Technical Information

LINEARSERV

Direct Drive Motor <LINEARSERV> Intelligent Drive <DrvGIII> Technical Information

TI 71M02D03-01E

YOKOGAWA ◆
YOKOGAWA ELECTRIC CORPORATION

TI 71M02D03-01E
1st Edition:2004.04.09

◆ Introduction

■ Overview of This Manual

This manual provides information about LINEARSERV, a direct drive servo motor. Make sure to refer to this manual when you use the motor.

■ Trademark

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■ Strategic Goods Advisory

It is required to obtain approval from the Japanese government to export goods regulated by the Foreign Exchange and Foreign Trade Control Law from Japan.

◆ Conventions

■ Symbols used in this manual

Throughout this manual, the following symbol marks are used to distinguish explained information.

DANGER : Describes cautions for avoiding danger in potentially hazardous situations that may put operators' lives and bodies in danger such as electric shock accident.

WARNING : Describes points to be noted in situations that may cause damages to software and/or hardware or system troubles.

CAUTION : Describes important points when understanding operations and functions.

TIP : Describes supplementary information about descriptions.

SEE ALSO : Describes items and pages that should be referenced.

◆ Precautions

■ Precautions Regarding this Manual

- Please make sure this manual is made available to all end users.
- Do not operate the product before reading this manual and thoroughly understanding its contents.
- This manual was created to provide detailed explanations of the functions offered by the product. It is not guaranteed that it will suit any particular purpose a customer might have.
- The reproduction or copying of any portion of this manual is strictly prohibited without prior permission from Yokogawa Electric.
- The information provided in this manual is subject to change without notice.
- If you have any questions or find any errors and/or omissions in the information provided in this manual, please contact our Sales Department or the dealer from whom the product was purchased.

■ Precautions Regarding Protection, Safety and Product Modification

- To ensure your protection and that of the product, as well as the systems that use the product, please observe all safety instructions and other precautions listed in this manual.
- If you operate the product in a manner contrary to the instructions provided in this manual, the safety protection may be lost. In such an event, we make no warranties for the quality, performance, functions and safety of the product.
- If you install protection/safety circuits for the product or systems that use this product, make sure to install them on the product separately and externally. Do not install them inside the product, nor should any internal parts of the product be modified in order to do so.
- Be sure to replace any parts and consumables of the product with parts specified by us.
- This product is neither designed nor manufactured to be used under conditions that may directly affect the safety of humans including in nuclear or radiation-related devices, railway facilities, aircraft instruments, marine instruments, air-navigation facilities or medical devices. If it is necessary to apply the product in systems that directly affect the safety of humans, it is the user's own responsibility to construct a system for securing the safety of humans with devices and equipment other than the applicable product.
- Modification of the product is strictly prohibited.

■ Product Disclaimer

- We make no warranty for the product except as prescribed by the guarantees.
- We assume no responsibility for damages any user or third party may incur through use of the product, nor for any direct or indirect damages that the user or a third party may incur due to product defects that cannot be predicted by us, etc.

■ Software

- We make no warranties for the software except as prescribed by the guarantees.
- Copying and use of the software for any purpose other than as intended by us, such as for use as a backup, is strictly prohibited.
- Keep the original storage media of this software in a safe place. If you do not have the original media, we may decline to offer our prescribed quality warranty and maintenance services.
- Reverse engineering of the software, including reverse compilation and reverse assembly, is strictly prohibited.
- The transfer, exchange or subleasing of any part of the software for unwarranted use by a third party is prohibited without prior permission from Yokogawa Electric.

■ General Precautions Regarding LINEARSERV

- Never install the motor in reverse, such as by fixing the slider of the motor and making the mounting plate move.
- When removing the drive's side panel to set jumpers or other items, be sure to turn the power supply OFF before doing so. It is dangerous to touch the high-voltage parts inside the unit.
- Be sure to ground the ground terminal to the earth.
- The clearance between the slider and the mounting plate is approximately 0.1 mm. Dirt or foreign substances adhering to the mounting surface may cause failures.
- Prepare a fixture on the load side for the cables that connect to the connectors of the slider, or fix them on the slider side using the cable attachment screws of the slider, etc., so that external force is not applied to the connectors. Failure to do so may lead to disconnection or breakdown.
- The optional cables provided by Yokogawa are consumables and have a limited life.
- Be sure that the mounting screws of a load never reach or exceed the effective screw depth of the slider.
- The motor's surface is magnetized. Keep objects that are affected by magnetism away from the motor.
- The motor structure is not resistant to dust, splashing or water (oil). When mounting the motor, please refer to the section "Specification/Installation, Precautions for Transportation and Storage" in this manual. Foreign substances and grease entering the encoder unit may cause malfunction and failure.
- The motor unit contains glass materials. Avoid subjecting it to vibration and impact.

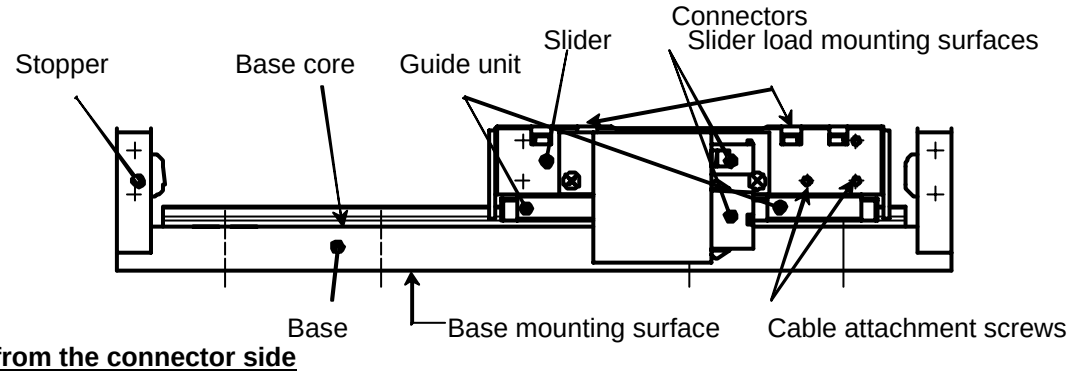

Figure viewed from the connector side

- The motor mounting plate of a product whose surface treatment suffix code is "N" is coated to prevent rust. Prior to mounting, wipe the coating of the base mounting surface completely with petroleum or chlorine solvent. If any coating remains, mechanical precision and function may be impaired. Please see the section "Installation" in this manual.

- The stopper in the motor is not intended to absorb impact during operation. Please prepare separate equipment for protection/safety procedures, such as a stopper and shock absorber. Refer to the section "Specification/Installation, Precautions for Transportation and Storage" in this manual.
- Be sure not to interfere with the movable area, including the load part, while the motor is operating. You may be injured if a hand is placed between the slider and the stopper, or if the movable part is touched.
- The guide unit requires grease for lubrication. Driving the motor under insufficiently lubricated conditions may lead to damage and failure. Please see the section "Maintenance/Inspection" in this manual.
- If you use the screw holes located above and below the box of the DrvGIII drive, be certain the tips of the screws penetrate less than 8mm below the drive's surface. If this precaution is not observed, it may cause an electric shock, short circuit and/or damage to the motor.
- The drive should be installed on an appropriate metal cabinet, observing the safety measures prescribed by the Low Voltage Directive and EMC Directives.
- Interchangeability between motors and drives is possible only if the drive and the motor are compatible. In other words, the LINEARSERV motor's three-digit model code (LM☐☐☐) must match that of the drive (UM1LG3-☐☐☐) if you wish to change the combination and use the motor with a different drive unit.
- In the LINEARSERV series, each motor has been tuned to operate with a specific head amplifier. If the combination is different, the motor may not operate normally, or one or more devices may be damaged. Please combine and use a motor and head amplifier having the same model code and serial number.
- If the product is installed in such a way that cables are bent in the machine, etc., be sure the minimum bend radius of the cable is 50mm or more. Moreover, do not install cables such that they are bent repeatedly. It may cause disconnection and failure.
- Do not conduct over-voltage tests. Circuitry in the drive or motor may become damaged as a result of these types of destructive tests.
- Never attempt to disassemble or modify the motor or drive. We assume no responsibility if you disassemble or modify them.

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1. Overview of the Product

1.1 LM Series Motor

The LINEARSERV LM Series motors are direct-drive linear servo motors. They allow highly accurate positioning control thanks to a fully closed loop configuration using Yokogawa's proprietary built-in optical linear encoder.
Additionally, they offer smooth drive characteristics that are not possible with conventional ball screws and AC servo motors.

- Absolute positioning accuracy: $5+\frac{5}{1000}\mathrm{LS}$ (LS: length of stroke), yielding a high precision of 10 μm with a stroke length of 1000 mm
- Repeated positioning accuracy: 0.1 to 0.5 μm (depending on the shape)
- Velocity ripple: 1%.
- The series offers an all-in-one type with integrated motor unit, encoder and linear guide unit that is easy to incorporate with other machinery.
- Unique positioning control configurations are possible with the multiple sliders.
- Stable operation is achieved with minimal temperature increase.
- A proven linear guide is employed for the mechanism, and sufficiently high rigidity is ensured under load conditions.
- The high-speed type allows operation at up to 2 m/sec.
- Eighteen types of strokes, ranging from 50 mm to 1800 mm, are available.
- The line includes standard, high-rigidity, high-speed and high-rigidity/high-speed models with motor thrust rating of 50 N, 100 N or 300 N, as well as a high-rigidity model with a motor thrust rating of 400 N.
- Wide-ranging applications are supported through various combinations of thrust, stroke and shape.

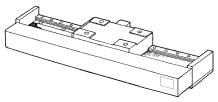
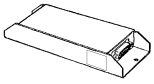
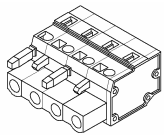
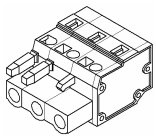
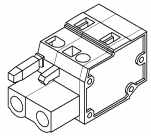
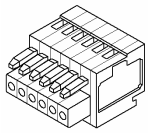
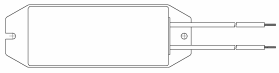
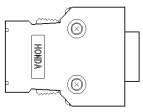
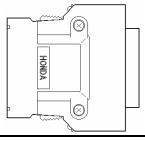
1.2 DrvGIII Drive

The DrvGIII is a direct drive servo motor drive. This next-generation drive was developed based upon the SD/SR/TM and DrvGII type drives. It has higher control performance and operability; its functions are improved while the size was reduced.

- The volume of the drive box is approximately half (compared to the 2kW class SD and SR drives) or approximately two thirds (compared to the 500 W class TM drive) the size of the earlier products.
- The resolution is four times (compared to DM series motor SD drive) or two times (compared to DR/LM motor SR/TM drive) that of the conventional products.
- A "utility software" (for Microsoft Windows) is provided that allows control of the motor and drive through a simple, yet powerful software interface.

1.3 Checking the Product

Please check the product as soon as you receive it. Please examine the label and check that the types and quantities of the parts and products received, as well as accessories you have ordered, are correct. Perform a visual inspection to ensure that there are no abnormalities in their appearance.
If you received a different product than you ordered or the product does not conform to your expectations, please contact us or the dealer from whom you purchased the product immediately.

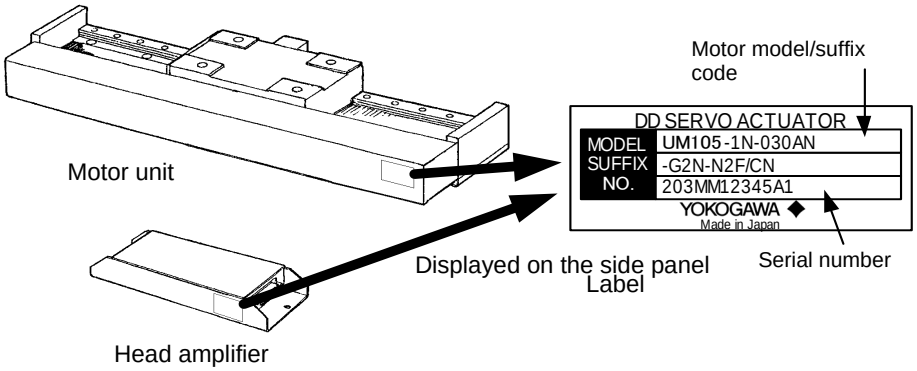
Name of product/accessory		Shape	Remarks
Motor unit	Motor unit		
	Head amplifier		Paired with a motor and tuned
Drive unit	Drive	The shape varies depending on the model.	
	TB1 power supply terminal connector (231-204/026-000 WAGO)		Standard accessories (one piece per drive)
	TB2 motor terminal connector (231-203/026-000 WAGO)		
	TB3 regeneration terminal connector (231-202/026-000 WAGO)		
	Screw-less terminal lever (231-131 WAGO)		
	TB4 sensor terminal connector (733-106 WAGO)		
	Regeneration resistor (See the table on the next page)		
	CN2 encoder/resolver connector (PCR-S20F, PCR-LS20LA1 Honda Tsushin Kogyo)		Supplied when order includes the additional suffix code "/CN."
	CN4 controller interface connector (PCR-S36FS, PCR-LS36LA Honda Tsushin Kogyo)		
Option cables			Optional

■ List of Models Provided with Regeneration Resistors

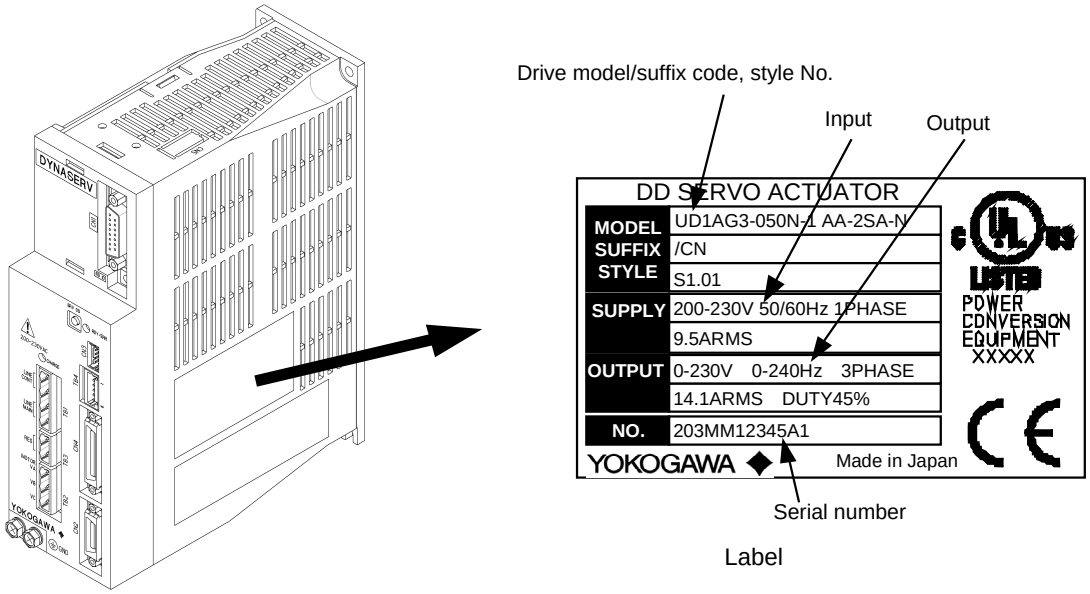
A regeneration resistor is provided for the models listed in the table below.

Model	Suffix code	Regeneration resistor	
UM1AG3	-□□□□-□□A-1□□-N	80W	60 Ω
	-□□□□-□□A-2□□-N	80W	200 Ω

■ Faceplate of the Motor



■ Faceplate of the Drive



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2. Specifications

2.1 Standard Specifications

■ Standard Model

Item			Unit	LM105	LM110	LM130
Motor and drive	Maximum thrust		N	50	100	300
	Rated thrust *2		N	25	50	150
	Maximum velocity (100/200 V)		m/s	1.06/1.06		
	Rated velocity (100/200 V)		m/s	0.83/0.83		
	Positioning	Encoder resolution *3	μm	0.25 (0.05)		
		Repeated positioning accuracy *3	μm	±0.5 (±0.1)		
		Absolute positioning accuracy by length of stroke [LS] *1	μm	$5+\frac{5}{1000}$ Ls		
	Maximum power consumption (100/200)		VA	300/600	350/700	400/800
	Rated power consumption (100/200) *2		VA	170/170	212/212	315/475
Motor	Maximum load		N	200	1000	
	Slider weight		kg	1.0	1.4	5.0
	Rail weight		kg/m	12	15	25
	Length of stroke [LS]		mm	50/100/150/200/300/400/500/600/700/800/900 1000/1100/1200/1300/1400/1500/1600/1700/1800		

*1. Scale accuracy specification at 23°C (expansion coefficient of glass lines: 8 x 10^{-6}/°C)
*2. Indicates CE continuous rating
*3. Values in ( ) indicate a resolution specification of 0.05 μm.

■ High-rigidity Model

Item			Unit	LM250	LM210	LM130	LM240
Motor and drive	Maximum thrust		N	50	100	300	400
	Rated thrust *2		N	25	50	150	200
	Maximum velocity (100/200 V)		m/s	1.06/1.06			
	Rated velocity (100/200 V)		m/s	0.83/0.83			
	Positioning	Encoder resolution *3	μm	0.25 (0.05)			
		Repeated positioning accuracy *3	μm	±0.5 (±0.1)			
		Absolute positioning accuracy by length of stroke [LS] *1	μm	$5+\frac{5}{1000}$ Ls			
	Maximum power consumption (100/200)		VA	300/600	350/700	400/800	550/1100
	Rated power consumption (100/200) *2		VA	170/170	212/212	315/475	315/475
Motor	Maximum load		N	600		2000	
	Slider weight		kg	1.4	1.8	8.7	10.0
	Rail weight		kg/m	15	18	45	50
	Length of stroke [LS]		mm	50/100/150/200/300/400/500/600/700/800/900 1000/1100/1200/1300/1400/1500/1600/1700/1800			

*1. Scale accuracy specification at 23°C (expansion coefficient of glass lines: 8 x 10^{-6}/°C)
*2. Indicates CE continuous rating
*3. Values in ( ) indicate a resolution specification of 0.05 μm.

■ High-speed Model

Item			Unit	LM505	LM510	LM530
Motor and drive	Maximum thrust		N	40	90	270
	Rated thrust *2		N	20	45	135
	Maximum velocity (100/200 V)		m/s	2.5/2.5		
	Rated velocity (100/200 V)		m/s	2.0/2.0		
	Positioning	Encoder resolution	μm	0.5		
		Repeated positioning accuracy	μm	±1		
		Absolute positioning accuracy by length of stroke [LS] *1	μm	$5+\frac{5}{1000}$ Ls		
	Maximum power consumption (100/200)		VA	300/600	350/700	550/1100
	Rated power consumption (100/200) *2		VA	250/250	315/355	315/630
Motor	Maximum load		N	200		1000
	Slider weight		kg	1.0	1.4	5.0
	Rail weight		kg/m	12	15	25
	Length of stroke [LS]		mm	50/100/150/200/300/400/500/600/700/800/900 1000/1100/1200/1300/1400/1500/1600/1700/1800		

*1. Scale accuracy specification at 23°C (expansion coefficient of glass lines: 8 x 10^{-6}/°C)
*2. Indicates CE continuous rating

■ High-rigidity/High-speed model

Item			Unit	LM305	LM310	LM330
Motor and drive	Maximum thrust		N	40	90	270
	Rated thrust *2		N	20	45	135
	Maximum velocity (100/200 V)		m/s	2.5/2.5		
	Rated velocity (100/200 V)		m/s	2.0/2.0		
	Positioning	Encoder resolution	μm	0.5		
		Repeated positioning accuracy	μm	±1		
		Absolute positioning accuracy by length of stroke [LS] *1	μm	$5+\frac{5}{1000}$ Ls		
	Maximum power consumption (100/200)		VA	300/600	350/700	550/1100
	Rated power consumption (100/200) *2		VA	250/250	315/355	315/630
Motor	Maximum load		N	600		2000
	Slider weight		kg	1.4	1.8	8.7
	Rail weight		kg/m	15	18	45
	Length of stroke [LS]		mm	50/100/150/200/300/400/500/600/700/800/900 1000/1100/1200/1300/1400/1500/1600/1700/1800		

*1. Scale accuracy specification at 23°C (expansion coefficient of glass lines: 8 x 10^{-6}/°C)
*2. Indicates CE continuous rating

■ Motor Environment Specifications

		Motor	Remarks
Operation	Temperature	0 ~ 45°C: Standard 0 ~ 40°C: CE continuous rating	
	Humidity	20 ~ 85% RH	No condensation
Storage	Temperature	-20 ~ 85°C	
	Humidity	20 ~ 85% RH	No condensation
Atmosphere		Must be no corrosive gasses, dust and dirt Must be used at a maximum altitude of 1000 meters above sea level (CE mounting condition)	

■ Drive Interface Specifications

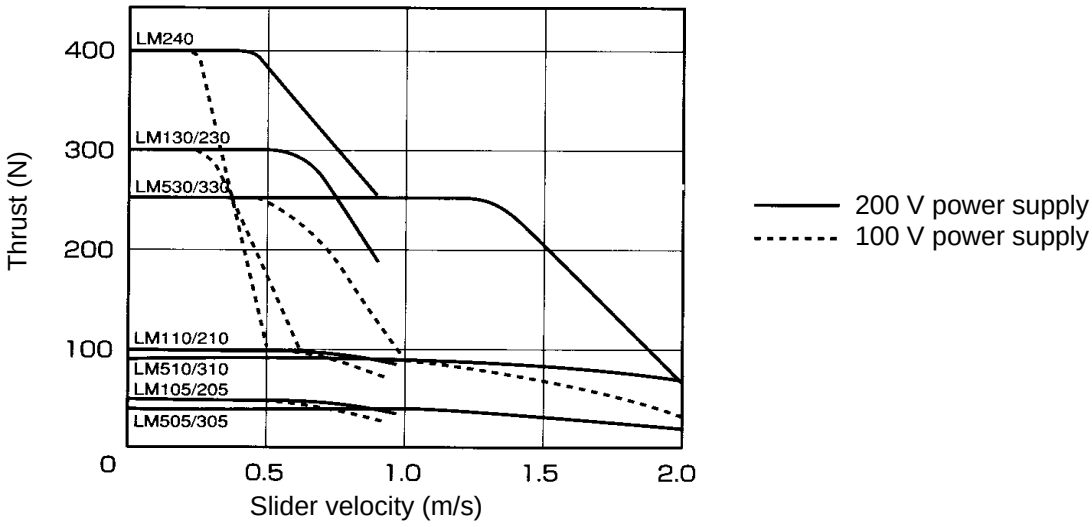
Suffix code		I/O input/output	Position command pulse input	Actual position pulse output	Analog input 1	Analog input 2
Type	Spec					
S	A	12 ~ 24VDC	Differential input (RS422A standard) Maximum 2MHz (500kHz for phases A and B)	■ Actual position value Differential output (RS422A standard) Maximum 3MHz (750kHz for phases A and B) ■ Home signal Differential output (RS422A standard)	None	Torque/thrust control, torque/thrust feed forward
	B	5VDC				
T	A	12 ~ 24VDC	Differential input (RS422A standard) Maximum 2MHz (500kHz for phases A and B)		Velocity, torque and thrust	
	B	5VDC				
U	A	12 ~ 24VDC	5V open collector Maximum 200kHz		None	
	B	5VDC				

■ Drive General Specifications and Function Specifications

			500W class
Basic Specification	Power supply	Main power supply	100 ~ 115VAC / 200 ~ 230VAC +10% -15% 50/60 Hz
		Control power supply	100 ~ 115VAC / 200 ~ 230VAC +10% -15% 50/60 Hz
		Maximum power consumption	1.3kVA
	Environment	Temperature	0 ~ +50°C (Operation) / 20 ~ +85°C (Storage)
		Humidity	20 ~ 90%RH, No condensing (Operation and Storage)
		Atmosphere	No corrosive gases, dust-free atmosphere Must be used at a maximum altitude of 1000 meters above sea level (CE mounting condition)
	Construction	Installation	Wall-mount
		Fan	N/A
		Regeneration resistor	External
	External Dimension		60 W x 195 H x 150 D (mm)
	Weight		1.2kg
	Conformed standard		Low voltage (declaration) EN50178, EMC (declaration) EN55011 class A group 1, EN61000-6-2
			UL508C
	HiPot		Insulating resistance: 10MΩ or more (500VDC), Withstand voltage 1500VAC, one minute
	Encoder Resolution Values inside ( ) is factory default value for command and monitor pulses		LINEARSERV UM1LG3-□□□B: 0.5μm (1.0μm) UM1LG3-□□□C: 0.25μm (0.5μm) UM1LG3-□□□E: 0.05μm (0.1μm)
Host interface	Serial Interface (RS232C/RS485)		Communication Start-stop system, binary communication Communication Speed 38,400 bps Multi-channel (RS485) Max. 10 channels
	Controller Interface		Pos. Command pulse (input) [PLS-SIGN (STEP-DIR)], [UP-DOWN], [A-B encoder] Pos. Monitor pulse (output) [UP-DOWN], [A-B encoder] I/O input/output 12 for input, 6 for output (with terminal all function) Analog input Velocity, Torque/Thrust command (select "T" for the model & suffix code), Torque/Thrust limit, Torque/Thrust feed forward
Mechanical Input Signal			Home sensor, End Of Travel (EOT) sensor
Control part	Pos. control		I-PD control, PID control
	Vel. control		Proportional control, proportional integral control
	Feed Forward		Position, velocity, acceleration
	Filter		Velocity command, velocity feedback, phase delay compensation and notch (2ch) filters
Operation Functions			Homing, test, auto-tuning, positioning and jog move functions
Protection Functions			Encoder error, over voltage, over current, low bus line power voltage, power failure, over load, regen. Error detection, over speed, excessive pos. deviation, hardware EOT and software EOT (for linear coordinate)
Monitor			Velocity, current instruction, analog (2ch) and digital (2ch)
Operation / Display			Operation display panel (optional) Operation display pendant (optional) Utility software
Miscellaneous			Servo deceleration function at power failure (immediate stop) Dynamic brake (Select -1B or -1L for the model & suffix code.)

