "Forward" command.
Feed Bw : Check the box to accept "reverse" command.

Servo off

To turn Servo off, click on the Set button and uncheck the checkbox in the dialog below.

Click on the OK button to accept the settings.

3 Motion Control

Move the motor with Jog motion or Single motion.
(You can also press the button on your keyboard that matches each button.)

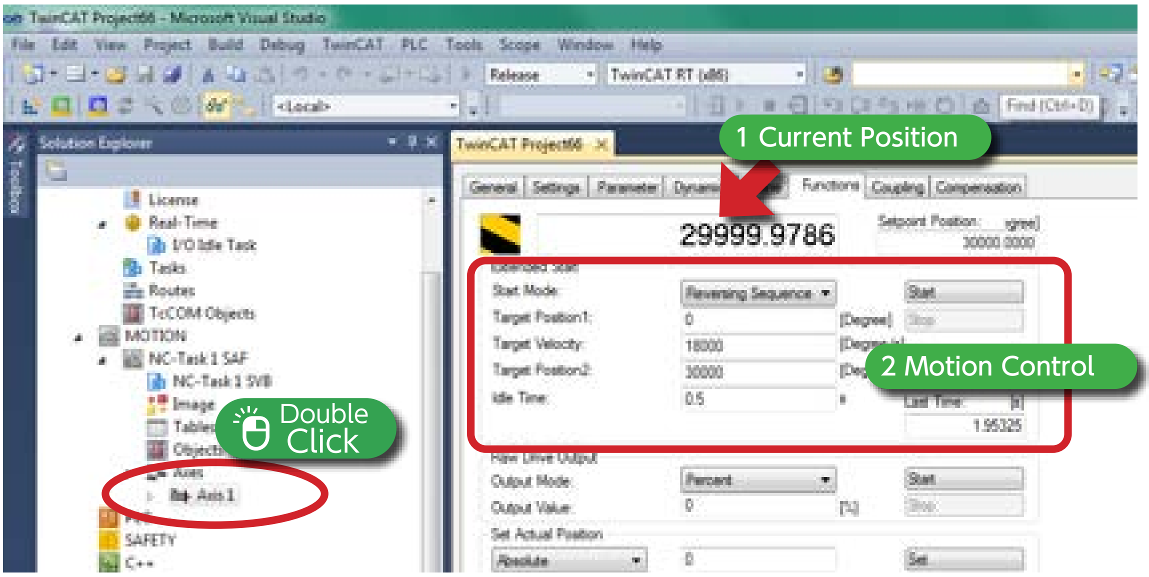
Key	Works
−− F1	Jog motion The motor moves while the button is pressed. The motor moves at high speed in the reverse direction.
− F2	Jog motion The motor moves at low speed in the reverse direction.
+ F3	Jog motion The motor moves at low speed in the forward direction.
++ F4	Jog motion The motor moves at high speed in the forward direction.
◈ F5	Single motion The motor moves under the conditions set in "Target Position" and "Target Velocity".
⊚ F6	Single motion The motor stops single operation.
® F8	Reset the motor operation.

2. Use Beckhoff's "TwinCAT"

Test motion (Repetitive motion)

The motor can be "repetitive motion" assuming actual equipment.

Double-click "Axis1" in "MOTION" "NC-Task xxx" "Axes" to display the Functions tab.



1 Current Position

2 Motion Control

Double Click

29999.9786

Setpoint Position: [Degree] 30000.0000

Extended Start

Start Mode: Reversing Sequence

Target Position1: 0 [Degree]

Target Velocity: 18000 [Degree/s]

Target Position2: 30000 [Degree]

Idle Time: 0.5 s

Last Time: [s] 1.95325

Raw Drive Output

Output Mode: Percent

Output Value: 0 [%]

Set Actual Position

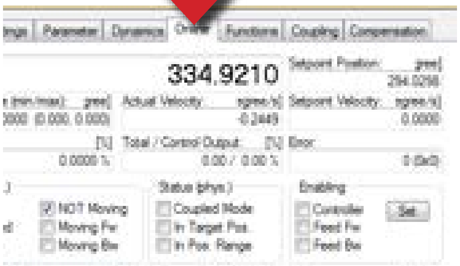
Absolute 0

TIP !

About "Servo state" control

Servo ON/OFF control function is not available in the "Function" tab.

To control the servo status, click the Set button in the "Enabling" frame of the "Online" tab.



Online tab screen

Before starting repetitive motion, do enough Jog motion or single motion to make sure you can move safely.

Then, perform sufficient repetitive motion at low speed to ensure safe operation before incorporating the motor into actual equipment.

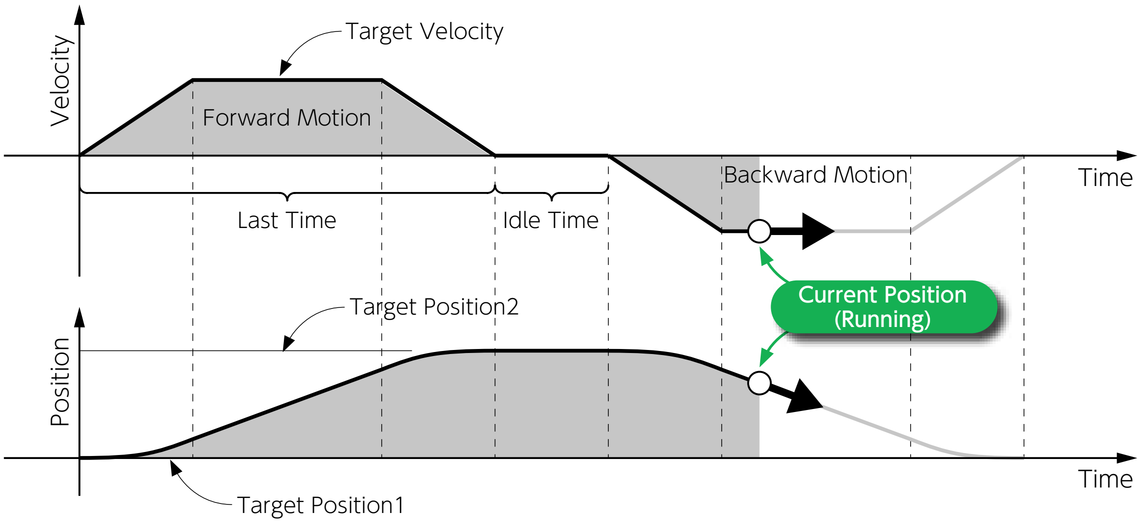
1 Current Position

The current position is displayed in the unit set in "Unit" on the Setting tab.

2 Motion Control

Items	Descriptions
Start Mode	Select the motion type. ・Reversing Sequence ・Absolute ・Relative ・Endless + (Continuous operation in one direction) …and so on.
Target Postion1	Set the target position (Start Position).
Target Velocity	Set the operating velocity.
Target Position2	Set the target position (stop position).
Idle Time	Set the time to wait for the next motion.
Last Time	Displays the duration[*] of the last motion. *) Time from "Motion Start" to "Positioning completion". The "Idle Time" is not included.
Start Button Stop Button	motion control buttons.

Example of "Repetitive motion"



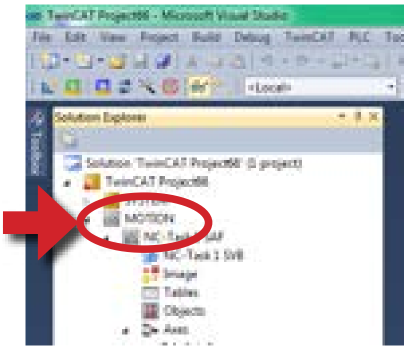
3. Homing on TwinCAT (hm mode)

Executes Homing motion specified by EiA402 by using TwinCAT3.

TIP !

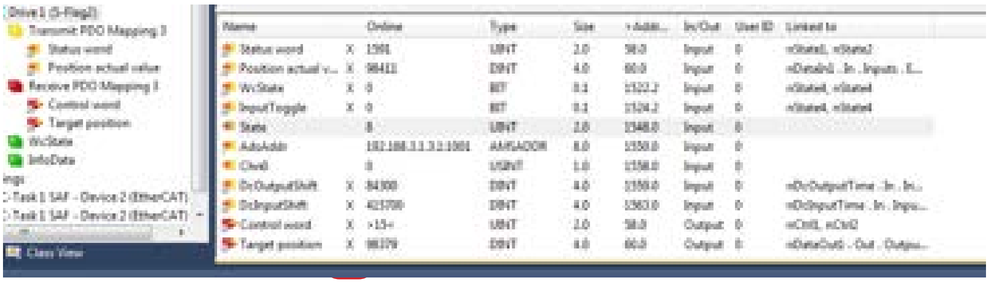
Possession of the object

If Master controller recognizes the slave device as "NC" when scanning EtherCAT network, the Master has no permission to access to object.
(System Manager navigation tree view showing "MOTION")



To directly rewrite values such as Controlword and TargetPosition object, use the "Online Force" function described on the following pages.

The object which has no permission, is shown as "X" in the object tree view.



Before starting Homing motion, do enough Jog motion or single motion to make sure you can move safely.
When using an Origin sensor, etc., confirm that the sensor is connected correctly and that it operates correctly.
Ensure that all equipment operates safely.

2. Use Beckhoff's "TwinCAT"

Homing

Start

Before starting Homing motion, do enough Jog motion or single motion to make sure you can move safely.
When using an Origin sensor, etc., confirm that the sensor is connected correctly and that it operates correctly.

1 Servo ON.

2 Switch the operation mode to the homing mode.

3 Set the Homing motion conditions.

4 Start homing.

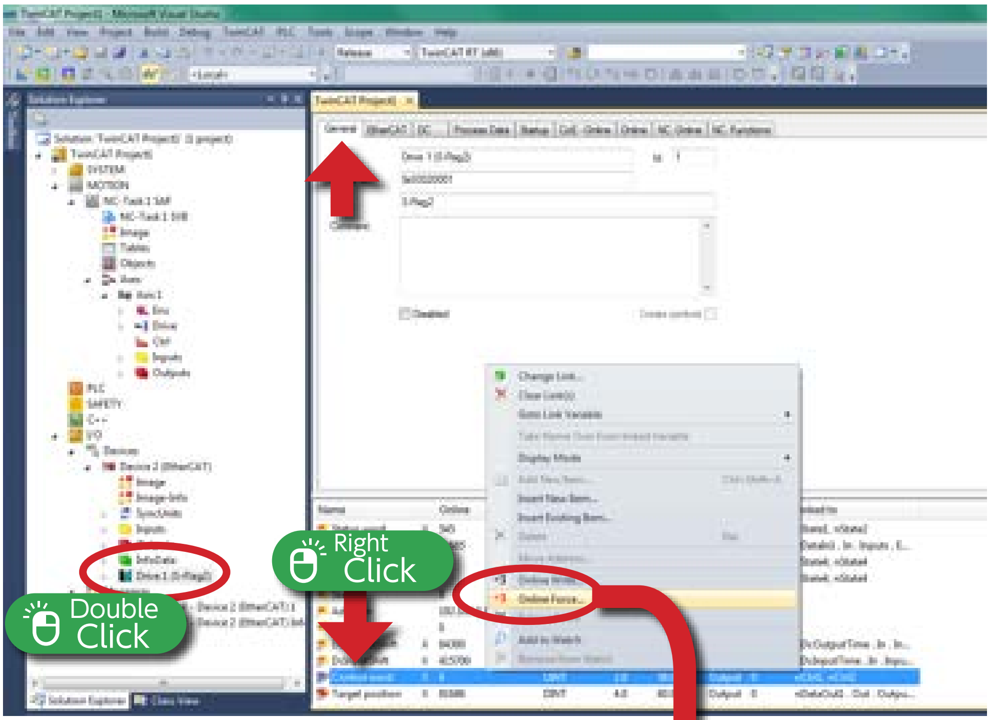
Finish

Operation preparations are complete.

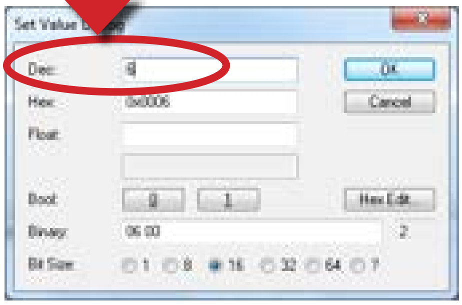
1 Servo ON.

Use "Controlword (6040 h)" to make a PDS state transition.

- Double-click "Device1 (S-Flag2)" in "I/O" to display the "General" tab.
- Right-click "Control word" in the object list and select "Online Force".



Set the Control word value as follows.



Dec: 6
Hex: 0x0006
Float:
Bool: 0 1
Binary: 06 00 2
Bit Size: ○ 1 ○ 8 ● 16 ○ 32 ○ 64 ○ ?

Transition to the "Shutdown" state.

Dec: 6 OK ← Click

Transition to the "Switch on" state.

Dec: 7 OK ← Click

Transition to the "Enable operation" state.

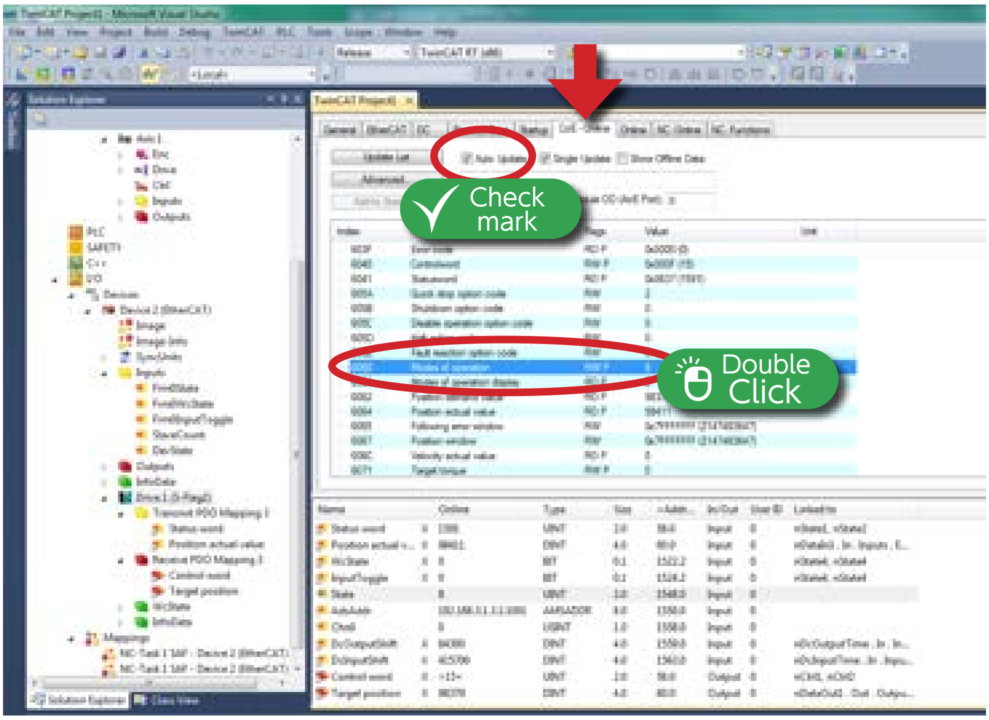
Dec: 15 OK ← Click

Servo ON

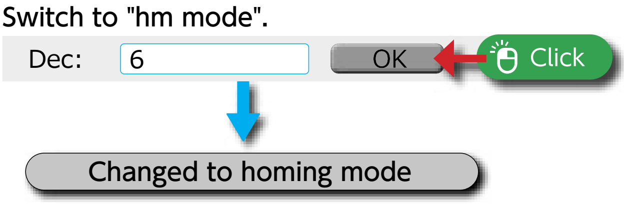
2 Switch the operation mode to the homing mode.

Switches Modes of Operation (6060 h) from "CSP mode" to "hm mode".

- Switch to the "CoE" tab.
- Check the "Auto Update" checkbox.
- Double-click "6060 Modes of Operation" from the object list.



Set the Modes of operation value to "6" (hm mode).



Dec: 6

Hex: 0x0006

Float:

Bool: 0 1

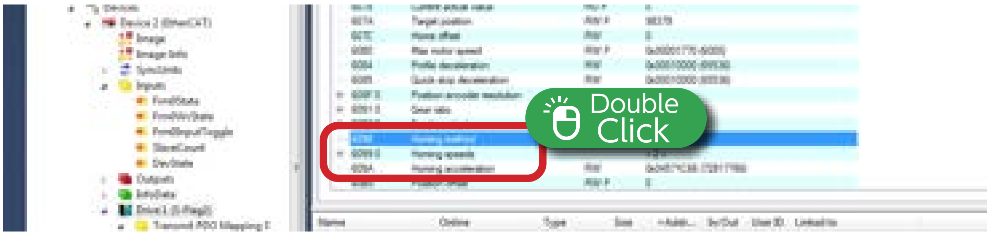
Binary: 06 00 2

Bit Size: ○ 1 ○ 8 ● 16 ○ 32 ○ 64 ○ ?

3 Set the Homing motion conditions.

Set the "Homing method (6098 h)", "Homing speeds (6099 h)", and "Homing acceleration (609 Ah)".

- Double-click "6098 Homing method", "Homing speeds", and "homing acceleration" respectively from the object list.



Homing method

Selects the type of homing operation. (Range: 1 -6, 17 -22, 33 -35, 37)

See [**1** **Operations**] for more information.

Homing speeds

Sets the speed of homing operation. (Unit: pulse/s)

sub-index: "01h"··· Speed at home sensor detection (high speed)

Corresponds to amp parameter No. 648.0 (Unit: rpm).

sub-index: "02h"···Speed to detect index pulse (low speed)

Corresponds to amp parameter No. 649.0 (Unit: rpm).

Homing acceleration

Sets the acceleration of homing operation. (Unit: pulse/s^2)

Corresponds to amp parameter No. 650.0 (Units: ms/1,000 rpm).

Configuration Complete

Relations between amplifier parameter values and TwinCAT3 settings

Convert [rpm] to [pulse/s] (For a 17 bit encoder)

Example: The motor rotational velocity of 100 rpm is converted to pulse/s unit for setting by TwinCAT3.

100 [rpm] = 100 [rev] × 131,072 [pulse/rev] / 60 [s] = **218,453.33···[pulse/s]**

Convert [ms/(1,000 rpm)] to [pulse/s^2] (For a 17 bit encoder)

Example:The motor acceleration/deceleration time of 30 ms/(1,000 rpm) is converted to pulse/s2 units for setting in TwinCAT3.

30 [ms/(1,000 rpm)] = 0.03 [s]/(1,000 [rev] × 13,1072 [pulse/rev]) / 60 [s]

= 0.03/(1,000 × 131,072) × 60 [s^2/pulse]

invert the result of this calculation → **72,817,777.77···[pulse/s^2]**

4 Start homing.

Setting bit 4 of Controlword (6040 h) to 1 starts homing.

- Right-click "Control word" in the object list and choose "Online Force".

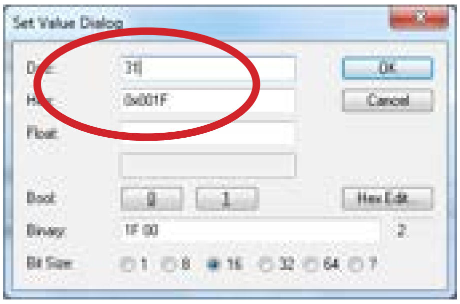
Being the Servo ON state, the "Control word" value is "15 (= 000Fh)".
Set "31 (= 001Fh)" to set bit 4 (Homing operation start) to "1".

Homing starts.

Dec: 31 OK ← Click

↓

Homing starts.



Dec: 31
Hex: 0x001F
Binary: 1F 00
Bit Size: ○ 1 ○ 8 ● 16 ○ 32 ○ 64 ○ ?

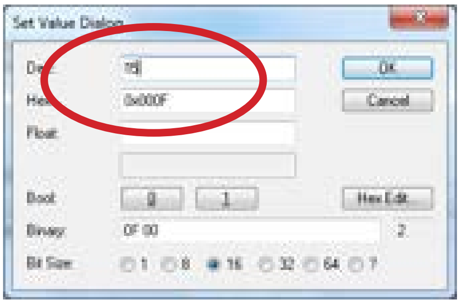
↓

- When the homing operation is completed(*), right-click "Control word" and select "Online Force".

Set bit4 (Homing operation start) back to "0".
Then, set the value to "15 (= 000Fh)".

Closes the homing operation.

Dec: 15 OK ← Click



Dec: 15
Hex: 0x000F
Binary: 0F 00
Bit Size: ○ 1 ○ 8 ● 16 ○ 32 ○ 64 ○ ?