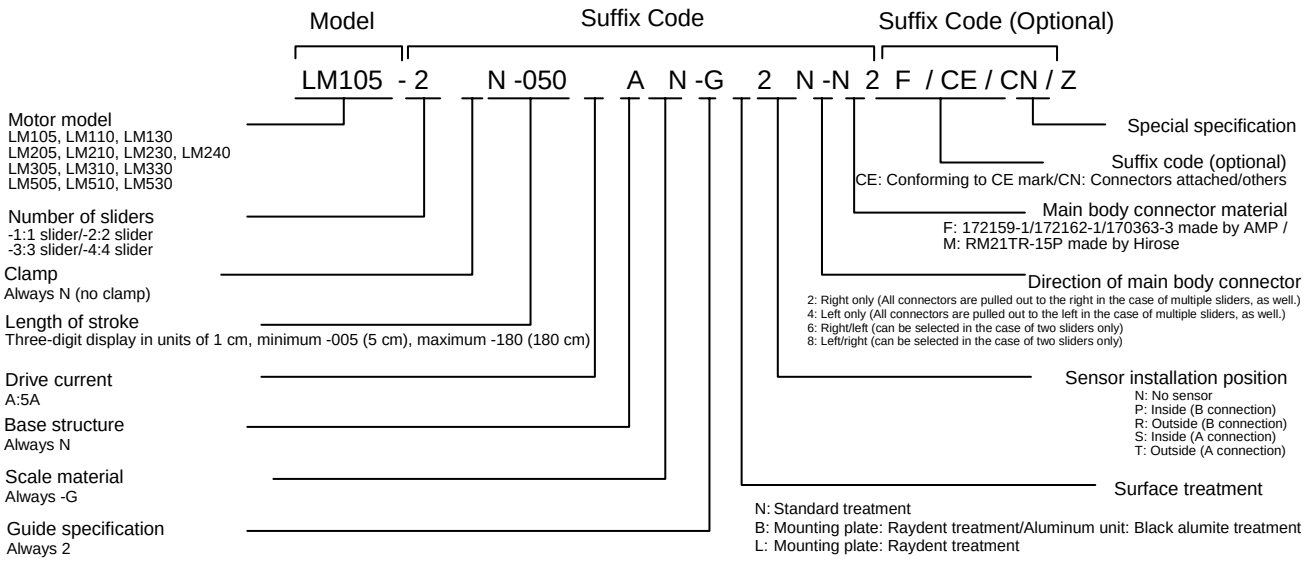
2.2 Thrust/Velocity Characteristics

■ LM□□□ Motor



2.3 Model and Suffix Codes

■ Motor



Model and Suffix Code Selection List

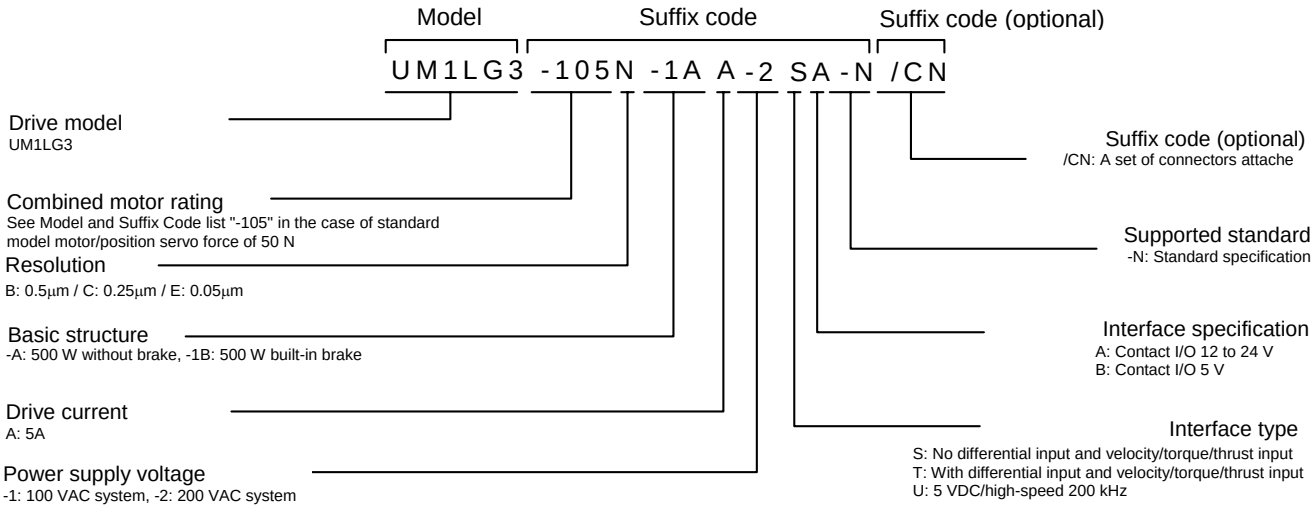
Model	Suffix Code											
	Number of sliders	Clamp	Length of stroke	Drive current	Base structure	Scale material	Guide specification	Surface treatment	Sensor installation position	Direction of main body connector	Main body connector material	Suffix code
LM105 LM110 LM505 LM510	-1	N	-005, -010, -015, -020, -030, -040, -050, -060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180	A	N	G	2	N, B, L	-N, -R, -T	2, 4	F, M	/CE, /CN, /TC1
									-P, -S		F	
	-2		-015, -020, -030, -040, -050, -060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180						-N, -R, -T	2, 4, 6, 8	F, M	
									-P, -S		F	
	-3		-030, -040, -050, -060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180						-N, -R, -T	2, 4	F, M	
									-P, -S		F	
	-4		-040, -050, -060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180						-N, -R, -T		F, M	
									-P, -S		F	

Model	Suffix Code											
	Number of sliders	Clamp	Length of stroke	Drive current	Base structure	Scale material	Guide specification	Surface treatment	Sensor installation position	Direction of main body connector	Main body connector material	Suffix code (optional)
LM130 LM530	-1	N	-005, -010, -015, -020, -030, -040, -050, -060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180	A	N	G	2	N, B, L	-N, -R, -T	2, 4	F, M	/CE, /CN, /TC1
									-P, -S		F	
	-2		-020, -030, -040, -050, -060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180						-N, -R, -T	2, 4, 6, 8	F, M	
									-P, -S		F	
	-3		-040, -050, -060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180						-N, -R, -T	2, 4	F, M	
									-P, -S		F	
	-4		-060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180						-N, -R, -T		F, M	
									-P, -S		F	

Model	Suffix Code											
	Number of sliders	Clamp	Length of stroke	Drive current	Base structure	Scale material	Guide specification	Surface treatment	Sensor installation position	Direction of main body connector	Main body connector material	Suffix code (optional)
LM205 LM210 LM305 LM310	-1	N	-005, -010, -015, -020, -030, -040, -050, -060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180	A	N	G	2	N, B, L	-N, -R, -T	2, 4	F, M	/CE, /CN, /TC1
									-P, -S		F	
	-2		-015, -020, -030, -040, -050, -060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180						-N, -R, -T	2, 4, 6, 8	F, M	
									-P, -S		F	
	-3		-030, -040, -050, -060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180						-N, -R, -T	2, 4	F, M	
									-P, -S		F	
	-4		-050, -060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180						-N, -R, -T		F, M	
									-P, -S		F	

Model	Suffix Code											
	Number of sliders	Clamp	Length of stroke	Drive current	Base structure	Scale material	Guide specification	Surface treatment	Sensor installation position	Direction of main body connector	Main body connector material	Suffix code (optional)
LM230 LM240 LM330	-1	N	-005, -010, -015, -020, -030, -040, -050, -060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180	A	N	G	2	N, B, L	-N, -P, -R, -S, -T	2, 4	F, M	/CE, /CN, /TC1
	-2		-030, -040, -050, -060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180							2, 4, 6, 8		
	-3		-060, -070, -080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180							2, 4		
	-4		-080, -090, -100, -110, -120, -130, -140, -150, -160, -170, -180									

■ Drive



Model and Suffix Code Selection List

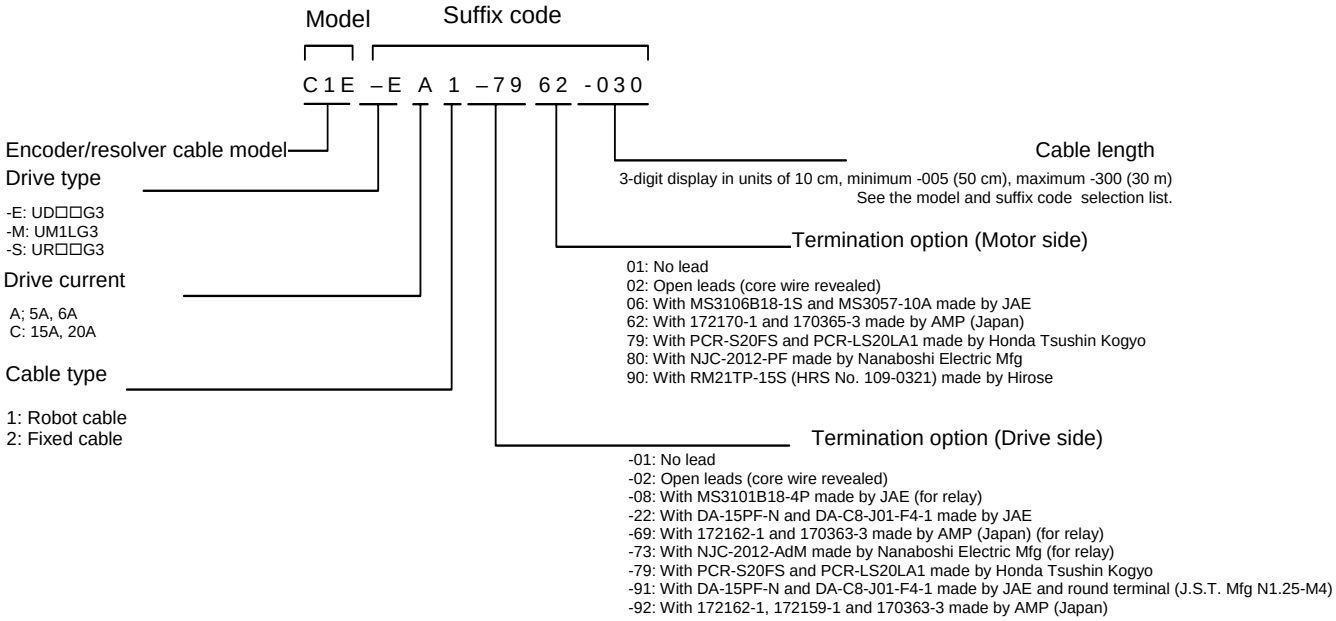
500W-class drive

Model	Suffix code								Suffix code (optional)
	Combined motor rating	Resolution	Basic structure	Drive current	Power supply voltage	I/F type	I/F specification	Supported standard	
UM1LG3	-150	C, E	-1A, -1B	A	-1, -1B	S, T, U	A, B	-N	/CN
	-110								
	-130								
	-205								
	-210								
	-230								
	-240								
	-305	B							
	-310								
	-330								
	-505								
	-510								
	-530								

2.4 Option Cables

2.4.1 Option Cable Model and Suffix Code

■ Encoder/Resolver Cable



Model and Suffix Code Selection List

Model	Suffix code						Description
	Drive type	Drive current	Cable type	Termination option (Drive side)	Termination option (Motor side)	Cable length	
C1E	-E	A	1, 2	-01, -02, -79	01, 02, 06, 62, 80	-005, -010, -015, -020 -025, -030, -035, -040, -045, -050, -060, -070, -080, -090, -100	
				-08, -69, -73			Relay cable
		C		-01, -02, -79		-005, -010, -015, 020, -025, -030, -035, -040, -045, -050, -060, -070, -080, -090, -100, -150, -200, -250, -300	
				-08, -69, -73			Relay cable
	-S	A		-01, -02, -79		-005, -010, -015, -020 -025, -030, -035, -040, -045, -050, -060, -070, -080, -090, -100	
				-08, -69, -73			Relay cable
		C		-01, -02, -79		-005, -010, -015, 020, -025, -030, -035, -040, -045, -050, -060, -070, -080, -090, -100, -150, -200, -250, -300	
				-08, -69, -73			Relay cable
	-M	A	1	-01, -02, -79	01, 02, 69, 79	-005, -010, -015, -020 -025, -030, -035, -040, -045, -050, -060, -070, -080, -090, -100	
				-08, -69, -73	06, 62, 80		Relay cable
				-22	62	-005, -010, -015, -020 -025, -030, -035, -040, -045, -050	Head amplifier cable
				-91, -92	90		
			2	-01, -02, -79	01, 02, 79, 80	-005, -010, -015, -020 -025, -030, -035, -040, -045, -050, -060, -070, -080, -090, -100	
				-08, -69, -73	06, 62, 80		Relay cable
				-22	62	-005, -010, -015, -020 -025, -030, -035, -040, -045, -050	Head amplifier cable

■ Motor Cable

Model Suffix code

C1M –N A 1 –60 61 –030

Motor cable model

Drive type
Always -N

Drive current
A; 5A, 6A
C: 15A, 20A

Cable type
1: Robot cable
2: Fixed cable

Cable length

3-digit display in units of 10 cm, minimum -005 (50 cm), maximum -300 (30 m)
See the model and suffix code selection list.

Termination option (Motor side)

01: No lead
02: Open leads (core wire revealed)
06: With MS3106B20-4S and MS3057-12A made by JAE
61: With 172167-1 and 170366-3 made by AMP (Japan)
70: With 3191-06R and 1189ATL made by Molex
74: With NCS-304-P made by Nanaboshi Electric Mfg

Termination option (Drive side)

-01: No lead
-02: Open leads (core wire revealed)
-03: With N2-4 made by J.S.T. Mfg
-08: With MS3106B20-4P made by JAE (for relay)
-20: With GND cable, N1.25-M4 or N2-4 made by J.S.T. Mfg
-60: With N1.25-M4 made by J.S.T. Mfg
-68: With 172159-1 and 170364-3 made by AMP (Japan) (for relay)
-71: With 3191-06P and 1190TL made by Molex (for relay)
-72: With NCS-304-Ad made by Nanaboshi Electric Mfg (for relay)

Model and Suffix Code Selection List

<table>
<tr><th rowspan="2">Model</th><th colspan="6">Suffix code</th><th rowspan="2">Description</th></tr>
<tr><th>Drive type</th><th>Drive current</th><th>Cable type</th><th>Termination option (Drive side)</th><th>Termination option (Motor side)</th><th>Cable length</th></tr>
<tr><td rowspan="4">C1N</td><td rowspan="4">-N</td><td rowspan="2">A</td><td rowspan="4">1, 2</td><td>-01, -02, -20, -60</td><td rowspan="2">01, 02, 61, 74</td><td rowspan="2">-005, -010, -015, -020, -025, -030, -035, -040, -045, -050, -060, -070, -080, -090, -100</td><td></td></tr>
<tr><td>-68, -72</td><td>Relay cable</td></tr>
<tr><td rowspan="2">C</td><td>-01, -02, -03, -20</td><td rowspan="2">01, 02, 06, 70, 74</td><td rowspan="2">-005, -010, -015, -020, -025, -030, -035, -040, -045, -050, -060, -070, -080, -090, -100, -150, -200, -250, -300</td><td></td></tr>
<tr><td>-08, -71, -72</td><td>Relay cable</td></tr>
</table>

■ Controller Cable

Model Suffix code

C1P –E N N –78 78 –030

Controller cable model

Drive type
-E: UD□□G3
-M: UM1LG3
-S: UR□□G3

Drive current
Always N

Cable type
Always N

Cable length
3-digit display in units of 10 cm, minimum -002 (20 cm), maximum -050 (5 m)
See the model name specification code selection table.

Termination option (Controller side)
01: No lead
02: Open leads (core wire revealed)
03: With MR-50LM made by Honda Tsushin Kogyo
07: With FCN-231J050-G/E and FCN-230C050-D/E (caulking) made by Fujitsu
42: With PCR-S36FS and PCR-LS36LA made by Honda Tsushin Kogyo
76: With DE-9SF-N and DE-C8-J9-F4-1 made by JAE (RS-232C for DOS)
77: With DB-25PF-N and DB-C8-J10-F4-1 made by JAE (RS-232C for PC 98)
78: With PCR-S50FS and PCR-LS50LA made by Honda Tsushin Kogyo

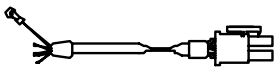
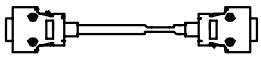
Termination option (Drive side)
-01: No lead
-02: Open leads (core wire revealed)
-22: With DA-15PF-N and DA-C8-J01-F4-1 made by JAE
-42: With PCR-S36FS and PCR-LS36LA made by Honda Tsushin Kogyo
-75: With DE-9PF-N and DE-C8-J9-F4-1 made by JAE (RS-232C)
-78: With PCR-S50FS and PCR-LS50LA made by Honda Tsushin Kogyo
-81: JAE DE-15

Model and Suffix Code Selection List

Model	Suffix code						Description
	Drive type	Drive current	Cable type	Termination option (Drive side)	Termination option (Controller side)	Cable length	
C1P	-E	N	N	-01, -02, -42, -78	01, 02, 07, 42	-002, -003, -004, -005, -006, -007, -008, -009, -010, -012, -015, -020, -022, -025, -030, -035, -040, -045, -050	
				-22	76	-020	RS232C (for DOS)
				-75	77		RS232C (for PC98)
	-S			-01, -02, -42, -78	01, 02, 07, 42	-002, -003, -004, -005, -006, -007, -008, -009, -010, -012, -015, -020, -022, -025, -030, -035, -040, -045, -050	
				-22	76	-020	RS232C (for DOS)
				-75	77		RS232C (for PC98)
	-M			-01, -02, -42, -78	01, 02, 07, 42	-002, -003, -004, -005, -006, -007, -008, -009, -010, -012, -015, -020, -022, -025, -030, -035, -040, -045, -050	
				-22	76	-020	RS232C (for DOS)
				-75	77		RS232C (for PC98)

2.4.2 Recommended Cables

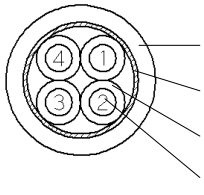
■ Recommended Cables for LM□□□ Motors

	Connector			Extension cable
	Extension cable drive side	Extension cable motor side	Motor unit side	
Motor cable	J.S.T. Mfg N1.25-M4	Made by AMP (Japan) Connector 172167-1 Contact 170366-3	Made by AMP (Japan) Connector 172159-1 Contact 170364-3	C1M-NA1-2061-□□□ 
Amplifier cable	Made by JAE Connector DA-15PF-N Contact DA-C8-J10-F4-1	Made by AMP (Japan) Connector 172170-1 Contact 170365-3	Made by AMP (Japan) Connector 172162-1 Contact 170363-3	C1E-MA1-2262-□□□ 
Encoder cable	Made by Honda Tsushin Kogyo Connector PCR -S20FS Cover PCR-LS20LA1	Made by Honda Tsushin Kogyo Connector PCR -S20FS Cover PCR-LS20LA1	Made by Honda Tsushin Kogyo Connector PCR -S20FS Cover PCR-LS20LA1	C1E-MA□-7979-□□□ 

Numbers in parentheses in the table show terminal treatment of the suffix code.
See "Model and Suffix code" for the terminal treatment codes for motor outgoing line.

2.4.3 Cable Specifications

■ Motor Cable



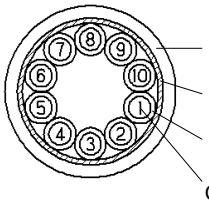
Identification of core wire

Layout number	1	2	3	4
Color of insulating material	Black	White	Red	Green

Cable specifications

Conductor	AWG#20 (0.5mm^2)
Insulating material external diameter	∅1.64mm
Finished external diameter	∅7.0mm

■ Amplifier Cable



Identification of core wire

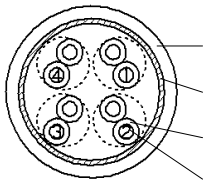
Layout number	1	2	3	4	5	6	7	8	9	10
Color of insulating material	Green	Yellow	Brown	Blue	Orange	Gray	Purple	Black	White	Red

Cable specifications

Conductor	AWG#22 (0.3mm^2)
Insulating material external diameter	∅1.29mm
Finished external diameter	∅8.5mm

■ Encoder Cable

(1) Fixed cable



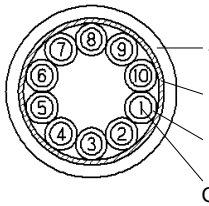
Identification of core wire

Layout number	1	2	3	4
Color of insulating material	Blue x blue/ white	Brown x brown /white	Red x Black	Orange x orange/ white

Cable specifications

Conductor	AWG#24 (0.2mm^2)
Insulating material external diameter	∅1.05mm (Twisted pair)
Finished external diameter	∅6.8mm

(2) Robot cable



Identification of core wire

Layout number	1	2	3	4	5	6	7	8	9	10
Color of insulating material	Green	Yellow	Brown	Blue	Orange	Gray	Purple	Black	White	Red

Cable specifications

Conductor	AWG#22 (0.3mm^2)
Insulating material external diameter	∅1.29mm
Finished external diameter	∅8.5mm

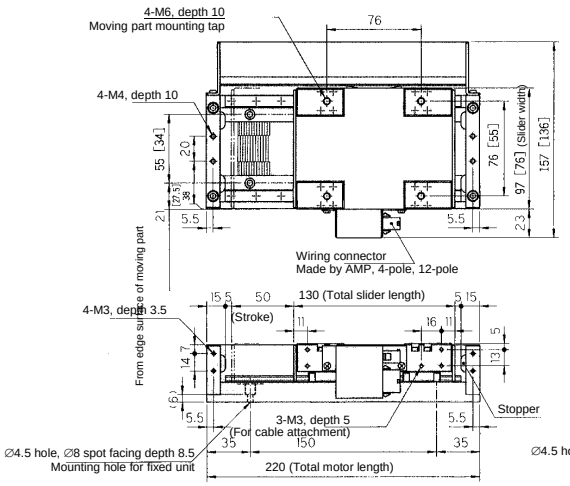
2.5 Outline Drawings

2.5.1 Motor

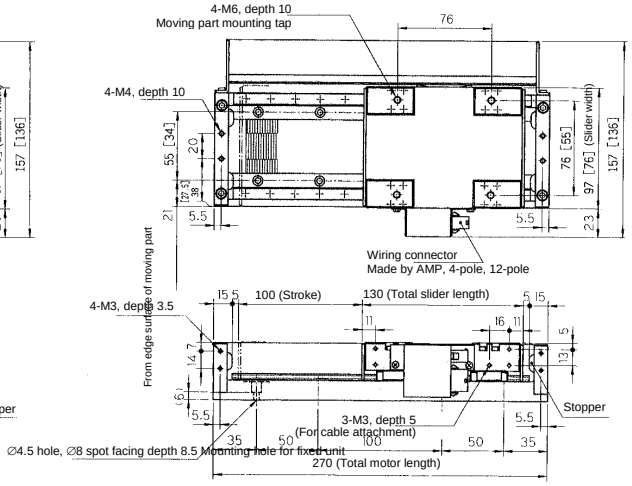
■ LM105/LM110/LM505/LM505 (Dimensions in [ ] indicate LM105/LM505)

Unit in figure: mm

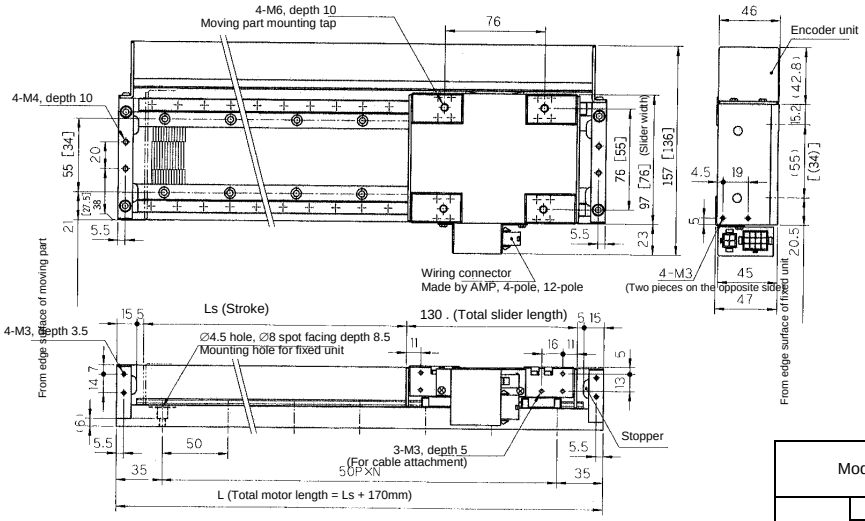
Length of stroke 50 mm



Length of stroke100 mm



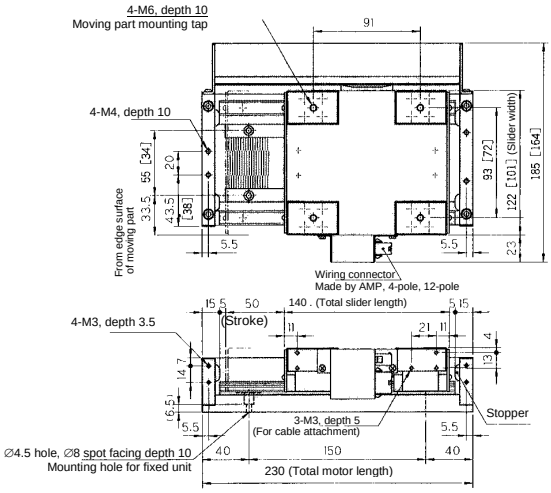
Length of stroke 150 to 1800 mm



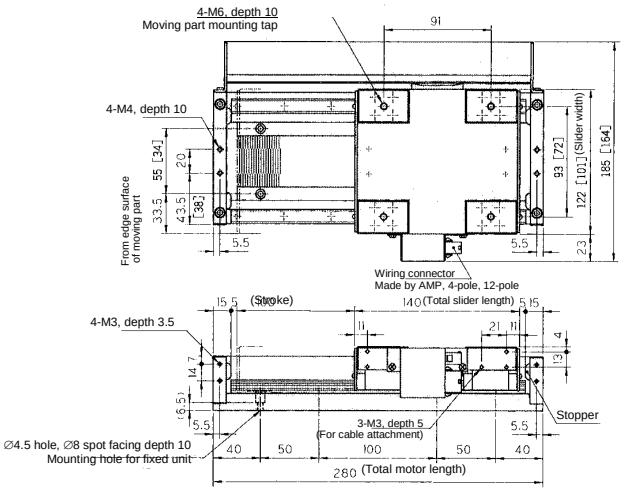
Model		L	Ls	N	Mounting hole for fixed unit
LM105 LM110 LM505 LM510	-1N-015	320	150	5	2 x 6 pieces
	-1N-020	370	200	6	2 x 7 pieces
	-1N-030	470	300	8	2 x 9 pieces
	-1N-040	570	400	10	2 x 11 pieces
	-1N-050	670	500	12	2 x 13 pieces
	-1N-060	770	600	14	2 x 15 pieces
	-1N-070	870	700	16	2 x 17 pieces
	-1N-080	970	800	18	2 x 19 pieces
	-1N-090	1070	900	20	2 x 21 pieces
	-1N-100	1170	1000	22	2 x 23 pieces
	-1N-110	1270	1100	24	2 x 25 pieces
	-1N-120	1370	1200	26	2 x 27 pieces
	-1N-130	1470	1300	28	2 x 29 pieces
	-1N-140	1570	1400	30	2 x 31 pieces
	-1N-150	1670	1500	32	2 x 33 pieces
	-1N-160	1770	1600	34	2 x 35 pieces
	-1N-170	1870	1700	36	2 x 37 pieces
	-1N-180	1970	1800	38	2 x 39 pieces

■ LM205/LM210/LM305/LM310 (Dimensions in [ ] indicate LM205/LM305)

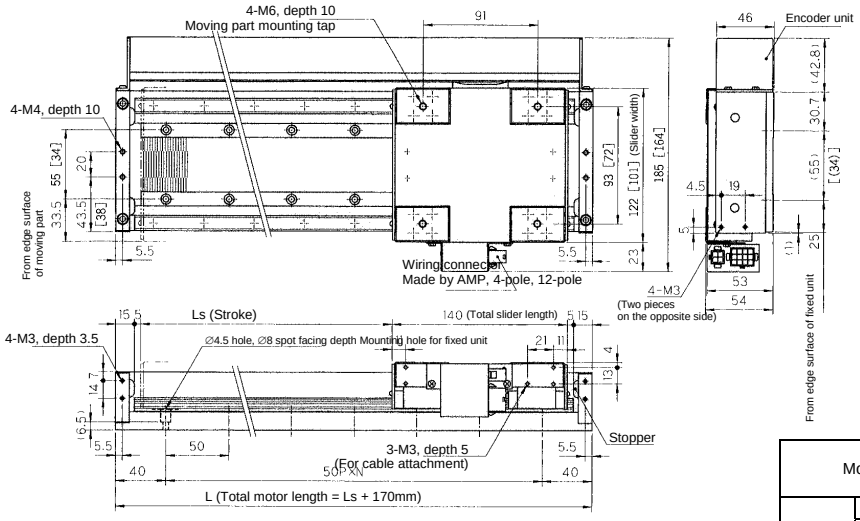
Length of stroke 50 mm



Length of stroke100 mm



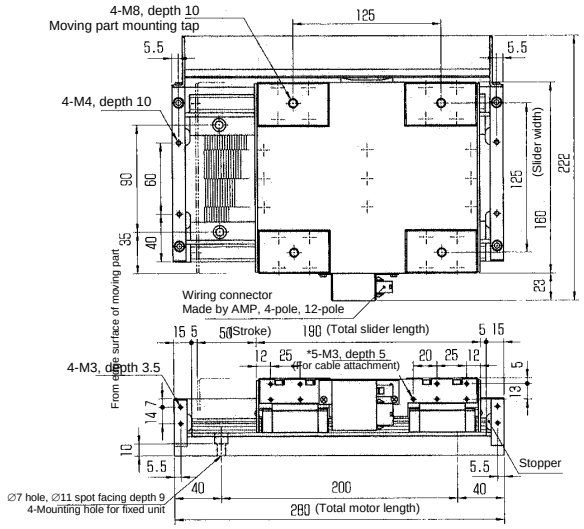
Length of stroke150 to 1800 mm



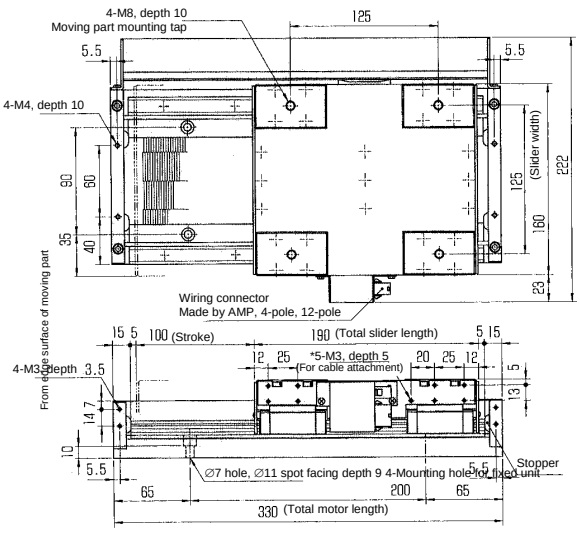
Model		L	Ls	N	Mounting hole for fixed unit
LM205 LM210 LM305 LM310	-1N-015	330	150	5	2 x 6 pieces
	-1N-020	380	200	6	2 x 7 pieces
	-1N-030	480	300	8	2 x 9 pieces
	-1N-040	580	400	10	2 x 11 pieces
	-1N-050	680	500	12	2 x 13 pieces
	-1N-060	780	600	14	2 x 15 pieces
	-1N-070	880	700	16	2 x 17 pieces
	-1N-080	980	800	18	2 x 19 pieces
	-1N-090	1080	900	20	2 x 21 pieces
	-1N-100	1180	1000	22	2 x 23 pieces
	-1N-110	1280	1100	24	2 x 25 pieces
	-1N-120	1380	1200	26	2 x 27 pieces
	-1N-130	1480	1300	28	2 x 29 pieces
	-1N-140	1580	1400	30	2 x 31 pieces
	-1N-150	1680	1500	32	2 x 33 pieces
	-1N-160	1780	1600	34	2 x 35 pieces
	-1N-170	1880	1700	36	2 x 37 pieces
	-1N-180	1980	1800	38	2 x 39 pieces

■ LM130/LM530

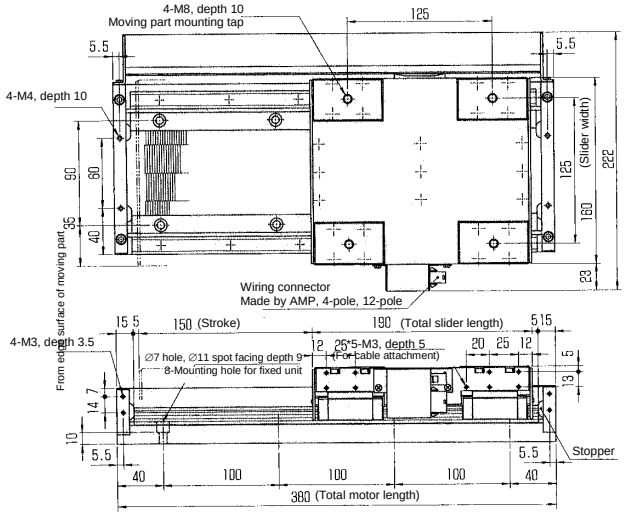
Length of stroke 50 mm



Length of stroke 100 mm



Length of stroke 150 mm



Sensor mounting position diagram (common to all models)

(1) Outside sensors (2) Inside sensors

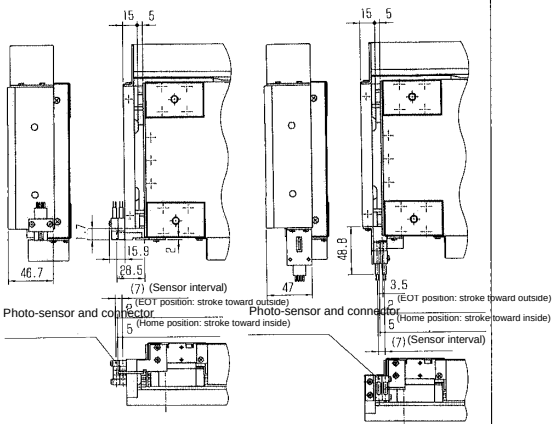
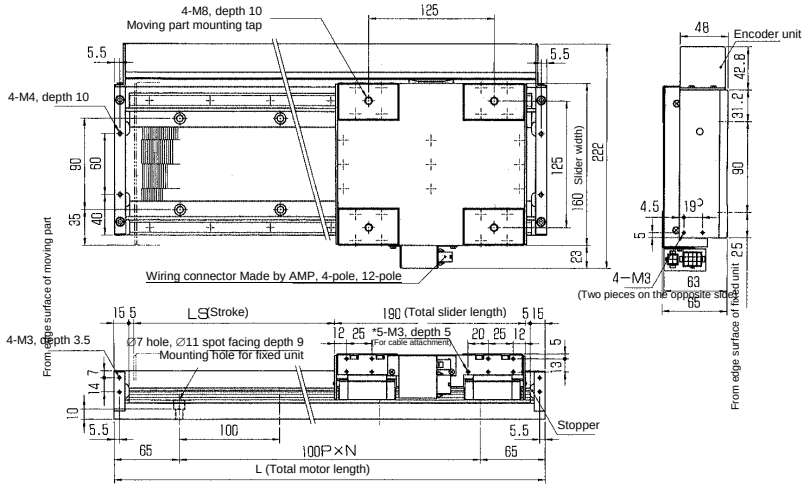


Photo-sensor: EE-SX670A (Omron)
Connector: EE-1001 (Omron)
Mounting 4 pieces, 2 for each side

■ LM105/LM110/LM505/LM505 (Dimensions in [ ] indicate LM105/LM505)

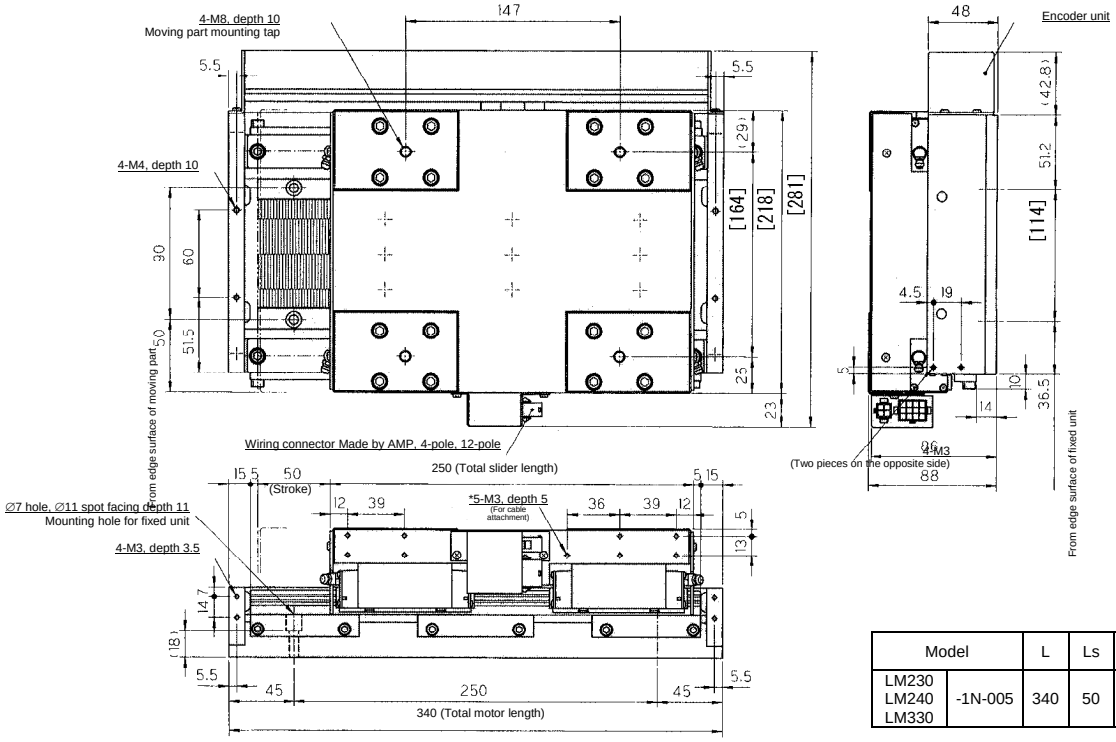
Length of stroke 150 to 1800mm



Model		L	Ls	N	Mounting hole for fixed unit
LM130 LM530	-1N-020	430	200	3	2 x 4 pieces
	-1N-030	530	300	4	2 x 5 pieces
	-1N-040	630	400	5	2 x 6 pieces
	-1N-050	730	500	6	2 x 7 pieces
	-1N-060	830	600	7	2 x 8 pieces
	-1N-070	930	700	8	2 x 9 pieces
	-1N-080	1030	800	9	2 x 10 pieces
	-1N-090	1130	900	10	2 x 11 pieces
	-1N-100	1230	1000	11	2 x 12 pieces
	-1N-110	1330	1100	12	2 x 13 pieces
	-1N-120	1430	1200	13	2 x 14 pieces
	-1N-130	1530	1300	14	2 x 15 pieces
	-1N-140	1630	1400	15	2 x 16 pieces
	-1N-150	1730	1500	16	2 x 17 pieces
	-1N-160	1830	1600	17	2 x 18 pieces
	-1N-170	1930	1700	18	2 x 19 pieces
	-1N-180	2030	1800	19	2 x 20 pieces

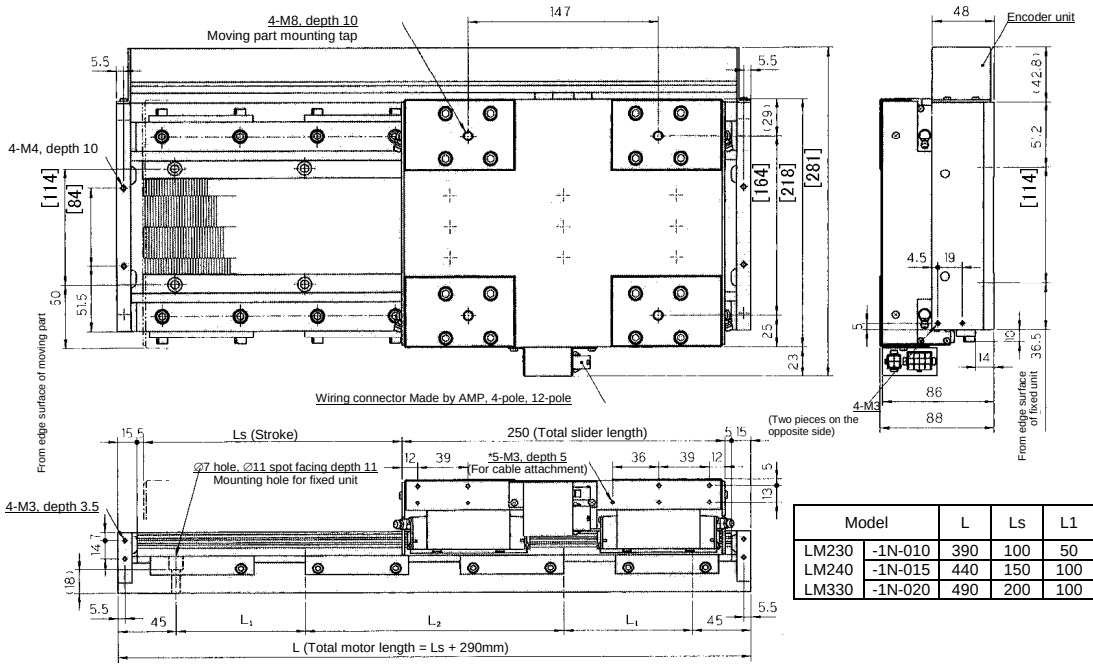
■ LM230/LM240/LM330 (Dimensions in [ ] indicate LM240)

Length of stroke 50mm



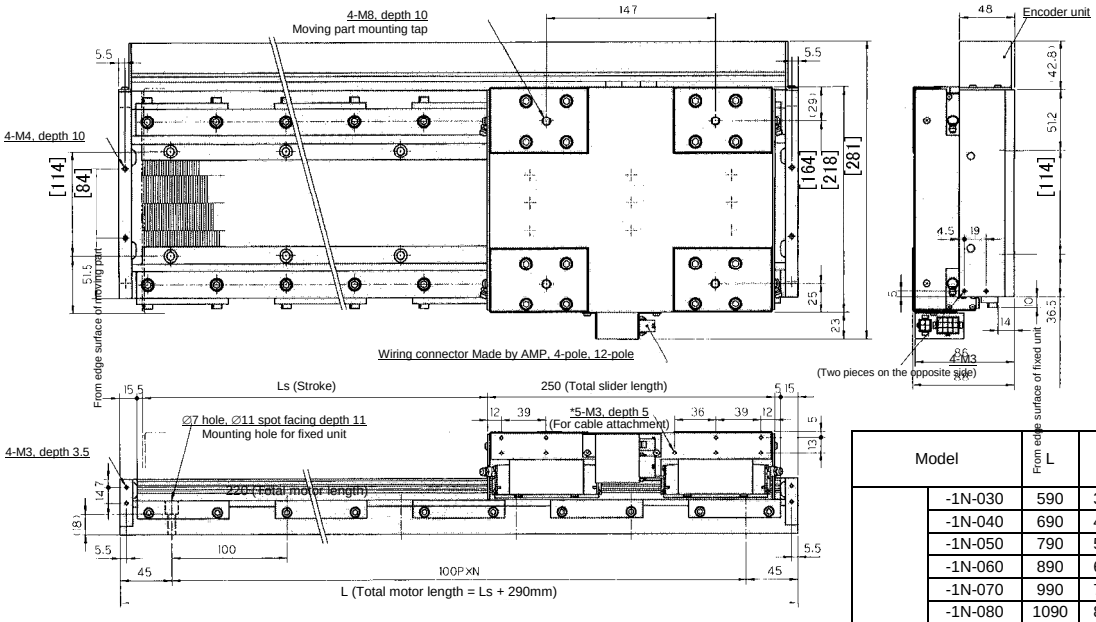
Model		L	Ls	Mounting hole for fixed unit
LM230 LM240 LM330	-1N-005	340	50	2 x 2 pieces

Length of stroke 100 to 200mm



Model		L	Ls	L1	L2	Mounting hole for fixed unit
LM230	-1N-010	390	100	50	200	2 x 4 pieces
LM240	-1N-015	440	150	100	150	2 x 4 pieces
LM330	-1N-020	490	200	100	200	2 x 4 pieces

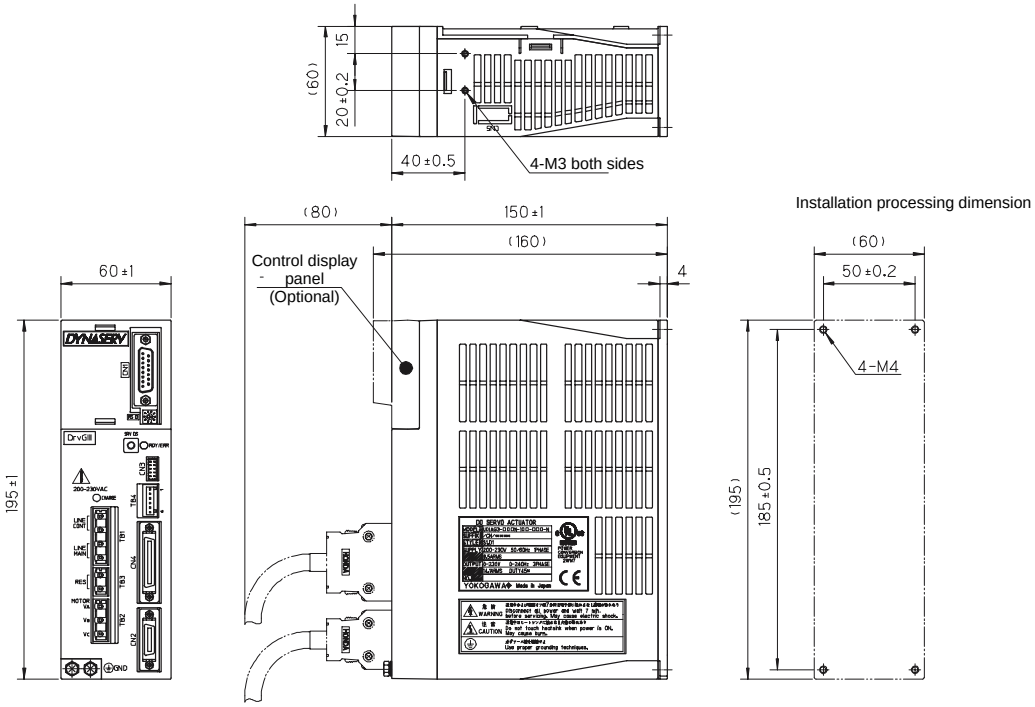
Length of stroke 300 to 1800mm



Model		From edge surface of fixed unit L	Ls	N	Mounting hole for fixed unit
LM230 LM240 LM330	-1N-030	590	300	5	2 x 6 pieces
	-1N-040	690	400	6	2 x 7 pieces
	-1N-050	790	500	7	2 x 8 pieces
	-1N-060	890	600	8	2 x 9 pieces
	-1N-070	990	700	9	2 x 10 pieces
	-1N-080	1090	800	10	2 x 11 pieces
	-1N-090	1190	900	11	2 x 12 pieces
	-1N-100	1290	1000	12	2 x 13 pieces
	-1N-110	1390	1100	13	2 x 14 pieces
	-1N-120	1490	1200	14	2 x 15 pieces
	-1N-130	4590	1300	15	2 x 16 pieces
	-1N-140	1690	1400	16	2 x 17 pieces
	-1N-150	1790	1500	17	2 x 18 pieces
	-1N-160	1890	1600	18	2 x 19 pieces
	-1N-170	1990	1700	19	2 x 20 pieces
	-1N-180	2090	1800	20	2 x 21 pieces

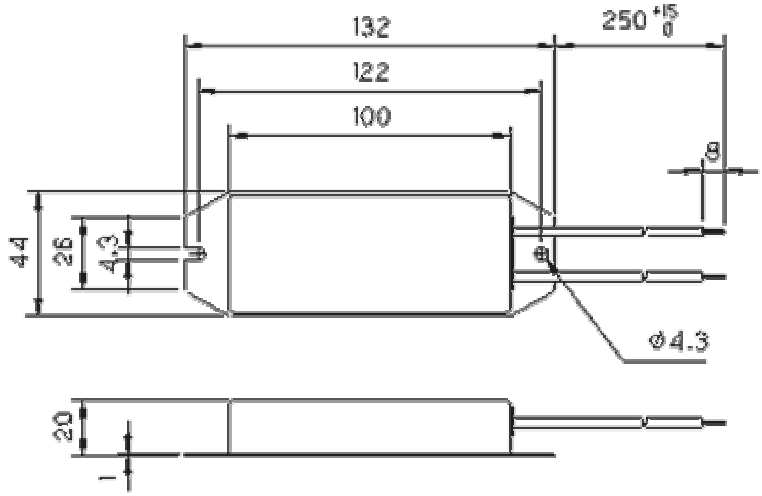
2.5.2 Drive

■ 500 W Class



2.5.3 Regeneration Resistor

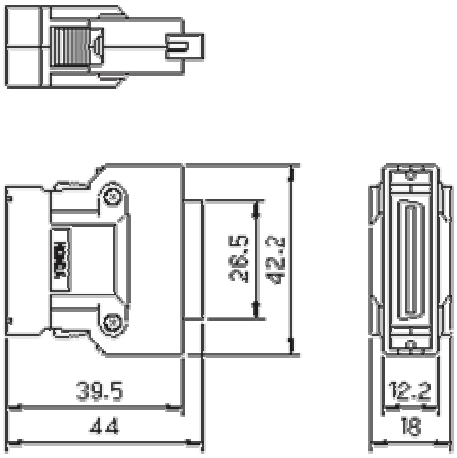
■ 80 W Regeneration Resistor



2.5.4 Connector

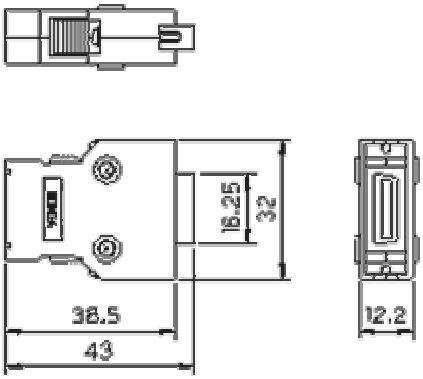
■ Controller Connector

Connector: PCR-S36FSA (made by Honda Tsushin Kogyo)
Housing: PCR-LS36LA (made by Honda Tsushin Kogyo)



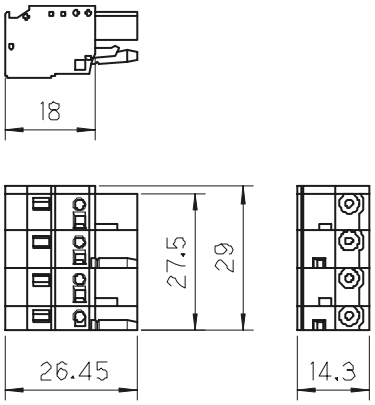
■ Encoder/Resolver Connector

Connector: PCR-S20FS (made by Honda Tsushin Kogyo)
Housing: PCR-LS20LA1 (made by Honda Tsushin Kogyo)

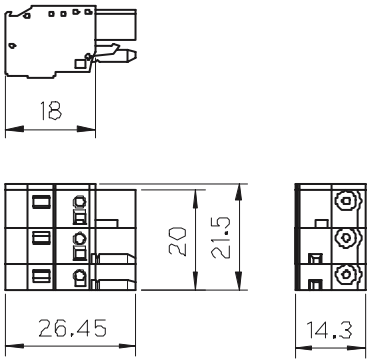


2.5.5 Terminals

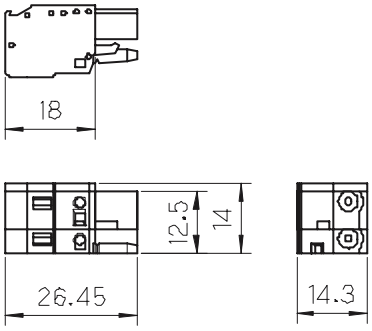
■ Main power supply/control power supply terminal
Connector: 231-204/026-000 (made by WAGO)



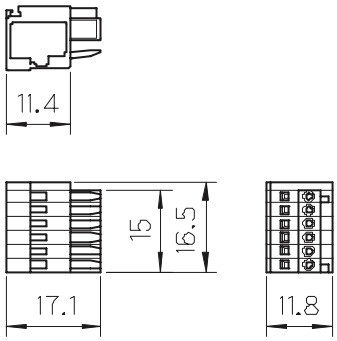
■ Motor terminal
Connector: 231-203/026-000 (made by WAGO)



■ Regeneration resistor terminal
Connector: 231-202/026-000 (made by WAGO)



■ Sensor terminal
Connector: 733-108 (made by WAGO)



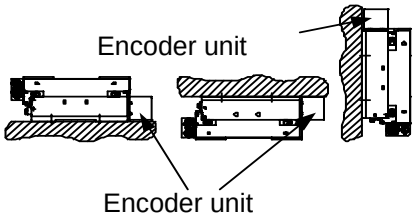
2.6 Precautions at Installation, Moving and Storage

2.6.1 Installation of the Motor

Mounting the motor the wrong way or at an inappropriate position may cause the deterioration of accuracy, shortening of the product's lifetime and a failure of the motor. Please be sure to observe the following precautions.