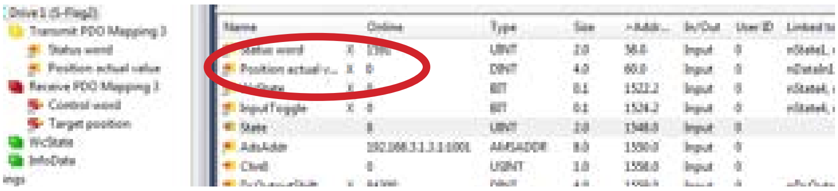
↓

Homing is completed.

*) You can check the completion of homing with Statusword (6041 h).
See [1 **Operations**] for more information.

After the homing operation is completed

The "Position Actual Value" becomes "0".



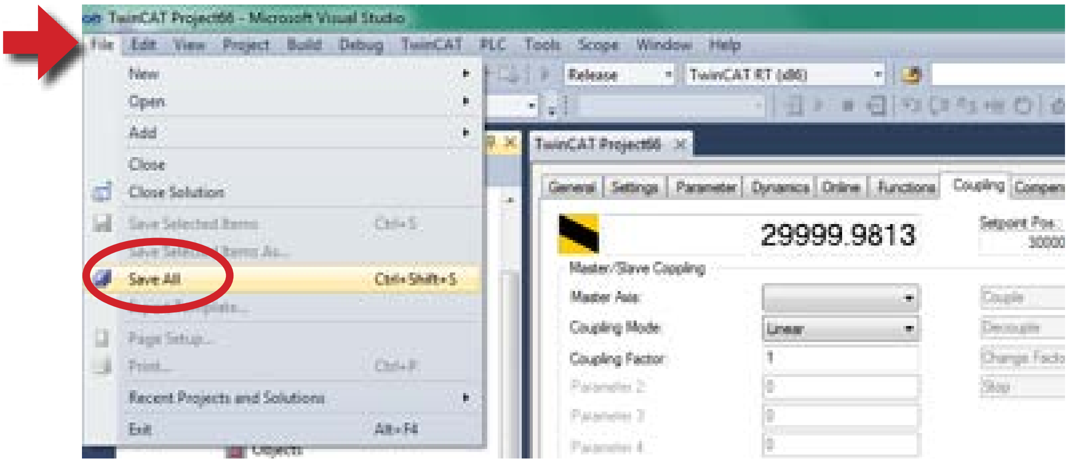
2. Use Beckhoff's "TwinCAT"

4. Save Project file

Save the project.

The project file stores connection information, settings, and test operation conditions. You can retrieve a saved project file.

Save the project file by choosing "Save All" from the "File" menu.



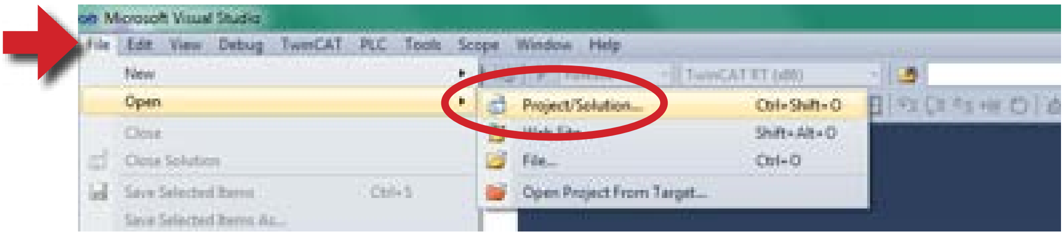
Finish

Saving the project file is complete.

5. Open Project file

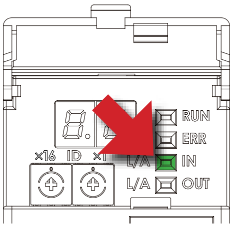
Open a saved project file.

Select "Project/Solution" in "File" → "Open" to open the saved project.

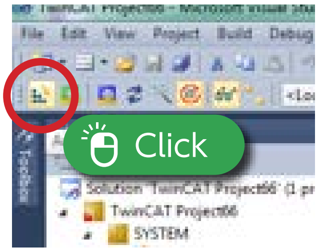


Turn on the control power to the amplifier.

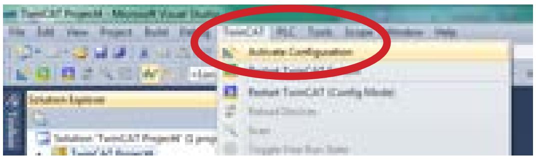
Wait until the L/A IN LED turns green to indicate that EtherCAT communication has been established.



Click on Activate Configuration to accept the configuration.



If there is no button on the toolbar, there is also a "Activate Configuration" button in the "TwinCAT" menu.



Finish

Reading the project file is complete.

MEMO

3

Timing Diagrams

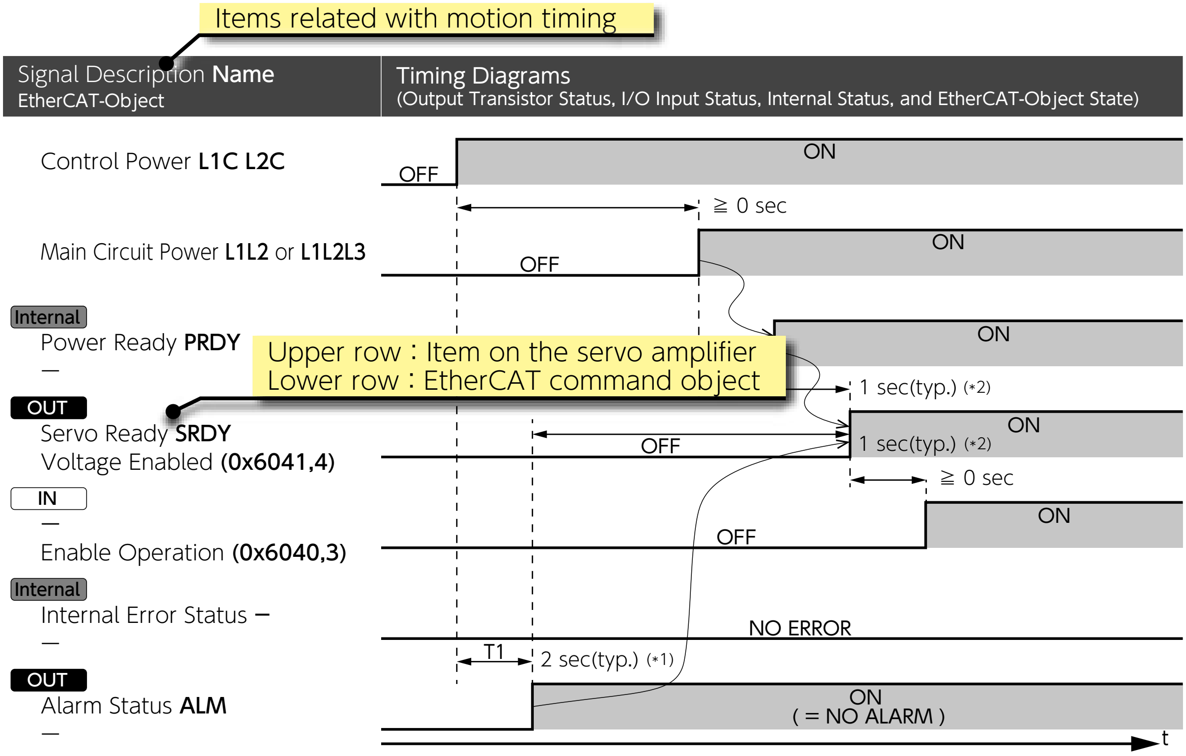
1. Timing Diagram Overview

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.

Description	Refer to
1. Turning the Power On	P. 3
2. Servo OFF → ON	P. 4
3. Servo ON → OFF (Motor idling)	P. 5
4. Servo ON → OFF (Motor rotating)	P. 6
5. Alarm Occurs	P. 7
6. Alarm Reset	P. 8
7. Brake Release	P. 9
8. Dynamic Brake Release	P. 10
9. Deceleration Stop Status During Free Run	P. 11
10. Delay time for Immediate Stop Complete	P. 12

Timing Diagram Overview



OUT : Output Signal

Output State	I/O Output Status (EtherCAT Command State)
OFF	Output Transistor is OFF. (0)
ON	Output Transistor is ON. (1)

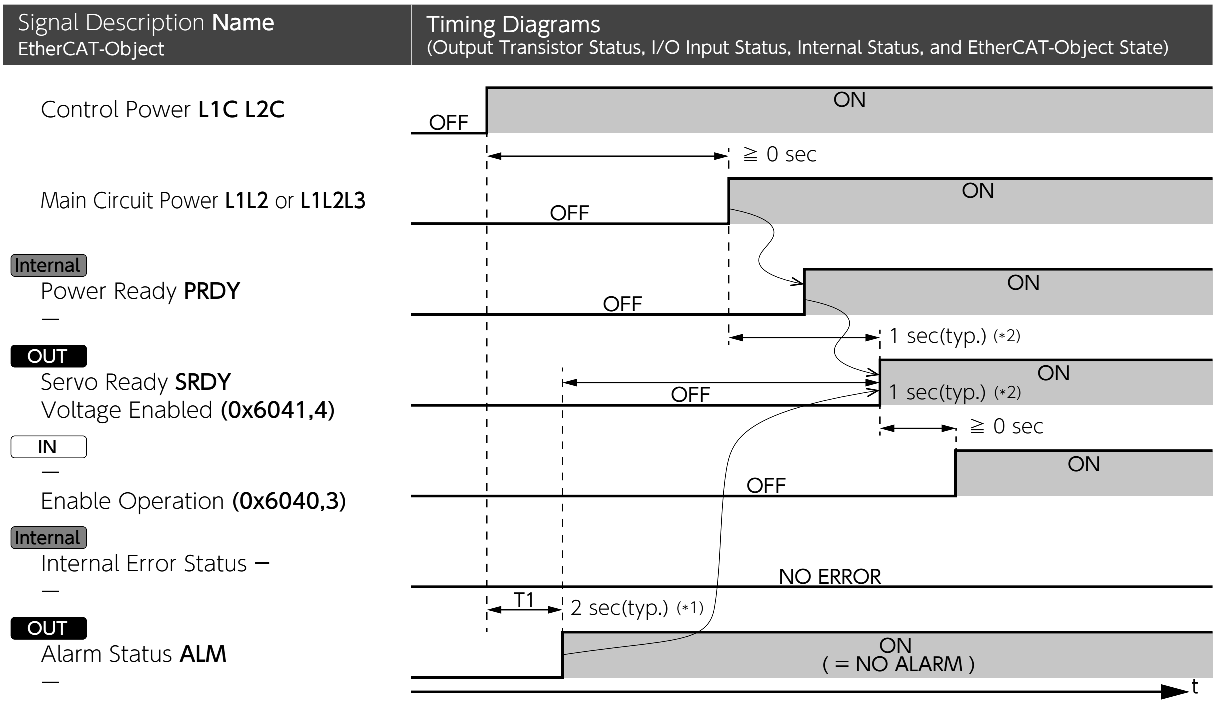
IN : Input Signal

Input State	I/O Input Status (EtherCAT Command State)
OFF	Open (0)
ON	Close (1)

Internal : Internal Status of the Amplifier

2. Timing Diagrams

1. Turning the Power On

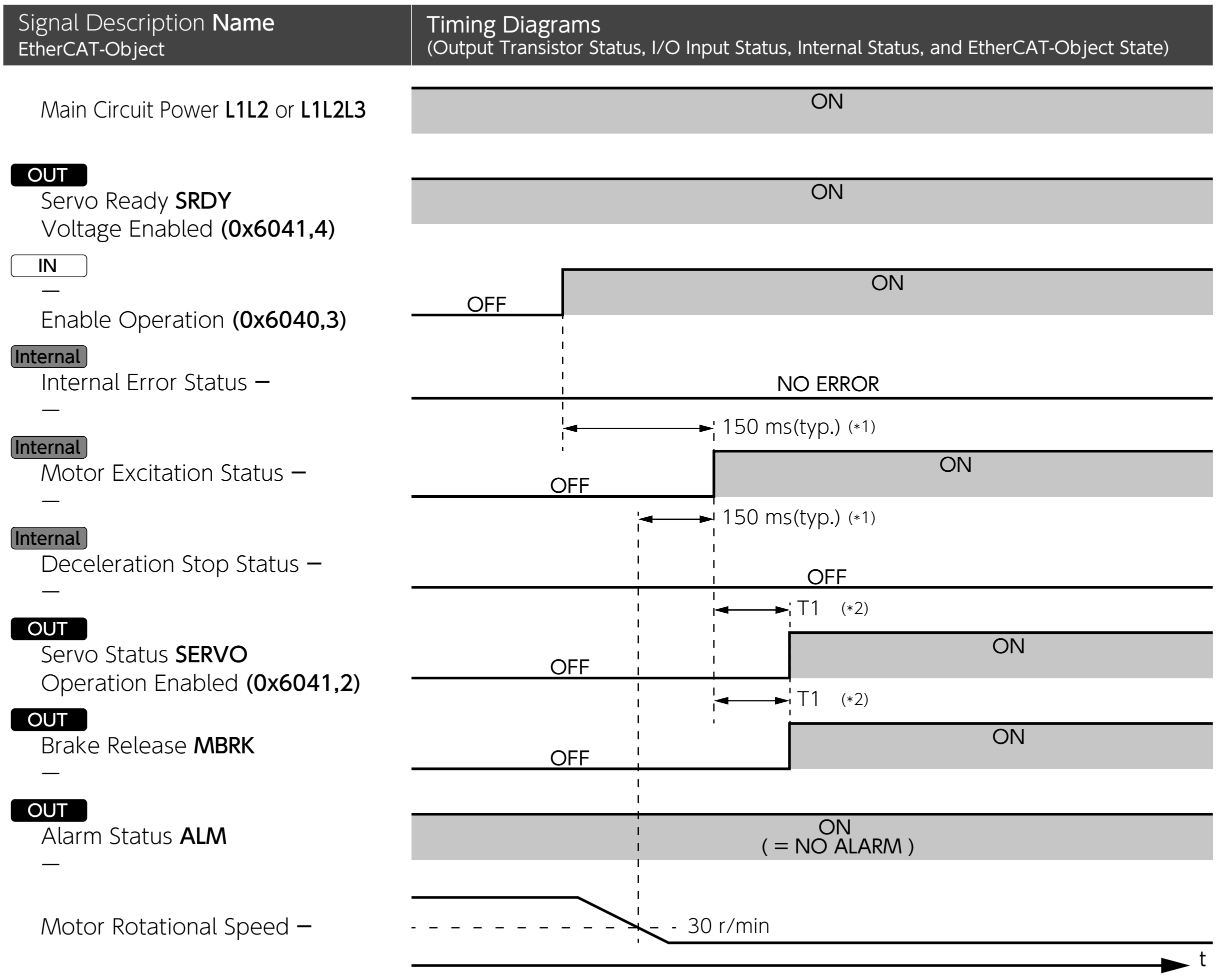


*1) After Clear Parameter execution, T1 needs approximately 10 seconds for parameter initialization.

*2) **SRDY** turns ON when **Primary Circuit Power** and **PRDY** turns ON consecutively while **Internal Error Status** remains No Errors.

2. Timing Diagrams

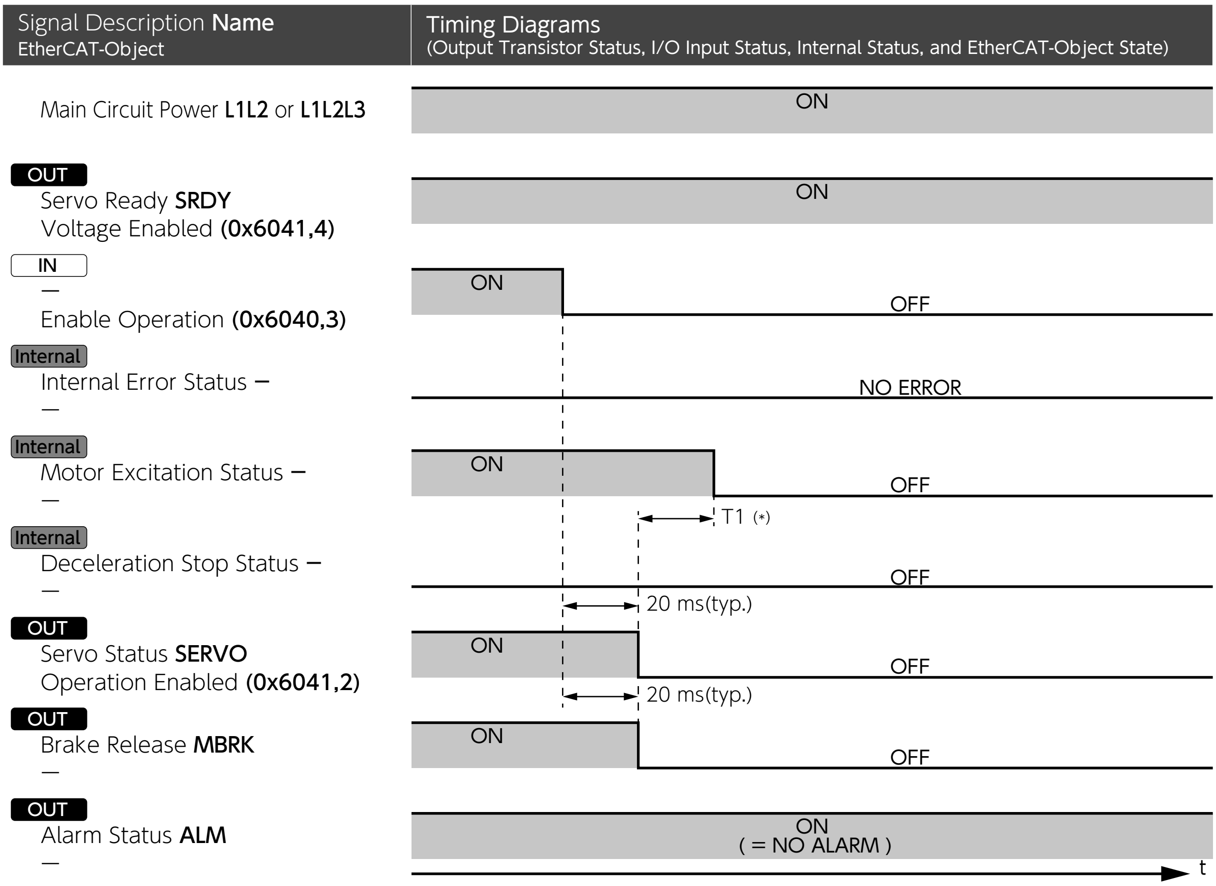
2. Servo OFF → ON



*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).