■ Mounting Direction

Mount the motor in one of the directions shown in the figures at right. If the motor is to be mounted vertically, mount it so that the encoder unit faces upward. If foreign substances or grease enter the encoder unit, the motor may malfunction or break down.



■ Installation Location

The motor is intended to be used in normal indoor conditions.

- Well ventilated places with little dust and debris
- Avoid installing the motor in an atmosphere with high temperature/high humidity or which contains dust, dirt, metal powder, corrosive gasses, etc.

		Motor	Remarks
Application	Temp.	0 ~ 45°C: Standard 0 ~ 40°C: CE continuous operation rating	
	Humidity	20 ~ 85% RH	There must be no condensation.
Average	Temp.	-20 ~ 85°C	
	Humidity	20 ~ 85% RH	There must be no condensation.
Atmosphere		There must be no corrosive gasses, dirt or dust Must be used at an maximum altitude of 1000 meters above sea level (CE mounting condition)	

■ Mechanical Connection

- The levelness of the load surface with respect to the slider's load mounting surface must be 0.01 mm or less.
- The clearance between the slider and mounting plate is approximately 0.1 mm. Dirt or foreign substances adhering to the base surface may cause failures.
- The motor mounting plate of products whose surface treatment suffix code is "N" is coated to prevent rust. Before mounting, wipe the coating of the base mounting surface completely with organic solvent (e.g. thinner, hydrocarbon solvent). If any coating remains, the mechanical precision and functions may be impaired. Prevent areas other than the base mounting surface, such as the core surface and guide unit, from being subjected to the solvent and any remaining coating. Failure to do so may cause deformation and breakdown. However, do not wipe off the grease in the guide unit.
- The tightening torque of screws for mounting the mounting plate and load on the slider must be 4 Nm for M4 screws, 13 Nm for M6 screws, 35 Nm for M8 screws, and 70 Nm for M10 screws. Prevent screws from loosening by applying Loctite 601 or an equivalent product.

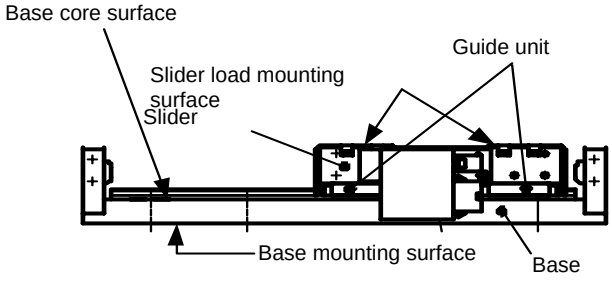


Figure shown from the connector side

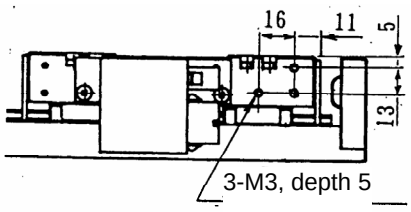
- Be sure the mounting screws of a load to the slider never reach or exceed the effective screw depth of the slider.
- The motor accuracy depends on the accuracy of the surface to which the mounting plate is attached. The surface accuracy affects the accuracy, lifetime, etc., of LINEARSERV. Therefore, the mounting plate should be mounted on a surface as accurate as possible. As a general guideline, use a reference value of 0.01 mm or less per 1000 mm of the motor's stroke length for the levelness of the mounting surface.
- Remove any burrs, dents, dirt and so forth from the surface on which the motor unit is mounted, and then place the motor unit on it carefully. Tighten the motor unit mounting bolts in the order from the center to both sides following the mounting surface. If the order of tightening the bolts is inappropriate or the bolts are tightened excessively, the motor unit may become deformed and accuracy may be impaired.

■ Stopper and Shock Absorption

The stopper in the motor is not intended to absorb impact during operation. If the stopper is subjected to shock when mounting a load, the LINEARSERV and connected devices may be damaged or broken. Carefully mount an external safety stopper, impact-absorbing mechanism or similar device in order to avoid impact while the motor is operating, stopped or in transit. Please prepare separate equipment for protection/safety procedures, such as a stopper and shock absorber.

■ Fixing Cables on the Slider

There are power and encoder cables exiting the connector parts at two places on the slider. During installation, fix the cables on the slider's side surface. Screw holes for that purpose are located on the slider's side surface. (See the figure below in the case of <LM105>, where cables are taken out to the right, or see the external appearance diagram for other models.) The connectors in the slider are for connecting the power cable and encoder cable. Prepare a fixture on the load side for the cables connected to the connectors of the slider, or fix them on the slider side using the cable attachment screws of the slider, etc., so that external force is not applied to the connectors. Failure to do so may lead to disconnection or breakdown.



<In the case of the LM105 model, where cables are taken out to the right>

2.6.2 Installation of the Drive

■ Installation Location

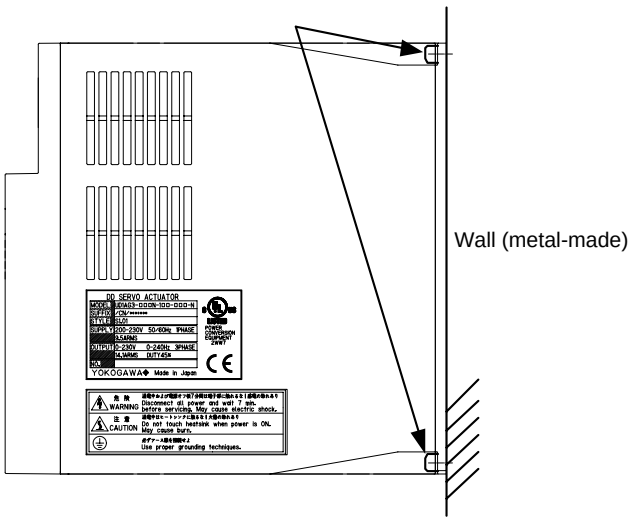
- Be sure to install the drive correctly in the control panel or on the machine.
- If there are other heating elements near the drive, make sure to prevent the temperature from becoming too high by installing a shield cover or similar protective device. Ensure that the temperature around the drive does not exceed 50°C.
- If there are vibration sources near the drive, install the drive using a vibration-proof material.
- Avoid installing the drive in an atmosphere with high temperature/high humidity or which contains dust, dirt, metal powder, corrosive gasses, etc.

		Drive environment specification	Remarks
At operation	Ambient temperature	0 ~ 50°C	
	Ambient humidity	20 ~ 90% RH	There must be no condensation.
At storage	Ambient temperature	-20 ~ 85°C	
	Ambient humidity	20 ~ 90% RH	There must be no condensation.
Atmosphere		There must be no corrosive gasses, dirt or dust. Must be used at an maximum altitude of 1000 meters above sea level (CE mounting condition)	

■ Installation Procedure

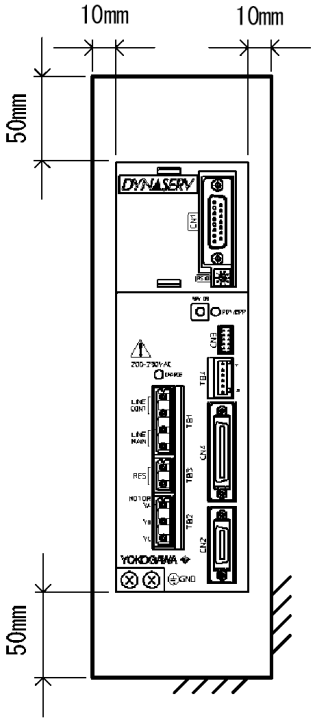
The drive is intended to be mounted on a vertical surface. Use the four mounting holes in the die cast section, and mount the drive securely to a metal plate.
If you use flat washers, use washers whose external diameter is 8mm (ISO).

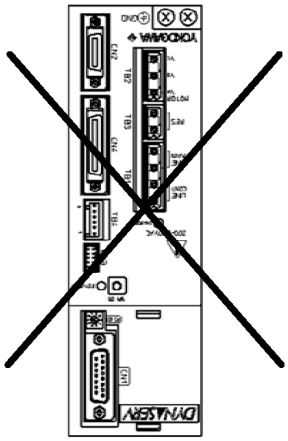
M4 screws in four places Tightening torque: 1.4N-m



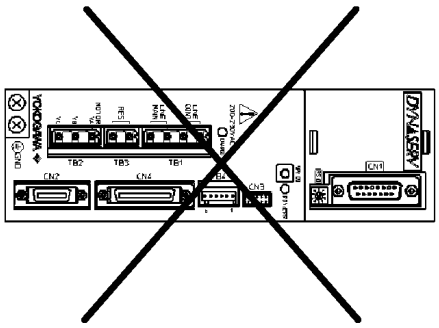
■ 500W Class Drives

- This drive utilizes convection (fanless) air cooling.
- Install the drive with the front panel facing forward. Do not install it with the panel surface facing upward or downward, up side down or sideways (see the figures below).
- Allow a clearance of 50mm or more above and below the drive and 10mm or more on the left and right sides for ventilation.
- The power consumption used by the drive itself is 30W.





Do not install up side down



Do not install sideways

2.7 Stop Function in Error State

When an error occurs, the DrvGIII has the servo-deceleration and dynamic brake functions (only by selecting the built-in brake option) to bring the motor to a stop.
The servo-deceleration function performs to decelerate motor by servo immediately after an error occurs.
The dynamic brake is an optional function in case “built-in brake” (Code -1B or -1L) is selected.
The combination of servo-deceleration and dynamic brake contributes to minimize the free running distance.

2.7.1 Servo-Deceleration

The servo-deceleration function is executed immediately when the defined error occurs. The servo -deceleration can be performed even in the case of a power failure because the control power is kept alive by internal capacitors for approximately 100msec (at rated voltage). The holding time length may be shortened by the power environment, operation condition and connection of operation display pendant / operation display panel. Also, the holding time length differs depending on the drive power output.
Detecting condition for the power failure is variable by the power monitoring cycle setup by “the parameter #110. System setup register 1.”

■ Effective Range of Servo-Deceleration

For specified error, the reaction of drive, how to execute the servo-deceleration, is available to set. Refer “ 6.1.4 Process Settings in Error State” for the detailed setup method. The error process settings disclose the related #parameters on the condition that the user bears the responsibility for any result by settings.

Errors that can use the servo-deceleration function

Error name	Error code
Over speed	24.0
Overload	22.1 22.2
Excessive position error	23.0
Excessive commanded position differential value	31.0
Coordinate error A	16.1
Bus voltage dropping	20.3
AC mains power supply voltage error	21.0
Hardware EOT	42.0 43.0
Software EOT	44.0 45.0
Monitor pulse output error	18.0
Interface emergency stop	46.2

Operation mode and error process type available for servo-deceleration

Drive Mode / Error Processing Type	Control by Built-in Controller		Control by External Controller		
	Table data operation	Jog operation	Position control	Velocity control	Torque control
Servo ON sustaining after deceleration and stop	○	○	○	x (Input is shutdown immediately after the error occurs, and the velocity command to drive becomes zero.)	x (Input is shutdown immediately after the error occurs, and the torque/thrust command to drive becomes zero.)
Servo OFF after deceleration and stop	○	○	○		
Servo ON sustaining after immediate stop	○	○	○		
Servo OFF after immediate stop	○	○	○		
Servo OFF immediately	x	x	x	x	x

X: Unavailable
○: Available

! DANGER

Control power may become uncontrollable or AC mains power may become below servo OFF level under power failure. In this case, motor may run freely if dynamic brake option is not selected. Make sure to implement safety measure such as braking by external system (mechanism).

! DANGER

If you select "Servo OFF immediately," the motor may run freely. Be sure to take steps to secure safety, such as using an external brake system.

! DANGER

Even if an error, for which the servo-deceleration is assigned, occurs, the servo is turned OFF and servo-deceleration function is unavailable if the following errors occur before such error or during the servo-deceleration.

- 4.0 Watch dog error
- 15.* Encoder error
- 20.1 Excessive voltage
- 20.2 IPM fault or Current transfer detected
- 20.4 Low voltage (servo OFF level)
- 20.5 Phases A and B actual current monitoring
- 25.* Regeneration error
- 30.0 Servo not ready

2.7.2 Dynamic Brake (with selection -1B)

The dynamic brake is an optional function is available only when "built-in brake" (code -1B) is selected.
This is supplemental brake to minimize free-run distance by motor control torque generated by shorted motor winding when an error occurs and servo is turned OFF.

When AC mains or control power is turned OFF, the dynamic brake is activated. When it is necessary to cancel the dynamic brake, make sure to set safe and appropriate external circuit so that the motor wiring is cutoff.

Braking force of dynamic brake differs depending on motor, load and operational conditions. Simulate under the worst conditions with the motor, and make sure to implement safety measure such as braking by external system (mechanism).

■ Effective range of dynamic brake

Dynamic brake activates under the following conditions. Set “System setup register 1 of parameter #110 to activate the brake when error occurs.

1. Shutdown of AC mains or control power
2. Bus voltage of drive drops down to below servo OFF level
3. Servo is turned OFF if “Brake-ON during servo-OFF” option of system setup register 1 in parameter #110 is set to “1: Enable).

The dynamic brake is in intended for use when servo is turned OFF by an error.
Do not use the brake for frequent stop operation in servo-OFF or power-OFF during operation or usage to rotate the motor by an external force. Continuous activation of dynamic brake circuit may cause degradation of element in drive and unexpected defect or malfunction.
Make sure to control the motor by normal control mode (torque, velocity or position command) in order to stop the motor.

2.7.3 Example

This example is a referential case on the basis of our examination conditions. The effect differs depending on the motor, drive, load and power environmental conditions.

■ Test Condition

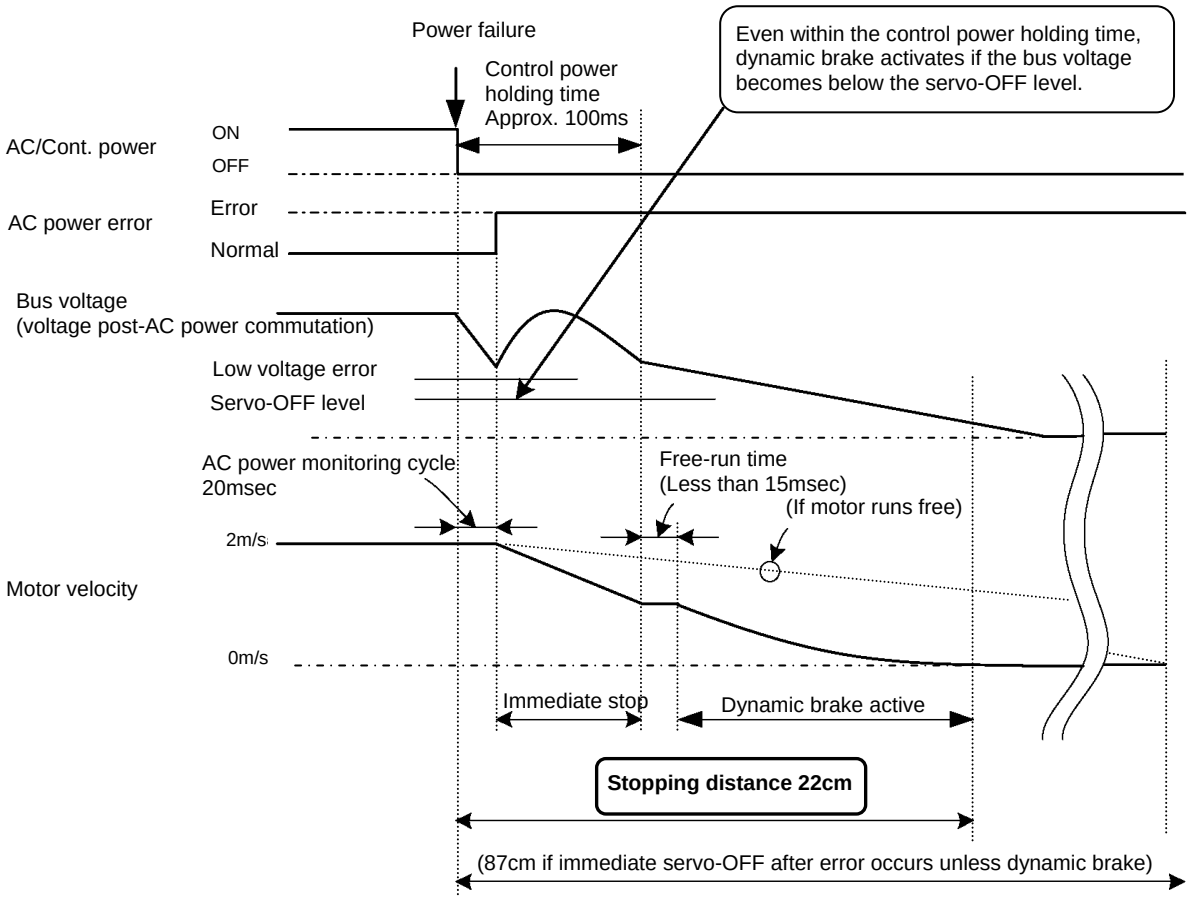
These conditions are for the simulation when the drive's AC mains and control powers are shutdown. AC power monitoring cycle can be set between 20 msec to 170 msec, and the effect of servo-deceleration differs depending on the range. In this case, it is set to make the highest sensitivity.

Operational conditions for motor and drive

Item	Condition
Drive	UM1LG3-330B-1BA-2SA-N
Motor	LM330-1N-120-AN-G2B-N2F
Load	025.5kg
Power	AC200V
Option	Without operation display pendant and display panel
Control mode	Position control mode
Velocity	2m/s (Jog operation)
Acceleration type	Constant acceleration and deceleration

Error processing conditions

Parameter setting		Setting
Brake-OFF during Servo-OFF (System setup register 1)		ON
AC power monitoring cycle (System setup register 1)		20msec
Main power error	Valid/Invalid (Error process setup register 1)	Valid
	Process (Error process setup register 1)	Servo ON sustaining after immediate stop
Bus voltage dropping	Valid/Invalid (Error process setup register 1)	Valid
	Process (Error process setup register 1)	Servo ON sustaining after immediate stop
Deceleration time for immediate stop (#80)		250msec



TIP

Sets dead zone for AC power monitoring cycle value against instant power failure. Power failure detection delays if this setting value (time) is large although it does not influence for an instant power failure. Consequently, the servo deceleration time becomes long, and it takes a time to stop.
Set the value upon consideration of power environment.

TIP

When considerable energy is required, e.g. at acceleration, the bus voltage may drop quickly. In this case the servo deceleration function cannot be used. Configure the system so that power failures are detected by an external system and the main power supply is backed up by an uninterruptible power supply or similar until the servo deceleration is complete.

2.8 Operating Restrictions

2.8.1 Restrictions on the Number of EEPROM Registrations

The user setting data (parameters, table data and I/O data) is stored in the EEPROM built into the drive. There is a restriction on the number of times to overwrite the data due to the EEPROM characteristics. The number of allowable times to overwrite each area (parameters, table data and I/O data) is approximately 1 million times, respectively.

2.9 Conformed Standards

In order to conform to the EMC directive, it is necessary to obtain certification for the entire equipment, including Yokogawa Electric's motor and drive, and control devices and electric components used in the customers' equipment.
The conformity of equipment to the EMC directive varies depending on the structure of control devices and components used in equipment, and wiring. It is the customers' responsibility to check and certify equipment's conformity.

■ Motor

- Low Voltage Directive (declaration) IEC34-1
- EMC directive (declaration) EN55011 class A group 1, EN61800-3

■ Drive

- Low Voltage Directive (declaration) EN50178
- EMC directive (declaration) EN55011 class A group 1, EN61800-3
- UL508C

[Conformation to UL standard]

The drive is certified to conform to the following UL standard:
Conformance with standard UL508C (File No. E238911)

[UL Standard Certification Conditions and Safety Precautions]

(i) Use 60/70 degrees Celsius CU wire only.
(ii) Open Type Equipment. Be sure to install the drive in the control panel before using it. It cannot be used if hung on a wall.
(iii) Suitable for use on a circuit capable of delivering not more than 5000 rms symmetrical amperes, 240V maximum.
(iv) Distribution fuse size marking is included in the manual to indicate that the unit shall be connected with a Listed Class RK1 Fuse with the current ratings as shown in the table below:

Model No.	Class RK1 Fuse
All 500 W models	5 [A]
All 2kW models	15 [A]

(v) Maximum surrounding air temperature 50 degrees Celsius.
(vi) CAUTION - Risk of Electric Shock - Capacitor discharge time is at least 7min.
(vii) CAUTION - Risk of Electric Shock - More than one disconnect switch may be required to deenergize the equipment before servicing.
(viii) Solid state motor overload protection is provided in each model.
(ix) Install device in pollution degree 2 environment.
(x) WARNING - Hot Surface – Risk of Burn.

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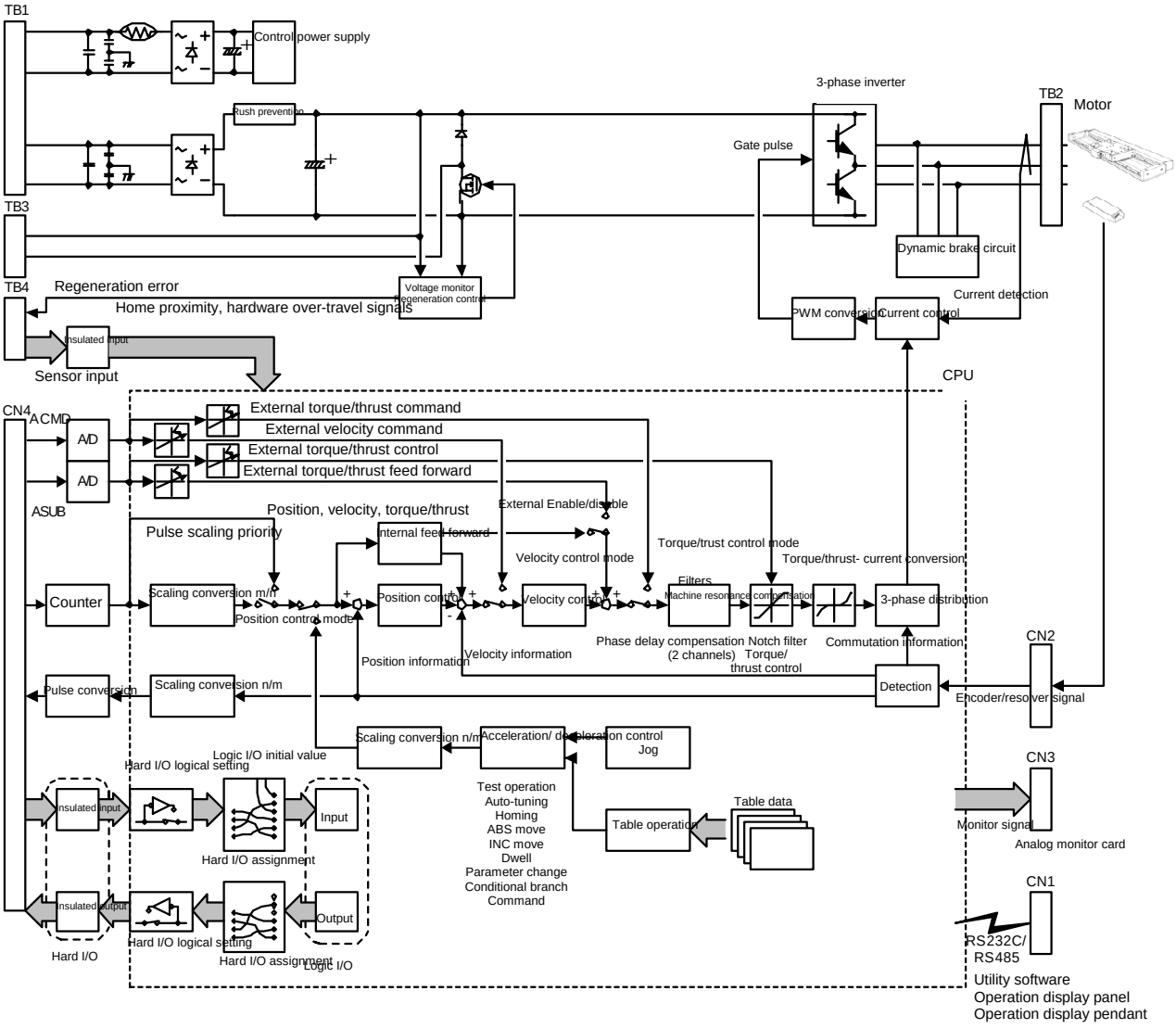
3. System Configuration

The system configuration of the drive is shown in the figure below.



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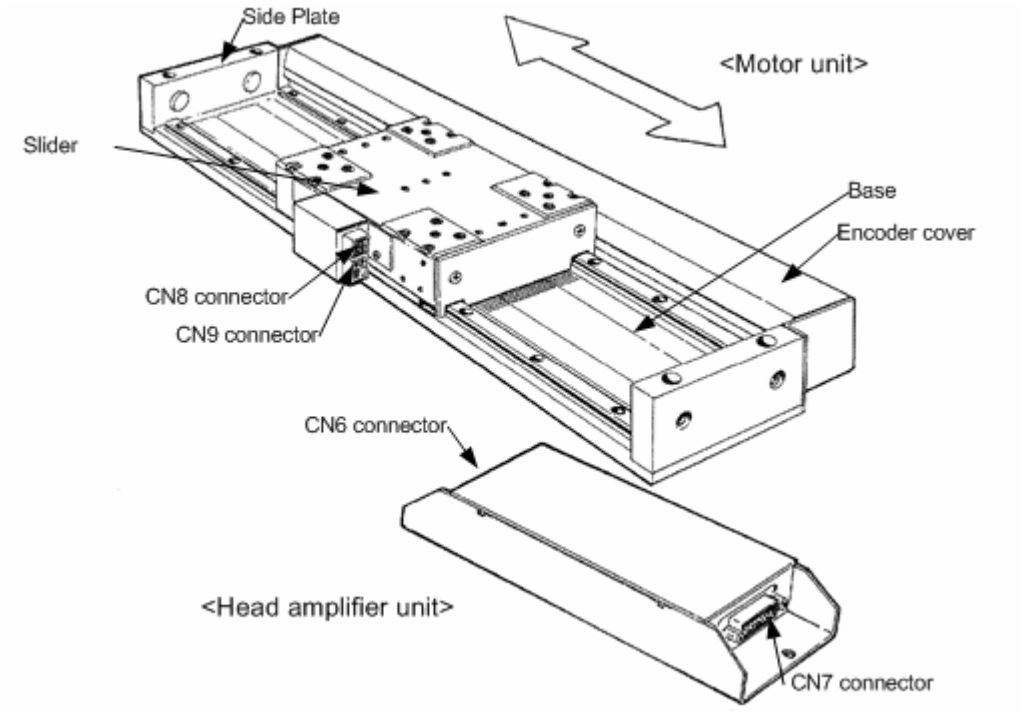
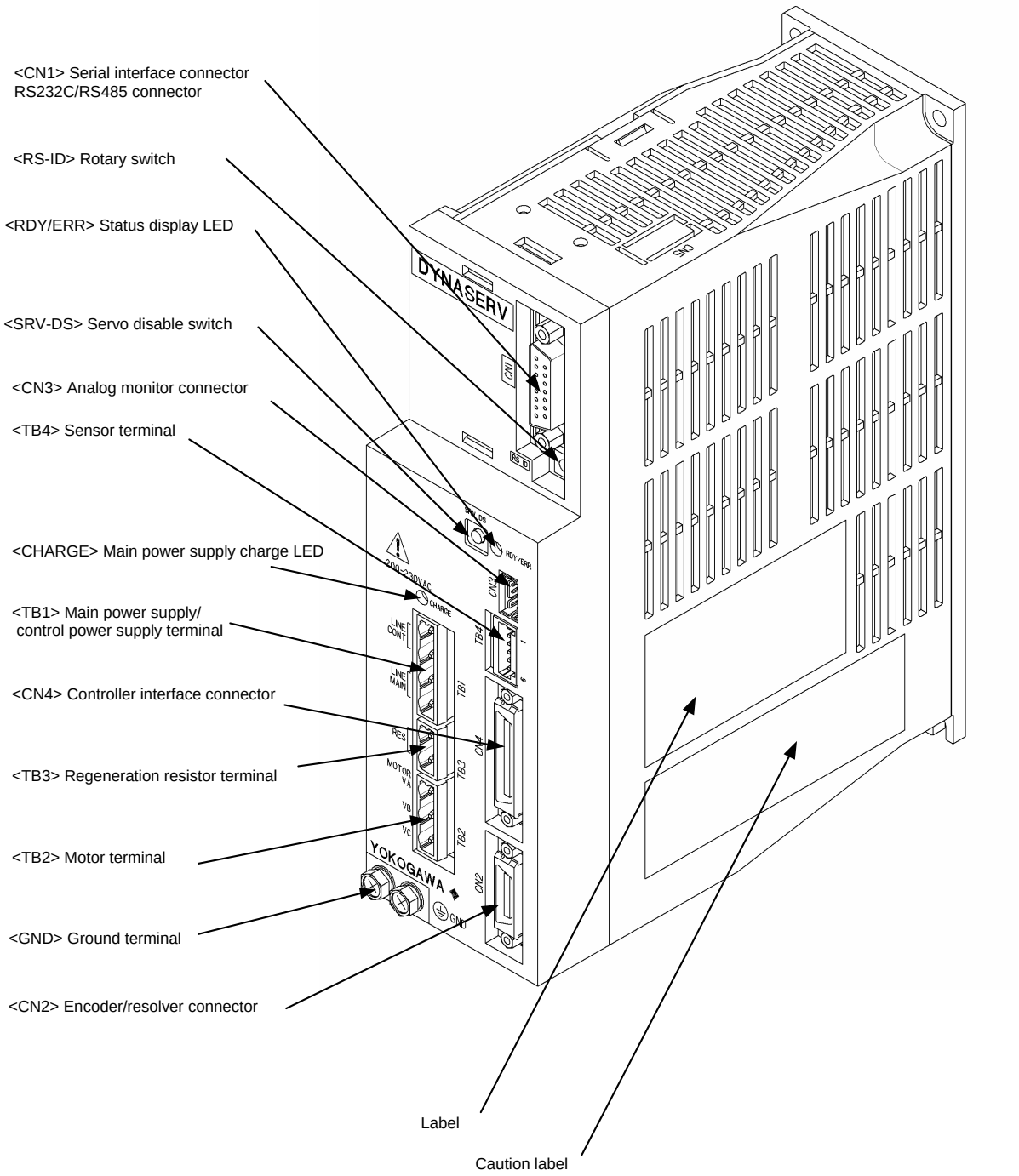
4. Name and Function of Each Part

4.1 Motor Unit

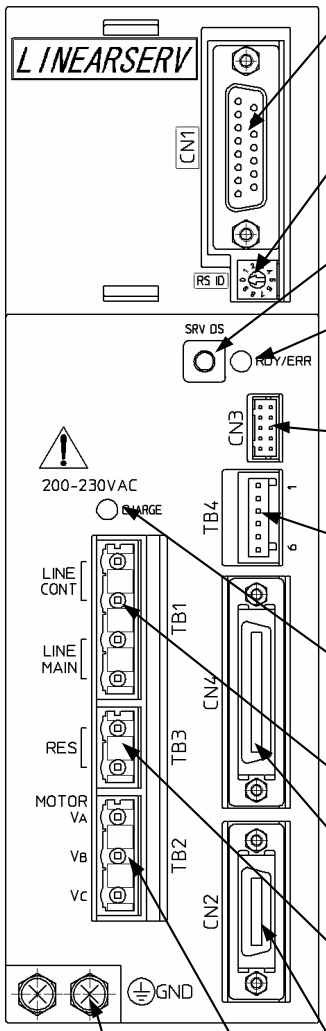


4.2 Drive Unit

4.2.1 500W Class



4.2.2 Explanation of the Front Panel



<CN1> Serial interface connector RS 232C/RS485
Connect the operation display panel, operation display pendant and PCs to this connector.

<RS-ID> Rotary switch
A slave station ID of multi-channel communication via RS485 is set according the status when the power supply is turned on.

The number of the rotary switch indicates a slave station ID.

<SRV-DS> Servo disable switch
The servo is turned off only while this switch is being pressed.

<RDY/ERR> Status display LED
It displays the status of the drive.
Green: RDY No error
Red: ERR Error occurred

<CN3> Analog monitor connector
It is possible to observe torque and velocity waveform with an oscilloscope.
The analog monitor card (optional, part number R7041WC) is available.

<TB4> Sensor terminal
It is a sensor input and error output.
Input Home sensor
EOT signals
Output Regeneration error

<CHARGE> Main power supply charge LED
It displays the status of the main power supply.
The internal electrolyte capacitor is being charged when it is lit.

<TB1> Main power supply/control power supply terminal
It is an input terminal for the main power supply/control power supply.

<CN4> Controller interface connector
Connect a controller such as PLC to this connector.

<TB3> Regeneration resistor terminal
Connect a regeneration resistor to this terminal.
500 W Connect the attached regeneration resistor.
2 kW External regeneration resistors will be required if you rotate the motor with external force.
(please consult us separately).

<CN2> Encoder/resolver connector
Connect the encoder/resolver cable of the motor to this connector.

<TB2> Motor terminal
Connect the power cable of the motor to this terminal.

<GND> Ground terminal
This is a ground terminal. Make sure to connect the motor ground and power supply ground.

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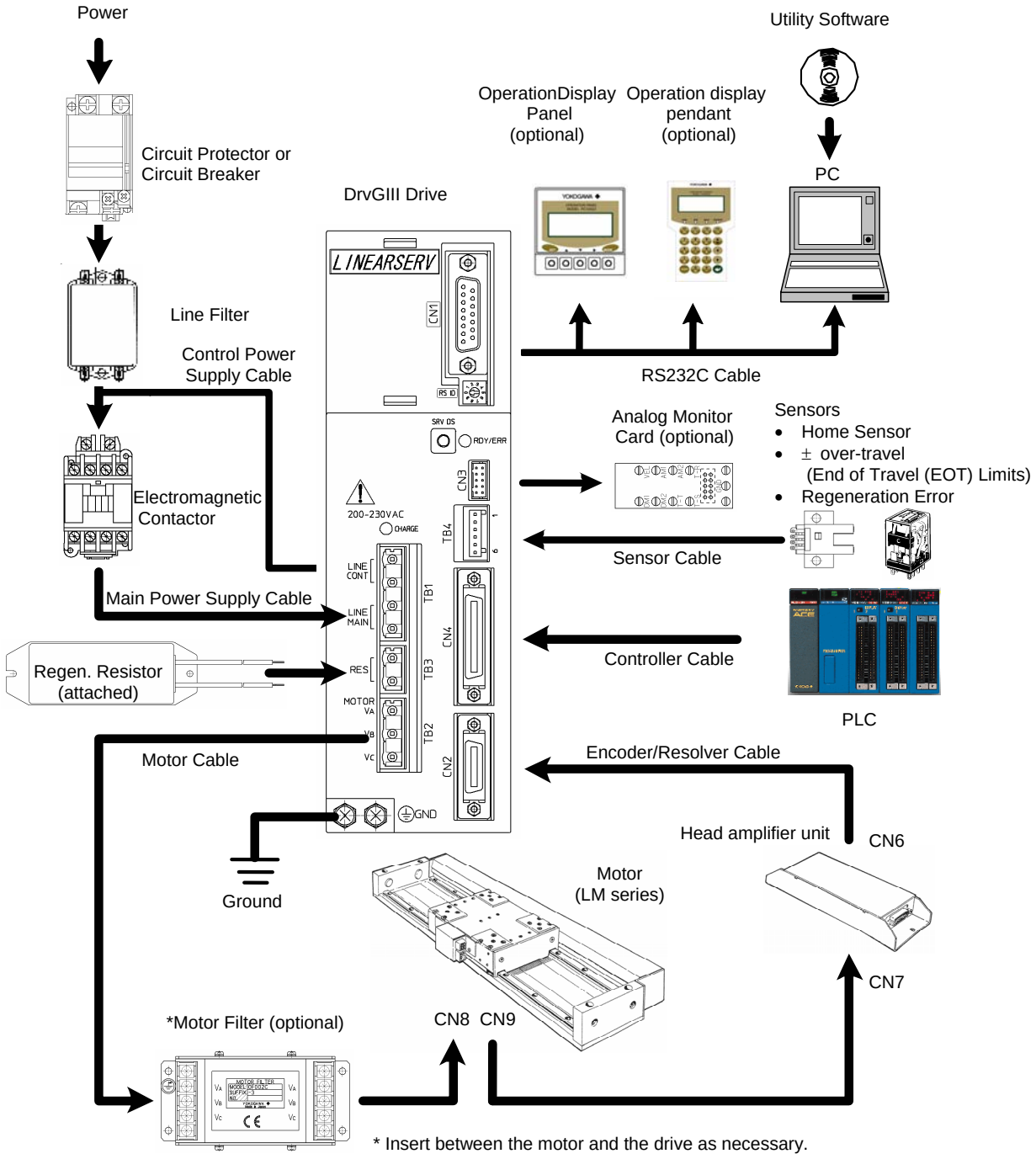
C

5. Wiring

5.1 Overall Connection

5.1.1 Connection Diagram



5.1.2 Circuit Protector

Drive	Circuit protector	
	Model	Specification
500W class	CP32FM/5W (Fuji Electric)	250VAC, 5A
	CP30-BA2P1M5A (Mitsubishi Electric)	250VAC, 5A
2kW class	CP32FM/15W (Fuji Electric)	250VAC, 15A
	CP30-BA2P1M15A (Mitsubishi Electric)	250VAC, 15A

DANGER

The drive does not have a built-in ground protection circuit. Install a ground-fault interrupt circuit with short-circuit protection or a ground-fault interrupt circuit for ground protection together with a circuit breaker if safety is of high priority in the system.

5.1.3 List of Recommended Parts

Drive	Electromagnetic contactor	Line filter		Motor filter
		Model	Specification	
500W class	SC11AA-M10 (Fuji Electric)	FN2070-6/06 (SCHAFFNER)	Single-phase AC 250V, 6A	OF002C-3 (Yokogawa Electric)
	S-N11 (Mitsubishi Electric)			
2kW class	SC18AA-M10 (Fuji Electric)	FN2070-10/06 (SCHAFFNER)	Single-phase AC 250V, 10A	
	S-N18 (Mitsubishi Electric)			

Drive	Sensors (EOT Limits and Home)	Relay
Common for 500W and 2kW classes	EE-SX670 (Omron)	MY2-D DC24V (Omron)

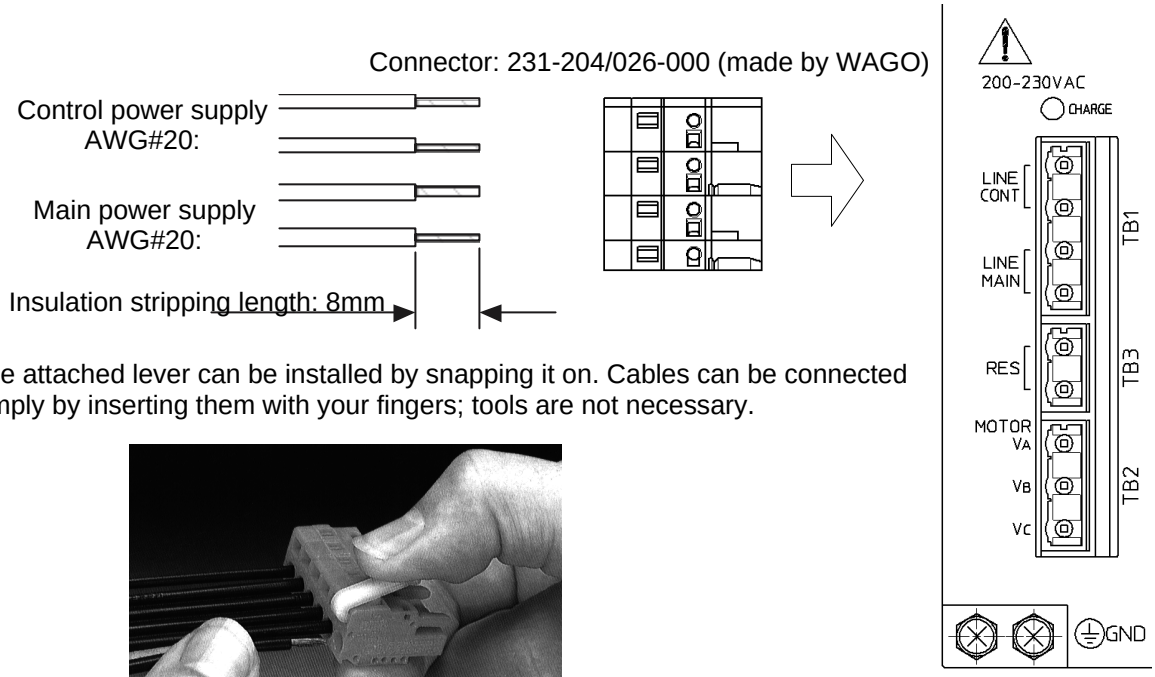
Notes: 1. Make sure to select parts that accommodate the total capacity of the system if two or more drives are used in the system.
2. Insert a motor filter as necessary.

5.1.4 List of Cable Specifications

■ 500 W Class Drive Connection Cables

Cable	Specification	Current
Main power supply	AWG#20 (2.0mm^2) or more, length 30m or less	6A
Control power supply	AWG#20 (0.5mm^2) or more, length 10m or less	1A
Motor	AWG#20 (0.5mm^2) or more, length 10m or less	6A
Ground	AWG#14 (2.0mm^2) or more (Use as thick a cable as possible.) Class 3 ground (ground resistance 100 Ω or less)	
Sensors (Limits and Home)	AWG#28 ~ 20 (0.08 ~ 0.5mm^2)	
Encoder/resolver	AWG#24 (0.2mm^2) twisted pair cable with a common shield, external diameter ∅9mm or less, length 10m or less	0.1A
Head amplifier	AWG#22 (0.3mm^2) twisted pair cable with a common shield, external diameter ∅9mm or less, length 5m or less	
Controller	AWG#28 ~ 20 (0.08 ~ 0.5mm^2) cable with a common shield, external diameter ∅14mm or less, length 3m or less	0.5 A
RS232C	Dedicated cable: C1P-ENN-2276-020 (2.0m)	

5.2 Main Power Supply/Control Power Supply Terminal <TB1>

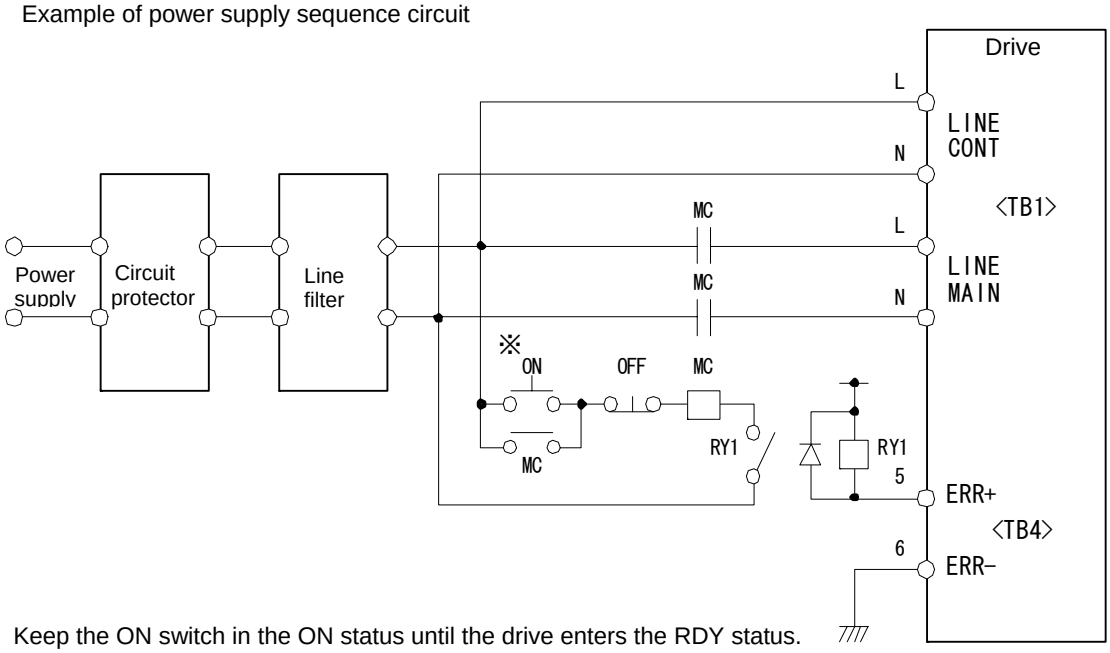


The attached lever can be installed by snapping it on. Cables can be connected simply by inserting them with your fingers; tools are not necessary.

CAUTION

Set up a sequence circuit similar to the one shown below in order to avoid accidents where the drive burns out in case of over-voltage errors and regeneration errors.

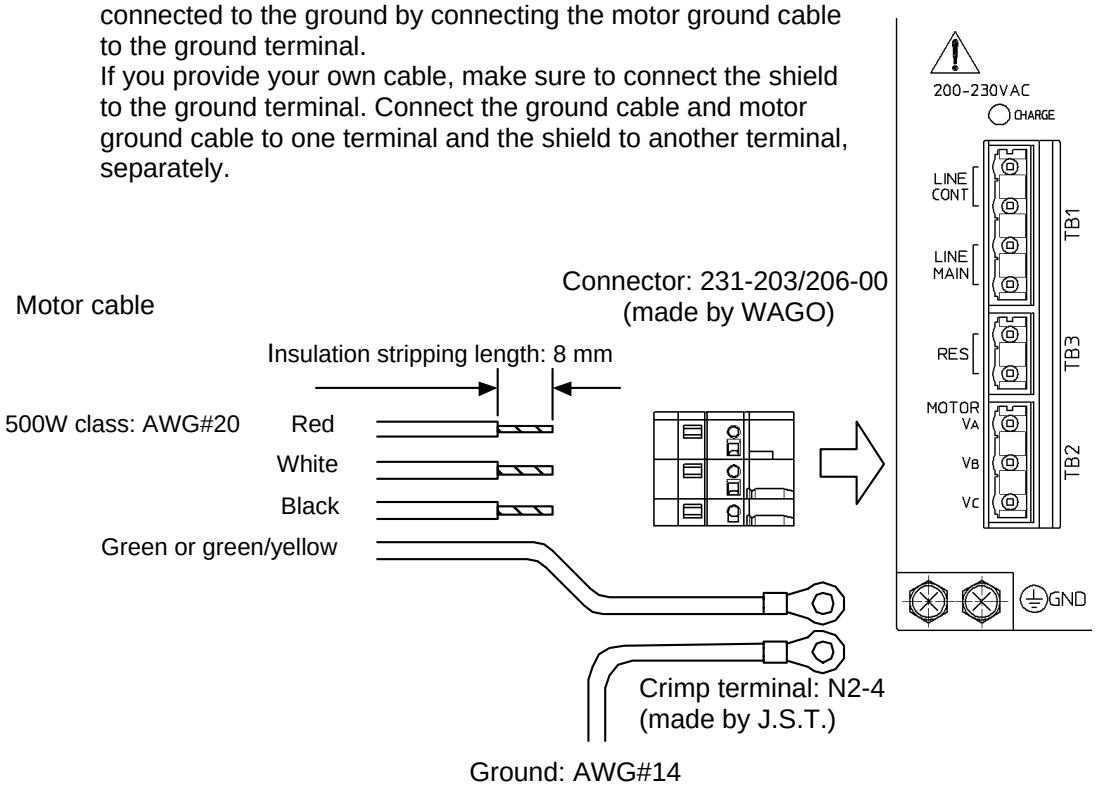
Example of power supply sequence circuit



Keep the ON switch in the ON status until the drive enters the RDY status.

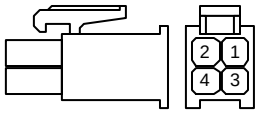
5.3 Motor Terminal/Ground <TB2>

Yokogawa's motor cables are twisted pair cables with a common shield with the motor ground cable. The shield is connected to the ground by connecting the motor ground cable to the ground terminal.
If you provide your own cable, make sure to connect the shield to the ground terminal. Connect the ground cable and motor ground cable to one terminal and the shield to another terminal, separately.



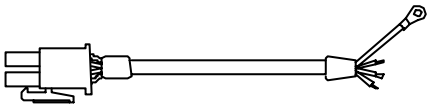
■ Terminal on Motor Side <CN8>

Housing: 172167-1 or 172338-1 (made by AMP)
Terminal: 170366-3 (made by AMP)
Manual tool : 755331-1 (made by AMP)



Pin #	Signal name
1	V_A
2	V_B
3	V_C
4	GND

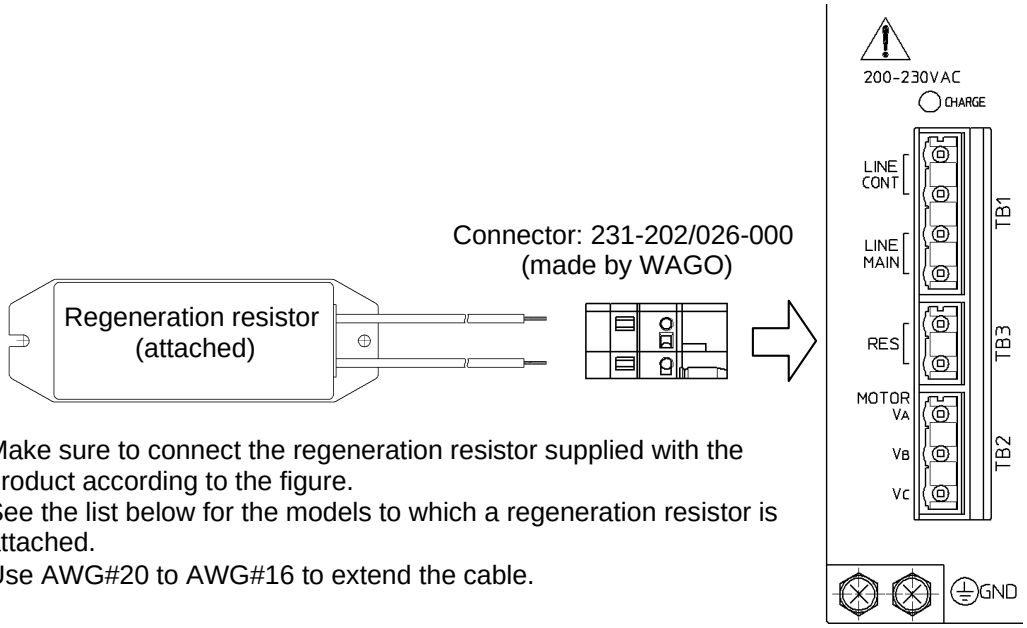
■ **Cable Specifications**

Cable	Specification
Motor	AWG#20 (0.5mm^2) or more, length 10 m or less
	Optional cable: C1M-NA1-2061-□□□ 
Ground	AWG#14 (2.0mm^2) or more (Use as thick a cable as possible.) Class 3 ground (ground resistance 100Ω or less) Tightening torque of the terminal screws: 1.2N-m (12kgf-cm) (terminal screws: M4 x 0.7)

! DANGER

Make sure to perform ground in order to avoid electric shock accidents. Moreover, make sure to connect the GND terminals of the motor and the drive.