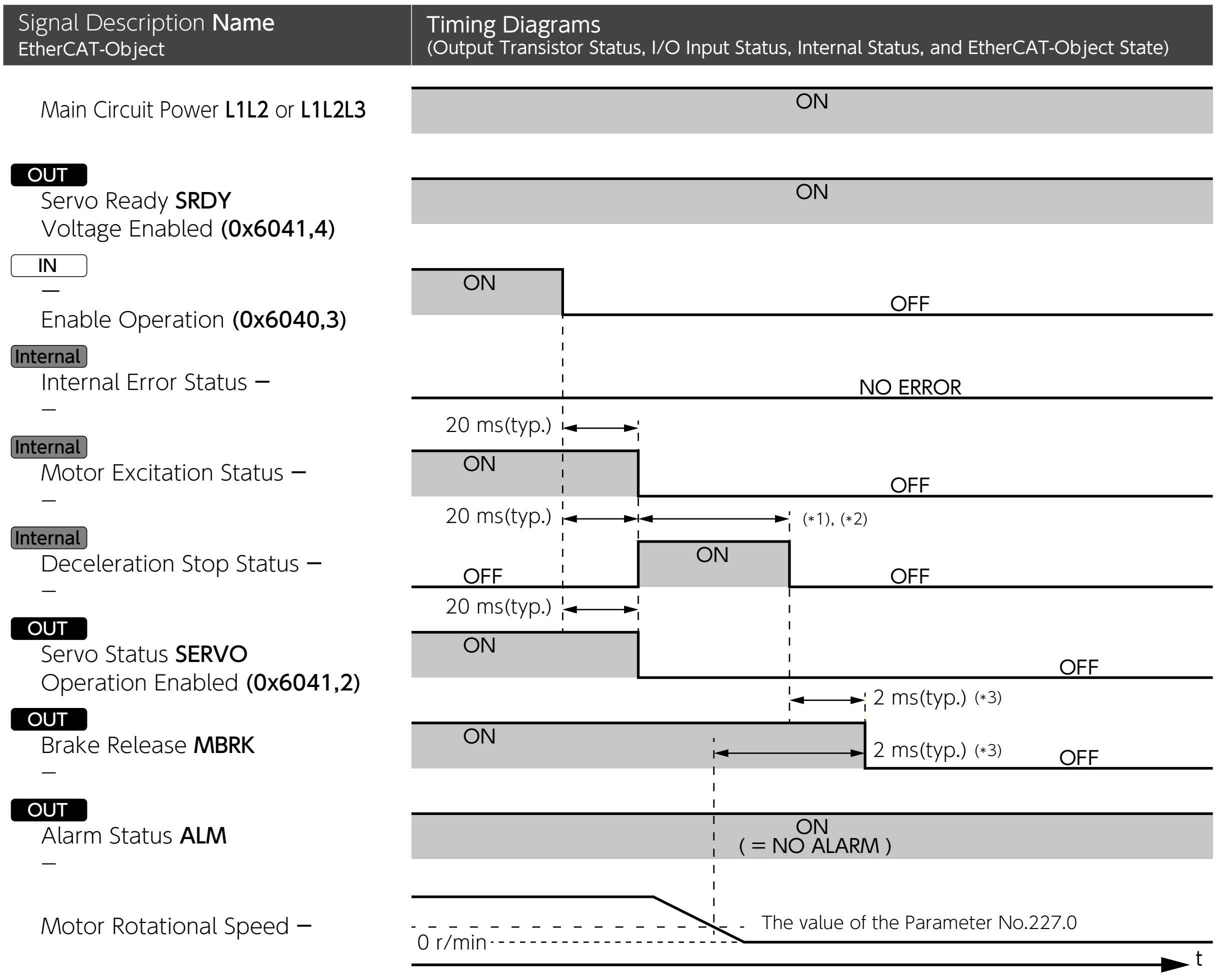
3. Servo ON → OFF (Motor idling)



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

2. Timing Diagrams

4. Servo ON → OFF (Motor rotating)



*1) The motor decelerates according to the method specified by Deceleration Stop Method (No.224.0)

*2) Immediate 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 (immediate stop) or 1 (short brake)

MBRK turns OFF when one of the following conditions is met :

a) **Deceleration Stop Status** turns OFF

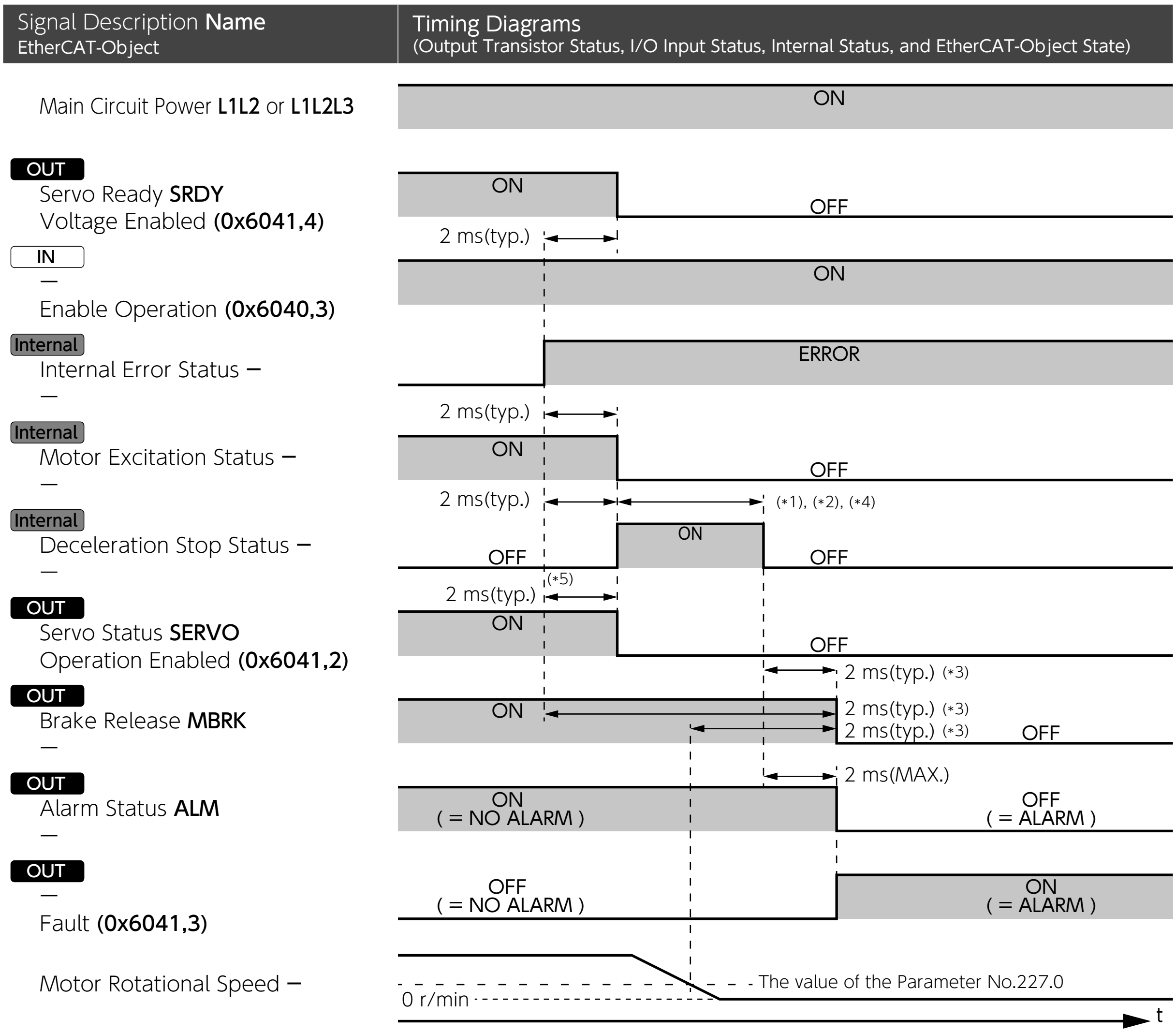
b) The rotational speed drops to the value specified by **Deceleration stop Rotational speed to cancel** (No.227.0) or below.

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

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

2. Timing Diagrams

5. Alarm Occurs



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

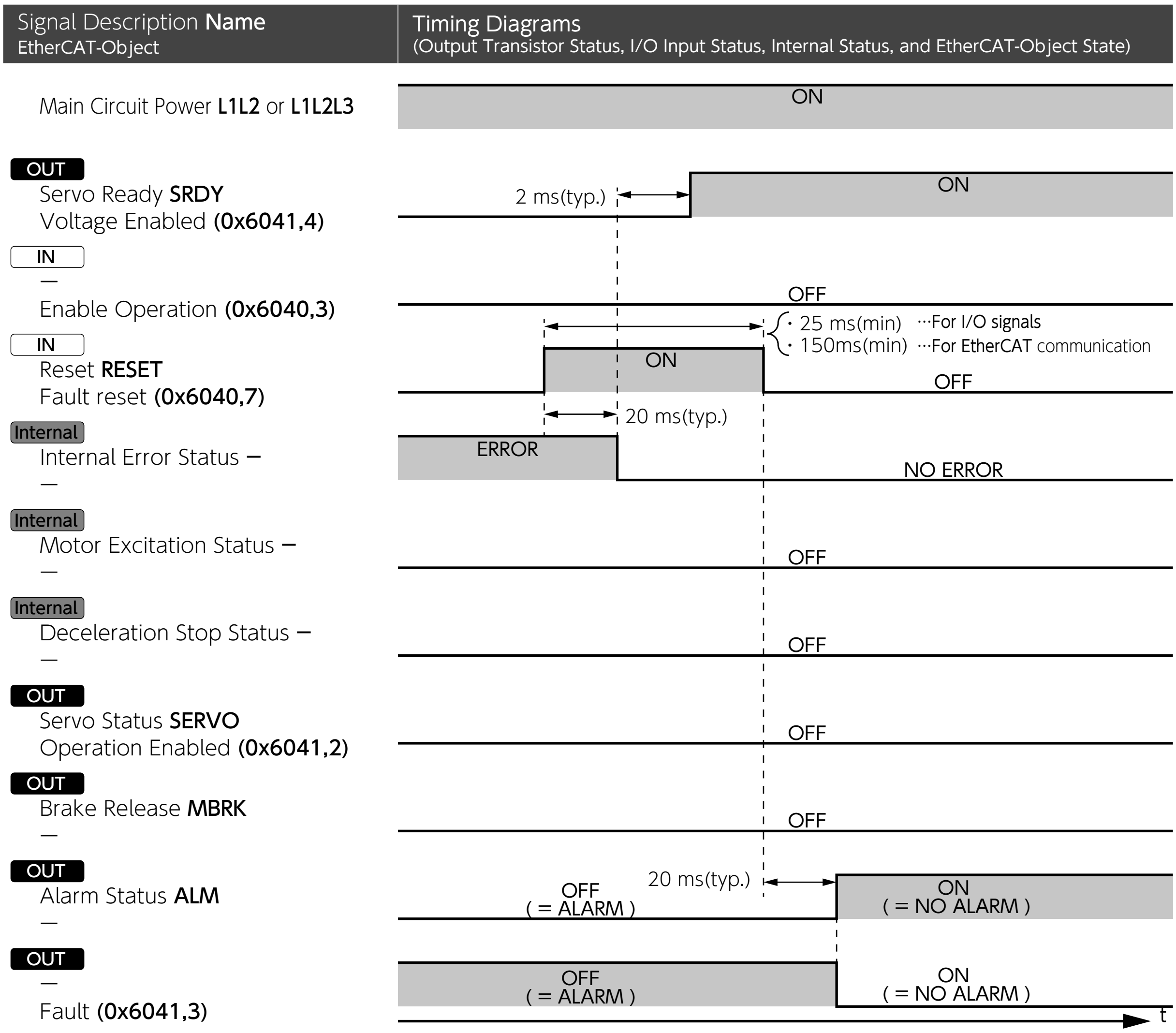
If Deceleration Stop Method (No.224.0) = 0 (no brake),
MBRK turns OFF when **Motor Excitation Status** turns OFF.

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

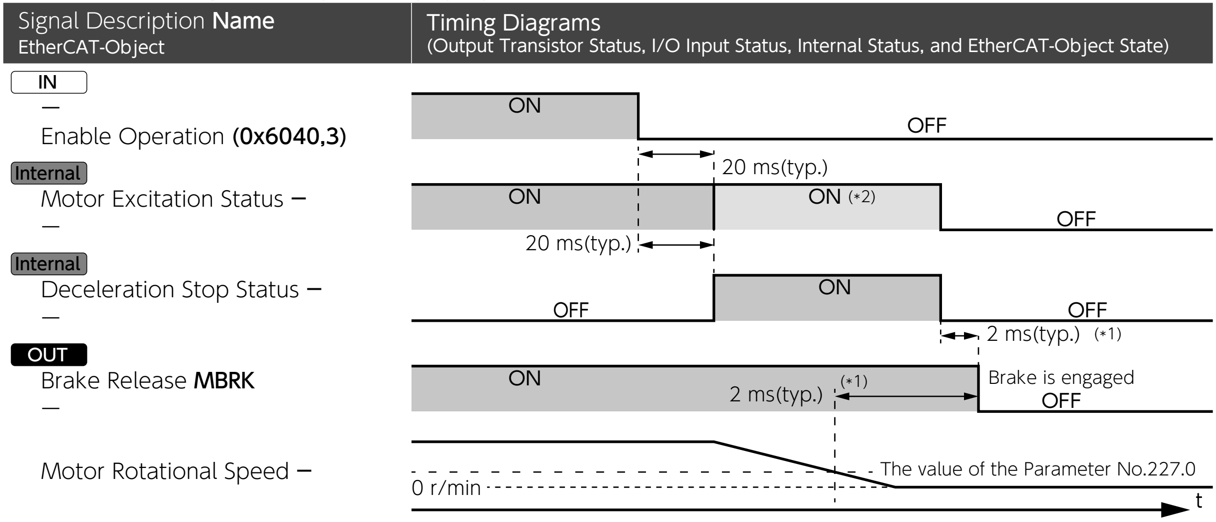
*5) In case of the following alarms, **Servo Status** will remain ON until **Deceleration Stop Status** turns OFF.
a) Encoder related errors
b) Control power voltage drop error

6. Alarm Reset



7. Brake Release

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

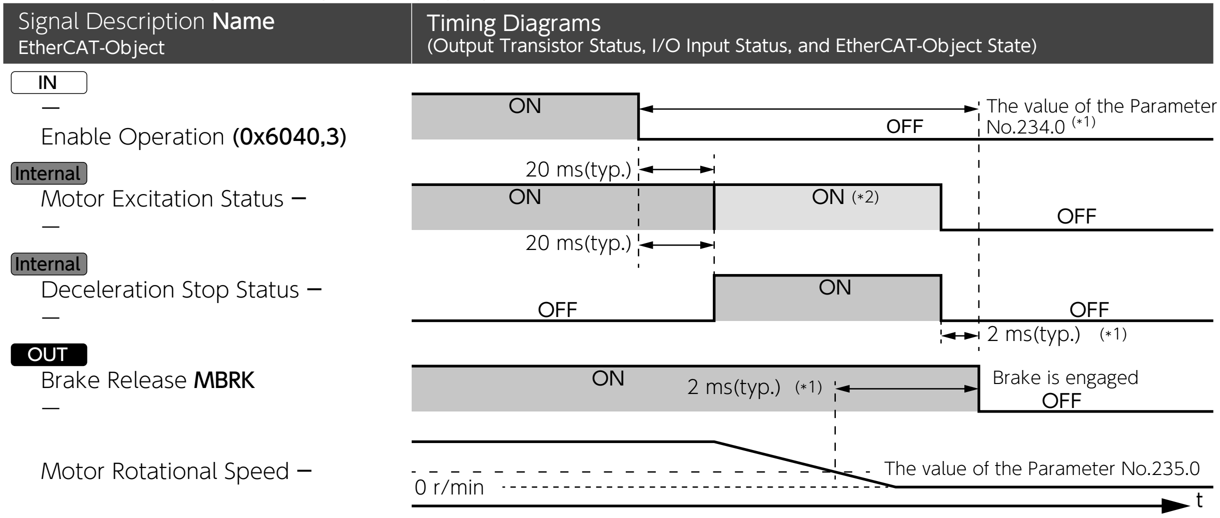


*1) **MBRK** turns OFF is when one of the following becomes true, a) Deceleration Stop completes, or b) **Motor rotational speed** drops to

the value of **Deceleration stop - Rotational speed to cancel** (No.227.0) or below.

*2) If the deceleration stop method is immediate stop, the motor will remain excited during deceleration stop.

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



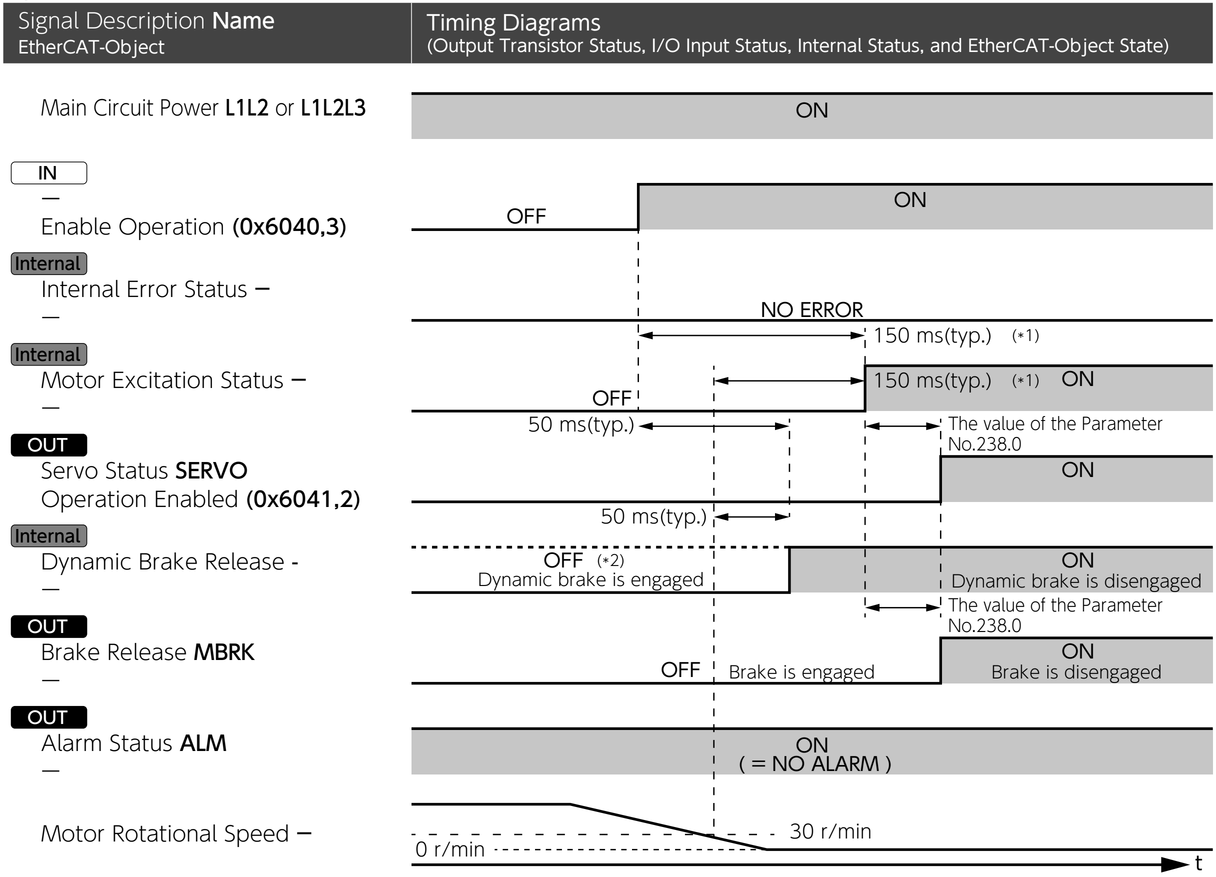
*1) **MBRK** turns OFF is when one of the following becomes true, a) Deceleration Stop completes, or b) Motor rotational speed, after the time

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 immediate stop, the motor will remain excited during deceleration stop.

8. Dynamic Brake Release

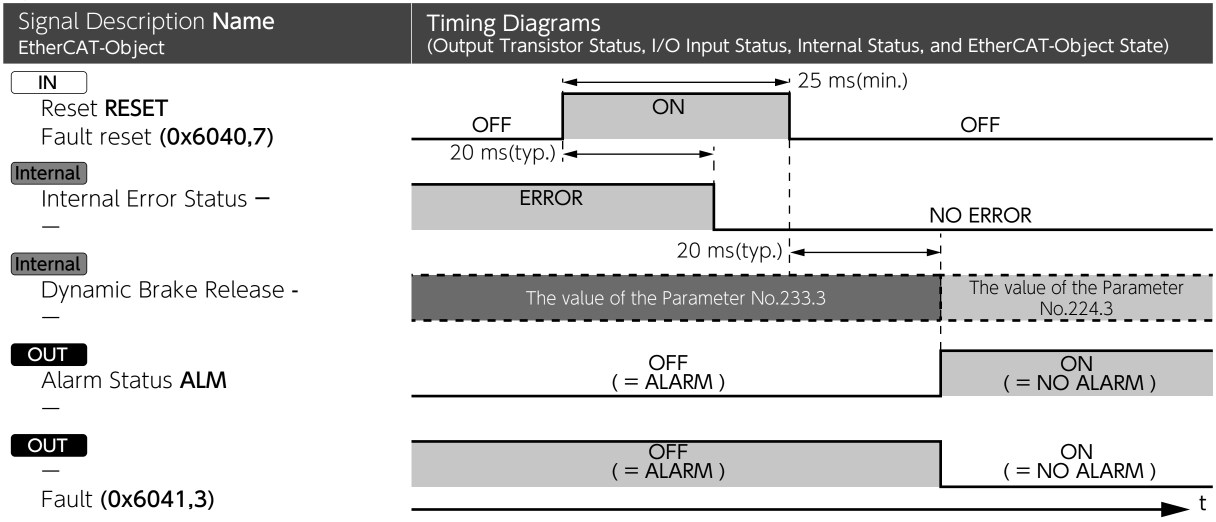
Upon Servo ON, if Deceleration stop (when Servo is OFF) : Method (No.224.0) = 3 (dynamic brake)



*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)