5.4 Regeneration Resistor Terminal <TB3>



- Make sure to connect the regeneration resistor supplied with the product according to the figure.
  See the list below for the models to which a regeneration resistor is attached.
- Use AWG#20 to AWG#16 to extend the cable.

■ List of Models Provided with Regeneration Resistors

Model	Suffix code	Regeneration resistor	
UM1LG3	-330□-□□A-1□□-N	80W	60 Ω
	-530□-□□A-1□□-N		
	-240□-□□A-1□□-N		
	-330□-□□A-2□□-N	80W	200 Ω
	-530□-□□A-2□□-N		
	-240□-□□A-2□□-N		

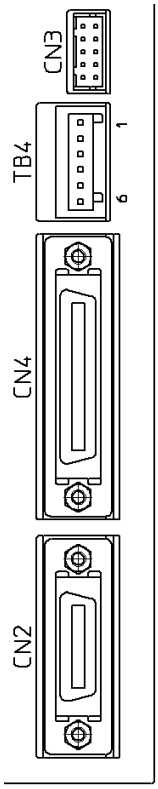
CAUTION

If the motor is rotated by external force, etc., additional large regeneration resistors will be required, regardless of whether or not a regeneration resistor is supplied with the model. Inquire at our sales department for more information.

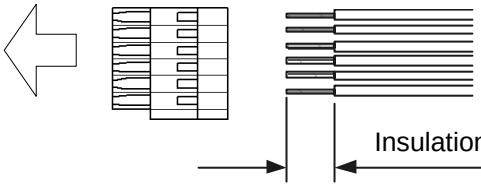
DANGER

A regeneration resistor generates high temperatures. Do not touch the regeneration resistor while operating the motor and the drive until the temperature has cooled down sufficiently.

5.5 Sensor Terminal <TB4>



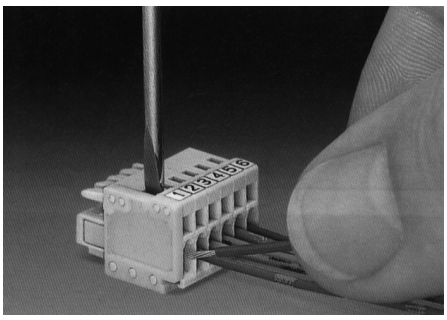
Connector: 733-106
(made by WAGO)



Wire size: AWG#28 to AWG#20

Insulation stripping length: 5mm

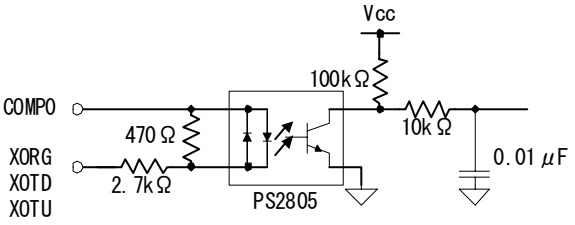
The connector can be attached through one-touch operation by pulling down the spring in the slot in the upper part of the connector using a drive.
(The size of the tip of a drive is 2.0 x 0.4mm.)

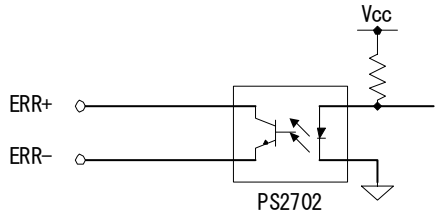


Pin No.	Signal name	Definition
1	COMP0	Sensor power
2	XORG	Home input B-contact
3	XOTD	- EOT input B-contact
4	XOTU	+ EOT input B-contact
5	ERR+	Regen. Resistor error output +
6	ERR-	Regen. Resistor error output -

Sensor input specification	
Rated voltage	12 to 24VDC (±10%)
Rated input current	4.1 mA/point (at 12VDC) 8.5 mA/point (at 24VDC)
Input impedance	3.0 kΩ
Operating voltage (relative to COMP0)	Off: Less than 3.0VDC On: 9.0VDC or more
Allowable leak current	Guarantee OFF at 1.0 mA or less

Regeneration error output	
Maximum service voltage	30VDC
Maximum output current	50 mA





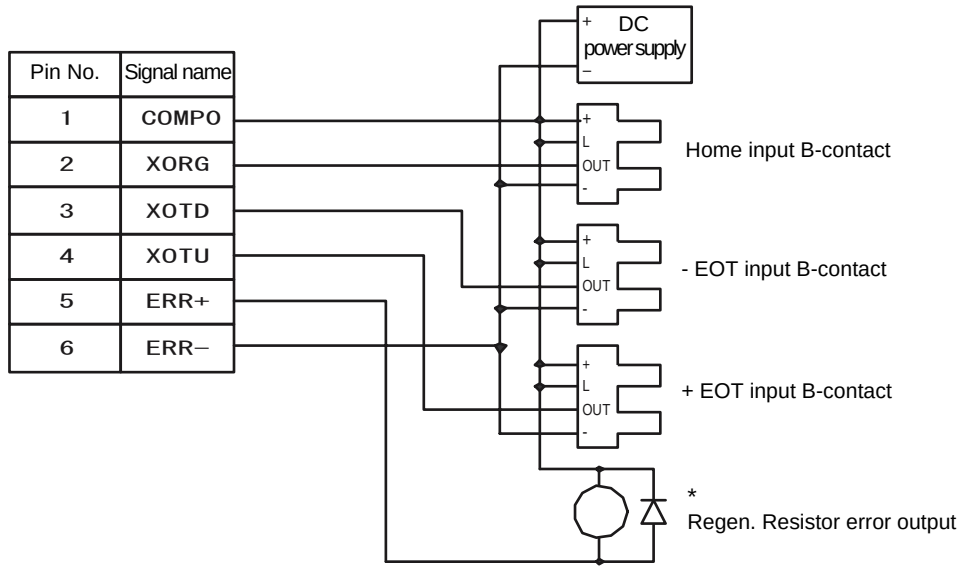
CAUTION

Make sure to set up a sequence circuit as shown in Section 5.2, "Main Power Supply/Control Power Supply Terminal <TB1>" in order to avoid accidents where the drive fails due to over-voltage errors and/or regeneration errors.

Example of sensor connection (Sensor: EE-SX670 made by Omron)

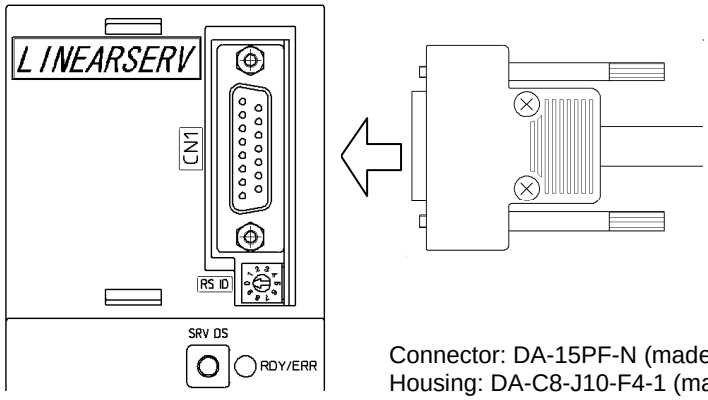
The sensor logic is connected to B-contact.
The sensor output must be set to switch OFF when the light is blocked.
The sensor of the type described above is turned off when the light is blocked by connecting cables as shown below.

Pin No.	Signal name
1	COMPO
2	XORG
3	XOTD
4	XOTU
5	ERR+
6	ERR−



* See Section 5.2, "Main Power Supply/Control Power Supply Terminal " for more information about wiring the regeneration alarm outputs.

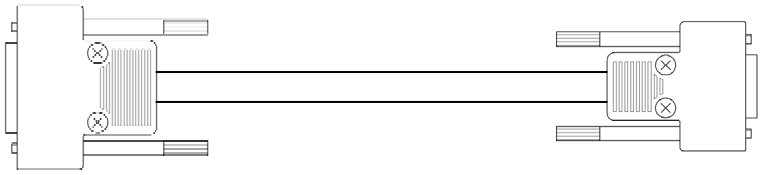
5.6 Serial Interface Connector <CN1>



Connector: DA-15PF-N (made by JAE)
Housing: DA-C8-J10-F4-1 (made by JAE)

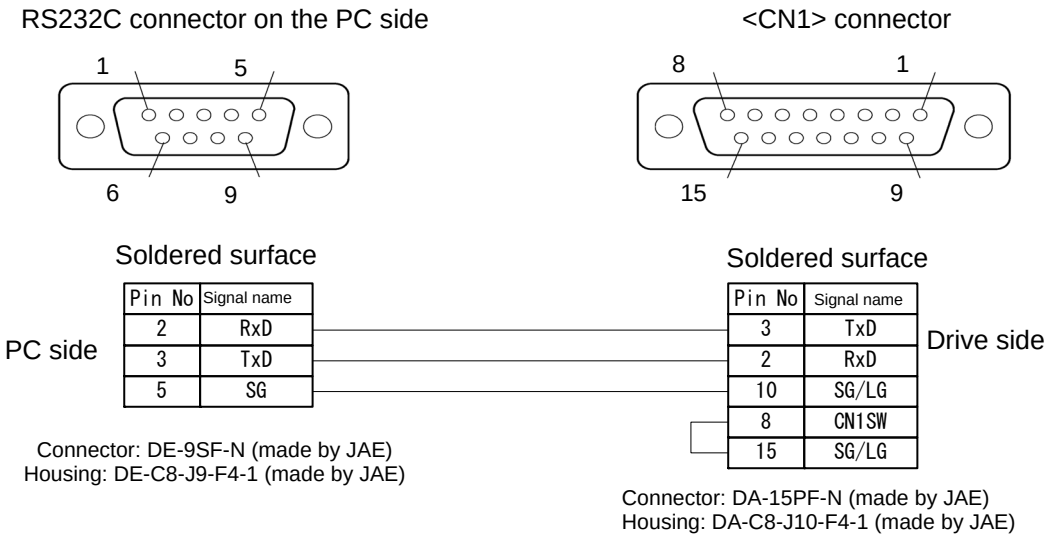
Pin No.	Signal name	Definition
1	FG	Frame GND terminal (Shield)
2	RxD	RxD terminal RS232C single channel communication
3	TxD	TxD terminal RS232C single channel communication
4	A	Rx (+) side terminal RS485 multi-channel communication
5	Y	Tx (+) side terminal RS485 multi-channel communication
6	485SW	Busy condition bit RS485 multi-channel
7	TRMP	Terminator terminal RS485 multi-channel communication (short circuited to #14 TRMN)
8	CN1SW	Busy condition bit CN1
9	+5V	+5V power (operation display panel and pendant)
10	SG/LG	Signal GND terminal
11	B	Rx (-) side terminal RS485 multi-channel communication
12	Z	Tx (-) side terminal RS485 multi-channel communication
13	SG/LG	Signal GND terminal
14	TRHN	Terminator - terminal RS485 multi-channel communication (short circuited to #7 TRMP)
15	SG/LG	Signal GND terminal

■ RS232C Cable (Optional)



C1P-ENN-2276-020 (2.0 m)

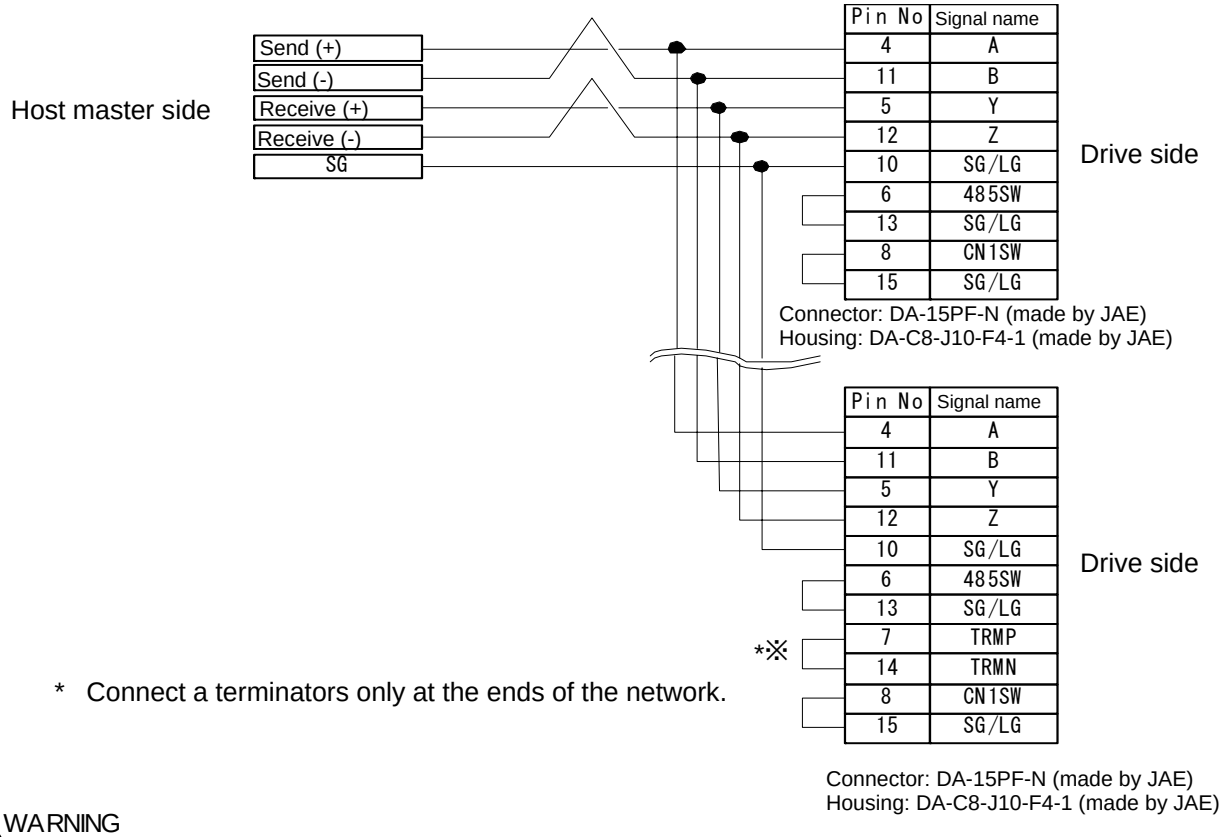
■ RS232C Cable Wiring



WARNING

Do not connect any line to pins that are not specified.
Wrong connections may cause the drive and/or PC to breakdown.

■ RS485 Cable Wiring

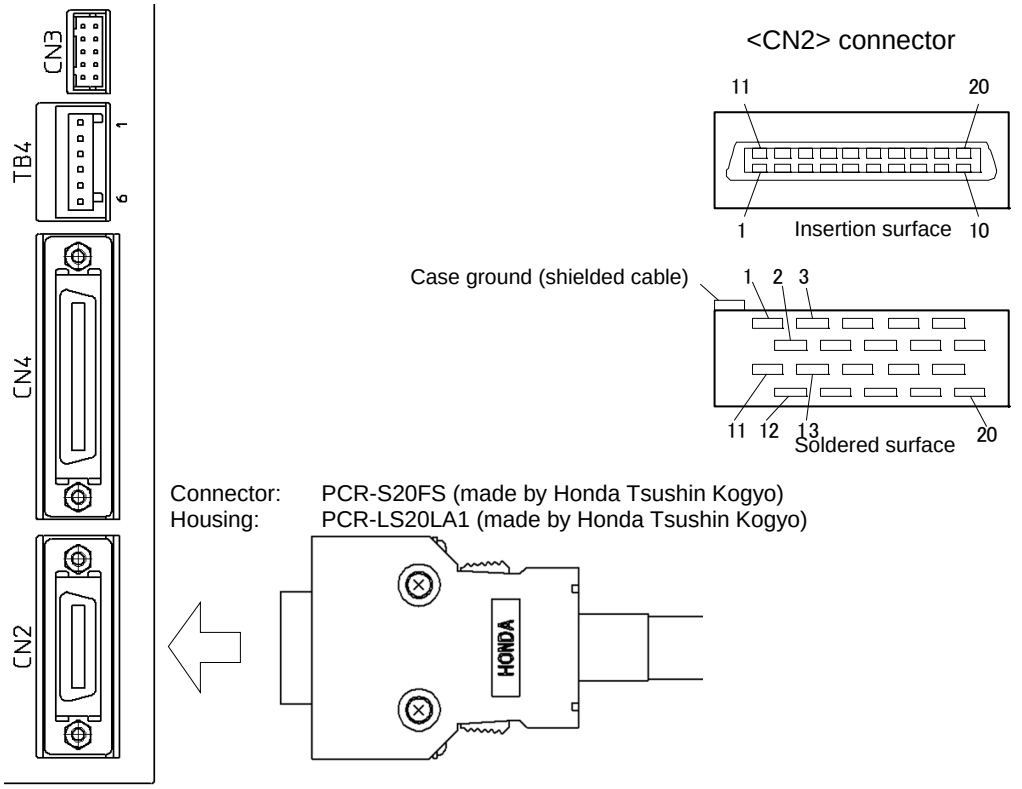


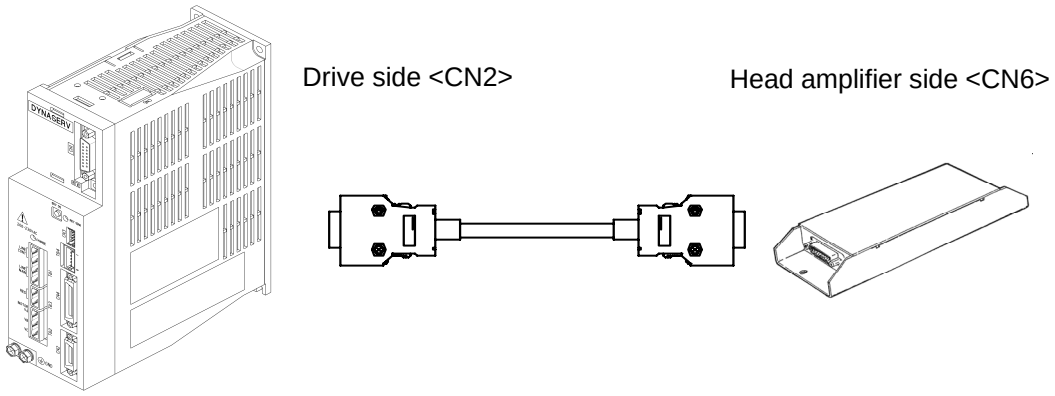
* Connect a terminators only at the ends of the network.

WARNING

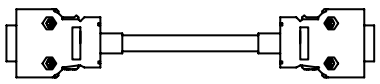
Do not connect any line to pins that are not specified.
Wrong connections may cause the drive and/or PC to breakdown.

5.7 Encoder/Resolver Connector <CN2>





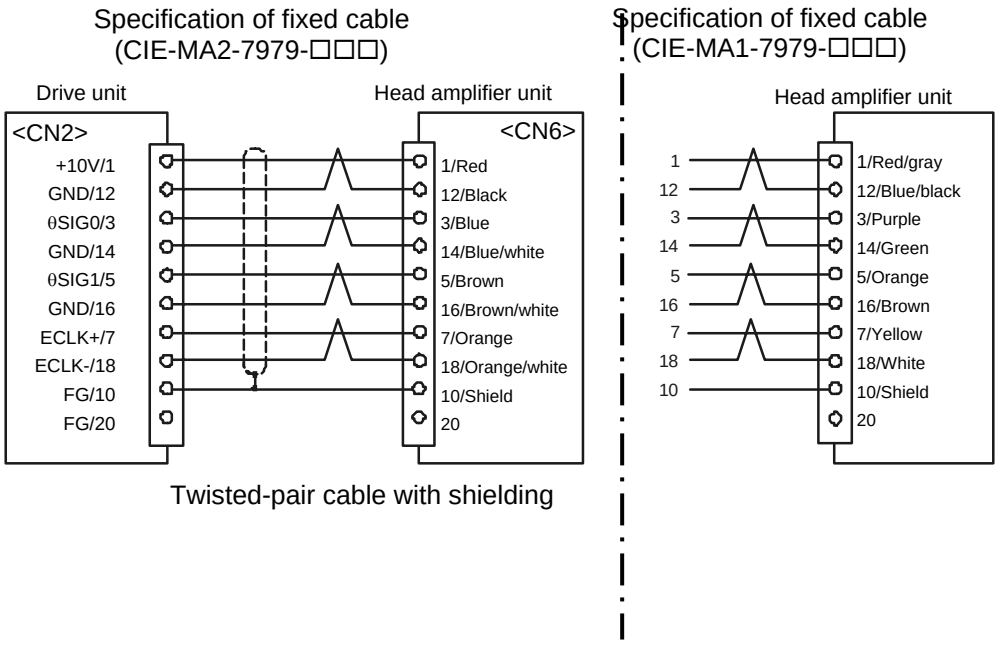
■ Cable Specifications

Cable	Specification
	AWG#24 (0.2mm^2), twisted pair cable with a common shield, external diameter ∅9mm or less, length 10m or less
	■ Optional cable C1E-MA□-7979-□□□ 

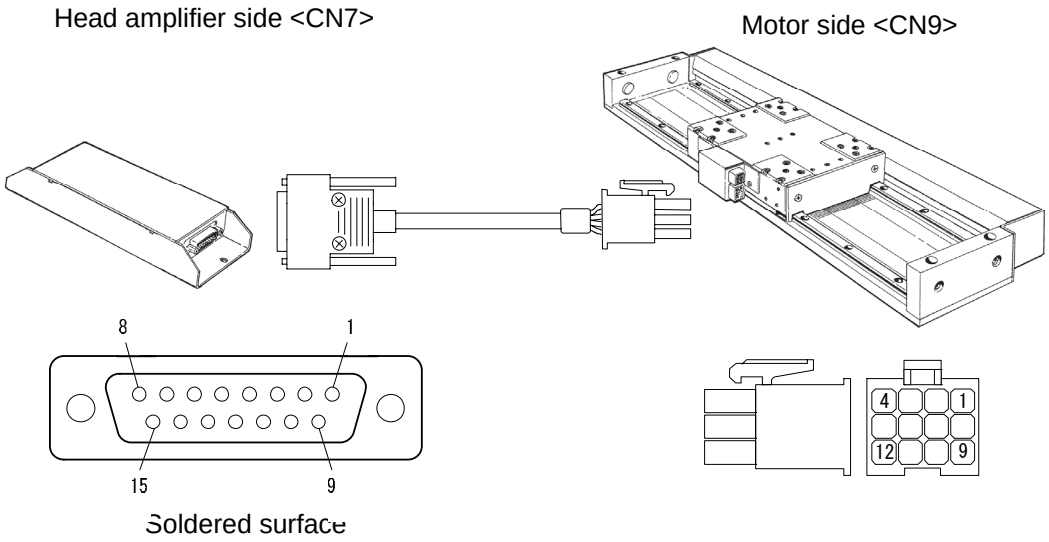
■ Table of Connector Signal Names and Wire Colors

Pin No.	Signal name	Fixed cable	Robot cable
1	+10V	Red	Red/gray
2			
3	θSIG 0	Blue	Purple
4			
5	θSIG 1	Brown	Orange
6			
7	ECLK+(3V)	Orange	Yellow
8			
9			
10	FG	Shielded cable	
11			
12	GND	Black	Blue/black
13			
14	GND	Blue/white	Green
15			
16	GND	Brown/white	Brown
17			
18	ECLK-(3V)	Orange/white	White
19			
20	FG		
Case			

■ Wiring between Head Amplifier and Drive



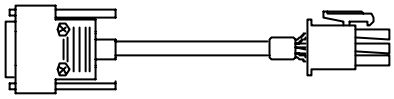
5.8 Head Amplifier Connectors <CN7, CN9>



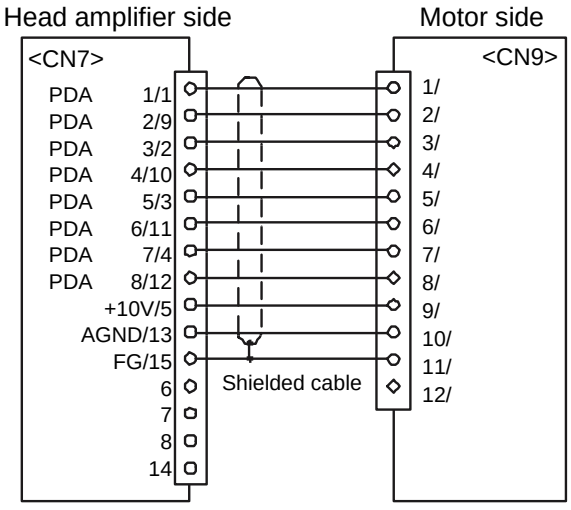
Connector: DA-15PF-N (made by JAE)
Housing: DA-C8-J10-F4-1 (made by JAE)