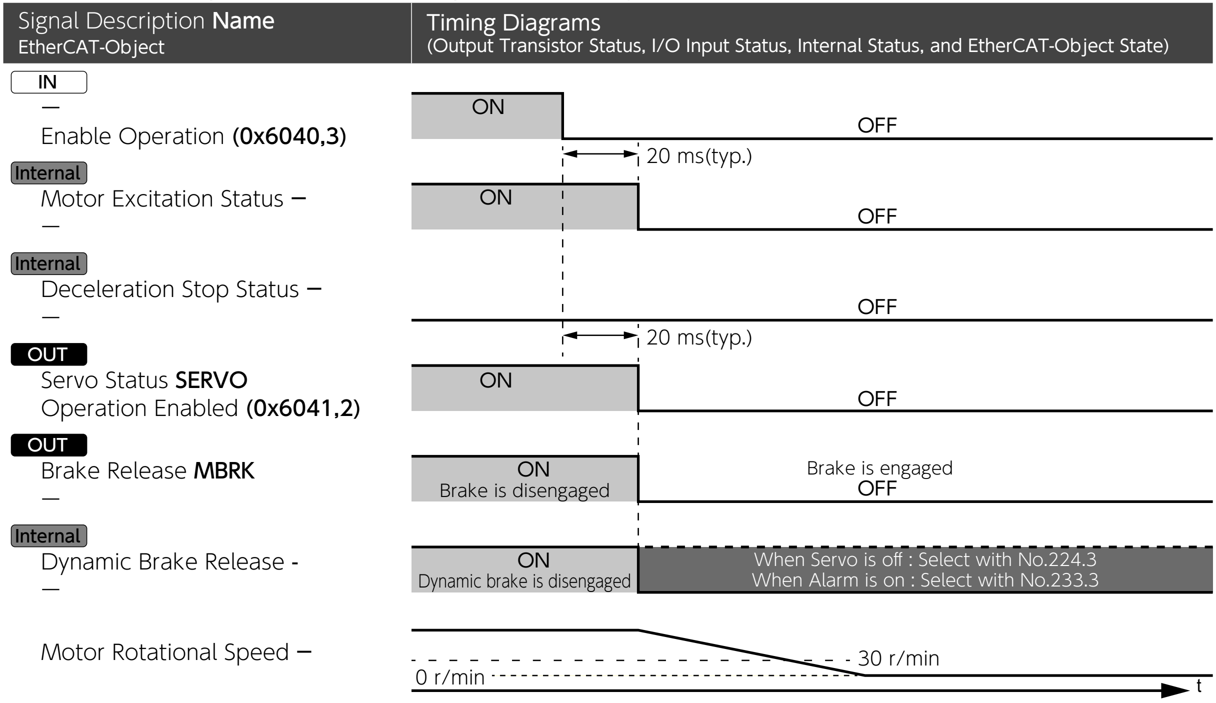


2. Timing Diagrams

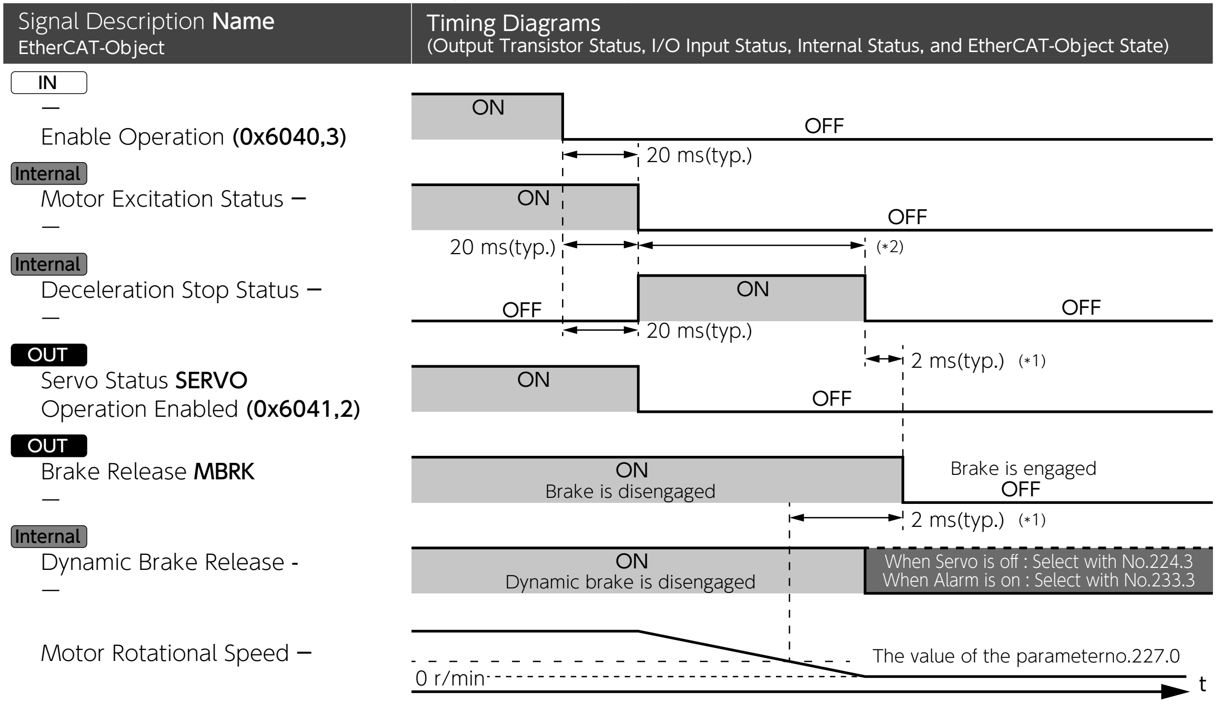
9. Deceleration Stop Status During Free Run

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.

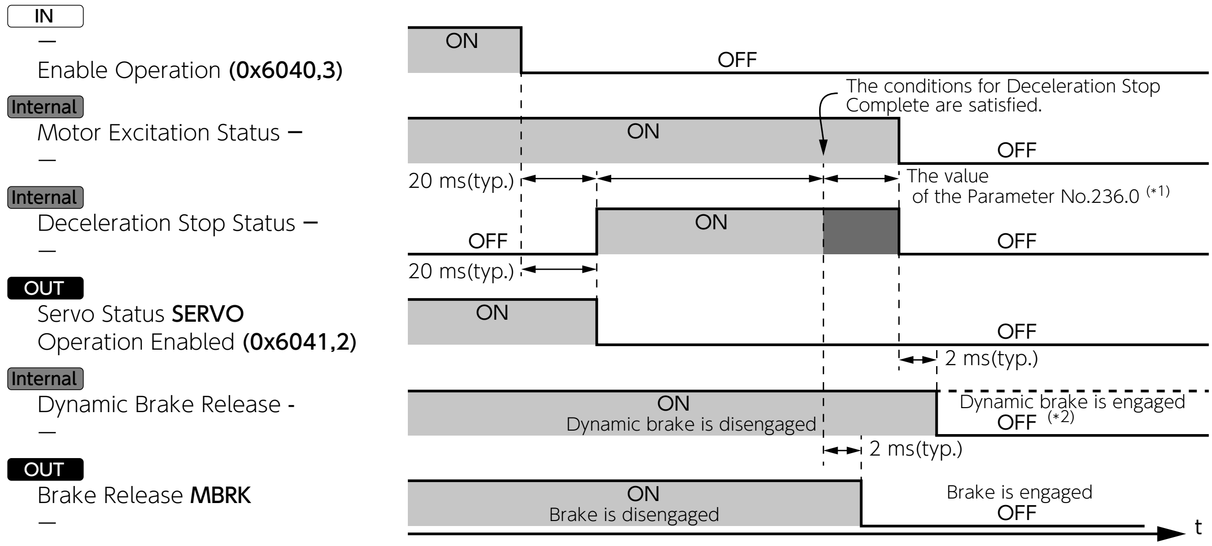
2. Timing Diagrams

10. Deceleration Stop Status on "Immediate Stop" configuration

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

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

Signal Description **Name** EtherCAT-Object	Timing Diagrams (Output Transistor Status, I/O Input Status, Internal Status, and EtherCAT-Object State)



*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 **Immediate Brake Delay Time** (No.236.0) elapses.

*2) When **DBRK** output (No.224.3) = 1 (dynamic brake) after Deceleration Stop (at Servo OFF) ends.

S-FLAG Ⅱ Instruction Manual
- EtherCAT -

Z

APPENDICES

1. Troubleshooting
2. Technical Information

AMO-NP-35475-42
SF2-E-Z
APR. 2023

MEMO

1

Troubleshooting

1. Checking Warnings and Alarms

Warnings and alarm numbers can be viewed on the Setup Panel or S-TUNE Ⅱ.
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 S-TUNE Ⅱ.

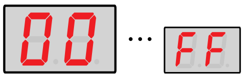
☞ **D- 1 About S-TUNE Ⅱ**

1. Using the Setup Panel

When a warning occurs, the amplifier LED blinks green.
In addition, the Setup Panel will automatically display the corresponding warning No.
When an alarm occurs, the amplifier LED changes from solid green to solid red.
In addition, the Setup Panel will automatically display the alarm No.

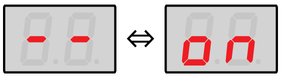
☞ **C- 1 Setup Panel**

EtherCAT communication node address



Displays the node address of the EtherCAT communication.
Displays for approximately 2 seconds.
If an alarm occurs when the amplifier is started, the node address is not displayed.

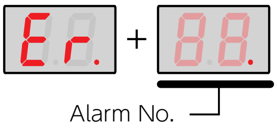
Servo status



Indicates the servo status of the amplifier.
The servo status is not displayed when an alarm occurs.

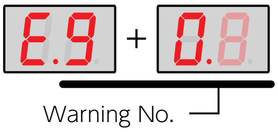
- - Servo **OFF**　　on Servo **ON**

Alarm status



Displays the alarm number that has occurred.
The alarms are from No.00 to No.34.

Warning status

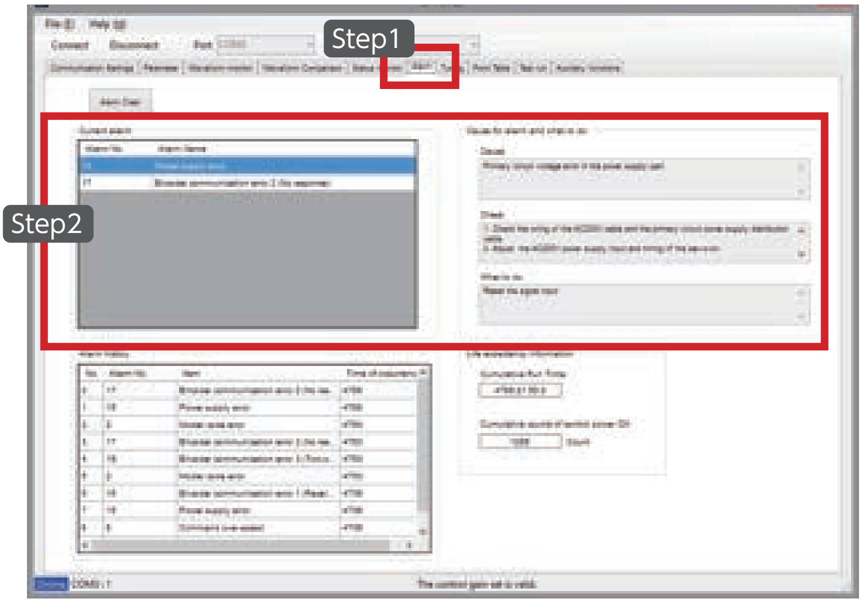


Displays the warning number that has occurred.
The warnings are from No.900 to No.904.

2. Using S-TUNE Ⅱ

Turn on the control power AC200 V to the amplifier and start S-TUNE Ⅱ.
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.

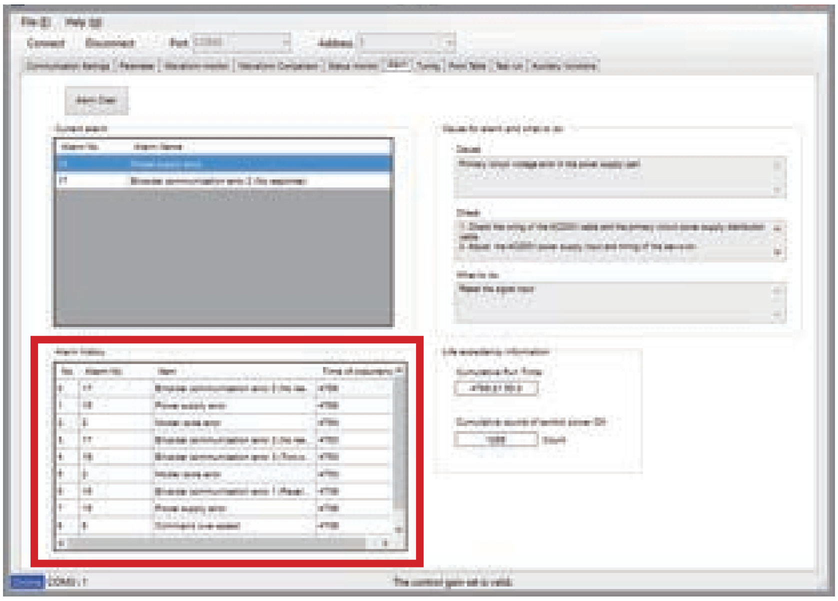
☞ **D- 1 About S-TUNE Ⅱ**



Step1 Select the Alarm tab in S-TUNE Ⅱ.

Step2 See [Current alarm] and [Cause for the alarm] and [What to do] windows for details.

Checking the Alarm History in S-TUNE Ⅱ



The alarm history area shows a list of the alarms.

1. Troubleshooting

2. Warnings and Remedies

1. Warning Output

There are two ways to output warnings.

1. Setup Panel Output

During waring output, the warning number will appear on the Setup Panel.

Warning No.	Display	Warning Description	Refer to
900	E.9 ···> 0.0	Encoder overheat detection	P. 5
901	E.9 ···> 0.1	Encoder battery voltage drop error detection	P. 5
902	E.9 ···> 0.2	Emergency stop	P. 5
903	E.9 ···> 0.3	Encoder communication warning	P. 6
904	E.9 ···> 0.4	Excessive position deviation	P. 6
905	E.9 ···> 0.5	Vibration prediction warning1	P. 7
906	E.9 ···> 0.6	SRDY warning	P. 7
907	E.9 ···> 0.7	Vibration prediction warning2	P. 8

2. S-TUNE Ⅱ

Select the Alarm tab in S-TUNE Ⅱ.
See [Current alarm] and [Alarm history] windows for details.

☞ **D- 1 About S-TUNE Ⅱ**

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, this warning will be automatically released.	

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, this warning will be automatically released.	

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, this warning will be automatically released.	
Related To	**Z- 2 Technical Information**	

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, this warning will be automatically released.	

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, this warning will be automatically released.	

2. Warnings and Remedies

Warning No.	905	Vibration prediction 1
Symptom and Possible Cause	**Predictive signs of vibration were detected.** Vibration is being suppressed now by reducing the gain set.	
Remedy	Reduce the gain set. If this does not resolve the problem, reduce the gain set further.	
Reset Method	This warning will be automatically released when the gain set is reduced.	

TIP !

When vibration occurs during use of the automatic notch filter function, if it can be suppressed by reducing the gain set, a warning will be issued and the operation will continue.

Warning No.	906	SRDY state warning (Power supply warning (main circuit AC power))
Symptom and Possible Cause	**Main circuit AC power was not input correctly.** i.e. SRDY (servo ready) status is not established.	
Remedy	(1) Check the wiring and main circuit power supply and its voltage. Make sure there are no connector mis-insertions or loose screws on the terminal block. Also be sure to check the single-phase/three-phase of the connected power supply and the setting of parameter No. 304.1. (2) Clear the amplifier error.	
Reset Method	**This warning will be automatically released when SRDY is established.**	

Warning No.	907	Vibration prediction 2
Symptom and Possible Cause	**Predictive signs of vibration were detected.** Vibration is being suppressed now by reducing the gain set.	
Remedy	Reduce the gain set. If this does not resolve the problem, reduce the gain set further.	
Reset Method	This warning will be automatically released when the gain set is reduced.	

TIP !

Warning No. 907 occurs at the same time as alarm No. 40.

This warning is issued when "Change alarm output to warning" is set in parameter No. 400.0.
i.e.: Alarm No. 40 is output as warning No. 907.

1. Troubleshooting

3. Alarms and Remedies

1. List of Alarms

Alarm No.	Display	Alarm Name	Refer to
0	Er. ···> 00.	System error	P. 11
1	Er. ···> 01.	EEPROM data error	P. 11
2	Er. ···> 02.	Product code error (Mismatching code)	P. 11
3	Er. ···> 03.	EtherCAT communication error	P. 11
4	Er. ···> 04.	Overspeed error	P. 12
5	Er. ···> 05.	Velocity deviation error	P. 12
6	Er. ···> 06.	Position deviation error	P. 12
7	Er. ···> 07.	Overload error	P. 13
8	Er. ···> 08.	Command overspeed error	P. 14
10	Er. ···> 10.	Positioning command overflow error / Homing failure	P. 14
11	Er. ···> 11.	Multi-turn counter error	P. 14
12	Er. ···> 12.	Overheat error	P. 15
14	Er. ···> 14.	Overvoltage error	P. 16
15	Er. ···> 15.	Power supply error (Primary circuit AC power)	P. 16
16	Er. ···> 16.	Encoder error (Received data)	P. 17

3. Alarms and Remedies

Alarm No.	Display	Alarm Name	Refer to
17	Er. ···> 17.	Encoder error (No response)	P. 17
18	Er. ···> 18.	Encoder error (Hardware)	P. 18
19	Er. ···> 19.	Encoder error (Communication)	P. 17
20	Er. ···> 20.	Encoder error (Multi-turn data)	P. 17
21	Er. ···> 21.	Encoder error (Voltage drop)	P. 18
22	Er. ···> 22.	Voltage error (Internal control power DC24V)	P. 19
23	Er. ···> 23.	Switch circuitry error	P. 19
24	Er. ···> 24.	Overcurrent error	P. 19
25	Er. ···> 25.	Inverter error 1	P. 20
26	Er. ···> 26.	Inverter error 2	P. 20
27	Er. ···> 27.	Current sensor error	P. 20
28	Er. ···> 28.	Encoder error (Overheat)	P. 20
29	Er. ···> 29.	Voltage error (Internal control power DC5V)	P. 20
32	Er. ···> 32.	Power supply error (Control circuit AC power)	P. 21
34	Er. ···> 34.	Product code error (Undefined model code)	P. 21
40	Er. ···> 40.	Vibration prediction	P. 21

RESET Signal

① Eliminate the cause.
② input RESET signal to the RESET terminal on the connector C5.

Control-power cycle

① Eliminate the cause.
② Cycle control-power.

CLEAR Encoder

① Eliminate the cause.
② Execute CLEAR Encoder
③ Cycle control-power.
After power cycle, perform Homing.

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	🔄	

Alarm No.	2	Product code error (Mismatching code)
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. - The encoder cable is disconnected.	
Remedy	Check the motor-amplifier pairing. Check the encoder cable connections.	
Reset Method	⏻	

Alarm No.	3	EtherCAT communication error
Symptom and Possible Cause	EtherCAT communication is not working properly.	
Remedy	・Check the "command mode (Parameter No.3.0)" value is 10. ・Check the EtherCAT communication cable. ・Check the connection status (ESM) with the host controller. ・Check for noise. → Use a shielded cable. If any of the above didn't resolve the issue, please contact our distributor.	
Reset Method	🔄	

3. Alarms and Remedies

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		

Alarm No.	5	Velocity 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		

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		

<table>
<tr><td>Alarm No.</td><td>7</td><td>Overload error</td></tr>
<tr><td>Symptom and Possible Cause</td><td colspan="2">Position control/Speed 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 machine collided with some object.
Load was applied for more than the specified time and torque.
(The machine has locked up.)
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. (Extremely sharp motions)
8. Noise was generated.</td></tr>
<tr><td>Remedy</td><td colspan="2">(See next page)</td></tr>
</table>

!	After alarm 7 occurs, allow 10 minutes of cooling before resuming operation.	⚠ ⚠

After alarm 7 occurs, allow 10 minutes of cooling before resuming operation.

(Continued from previous page / Alarm No. 7)

<table>
<tr><th>Alarm No.</th><th>7</th><th>Overload error</th></tr>
<tr><td>Remedy</td><td colspan="2">Executing overloaded motions continuously may burnout the motor.
<table>
<tr><th>Cause</th><th>Remedy</th></tr>
<tr><td>1, 2</td><td>- Check the motor power cable connections.
(Make sure that the combination of the motor power cable and encoder cable is correct when using it with multiple axes.)</td></tr>
<tr><td>3</td><td>- Verify that the user-selected motor capacity is appropriate.
- Verify that the brake is disengaged.
Make sure that the system is not locked.
- Verify that the deceleration ratio is appropriate.</td></tr>
<tr><td>4</td><td>- During Acceleration - Check the acceleration time, torque wave form and load ratio.
- Otherwise - Verify that there are no obstacles inside the work area of the equipment.
Make sure that the system is not locked.</td></tr>
<tr><td>5</td><td>- Check the torque waveforms and load ratio.
- Check the inertia ratio.
Increase the motor capacity. Install a decelerator</td></tr>
<tr><td>6, 7</td><td>- 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.</td></tr>
<tr><td>8</td><td>- Configure countermeasures for noise such as a notch filter or low-pass filter.</td></tr>
</table></td></tr>
<tr><td>Reset Method</td><td colspan="2"></td></tr>
</table>

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 **EtherCAT communication command: Ratio** (No.34.0 and No.36.0). Check the commands from the host controller.	
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	🔄	

Alarm No.	11	Multi-turn counter error
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	🔄	

3. Alarms and Remedies

Alarm No.	14	Overvoltage error
Symptom and Possible Cause	The primary circuit voltage of the control unit has exceeded the upper limits.	
Remedy	If the alarm occurs only during deceleration By using the Setup Panel or S-TUNEⅡ, 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	↻	

3. Alarms and Remedies

Alarm No.	15	Power supply error (Primary circuit AC 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. Enable Operation (0x6040,3) 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 Enable Operation (0x6040,3) 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 S-TUNE Ⅱ. 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		

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. Check that the encoder temperature does not exceed the specified range. If any of the above didn't resolve the issue, please contact our distributor.	
Reset Method	⏻	

RST RESET Signal	⏻ Control-power cycle	CLR CLEAR Encoder
① Eliminate the cause. ② input RESET signal to the RESET terminal on the connector C5.	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.