Terminal: 170365-3 (made by AMP)
Housing: 172170-1 or 172341-1(made by AMP)
Manual tool: 755330-1 (made by AMP)

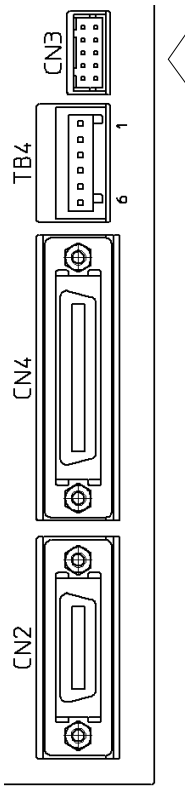
■ Cable Specifications

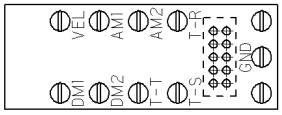
Cable	Specification
Head amplifier	■ AWG#22 (0.3mm^2), Multi-conductor cable with a common shield, length 5 m or less ■ Use a highly flexible robot cable, as it is attached to a moving part.
	■ Optional cable C1E-MA1-2262-□□□ 

■ Wiring between Head Amplifier and Motor



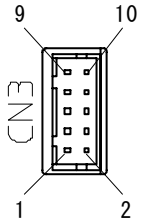
5.9 Analog Monitor Connector <CN3>





Analog monitor card (optional, R7041WC)

<CN3> connector



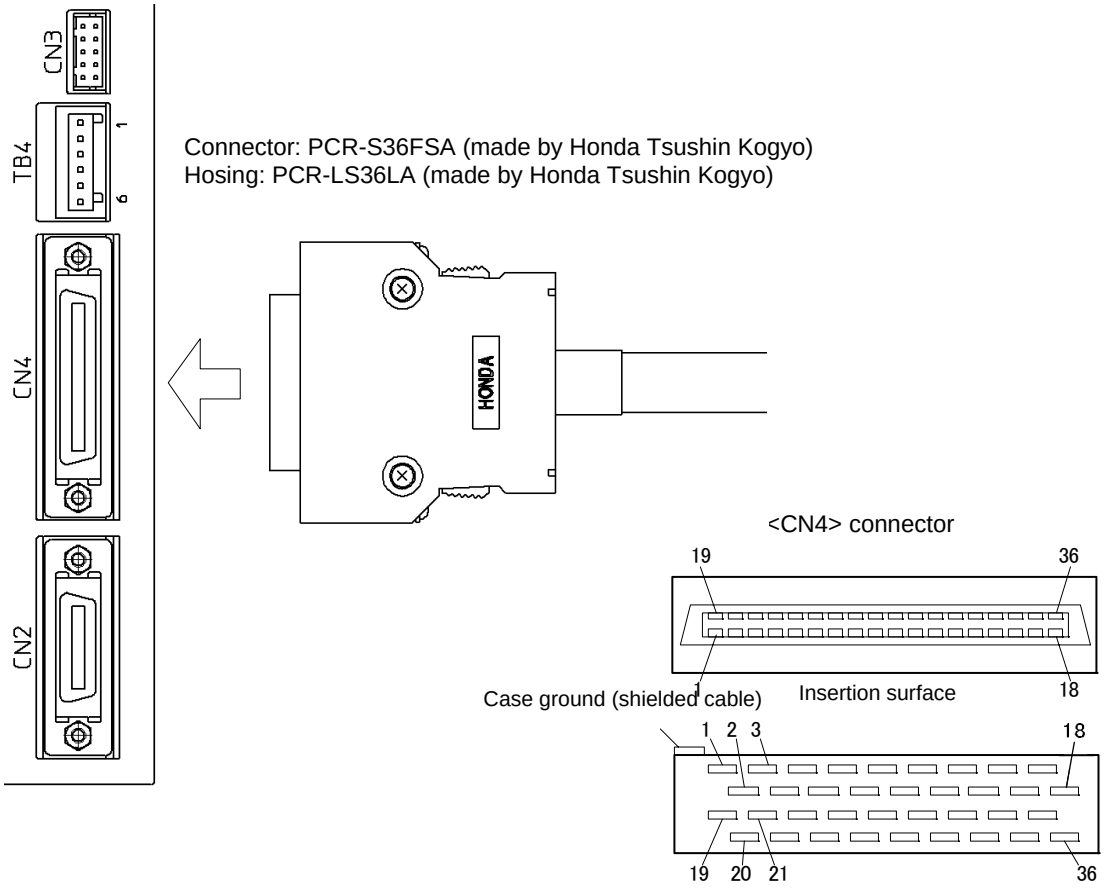
Pin No.	Signal name	Definition
1	VEL	Velocity monitor terminal
2	AM1	Analog monitor terminal 1 (general purpose monitor 1)
3	AM2	Analog monitor terminal 2 (general purpose monitor 2)
4	DM1	Digital monitor terminal 1 (general purpose monitor 1)
5	DM2	Digital monitor terminal 2 (general purpose monitor 2)
6	T-R	Current command
7	T-T	Reserved
8	T-S	Reserved
9	<Prohibited>	Reserved Do not connect any line.
10	GND	GND terminal for monitor

It is possible to monitor various states of the drive using the analog monitor card (optional).

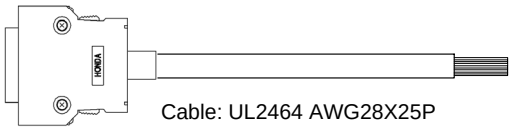
CAUTION

These signals are used for observation and troubleshooting only! Do not use them as feedback data to controllers. Make sure to use the analog monitor card (optional) to observe these signals.

5.10 Controller Interface Connector <CN4>



■ Cable Specifications

Interface	AWG#28 to AWG#20 (0.08 ~ 0.5mm^2), cable with a common shield, external diameter ∅14mm or less, length 3m or less
	Option cable: C1P-ENN-4202-□□□  Cable: UL2464 AWG28X25P

■ Table of Connector Signal Names and Wire Colors

Pin No.	Signal name	Wire color		Definition	Comment
		Color	Mark		
1	COMP1	White	Blue or black 3	Interface power supply +	Input appropriate power according to the interface spec.
2	COMN1	Orange	Blue or black 1	Interface power supply -	
3	DO_0	Orange	Red 1	I/O output 0	The definition is assigned by the hard I/O assignment function.
4	DO_1	Gray		I/O output 1	
5	DO_2	White		I/O output 2	
6	DO_3	Yellow		I/O output 3	
7	DO_4	Pink		I/O output 4	
8	DO_5	Orange	Red 2	I/O output 5	
9	UA_OUT+	Gray	Red 2	Position present pulse 1 +	Able to select UP-DOWN or A-B encoder output according to parameter setting.
10	UA_OUT-		Blue or black 2	Position present pulse 1 -	
11	DB_OUT+	White	Red 2	Position present pulse 2 +	
12	DB_OUT-		Blue or black 2	Position present pulse 2 -	
13	Z_OUT+	Yellow	Red 2	Z-pulse +	Outputs the Z-pulse of the motor.
14	Z_OUT-		Blue or black 2	Z-pulse -	
15	PUA_IN+	Pink	Red 2	Position command pulse 1 +	Able to select PLS-SIGN (STEP-DIR), UP-DOWN or A-B encoder input according to parameter setting.
16	PUA_IN-		Blue or black 2	Position command pulse 1 -	
17	SDB_IN+	Orange	Red 3	Position command pulse 2 +	
18	SDB_IN-		Blue 3	Position command pulse 2-	
19	DI_0	Gray	Red 3	I/O input 0	The definition is assigned by the hard I/O assignment function.
20	DI_1	White		I/O input 1	
21	DI_2	Yellow		I/O input 2	
22	DI_3	Pink		I/O input 3	
23	DI_4	Orange	Red 4	I/O input 4	
24	DI_5	Gray		I/O input 5	
25	DI_6	White		I/O input 6	
26	DI_7	Yellow		I/O input 7	
27	DI_8	Pink		I/O input 8	
28	DI_9	Orange	Continuous red line	I/O input 9	
29	DI_10	Gray		I/O input 10	
30	DI_11	White		I/O input 11	
31	(NC)				Do not connect any line.
32	(NC)				
33	ASUB_IN+	Yellow	Continuous red line	Analog sub (auxiliary) input +	Able to execute torque/force limit or torque feed forward by enabling through parameter.
34	ASUB_IN-		Continuous blue line	Analog sub (auxiliary) input -	
35	ACMD_IN+	Pink	Continuous red line	Analog command input +	Inputs velocity or torque/force command (select "T" in the model & suffix code).
36	ACMD_IN-		Continuous blue line	Analog command input -	
Shield				Shield treatment terminal	Make sure to connect this.

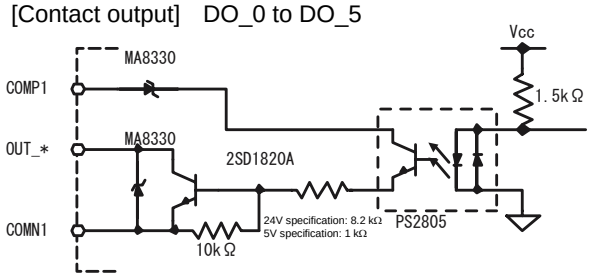
■ DI/DO Initial Setting

DO_0 to DO_5 initial setting				
Pin No.	Signal name	Logic I/O signal abbreviation	Logic I/O signal name	Logic
3	DO_0	OUT_DRDY	Drive (CPU) ready	Positive
4	DO_1	OUT_SRDY	Servo ready	Positive
5	DO_2	OUT_BUSY	Busy	Positive
6	DO_3	OUT_OVL	Overload sig.	Negative
7	DO_4	OUT_OVER	Over speed	Positive
8	DO_5	OUT_COIN	COIN Sig.	Positive

DI_0 to DI_11 initial setting				
Pin No.	Signal name	Logic I/O signal abbreviation	Logic I/O signal name	Logic
19	DI_0	IN_ERR_RESET	Error reset	Positive
20	DI_1	IN_SERVO	Servo command	Positive
21	DI_2	IN_START	Drive execution command	Positive
22	DI_3	IN_ABORT	Drive stop command	Positive
23	DI_4	IN_I_CODE.0	Code input 0	Positive
24	DI_5	IN_I_CODE.1	Code input 1	Positive
25	DI_6	IN_POSW.0	COIN width select 0	Positive
26	DI_7	IN_POSW.1	COIN width select 1	Positive
27	DI_8	IN_VELFREQ_SEL	Velocity control bandwidth select	Positive
28	DI_9	IN_POSFREQ_SEL	Position control bandwidth select	Positive
29	DI_10	IN_PLS_DIRECT	Pulse priority select	Positive
30	DI_11	IN_POSINT_INH	Pos. control integration prohibited	Positive

■ DI/DO Contact Specifications

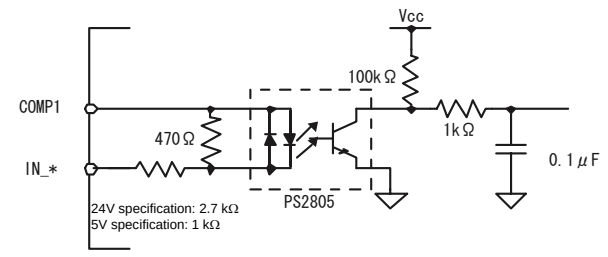
[Contact output] DO_0 to DO_5



Interface suffix code	A	B
Rated voltage	12 ~ 24VDC (±10%)	5VDC (±10%)
Maximum load current	0.1A/point, 0.5A/common	
Turn-On voltage	0.5VDC or less	
Leakage current at off	0.1mA or less	

Positive logic: The output transistor switches on when the conditions for the signal are satisfied.
[Example] OUT_DRDY: The output transistor switches on when the drive is ready.

[Contact input] DI_0 to DI_11



Interface suffix code	A	B
Rated voltage	12 ~ 24VDC (±10%)	5VDC (±10%)
Rated input current	4.1mA (at 12VDC) 8.5mA (at 24VDC)	4.0mA (at 5VDC)
Impedance	3.0kΩ	1.0kΩ
Operating voltage (relative to COMP*)	ON: 3.0VDC or less OFF: 9.0VDC or more	ON: 1.0VDC or less OFF: 4.0VDC or more
Allowable leakage current	Guarantee off at 1.0mA or less	

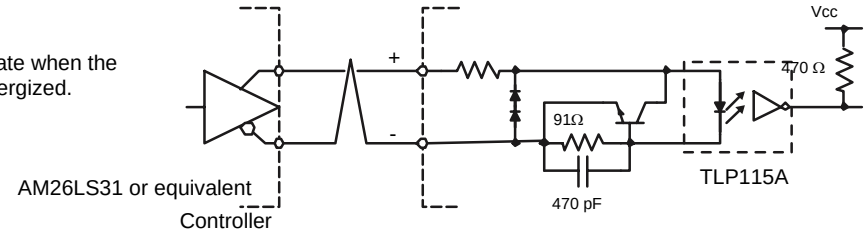
Positive logic: Current is conducted into the input photo-coupler when the conditions for the signal are satisfied.
[Example] IN_SERVO: Current is conducted into the photo-coupler when the servo is turned on.

■ Position Command Pulse Specifications

[Differential Input Spec.] PUA_IN±, SDB_IN±

Connect a differential line drive conforming to the RS422A standard, such as an AM26LS31 or equivalent.

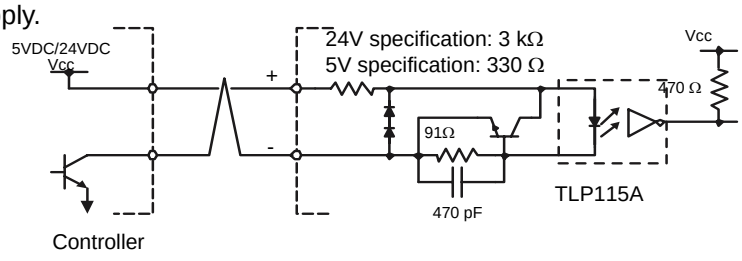
Input is in the on-state when the photo-coupler is energized.



[Open Collector Input Spec.] PUA_IN±, SDB_IN±

Input the interface power supply.

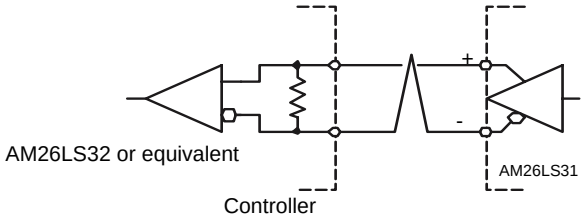
Input is in the on-state when the photo-coupler is energized.



■ Actual position Pulse Output Specifications UA_OUT±, DB_OUT±, Z_OUT±

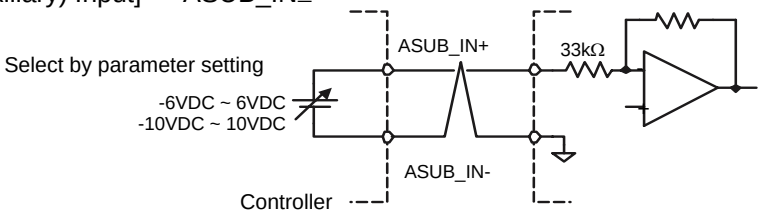
Connect a differential line receiver conforming to the RS422A standard, such as an AM26LS32 or equivalent.

Output is in the on-state when the + terminal becomes a higher voltage than the - terminal.

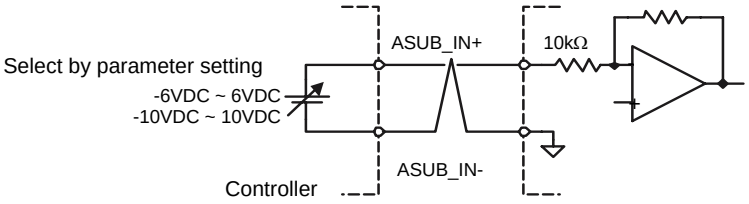


■ Analog Input Specifications

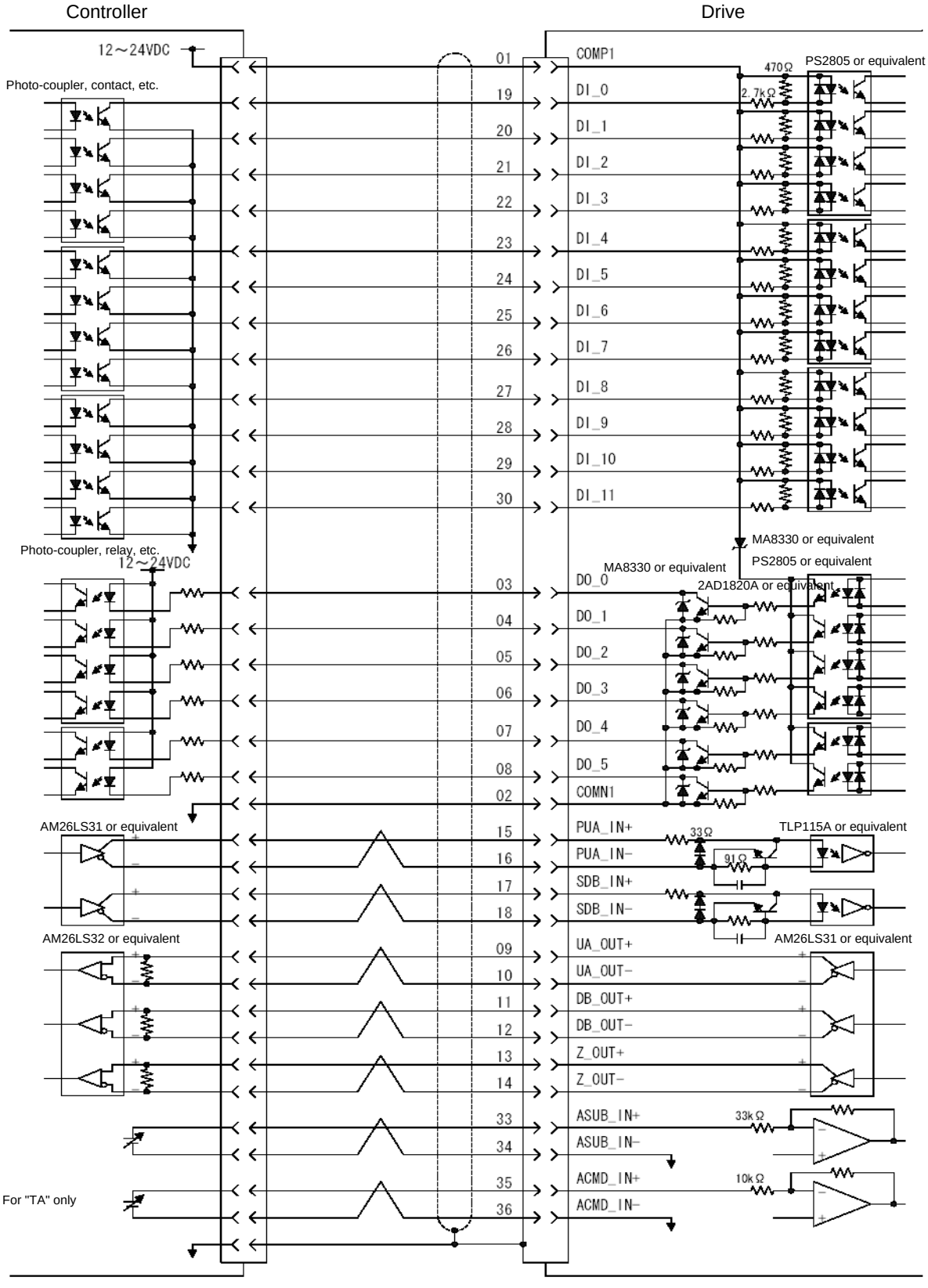
[Analog Sub (Auxiliary) Input] ASUB_IN±



[Analog Command Input] ACMD_IN±

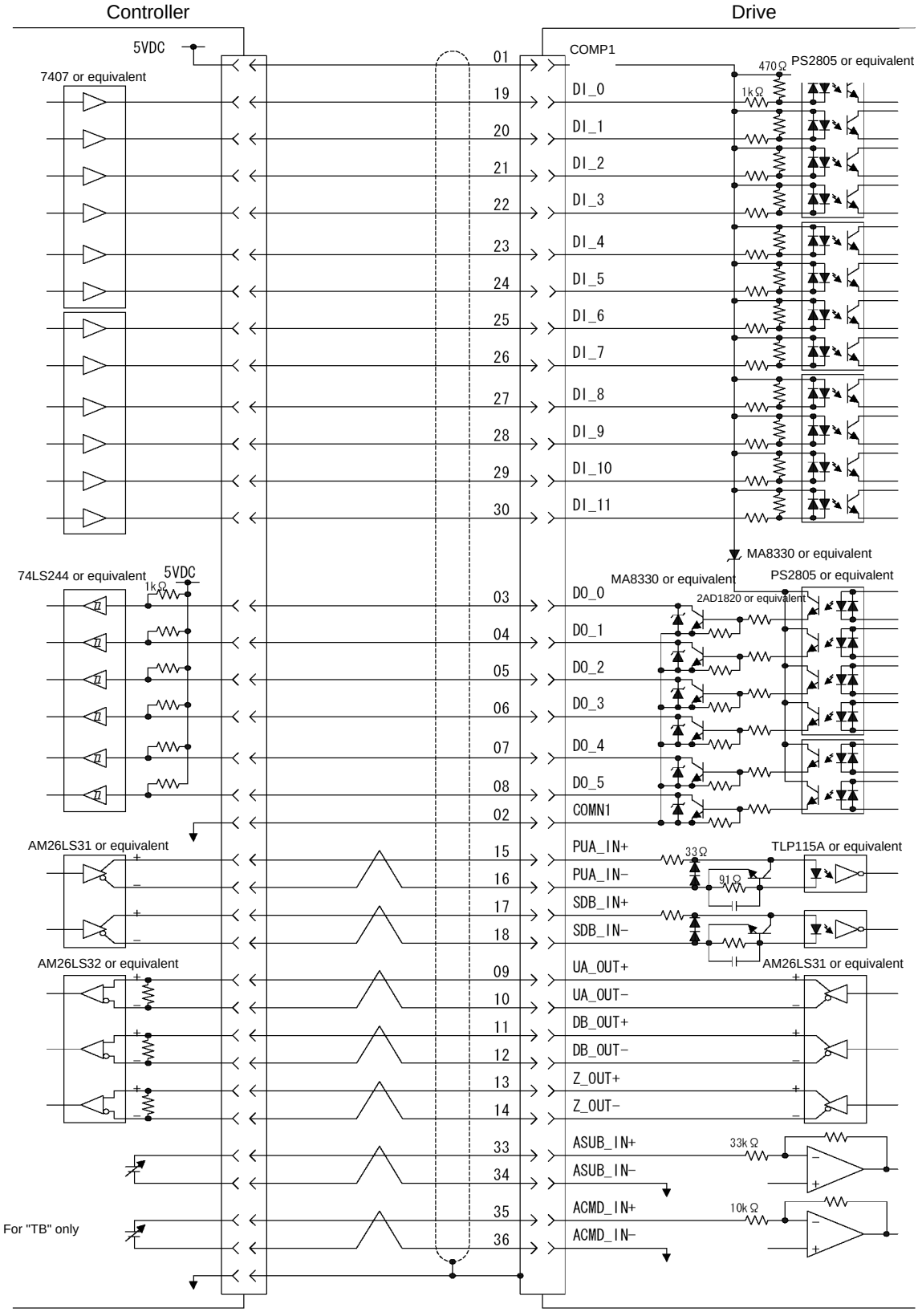


■ Connection Example In the case of "SA (with differential input and velocity/torque/no thrust input, 12 to 24V I/O input/output)" and "TA (with differential input and velocity/torque/thrust input, 12 to 24V I/O input/output)"



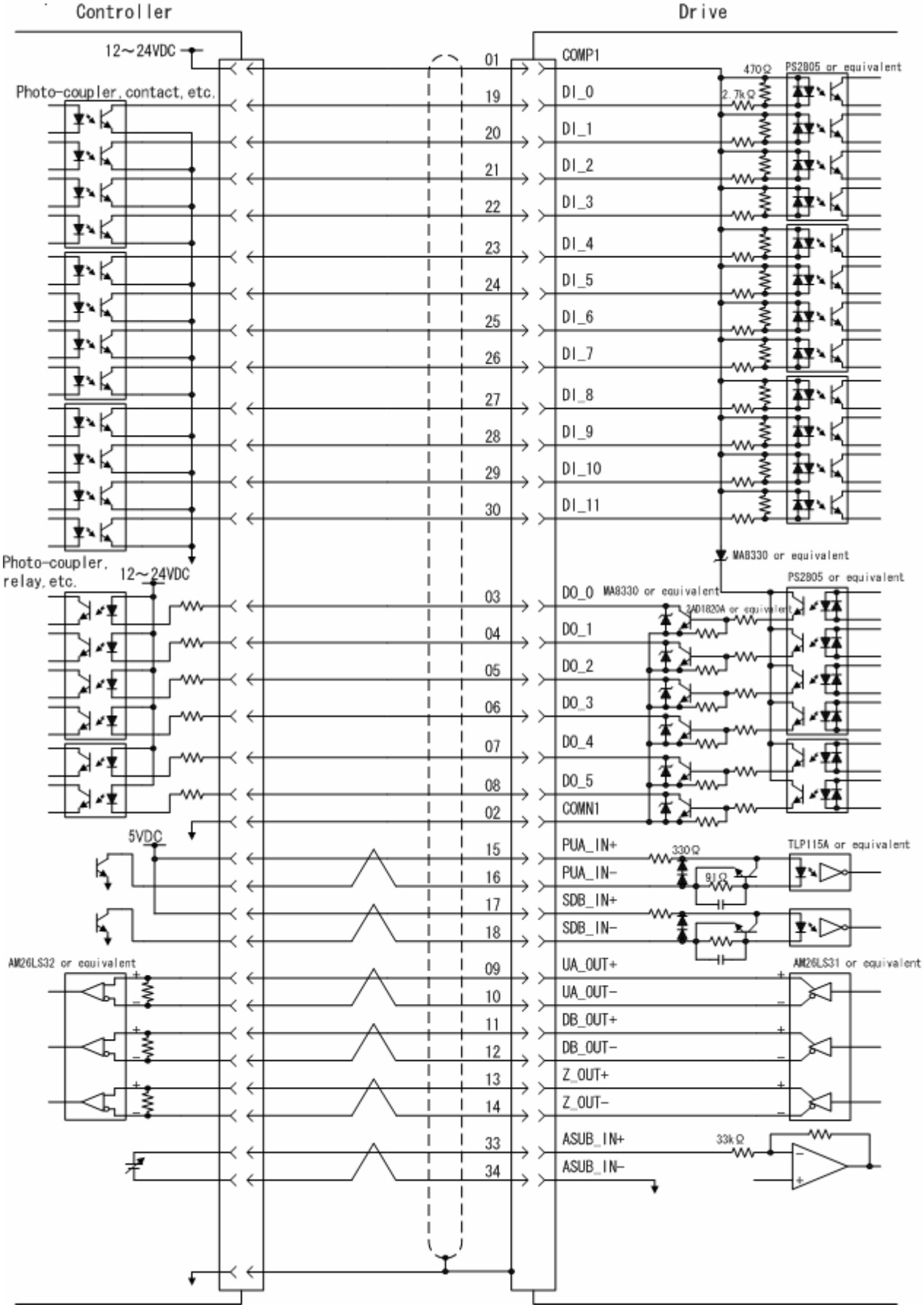
Connect the shield to the case of the connector.