Alarm No.	18	Encoder error (Hardware)
Symptom and Possible Cause	**Anomaly of the encoder itself has been detected.** **The encoder temperature has exceeded the specification and output data has become abnormal.** **The battery voltage of the absolute encoder dropped or the battery became disconnected. (Alarm No.21 is output in this case)**	
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. **Check that the encoder temperature does not exceed the specified range.** If you are using an absolute system →Replace the battery, connect it, and initialize the encoder. If any of the above didn't resolve the issue, Check the alarm number in the S-TUNE Ⅱ and contact our distributor.	
Reset Method	⚡ ⏻	

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	⚡ ⏻	

3. Alarms and Remedies

Alarm No.	22	Voltage error (Internal control power DC24V)
Symptom and Possible Cause	The control power voltage (24VDC) inside of the amplifier has dropped.	
Remedy	Check the control power AC200 V voltage. Check for insufficient control power capacity. 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	⟳	

Alarm No.	23	Switch circuitry error
Symptom and Possible Cause	Control circuit is faulty.	
Remedy	Please contact our distributor.	
Reset Method	⟳	

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	⟳	

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	🔄	

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	🔄	

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	🔄	

Alarm No.	29	Voltage error (Internal control power DC5V)
Symptom and Possible Cause	The control power voltage (5VDC) 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	🔄	

3. Alarms and Remedies

Alarm No.	32	Power supply error (Control circuit AC power)
Symptom and Possible Cause	Abnormality of high or low control voltage ・The control power was not input. ・The control power supply voltage was out of the input range. ・The control power supply voltage fluctuated and went out of range.	
Remedy	・Check the control power supply voltage. ・Check that there is no voltage fluctuation due to the operation of the entire equipment. ・Use a power supply with sufficient supply capacity to prevent voltage fluctuation. If any of the above didn't resolve the issue, please contact our distributor.	
Reset Method	🔄	

Alarm No.	34	Product code error (Undefined model code)
Symptom and Possible Cause	Encoder communication was lost. The motor model code is incorrect.	
Remedy	Please contact our distributor.	
Reset Method	⚡ ⏻	

Alarm No.	40	Vibration prediction
Symptom and Possible Cause	Predictive signs of vibration were detected. Tried to prevent vibration by reducing the gain set, but could not suppress the vibration.	
Remedy	- Reduce the gain set. (After the error is reset, the system is ready to operate.) - If this does not resolve the problem, reduce the gain set further.	
Reset Method	🔄 Turn down the gain set before inputting the RESET signal	

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**	The Setup Panel does not show.	P. 21

Problem	Symptom	Refer to
Problem 2 **Servomotor not turning ON**	The Setup Panel shows, but the servo cannot be turned on.	P. 22

Problem	Symptom	Refer to
Problem 3 **No motor rotation**	The servo is on, but the motor does not rotate.	P. 23

Problem	Symptom	Refer to
Problem 4 Unstable motor motions	The motor does rotate, but its motions are unstable.	P. 24

Problem	Symptom	Refer to
Problem 5 **Positional aberration**	The motor does rotate, but position aberration occurs.	P. 25

Problem	Symptom	Refer to
Problem 6 **Vibration and abnormal noise**	The motor is experiencing vibration or abnormal noise.	P. 26

Problem	Symptom	Refer to
Problem 7 EtherCAT communication cannot be established	Cannot transition to OP mode (ErrLED flashing)	P. 27

Problem	Symptom	Refer to
Problem 8 **Servomotor not turning ON-2**	The motor is not energized.	P. 28

Problem	Symptom	Refer to
Problem 9 **No motor rotation-2**	The motor does not rotate or rotates but stops.	P. 29

4. Troubleshooting

Problem 1. No display on the Setup Panel

The Setup Panel does not show.

Cause	Remedy
The controller power is not connected to the user I/O connector.	Connect the controller power to the amplifier.
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 Enable Operation (0x6040,3) signal is not being input.	Check the EtherCAT communication cable for proper connections. Input the Enable Operation (0x6040,3) signal.
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.

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. ☞ **F- 1 Operations**
Command from the host controller is not correctly input.	Check the command from the host controller. Use S-TUNE Ⅱ to measure the input command waveforms 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. ☞ **B- 2 Mounting and Wiring**
Torque command limit is not set right.	Verify that **Torque command limit: Value 1**(No.147.0) are set correctly.
The power line is disconnected or has poor contact.	Make sure it is wired correctly.
Brakes not released.	Make sure the brake is released. Make sure it is wired correctly.

TIP !

The "motor does not rotate" may be caused by a combination of factors.

① Brake not released.
② Torque limit is set low.
③ The position deviation abnormality detection threshold is extremely large.

When these conditions are combined, the motor may not be able to rotate as a result of compounding factors.

🚫	**DO NOT drive the motor without the brake released.** The brake plate is worn out and the motor is highly likely to be damaged.	⚠

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 S-TUNEⅡ, check the command from the host controller. Check for proper connection of the I/O connector.
Tuning is incomplete.	Adjust the parameters.

4. Troubleshooting

Problem 5. Positional aberration

The motor does rotate, but position aberration occurs.

Cause	Remedy
The command signal is interfered with noise.	Check the following two items. 1. Status 810h Target Position (EtherCAT communication position command input) agrees with the host controller output. 2. Status No.65 "Position command" and Status No.67 "Position feedback" agree. If any of the above conditions fails, take countermeasures for noise. -Connect FG correctly. -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. Verify that a normal command is input. Verify that the host controller is obtaining Z-phase correctly.
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.

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. ☞ **C- 3 Tuning**
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 S-TUNE Ⅱ. In case of wrong pairing, clear the parameters saved in EEPROM and change the motor model code.
Mismatch between EtherCAT communication synchronization mode and ModeofOperation.	When the synchronization mode is FreeRun, set ModeofOperation to something other than CSP.

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*) This problem may occur in a low-rigidity case such as belt drive whose load inertia ratio is over 30 times.

4. Troubleshooting

Problem 7. EtherCAT communication cannot be established

Cannot transition to OP mode (ErrLED flashing)

Cause	Remedy
The amplifier is set to internal command mode.	Check if the value of parameter No.3.0 (command mode) is 10 (EtherCAT directive).
EtherCAT communication cycle out of specification.	The communication cycles are 250 μs, 500 μs, 1 ms, 2 ms, and 4 ms. Set to one of the above values.
ESM (EtherCAT State Machine) State Transition Control is Incorrect,	Set the amplifier in the following order: **Init → PreOP → SafeOP → OP**.
ESI file is incorrect	Use an ESI file with the same version as the F/W version of the amplifier.
Unsupported object is mapped to PDO.	Check the PDO mapping.
Incorrect LAN cable connection	Check the wiring of the LAN cable.

4. Troubleshooting

Problem 8. Servomotor not turning ON-2

The motor is not energized.

Cause	Remedy
Synchronization type is set to SM synchronization.	**Set to DC Synchronization or FreeRun.**
Mode of operation is set to a mode other than the available mode.	Set to CSP (8), CSV (9), CST (10) or Homing (6).
PDS (Power Drive Systems) State Transition Control is Incorrect,	Check the specifications for the CiA 402 PDS transition. Check that the amplifier transition is complete before issuing the next transition command. (Switch on disabled -> Ready to switch on -> Switched on -> Operation enabled)
EtherCAT communication cycle out of specification.	Set the amplifier in the following order: **Init → PreOP → SafeOP → OP.**
The torque upper limit value is not appropriate.	Check the Max torque (6072h) setting.
Main circuit power is not supplied correctly. (SRDY not successful)	Check the wiring and voltage.
E-Stop (emergency stop) signal is input.	Check the wiring of the E-Stop signal. Check the polarity setting of the E-Stop signal input.
The amplifier is in an alarm state.	Recover from the alarm state.
The motor power cable is not connected.	Check the connection of the motor power cable.

4. Troubleshooting

Problem 9. No motor rotation-2

The motor does not rotate or rotates but stops.

Cause	Remedy
"Mode of operation" and "command input method" do not match.	The command for each mode must be inputted with the following object CSP (8) : Target position (607Ah) CSV (9) : Target velocity (60FFh) CST (10) : Target Torque (6071h) Homing(6) : The command is generated inside the amplifier. Homing starts using Controlword (6040h) bit 4.
The setting of the speed upper limit or the torque upper limit is not appropriate.	Check the settings for each of the following objects. Max torque (6072h) Max motor speed (6080h) Max profile velocity (6081h)
Drive inhibit signal is input.	Check the wiring and setting of the drive inhibit signal (POT or NOT).

2

Technical Information

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

☞ P. 4 Backup Batteries

③ An absolute encoder Cable

☞ P. 6 Absolute Encoder Cable

Checking the model code

Use the modes that supports absolute systems.

Motor Product Code:

Common to 23 Bit and 17 Bit encoder

Encoder Code	Specifications
N	Incremental
A	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.

   ☞ P. 4 Backup Battery

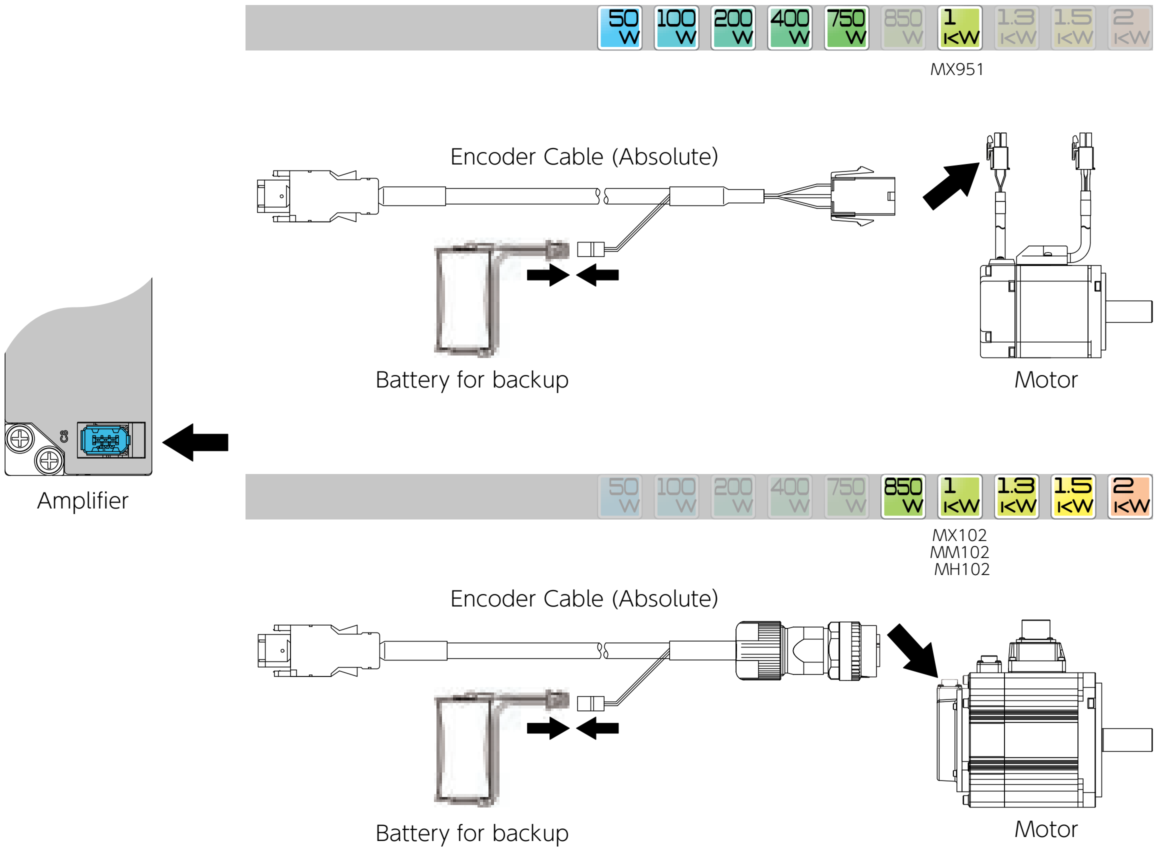
3. After connecting the battery, secure the battery to the absolute encoder cable by using a cable tie.

   ☞ P. 5 Securing the Battery

4. Initialize the absolute encoder.

   ☞ P. 7 Initializing Absolute Encoder

Cable and Battery Connections



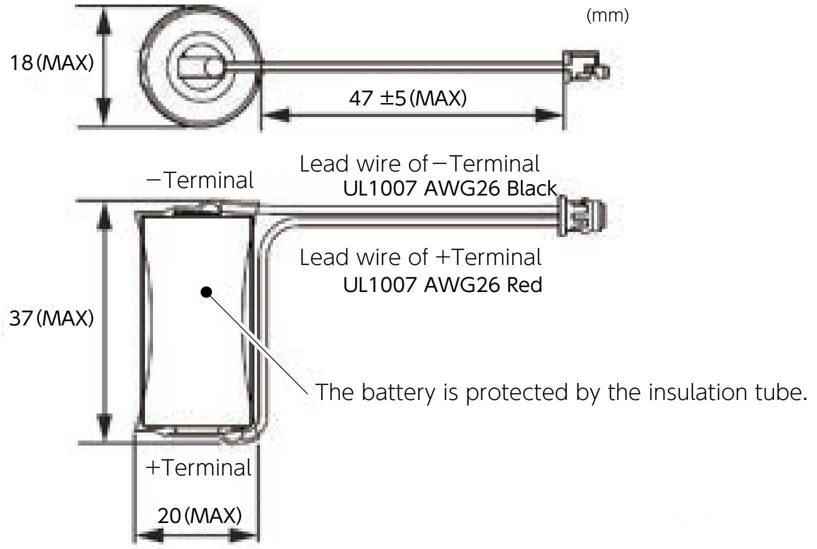
3. Backup Battery

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



Precautions for Battery Storage and Installation

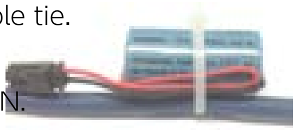
Avoid places subjected to any of the following:

- 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

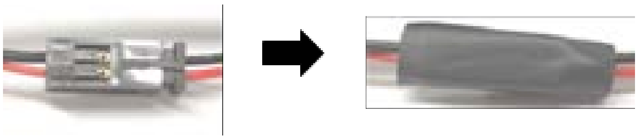
1. Securing the Battery

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

You can purchase recommended cables at the online shop of Misumi Corporation.

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.

☞ B- 2 Mounting and Wiring

5. Initializing Absolute Encoder

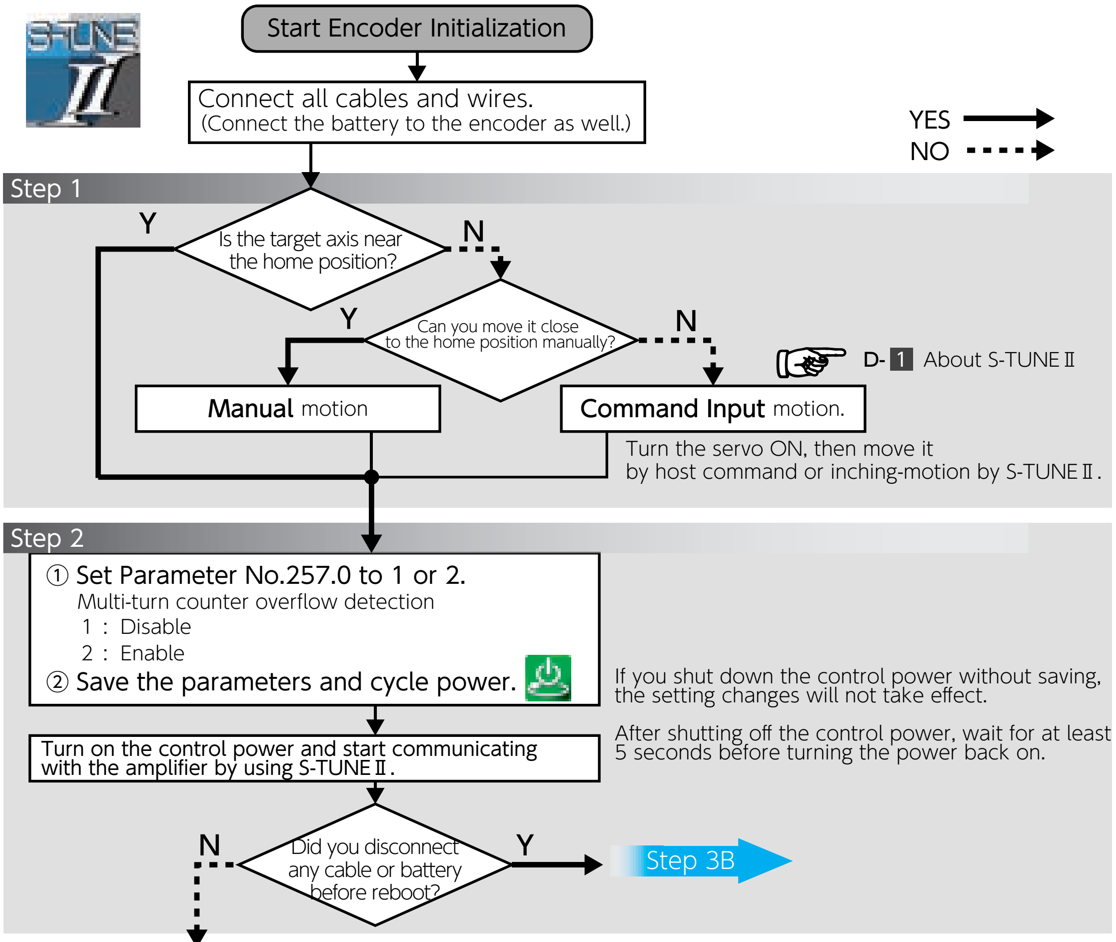
When using an absolute system for the first time or using it after replacing the motor, you need to initialize the encoder.

Use the Encoder Clear function by using S-TUNE Ⅱ 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.	⚠ ⚠

Initializing Encoder with S-TUNE Ⅱ

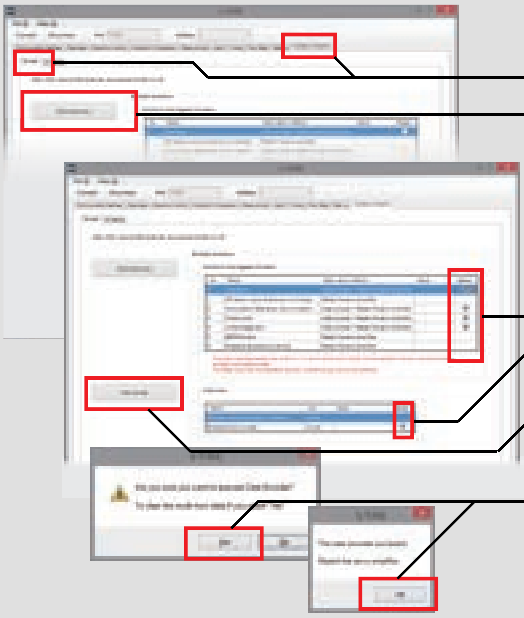


Turn the servo ON, then move it by host command or inching-motion by S-TUNE Ⅱ.

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.

Step 3A

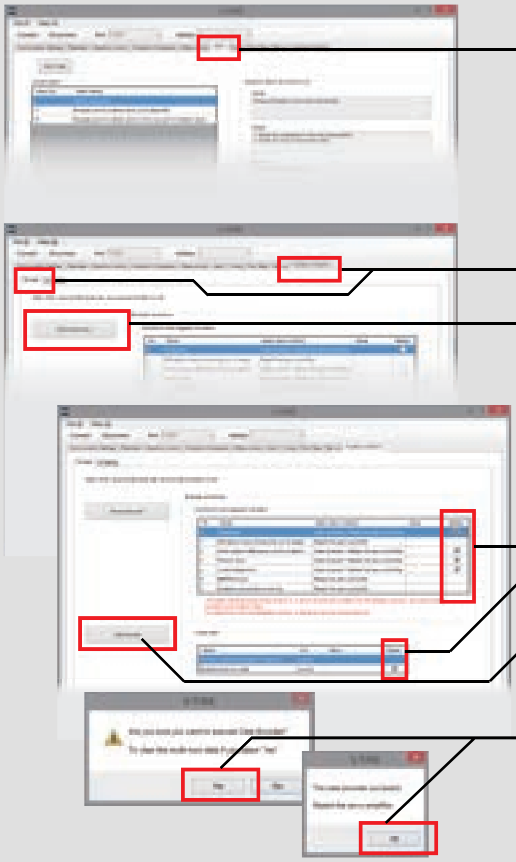


1. Under the Auxiliary function tab, click Encoder
2. Click on Get Encoder Status.
3. Check one of the boxes.
4. Click **Clear encoder**.
   Until checking the boxes, the Clear encoder button does not work.
5. Click **Yes**.
6. Cycle the control power.

Confirm

Initializing Encoder with S-TUNE Ⅱ (continued)

Step 3B

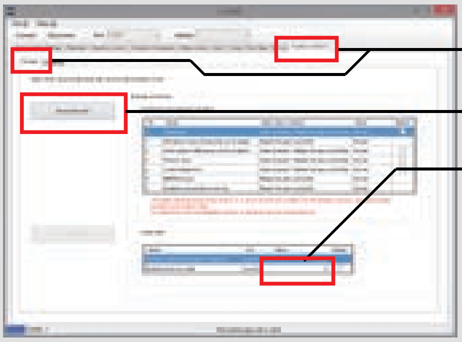


1. Under the Alarms tab, check the following alarms that are occurring.
   - No. 18 Encoder error (hardware)
   - No. 20 Encoder error (multi-turn data)
   - No. 21 Encoder error (voltage drop)
2. Under the Auxiliary functions tab, select Encoder.
3. Click on Get Encoder Status.
4. Check one of the boxes.
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 S-TUNEⅡ.



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.

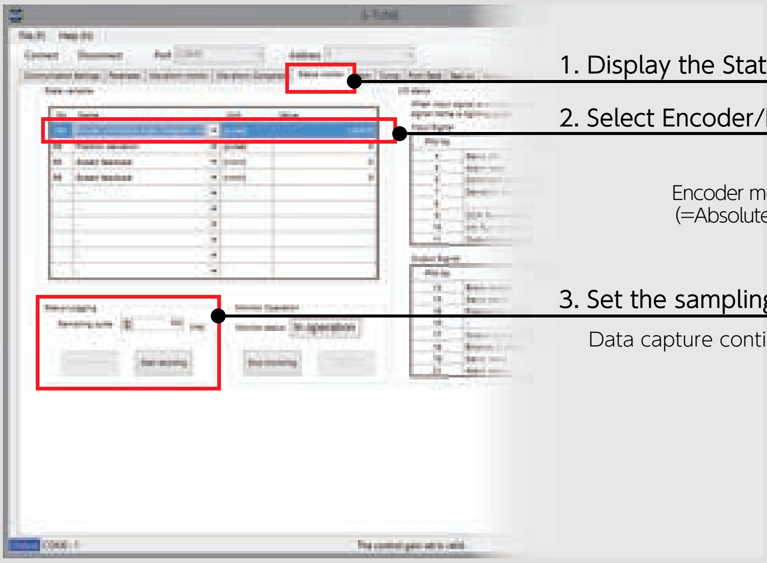
↓

END

6. Obtaining Absolute Data

Start S-TUNE Ⅱ and start communicating with the amplifier.

Use the【Status monitor】tab.



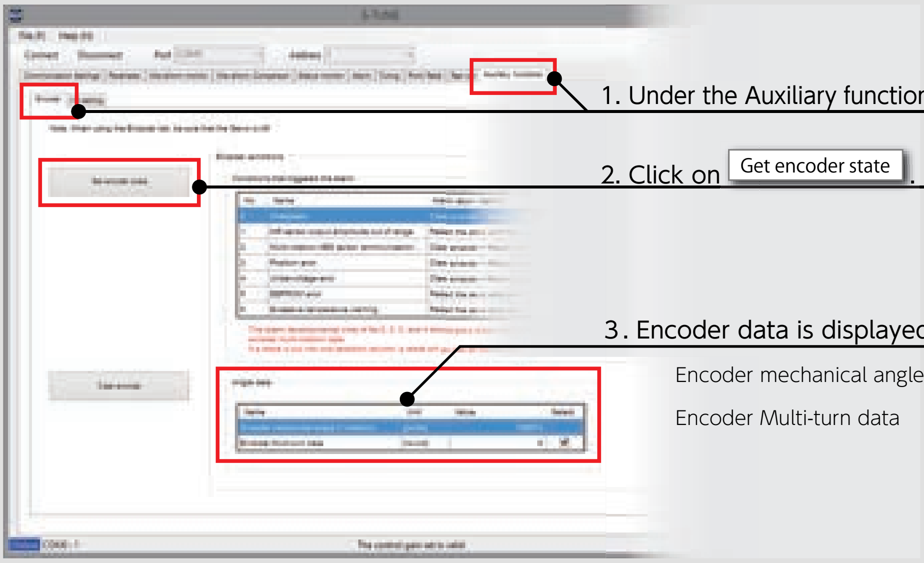
1. Display the Status monitor view.
2. Select Encoder/Rotor mechanical angle (integrated value)

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)).

Ⓐ = Ⓑ + Ⓒ × (Encoder Resolution)

Ⓐ : Encoder mechanical angle (integrated value)(=Absolute data)

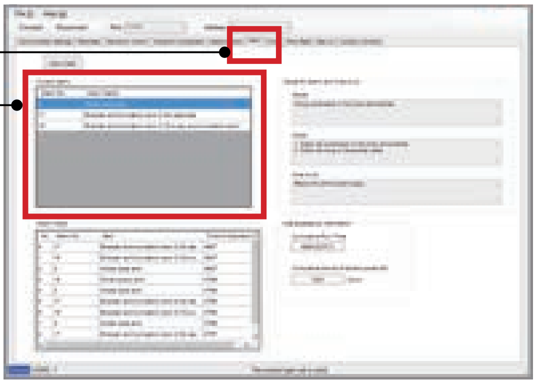
Ⓑ : Encoder mechanical angle (1 rotation)

Ⓒ : Encoder Multi-turn data

7. Alarm

By using S-TUNE Ⅱ, 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.

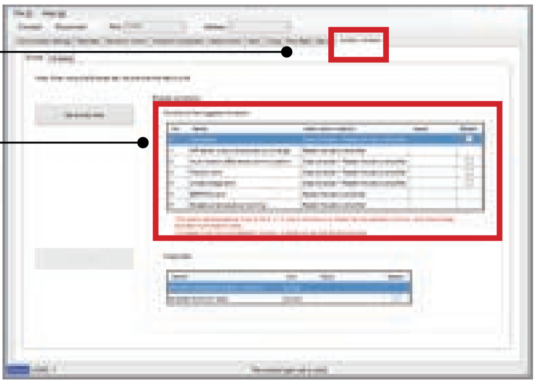
1. Click on the Alarms tab.
2. Check the alarms that are occurring.



Alarm No.	Alarm Description	Symptoms and Remedy
11	Multi-turn counter error	· 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 (Hardware)	· Anomaly of the encoder itself. · Check the alarm details. ☞ P. 12 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 S-TUNE Ⅱ 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 S-TUNE Ⅱ.
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	Overvelocity error	Multi-turn sensor error occurred during backup, or overvelocity 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 E.9 0.1)

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 S-TUNE Ⅱ.

The battery voltage is checked at the time of power turning on and every time interval. hour afterwards.

- 17bit ··· Every one hour
- 23bit ··· Every one second

2. Function

1. Deceleration Stop

Deceleration stop settings

A motor in running will stop in the following events.
For each stop events, the motor stop method and the state after stop are set by parameters.

Flow of setting up deceleration stops

Start Configures the deceleration stop function.

1 **Confirm the "conditions for starting deceleration stop.** ☞ P. 14

Specify the deceleration stop function for each case of "when I/O signal is input" and "when alarm occurs".

2 **Choose the stop method.** ☞ P. 15-

Set the parameters with reference to "Details of Stop Method.

Set the parameters for each "Condition to start deceleration stop".

3 **Specify the release condition for "deceleration stop state".** ☞ P. 16

The "deceleration stop state" is one of the internal control states of the amplifier.

When the deceleration stop operation time or motor speed satisfies the conditions set by the parameters, the amplifier shifts from the deceleration stop state to the "stop state.

4 **Specifies the amplifier state after the motor is stopped.** ☞ P. 17

The amplifier will transit to the "stop state" when the "deceleration stop state" is completed.

Specify the brake state and alarm state after the stop using the parameters.

Fnish

⚠ CAUTION

🚫	DO NOT use the holding brake to stop a running motor. The brake may be damaged.	⚠

1 Choose "Trigger condition to initiate deceleration stop".

The deceleration stop operation setting differs between "when I/O signal is input" and "when an alarm occurs. Be sure to configure the settings for each case.

Trigger to begin deceleration stop

In case of I/O signal inputed

The motor decelerates and stops when one of the following signals is input to I/O.

- I/O SVON : SVON (servo-on) is turned OFF (open)
- I/O E-STOP : E-STOP (emergency stop) is set to OFF (open)
- I/O CCWL/CWL : CCWL, CWL (drive inhibition) is set to ON (closed)

> **Note: When "E-STOP" is input**
>
> To notify the host controller that the amplifier has come to an emergency stop, set parameter No. 225.0. A warning (Err902) can be output by setting the parameter. No alarm is generated.When E-STOP is turned ON (closed) to release the emergency stop status, the motor can be operated.

> **Note: When "drive inhibit" is input**
>
> If the position command pulse remains input to the amplifier, position deviation will occur. Make settings related to the position deviation counter in parameter No. 67.3.

In case of alarm

- ALM :Once an alarm occurs, the motor will decelerate to a stop.

• When a control power failure occurs

If "1: Decelerate to stop" is set in parameter No. 224.2, the motor will decelerate to stop.

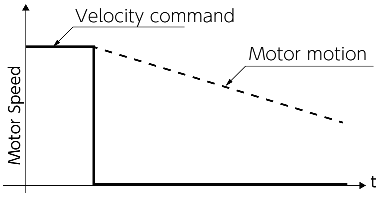
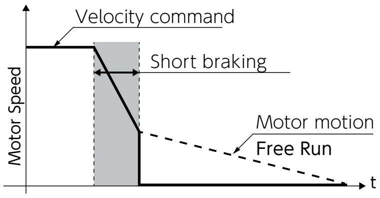
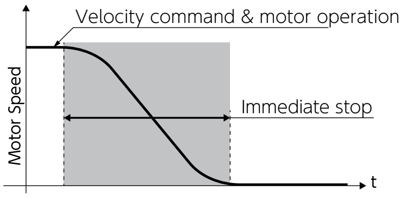
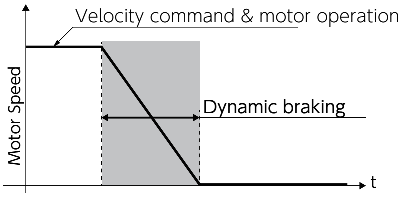
If you close E-STOP to turn Emergency Stop Status off while SVON is being input, any command input immediately starts motor motion.

NEXT 2 Choose the stop method.

Deceleration stop settings

2 Choose the stop method.

Deceleration and stop can be selected from the following four methods.
The stop method is set by a parameter.

method of stopping	Description
F RUN **Free run**  	"Free-run" immediately stops **servo control**. The motor enters an uncontrolled "free-running (coasting)" state. Make sure that safety is sufficiently ensured before use. **Never use the motor on a vertical axis.** There is a danger of the vertical axis of the device falling. ☞ P. 16
S STOP **Short braking**  	In the "Short braking" mode, the inverter is controlled to apply emergency braking to stop the motor. After the duration of deceleration and stop state elapses, the servo control is stopped and the motor enters a free-running state. Continuous use of the short brake may damage the amplifier. It will not function in the event of inverter failure. (Use of dynamic braking is recommended.) ☞ P. 17
P STOP **Immediate stop**  	"Immediate Stop" controls the inverter to decelerate the motor to a stop. Deceleration and smoothing filter can be set. The motor can be stopped relatively smoothly. Continuous use of immediate stop may damage the amplifier. Does not function in the event of inverter failure. ☞ P. 18
D STOP **Dynamic braking**  	In the "Dynamic braking," the motor is brought to an abrupt stop by a dynamic brake circuit built into the amplifier. This brake converts the motor's rotational energy into thermal energy. Continuous use of the dynamic brake may damage the amplifier. (Please allow an **interval of about 15 minutes**). It can also be operated in the event of inverter failure. ☞ P. 19

NEXT 3 Specify the release condition for "deceleration stop state". ☞ P. 20

2 Choose the stop method.

Free run

"Free-run" immediately **stops servo control**.
The motor enters an uncontrolled "free-run (coasting)" state.

Setting up a free-run stop.

Free-run stop setting	Parameters to be set
I/O SVON I/O E-STOP	No.224.0 = 0
ALM	No.233.0 It depends on the alarm No. Select the mode that includes the free-run setting.
I/O CCWL/CWL	No.67.1 = 0

⚠ CAUTION

⊘	It is not recommended to select free-run for motors with brakes. If free-run is selected, set brake actuation timing No. 232.3.	⚠ ⚠
	Never use the device on a vertical axis. There is a danger of the vertical axis of the device falling.	
❗	Please verify the operation thoroughly and confirm safety before use.	

NOTE: Do not change the setting in No. 232.1 (Handling of "deceleration stop state" during free run).

Deceleration stop settings

2 Choose the stop method.

Short braking

In the "short braking" mode, the inverter is controlled to apply emergency braking to stop the motor. After the deceleration and stop state duration time elapses, the servo control is stopped and the motor enters a free-run state.

Setting up a short braking.

Short braking setting	Parameters to be set
I/O SVON I/O E-STOP	No.224.0 = 1
ALM	No.233.0: It depends on the alarm No. Select the mode that includes the short braking setting.
I/O CCWL/CWL	No.67.1 = 1

⚠ CAUTION

🚫	DO NOT use the short brake continuously.	⚠ ⚠

Dynamic braking is recommended.

2 Choose the stop method.

Immediate stop

"Immediate Stop" controls the inverter to decelerate the motor to a stop.
Deceleration and smoothing filter can be set. The motor can be stopped relatively smoothly.

Setting up a Immediate stop.

Immediate stop setting	Parameters to be set
I/O SVON I/O E-STOP	No.224.0 = 2
ALM	No.233.0: It depends on the alarm No. Select the mode that includes the immediate stop setting.
I/O CCWL/CWL	No.67.1 = 2

No.225.2 setting	Immediate stop - Smoothing filter switch
0	Disable
1	Enable

No.229.0 setting	Immediate stop - Moving average counter for velocity command smoothing filter
40	Moving average count × 100μs = Delay Time The default setting of 40 is a 4 ms setting.

No.236.0 setting	Immediate stop - Time extension
0	Sets the time to continue in the immediate stop state after the deceleration stop state is released. Set this parameter to compensate for brake response time.

No.239.0 setting	Immediate stop - Decelerating time
0	Specifies the deceleration time for an immediate stop. Sets the time it takes for the speed command to reach 0 r/min from 1,000 r/min.

No.151.0 setting	Immediate stop - Torque command limit
2,400	Specifies the torque command limit value for immediate stop. This is a ratio to 100% of the rated torque.

Deceleration stop settings

2 Choose the stop method.

Dynamic braking

In the "dynamic braking," the motor is brought to an abrupt stop by a dynamic brake circuit built into the amplifier.
This brake converts the motor's rotational energy into thermal energy.

Set up a dynamic braking.

Dynamic Braking Settings	Parameters to be set
I/O SVON I/O E-STOP ➡	No.224.0 = 3
ALM ➡	No.233.0: It depends on the alarm No. Select the mode that includes the dynamic brake setting.
I/O CCWL/CWL ➡	(Cannot be configured.)

⚠ CAUTION

!	After using the dynamic brake, allow an **interval of about 15 minutes**. Continuous use of the dynamic brake may damage the amplifier.	⚠ ⚠

3 Specify the release condition for "deceleration stop state".

The amplifier performs the set stop operation during the "deceleration stop state."

The deceleration stop state is released when the deceleration stop operation time or motor speed satisfies the conditions set by the parameters.

Releasing condition of deceleration stop state

The release condition is selected by parameter No. 224.1.

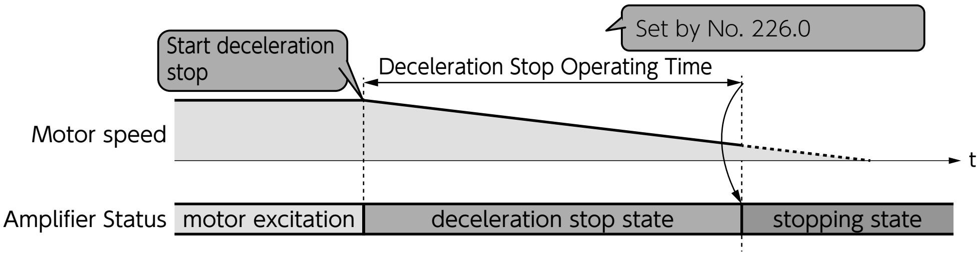
I/O SVON
I/O E-STOP
I/O CCWL/CWL
ALM

Choose the release condition for parameter No. 224.1.

No.224.1 setting	Release Conditions
0	After the deceleration stop operation time (No. 226.0) has elapsed
1	When "deceleration stop operation time (No. 226.0)" or "deceleration stop release rpm (No. 227.0)" is met earlier.

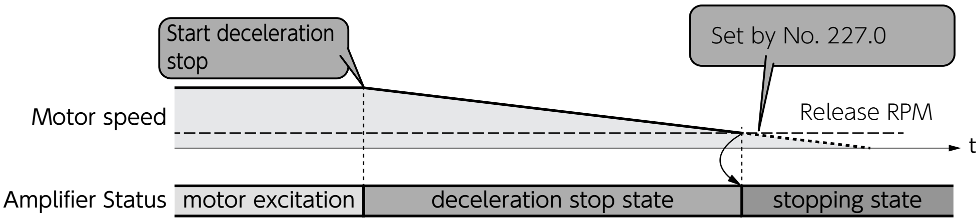
Requirement 1. Deceleration stop operation time

Specifies the duration of deceleration stop state. (Parameter No. 226.0)



Requirement 2. Deceleration Stop Release RPM

Specifies the motor speed at which the deceleration stop state is terminated. (Parameter No. 227.0)



When the "deceleration stop state" is released, the amplifier terminates the deceleration stop operation and shifts to the "stopping state".

NEXT 4 Specifies the amplifier state after the motor is stopped.

4 Specifies the amplifier state after the motor is stopped.

The amplifier enters the "stop state" when the "deceleration stop state" is released.
Configure the "stop state" holding brake and warning outputs.

Amplifier state after motor is stopped

Dynamic braking state after stopping

Selects whether dynamic braking is used to maintain a stop or free-run condition.
The parameters to be set differ for each condition to start deceleration and stop.

Requirements to start deceleration stop	Parameters to be set	Settings
I/O SVON I/O E-STOP I/O CCWL/CWL →	No.224.3	0 : Free Run
		1 : Dynamic Braking
ALM →	No.233.3	0 : Free Run
		1 : Dynamic Braking

Holding brake setting (only for motors with holding brake)

Configures the timing for activating the holding brake.

No.232.3 setting	Timing of holding brake engagement
0	Upon release of the "Deceleration Stop Condition". Typically, use this. (Related parameter : No.224.1, 226.0, 227.0)
1	Upon Braking Condition. Set this parameter when the holding brake to be activated after the motor is stopped is to be activated later than the brake specified in the stopping method. This setting may be used to prevent damage to the holding brake. (Related paramete : No.224.1, 226.0, 227.0, 234.0, 235.0)

⚠ CAUTION

Once the emergency stop condition is released while SVON is input, the motor operation starts immediately by input command.

4 Specifies the amplifier state after the motor is stopped.

Amplifier state after motor is stopped

Output warning

I/O E-STOP

You can set the warning output. Set the warning output "Switching" and "Timing".

No.225.0 setting	Warning output
<u>0</u>	<u>Disable</u>
1	Enable

No.225.1 setting	Warning output timing
<u>0</u>	<u>After the motor makes a deceleration stop</u>
1	Immediately after the warning occurs

Position deviation counter at drive inhibit input

I/O CCWL/CWL

In the "stop state" at the time of drive inhibit input, you can select either "free-run state" or "zero clamp state".

No.67.2 setting	standstill
<u>0</u>	<u>Free Run</u>
1	Zero clamp (= servo-on state)

The "zero clamp state" is a state in which the motor is stopped with the servo on.

If a position command pulse remains input to the amplifier in the drive inhibit input state, a position deviation will occur.
make settings related to the position deviation counter in parameter No. 67.3.

No.67.3 setting	Position deviation counter
<u>0</u>	<u>Holding</u>
1	Clearing (Cleared only once upon input of drive inhibit.)
2	Clearing (Keeping clearing during drive inhibit input.)

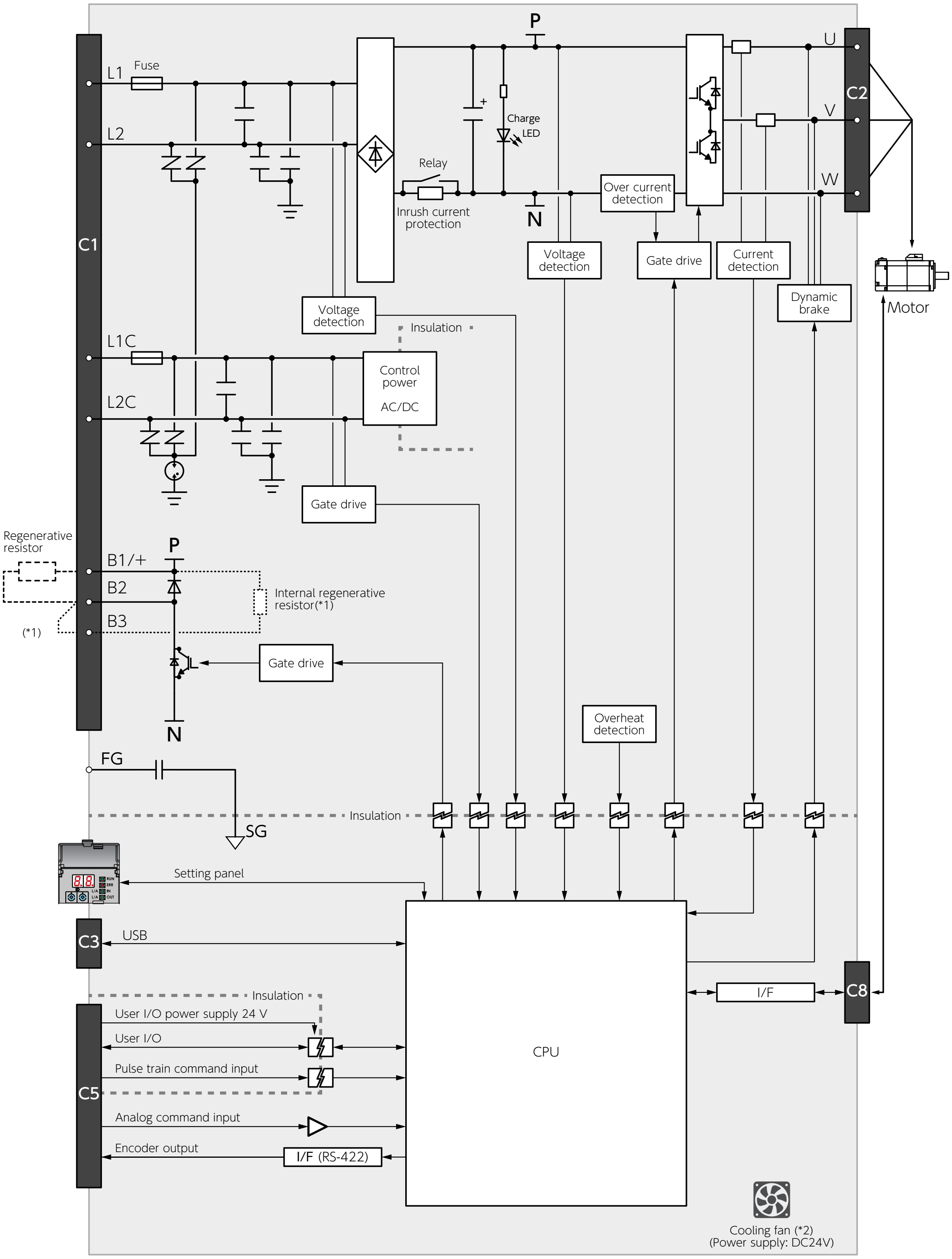
Finish

This completes the setting of the deceleration stop function.

3. Amplifier Circuit System Block Diagram

1. Amplifier Circuit System Block Diagram

Amplifier	Motor rated output power	50 W	100 W	200 W	400 W	750 W	850 W	1 kW	1.3 kW	1.5 kW	2 kW



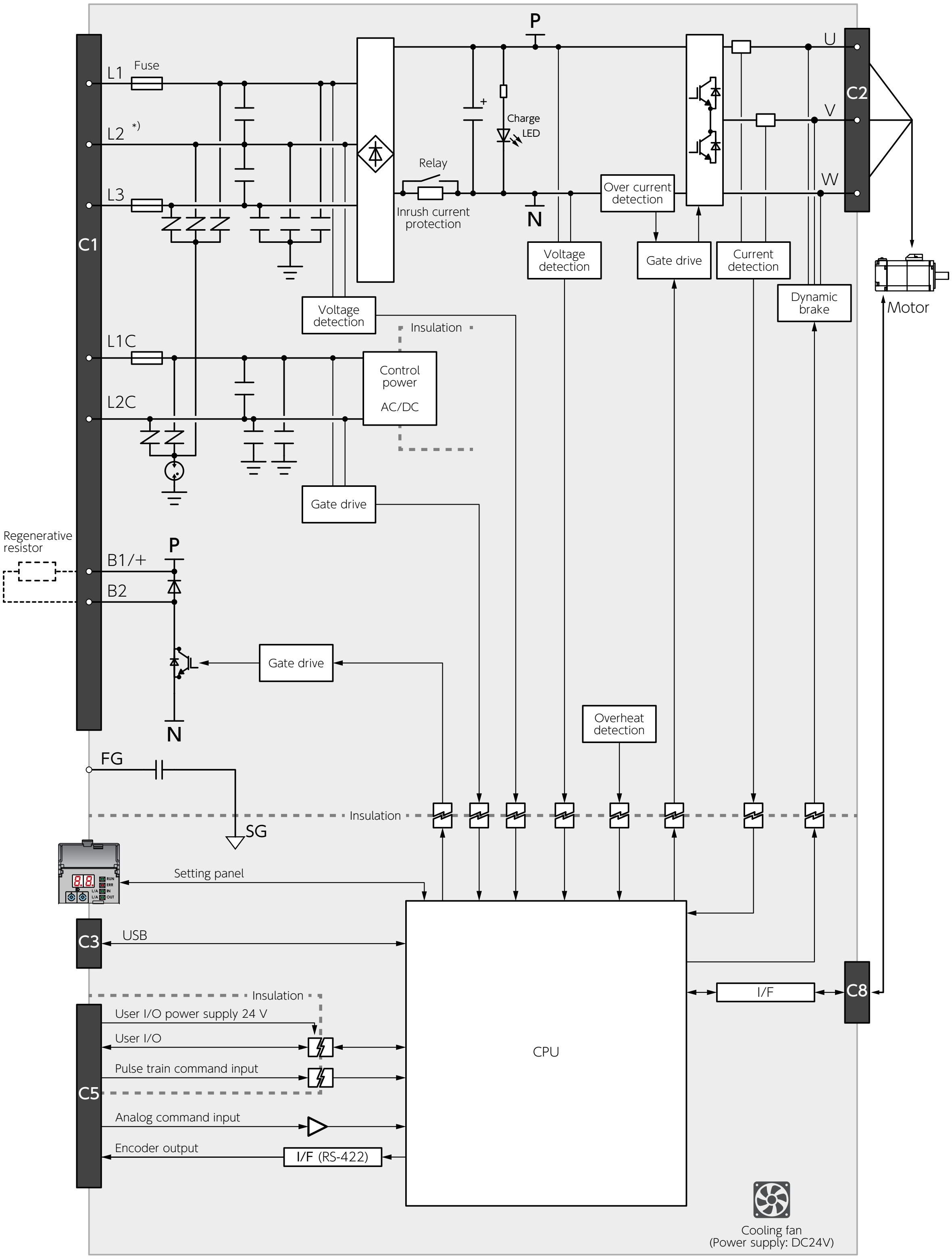
*1): Option 400W and 750W amplifier only

*2): 750W amplifier only

3. Amplifier Circuit System Block Diagram

Amplifier Motor rated output power

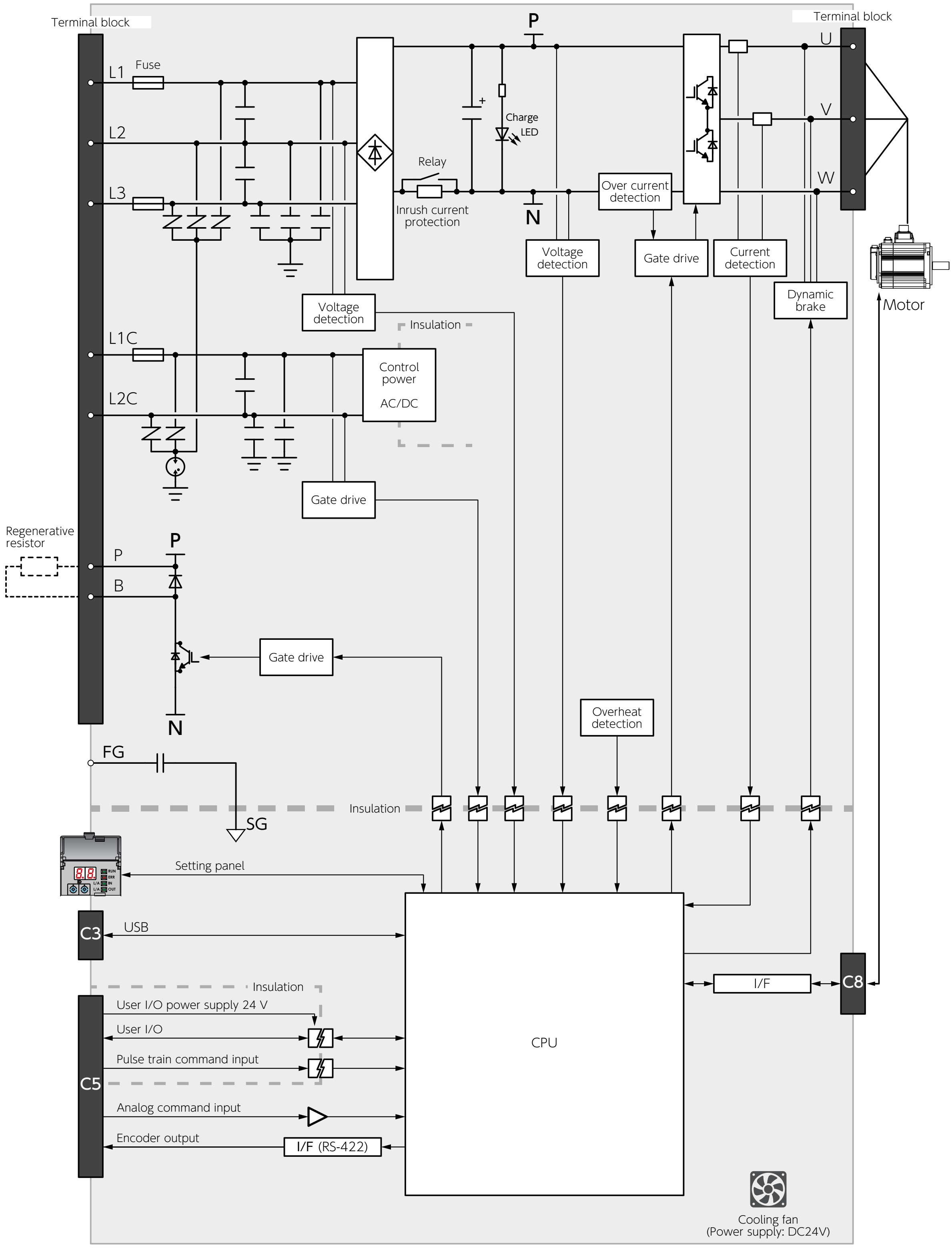
50 W	100 W	200 W	400 W	750 W	850 W	**1 kW**	1.3 kW	1.5 kW	2 kW



*): When having single-phase power wired to a 1 kW amplifier (DB64A11), wire the main power AC200 V between the L1 and L3 terminals of the amplifier.

3. Amplifier Circuit System Block Diagram

Amplifier	Motor rated output power	50 W	100 W	200 W	400 W	750 W	850 W	1 kW	1.3 kW	1.5 kW	2 kW



4. Status Display

1. Introduction

You can check status data by using S-TUNEⅡ.

Note

This manual uses the following two types of pulse units to explain status variables.

Unit of **E-pulse** (= 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 23-bit (or 17-bit). It is a pulse value resulting from division/ multiplication in the amplifier.

Unit of **C-pulse** (= 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.

4. Status Display

2. List of Status Variables

Status Variables of Servo Amplifier

Status No.	Status Variable	Units	Refer to
16	I/O Status	–	P. 28
24	Control Component Temperature	℃	P. 28
64	Positioning Status	–	P. 29
65	Internal Command Value	E-pulse	P. 29
67	Position Feedback	E-pulse	P. 29
69	Position Deviation	E-pulse	P. 29
74	ABS Position Command	C-pulse	P. 30
76	Absolute Position Feedback	C-pulse	P. 30
78	Command Position Deviation	C-pulse	P. 30
80	ABS Position Deviation	C-pulse	P. 30
97	Speed Command Value	r/min	P. 30
98	Speed Feedback	r/min	P. 31
99	Speed Deviation	r/min	P. 31
113	Torque Command Value	0.1%	P. 31
131	Load Factor	digit	P. 32
132	Load Factor(%)	%	P. 32
194	Encoder/Rotor mechanical angle (single-turn value)	E-pulse	P. 32
195	Encoder/Rotor mechanical angle (integrated value)	E-pulse	P. 32
205	Encoder Temperature	℃	P. 33
206	Encoder Battery Voltage	0.1 V	P. 33
216	Encoder Communication Retry Count	times	P. 33
218	Encoder Data Error Count	times	P. 33
228	Regeneration Status	–	P. 34
232	Primary Circuit Power Supply Voltage	0.1 V	P. 34
371	Inertia Ratio Estimate	%	P. 34
483	Quadrant glitch compensation: internal state	–	P. 35

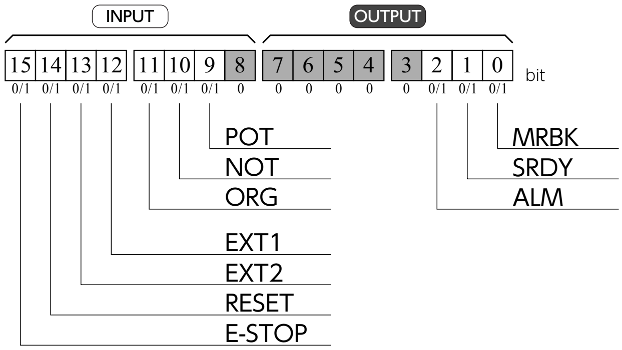
Status Variables of EtherCAT Communication Objects

Status No.	Status Variable	Units	Refer to
2064	Target Position	C-pulse	P. 36
2074	Position actual value	C-pulse	P. 36
2080	Target Velocity	C-pulse/s	P. 36
2090	Velocity actual value	C-pulse/s	P. 36
2096	Target Torque	0.1%	P. 36
2098	Torque actual value	0.1%	P. 36

3. Details of Each Status Variable

Status	I/O Status	Units
Status No.	16	–
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 S-TUNEⅡ. 【waveform monitor】displays total value of I/O bits in decimal. 【status monitor】displays I/O bits in binary.	

Bit Tables



Status	Control Component Temperature	Units
Status No.	24	℃
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℃.	

4. Status Display

Status	Positioning Status	Units
Status No.	64	–
Description	Indicates whether positioning is completed or not 0: Not completed 1: Completed	

Status	Internal Command Value	Units
Status No.	65	E-pulse
Description	Indicates the command value being input to the positioning loop. This is a value of the position command input divided/multiplied and smoothed.	

Status	Position Feedback	Units
Status No.	67	E-pulse
Description	Indicates the position data of the motor returned from the encoder to the amplifier.	

Status	Position Deviation	Units
Status No.	69	E-pulse
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 position 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)	

4. Status Display

Status	ABS　Position Command	Units
Status No.	74	C-pulse
Description	This indicates a position command value based on the home-position offset.	

Status	Absolute Position Feedback	Units
Status No.	76	C-pulse
Description	Indicates the absolute position data returned from the encoder to the amplifier.	

Status	Command Position Deviation	Units
Status No.	78	C-pulse
Description	Indicates the deviation between a position command value and the feedbacked position value.	

Status	ABS Position Deviation	Units
Status No.	80	C-pulse
Description	Indicates the deviation between a value of ABS Position Command (Status No.74) and the value of ABS Positioning Feedback (Status No.76).	

Status	Velocity Command Value	Units
Status No.	97	r/min
Description	Indicates the velocity command value. While tuning, by measuring this value (waveform data displayed in S-TUNE Ⅱ) 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.	

4. Status Display

Status	Speed Feedback	Units
Status No.	98	r/min
Description	Indicates the speed value returned from the encoder to the amplifier. With this, you can check command response and motor rotational speed.	

Status	Speed Deviation	Units
Status No.	99	r/min
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	

Status	Torque Command Value	Units
Status No.	113	0.1 %
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.	

4. Status Display

Status	Load Factor	Units
Status No.	131	digit
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% = $\sqrt{}$ (Load factor digit × 10)	

Status	Load Factor (%)	Units
Status No.	132	%
Description	The motor load factor is presented in%. (S-TUNE Ⅱ only)	

Status	Encoder/rotor mechanical angle (single-turn value)	Units
Status No.	194	E-pulse
Description	Indicates single-turn data of the motor. This value is an absolute value.	

Status	Encoder/rotor mechanical angle (integrated value)	Units
Status No.	195	E-pulse
Description	This indicates multi-turn data of the motor. It is presented as a total of encoder feedback pulses. (Single-turn value) + (Encoder resolution × Encoder Multi-turn data) This item is the absolute data if you are using an absolute encoder.	

4. Status Display

Status	Encoder temperature	Units
Status No.	205	℃
Description	Indicates the encoder internal temperature. (for reference only)	

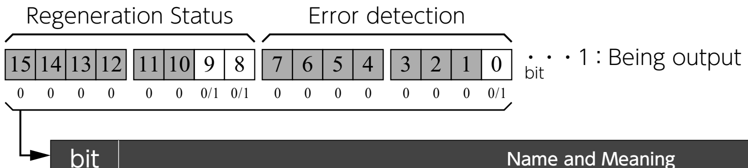
Status	Encoder battery voltage	Units
Status No.	206	0.1 V
Description	Indicates the voltage of the encoder backup battery.	

Status	Encoder communication retry times	Units
Status No.	216	times
Description	Indicates the communication retry count upon encoder communication error.	

Status	Encoder Data Error Counter	Units
Status No.	218	times
Description	Indicates the cumulative count of errors in receiving encoder data.	

Status	Regeneration Status	Units
Status No.	228	–
Description	This item indicates the regeneration status of the amplifier power circuit. Setup Panel ☞ **C-1 Setup Panel** S-TUNE Ⅱ 【waveform monitor】displays total value of I/O bits in decimal. 【status monitor】 displays I/O bits in binary.	

Bit Tables



bit	Name and Meaning
0	**Regeneration control output** Indicates the operation status of the regenerative power processing circuit.
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.
9	**Regeneration voltage threshold** Indicates the primary circuit power voltage has reached the threshold. A power error, alarm **No.14** or **No.15** , will occur if the regenerative resistor is not connected.

Status	Primary Circuit Power Voltage	Units
Status No.	232	0.1 V
Description	Indicates the primary circuit power voltage (for reference only).	

Status	Inertia Ratio Estimate	Units
Status No.	371	–
Description	This item indicates the inertia ratio value estimated in auto turning.	

4. Status Display

Status	Quadrant glitch compensation: internal state	Units
Status No.	483	–
Description	Displays the status of Quadrant glitch compensation.	

Value	State	Description
1	Initial	This state is noncompensated. Note: Positive / Negative direction does not matter.
2	Delay	This state is compensation delay. Note: Positive / Negative direction does not matter.
4	Compensation (forward direction)	Positive direction is compensated.
8	Compensation (negative direction)	Negative direction is compensated.
16	Neutral (*)	Switching compensation direction or checking status. Note: Positive / Negative direction does not matter.

*) No compensation is processed in this state.

- When a command is input within 10ms: Transit to the delay state.
- If the command remains at "0" for 10ms: Transit to the initial state.

Status	Target Position	Units
Status No.	2064	C-pulse
Description	Set the position command value.	

Status	Position actual value	Units
Status No.	2074	C-pulse
Description	Displays the actual position of the motor.	

Status	Target Velocity	Units
Status No.	2080	C-pulse/s
Description	Sets the velocity command.	

Status	Velocity actual value	Units
Status No.	2090	C-pulse/s
Description	Displays the actual velocity of the motor.	

Status	Target Torque	Units
Status No.	2096	0.1%
Description	Sets the torque command value.	

Status	Torque actual value	Units
Status No.	2098	0.1%
Description	Displays the actual torque value.	

5. Auto-Tuning (Quick Tuning) in previous versions

If your amplifier and S-TUNE II are using less than the following versions, you can use this procedure for tuning.

Supported Models	Supported Versions
Software S-TUNE Ⅱ	**2.1.0.0** (less than)

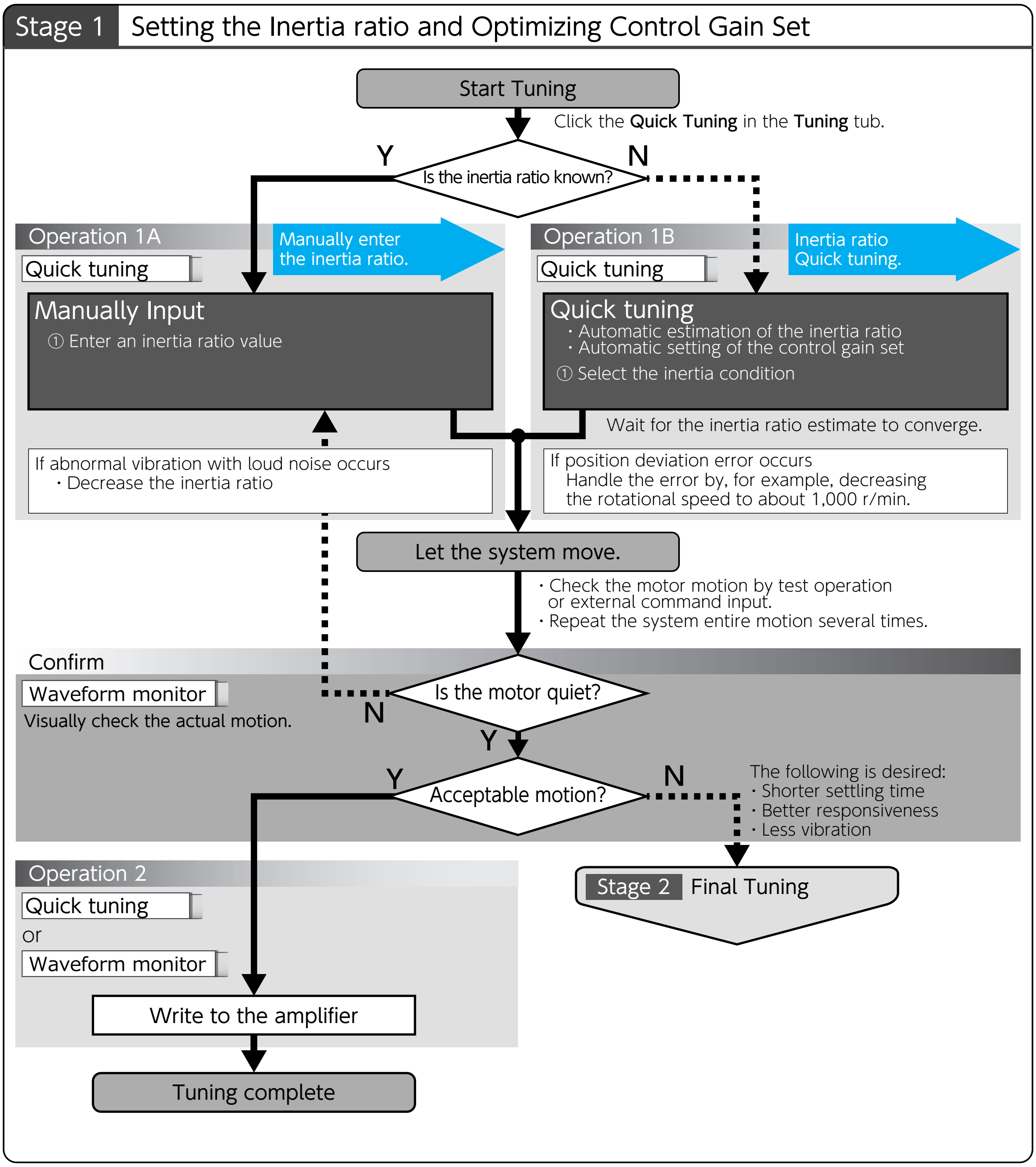
Position Control Mode

P

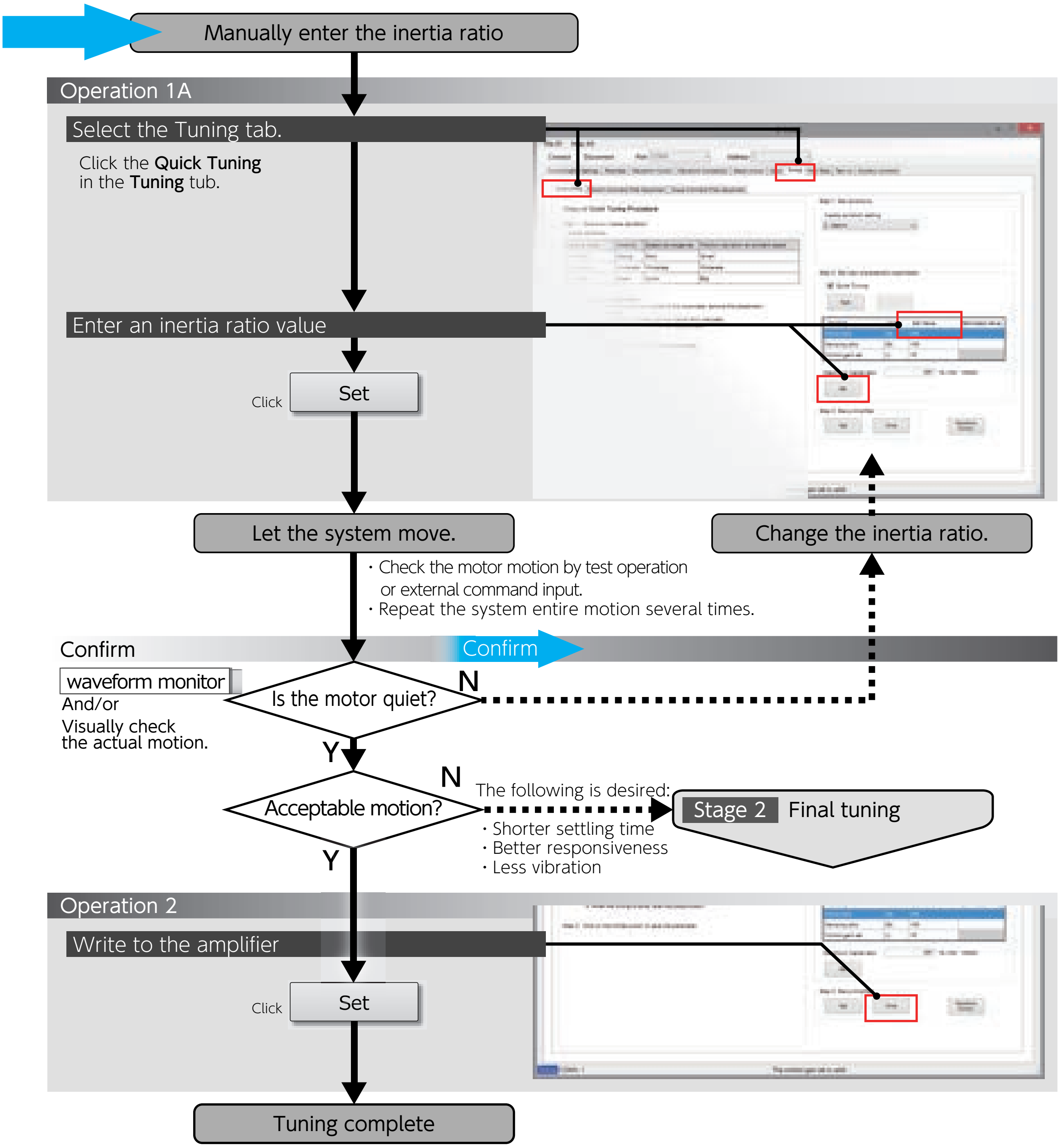
Stage 1 Quick Tuning	**Setting the Inertia ratio and Optimizing Control Gain Set** The inertia ratio value is presumed automatically. The control gain set will be automatically adjusted according to the auto estimate of inertia ratio. This method does not generate noise caused by disagreement between the inertia ratio and the gain set.
Stage 2 Final Tuning (Performed by S-TUNE Ⅱ)	**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.

5. Auto-Tuning (Quick Tuning) in previous versions

Quick Tuning on S-TUNE Ⅱ

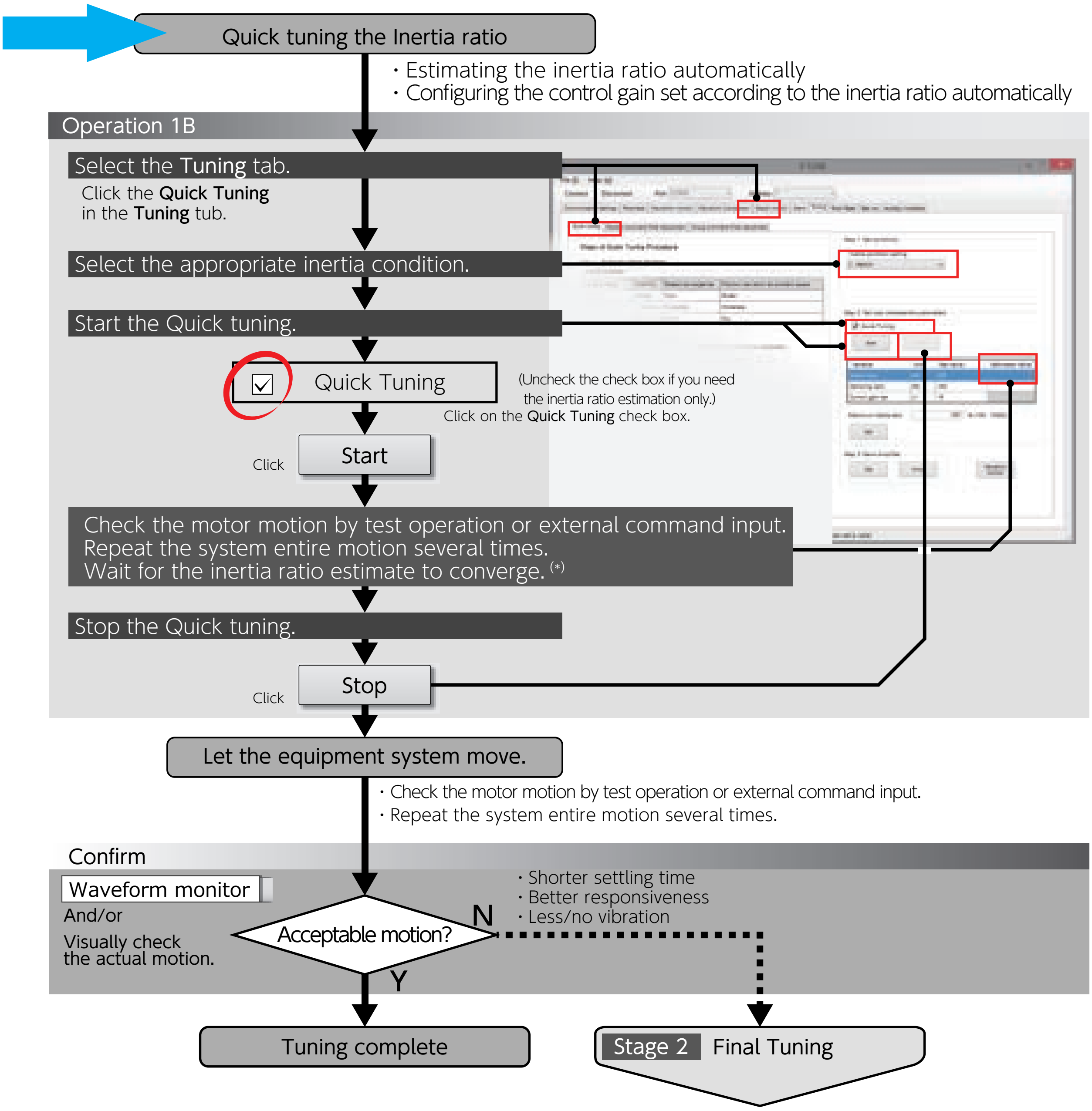


Quick Tuning on S-TUNE Ⅱ : Operation 1A



5. Auto-Tuning (Quick Tuning) in previous versions

Quick Tuning on S-TUNE Ⅱ : Operation 1B



Quick tuning the Inertia ratio

- Estimating the inertia ratio automatically
- Configuring the control gain set according to the inertia ratio automatically

Operation 1B

Select the **Tuning** tab.

Click the **Quick Tuning** in the **Tuning** tub.

Select the appropriate inertia condition.

Start the Quick tuning.

☑ Quick Tuning

(Uncheck the check box if you need the inertia ratio estimation only.)

Click on the **Quick Tuning** 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 Quick tuning.

Click Stop

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?

- Shorter settling time
- Better responsiveness
- Less/no vibration

Y: Tuning complete

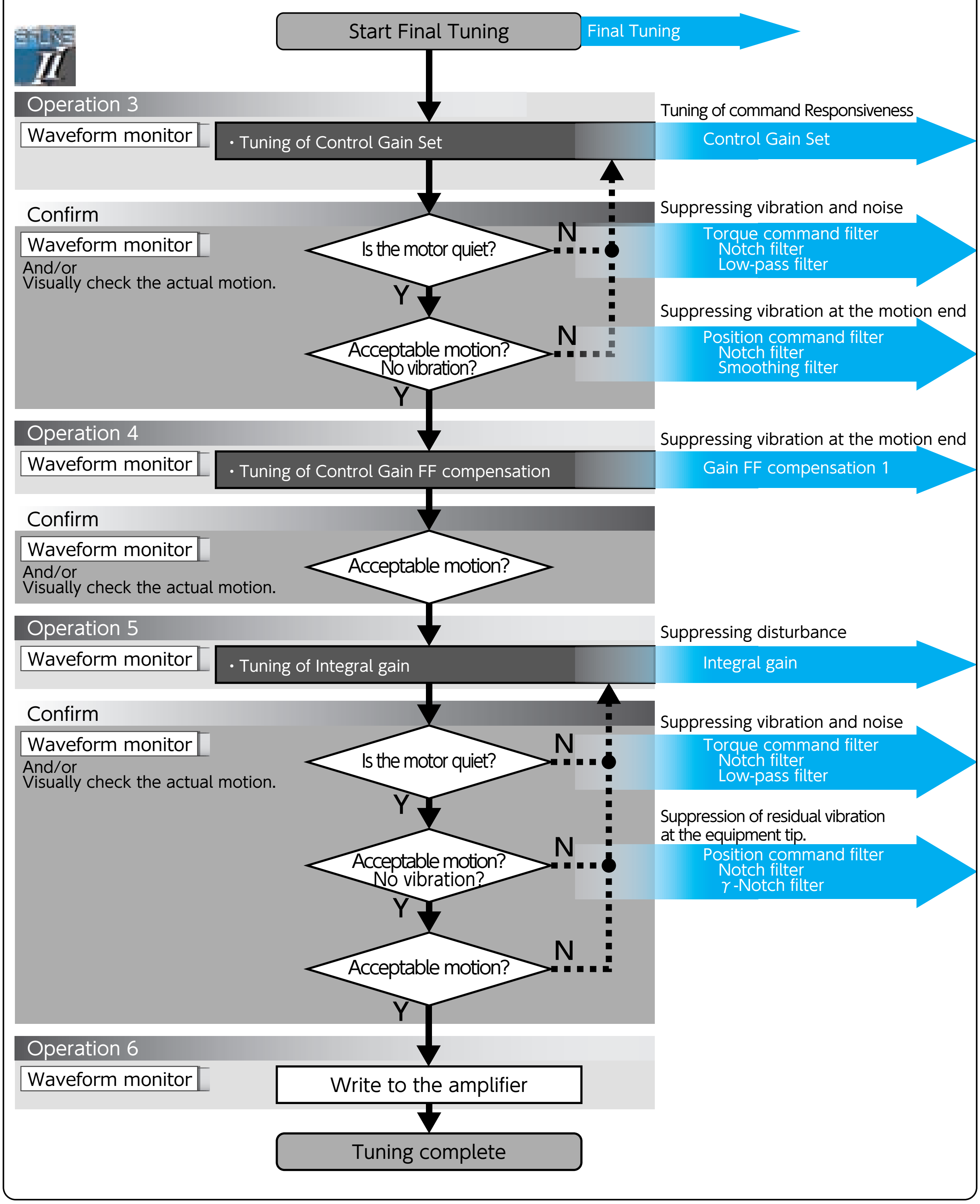
N: Stage 2 Final Tuning

*) Extremely large load may cause vibration. In such a case, decrease the parameter setting of Tuning: Control gain set - Tuning constant (No.121.0).

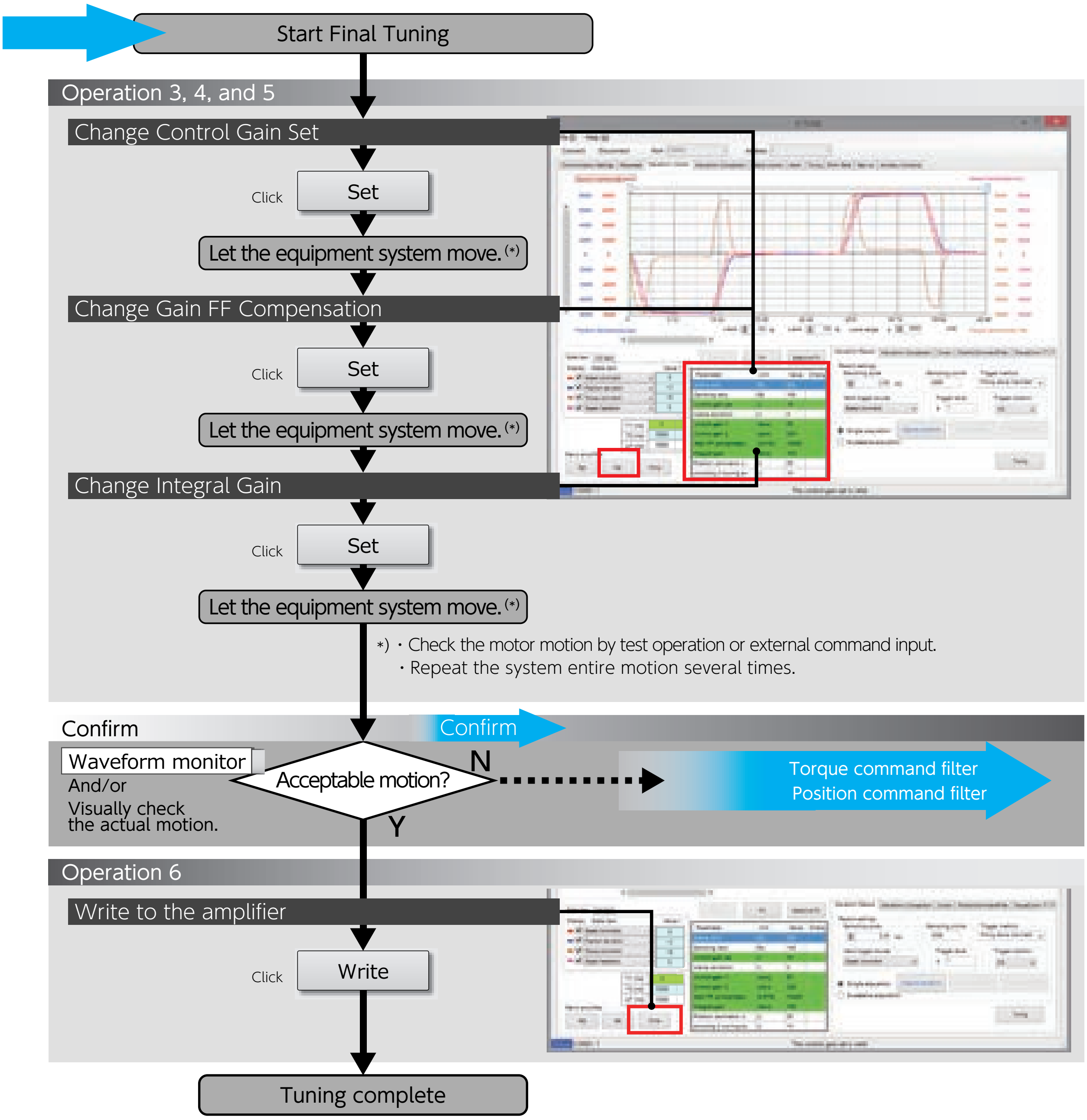
Make sure to click on Stop to finish Quick Tuning.
Starting Final Tuning Mode while Quick Tuning is still in process will make the tuning difficult because of inertia ratio changes.

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.

MEMO

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Please study this manual first and use the product properly and safely.

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