■ Connection Example In the case of "SB (with differential input and velocity/torque/no thrust input, 5V I/O input/output)" and "TB (with differential input and velocity/torque/thrust input, 5V I/O input/output)"



Connect the shield to the case of the connector.

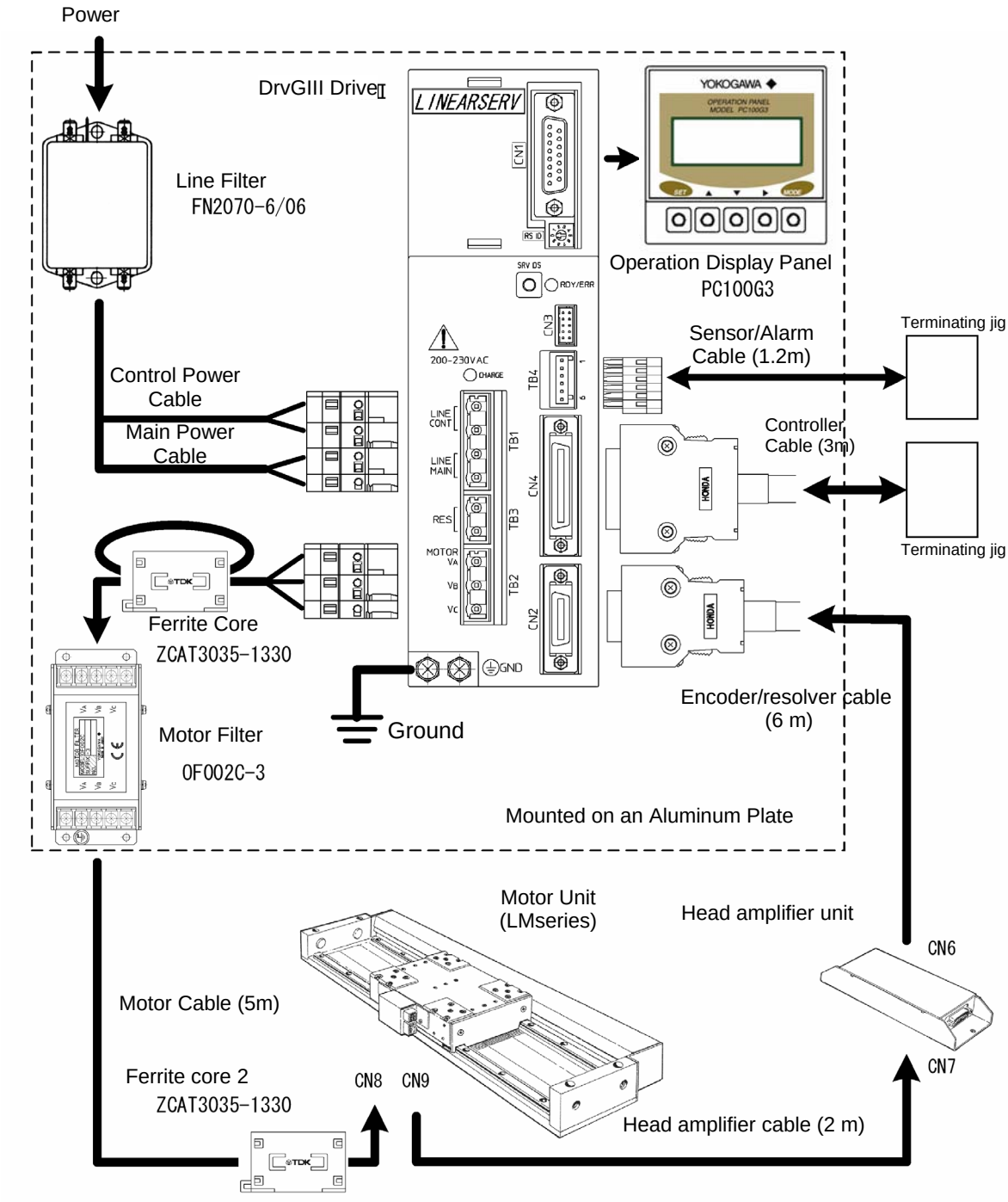
■ Connection Example "UA (5VDC/200kHz, I/O input/output 12 to 24V)"



Connect the shield to the case of the connector.

5.11 Noise Prevention and Installation Conditions

A CE Declaration of Conformity (declaration) regarding EMC has been made for the DrvGIII drive under the following installation conditions.



CAUTION

This installation guideline does not guarantee the performance. The installation conditions vary depending on the device used.

5.11.1 Line Filter

A line filter is effective as a means of suppressing any inverter noise that is conducted back into the power supply line. Because inverter noise may cause nearby devices to malfunction, be sure to insert a line filter.

■ Selecting Line Filter

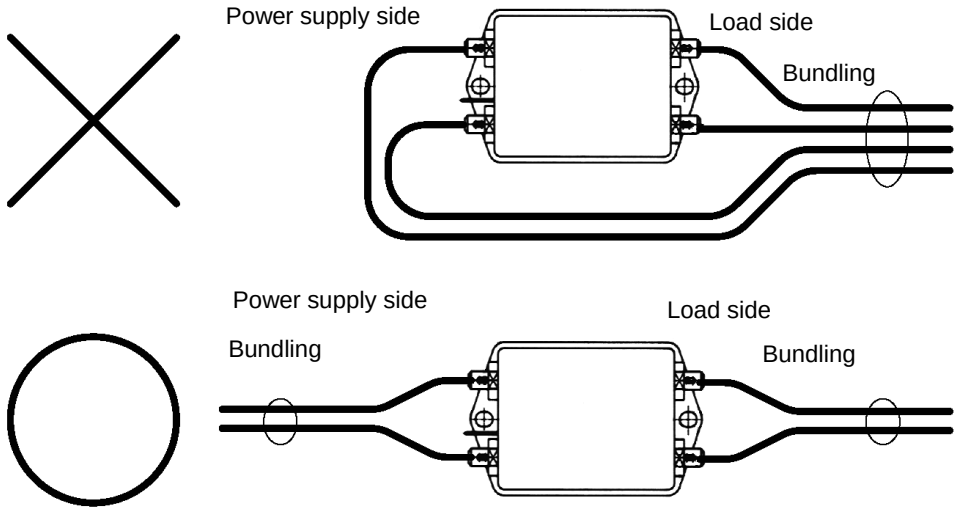
The switching frequency of the inverter part is 10 kHz. Because inverter noise is caused by harmonic components when switching, select a line filter with good damping characteristics in the frequency band of 100 kHz to 1 MHz.
(Line filters with common mode coils of 5 mH or more)
Please use the recommended line filter or an equivalent product.

■ Obtaining Current Capacity

Please see Section 5.12, "Drive Input Current."

■ Mounting Filter

Secure the filter to a metal plate. If rust proofing is required for the metal plate, apply electrically conductive plating. If the filter has to be mounted on a coated surface, be sure to remove the coating before mounting the filter. (The same holds for the mounting surface of the drive.)
If you connect the wires for filter inputs and outputs, the noise will transfer between the wires and the effect of the filter will be lost. Be sure the wires are kept separate.



5.11.2 Ferrite Core 1

The ferrite core 1 is effective as a means of suppressing noise radiating from motor cables. Mount it on a motor cable as close to the drive as possible.
The ferrite core 1 is not required if the drive is installed in a metal control panel/equipment and does not affect devices located within the same equipment.

5.11.3 Ferrite Core 2

Ferrite core 2 is effective as a means of suppressing motor vibration caused by noise conducted into the motor cables and encoder/resolver cable. Conductive noise is caused by the capacitive and inductive coupling that occurs when cables are wired in parallel, thereby acting as noise sources.
Mount it on a motor cable as close to the drive as possible.
Ferrite core 2 is not required if there is no noise source that may cause motor vibration in the same equipment.

5.11.4 Motor Filter

A motor filter is effective as a means of suppressing the common mode noise generated by an inverter.
Common mode noise is caused by high-frequency harmonic components in the current due to switching in the inverter, which is conducted via the coupling capacity between motor cable and motor coil and ground. A motor filter effectively suppresses high-frequency common mode noise current.
If a CCD camera or measurement instrument is mounted on a platform where the length of a motor cable exceeds 10m, in particular, the ground may become unstable due to the common mode noise current, leading to a device malfunction.
Attach the filter to a motor cable as close to the drive as possible. Secure it to a metal plate in the same way as for a line filter. However, be careful not to connect the input and output wires of a filter. A motor filter is not required if the motor cables are short or there is no effect on other devices located within the equipment.

5.11.5 Shielding of Cables

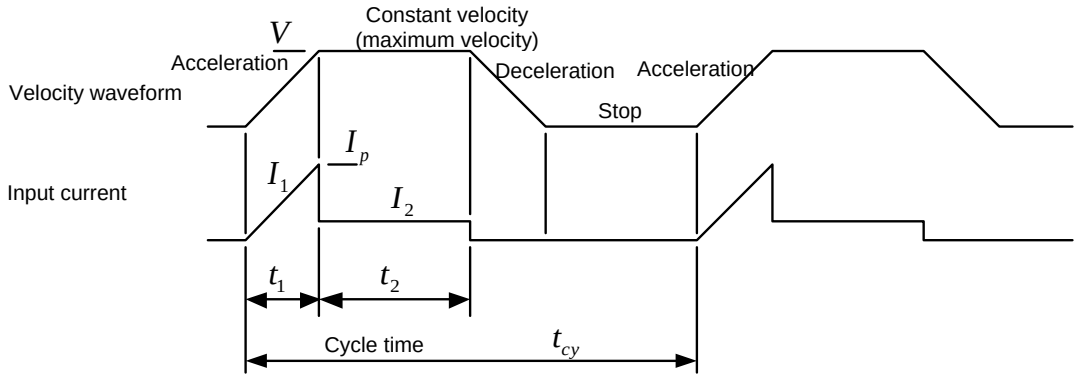
The shielding of cables is effective as a means of suppressing motor malfunction due to external noise and inverter noise, and in suppressing the influence on other devices resulting from the inverter harmonic components and noise irradiated from the CPU clock.
The shielding of motor cables and encoder/resolver cables must be securely connected to grounds on the drive and motor sides. Such shielding lowers the high-frequency impedance to the ground between the motor and drive, and it suppresses the malfunctioning of the encoder due to external noise and inverter noise.
For a controller cable, securely connect the shielding to the ground on both the drive and controller sides. Such shielding lowers the impedance to the ground between the controller and drive, and it suppresses the malfunction of pulse position command input and analog velocity command.

5.12 Drive Input Current

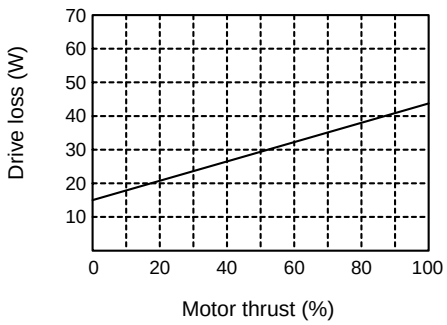
To select a circuit breaker, line filter and others in the device design, it is necessary to know the input current of the drive. This section explains how to estimate the drive input current from the motor's operation pattern.
Use the drive current thus calculated only as a reference value. Be sure to verify the actual drive current with the actual drive.

5.12.1 How to Obtain Input Current

The rated current of a circuit breaker and line filter should be chosen to match the actual current value. If the motor is operated in a cycle of "acceleration - constant velocity - deceleration - stop," the drive input current changes as shown in the graph below in each interval. For this reason, it is necessary to obtain the effective current value for one cycle from one acceleration to the next acceleration.
In the case of a circuit breaker and fuse, it is necessary to check the maximum input current *Ip*, and that the time is within the operation characteristic curve.
When the motor is accelerating, the input current increases proportionally to the increase of velocity. When the motor is at constant velocity, the constant input current is conducted according to drive loss, guide friction and external load friction. When the motor is decelerating, no input current is conducted because regeneration energy is returned.



The drive loss under acceleration and at constant velocity can be obtained from the graph below, which shows drive loss as a function of motor torque. Normally, 70% to 80% of the maximum thrust is used for thrust during acceleration and deceleration. The thrust at constant velocity is the value obtained by adding motor guide friction and load friction (e.g. from the cable bearer). Here, the drive loss is estimated by setting the guide friction to 10% of the motor's maximum thrust.



Obtain the maximum current Ip at acceleration from the motor thrust and maximum velocity. The motor efficiency varies with velocity and thrust. Here, it is estimated at 60%. Note that 80% of the maximum torque is used for the motor torque.

$$I_p = \frac{V\,x\,F \times 0.8}{\eta_m \times P_f \times E_{in}} + \frac{D_{L1}}{P_f \times E_{in}}$$

Obtain the effective current at acceleration $I_{1\,(rms)}$:

$$I_{1(rms)} = \frac{I_p}{\sqrt{3}}$$

Obtain the current I_2 at a constant velocity:

$$I_2 = \frac{V \times (F_{LG} + F_{LL})}{\eta_m \times P_f \times E_{in}} + \frac{D_{L2}}{P_f \times E_{in}}$$

V:	Maximum motor velocity	(m/s)
F:	Motor thrust	(Nm)
D_{L1}:	Drive loss at acceleration	(W)
D_{L2}:	Drive loss at a constant velocity	(W)
η_m:	Motor efficiency 60%	
P_f:	Power factor 0.5	
E_{in}:	Power supply input voltage	(V)
F_{LG}:	Guide friction Thrust/10	(N)
F_{LL}:	Load friction	(N)

Obtain the effective input current $I_{in\,(rms)}$:

$$I_{in(rms)} = \sqrt{\frac{I_{1(rms)}{}^2 \times t_1 + I_2{}^2 \times t_2}{t_{cy}}}$$

■ Example of Calculation

The rated currents of a circuit breaker and filter are calculated under the following operating conditions:

Obtain the maximum current I_p:

$$I_p = \frac{0.8 \times 400 \times 0.8}{0.6 \times 0.5 \times 230} + \frac{38}{0.5 \times 230} = 4.04A$$

Motor operation condition

Motor thrust:	400N
Maximum velocity:	0.8m/s
Acceleration/deceleration time:	50 ms
Constant velocity time:	100 ms
Stop time:	100 ms
Cycle time:	300 ms
Power supply input voltage:	230 V
Load friction:	50N

Obtain the effective current at acceleration $I_{1\,(rms)}$:

$$I_{1(rms)} = \frac{4.04}{\sqrt{3}} = 2.33A$$

Obtain the current at a constant velocity I_2:

$$I_2 = \frac{0.8 \times (40 + 50)}{0.6 \times 0.5 \times 230} + \frac{21}{0.5 \times 230} = 1.2A$$

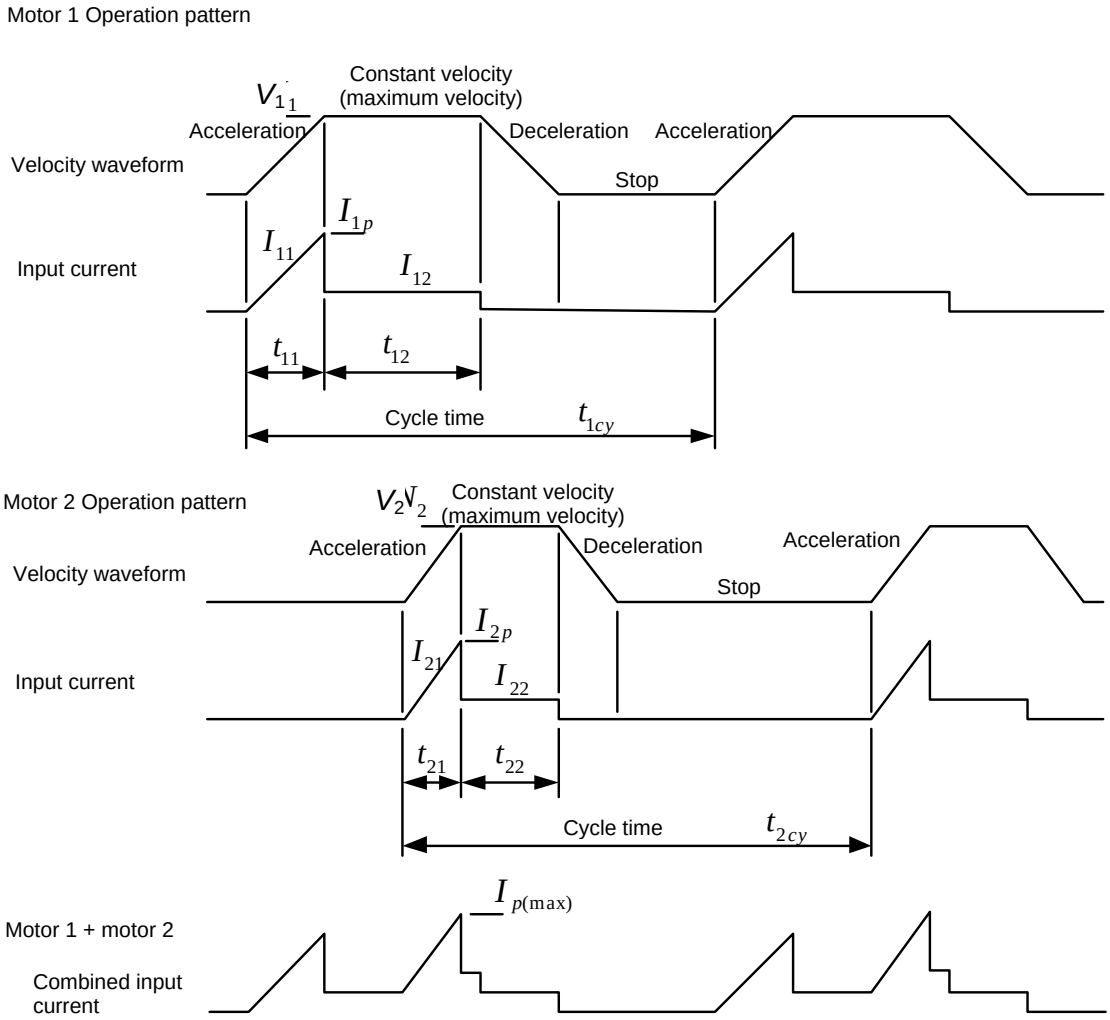
Obtain the effective input current $I_{in\,(rms)}$:

$$I_{in(rms)} = \sqrt{\frac{2.33^2 \times 0.05 + 1.2^2 \times 0.1}{0.3}} = 1.18A$$

Thus, the rated current is "2A."
Be sure to verify that the value of I_p is within the operation characteristic curve for the selected circuit breaker and fuse.

5.12.2 How to Obtain Input Current When Operating Multiple Drives

If multiple drives are to share one circuit breaker and line filter, obtain the effective input current for each drive from the motor operation pattern and add all the values to obtain the required rated current.



Obtain the effective input current $I_{1in\ (rms)}$, $I_{2in\ (rms)}$ and so on of each drive from the motor operation pattern using the procedure in Section 5.12.1, "How to Obtain Input Current." Obtain the total current of each drive input current, $I_{in\ (rms)}$, and then select a circuit breaker and line filter that satisfy this value.

$$I_{in(rms)} = I_{1in(rms)} + I_{2in(rms)} + \ldots$$

Be sure to verify that the value of the maximum current of the combined drive input current $I_{p\ (max)}$ is within the operation characteristics curve for the selected circuit breaker and fuse.

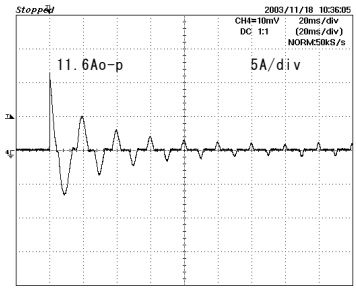
5.13 Drive Inrush Current

Drive inrush current is an important factor in selecting a circuit protector and fuse in the device design. This section illustrates some typical inrush current waveforms of the drive. Please use them as references when selecting a circuit breaker and fuse.

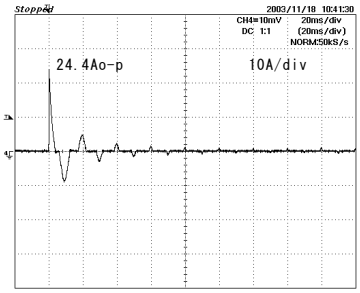
5.13.1 Inrush Current Waveforms (representative examples)

The following graphs show the inrush current waveforms of the control power supply and main power supply during a cold start at room temperature (25°C). The waveforms vary with the power supply line impedance, input voltage and ambient temperature.
When multiple drives are connected, the inrush current is not necessarily simply n times the waveforms below, due to existing power supply line impedance. Be sure to verify using the actual drives.

500 W class, 115 VAC input



500 W class, 230 VAC input



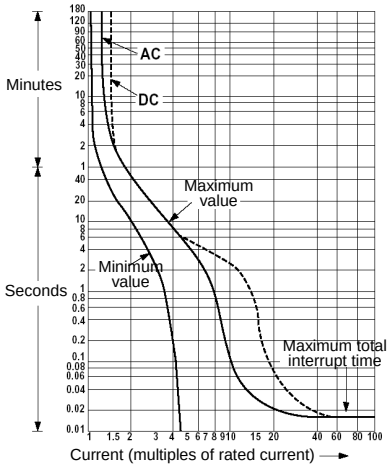
5.13.2 Selecting Circuit Breaker

Select a circuit breaker where the drive's inrush current peak value is within the curve of operation characteristics. A correction coefficient is applied to the characteristics curve according to the ambient temperature and posture. Please refer to the manufacturer's catalog.
In the case of a 500 W class drive with input voltage of 230 V, the input current is 24.4 A. Since the horizontal axis of the characteristic curve (scale factor relative to the rated current) gives a value of approximately five times, the rated current is:

$$\text{Rated current} = \frac{24.4}{5} = 4.88A$$

Thus, a breaker of 5 A or more should be selected.

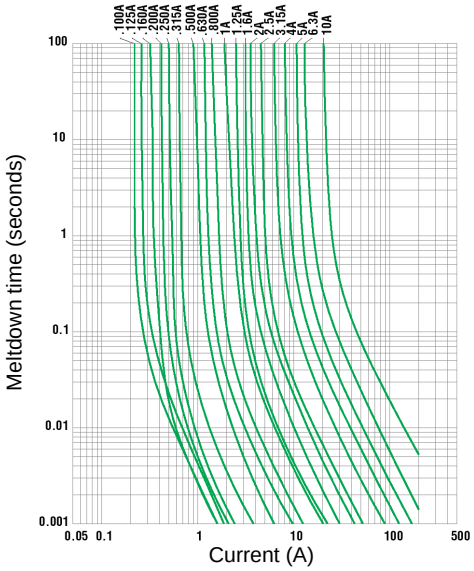
Example of operation characteristics curve



5.13.3 Selecting Fuse

Verify that the inrush current is within the range of the meltdown characteristics curve. Note, however, that this characteristics curve is created based on average data values. Therefore, a certain margin must be taken into account.
Moreover, since a fuse melts down due to joule heat, the nominal rated value of I^2t is specified in the catalog. Check that the value of I^2t due to inrush current is less than the rated value. Since the nominal rated value of I^2t decreases in the case of repetitive inrush current, if the number of inrushes is 10,000 times, a margin factor of three to four is required. Please confirm with the manufacturer regarding the reduction in the nominal rated value of I^2t in the case of repetitive inrush current.
The value for I^2t is as follows in the case of Section 5.13.1, "Inrush Current Waveforms." Calculate I2t until the peak current of Ip becomes the rated current of the fuse or less, and then add all the values.

Example of meltdown characteristics curve



■ In the case of 500 W input and 115 VAC

$$I_2t_{(115)} = \frac{I_{P1}{}^2 \times t_2}{3} + \frac{I_{P2}{}^2 \times t_2}{2} + \frac{I_{P3}{}^2 \times t_3}{2}$$

$$= \frac{11.6^2 \times 5 \times 10^{-3}}{3} + \frac{7^2 \times 8 \times 10^{-3}}{2} + \frac{5^2 \times 8 \times 10^{-3}}{2} = 0.52$$

■ In the case of 500 W input and 230 VAC

$$I_2t_{(230)} = \frac{I_{P1}{}^2 \times t_2}{3} + \frac{I_{P2}{}^2 \times t_2}{2} + \frac{I_{P3}{}^2 \times t_3}{2}$$

$$= \frac{24.4^2 \times 5 \times 10^{-3}}{3} + \frac{9^2 \times 8 \times 10^{-3}}{2} + \frac{5^2 \times 5 \times 10^{-3}}{2} = 1.38$$

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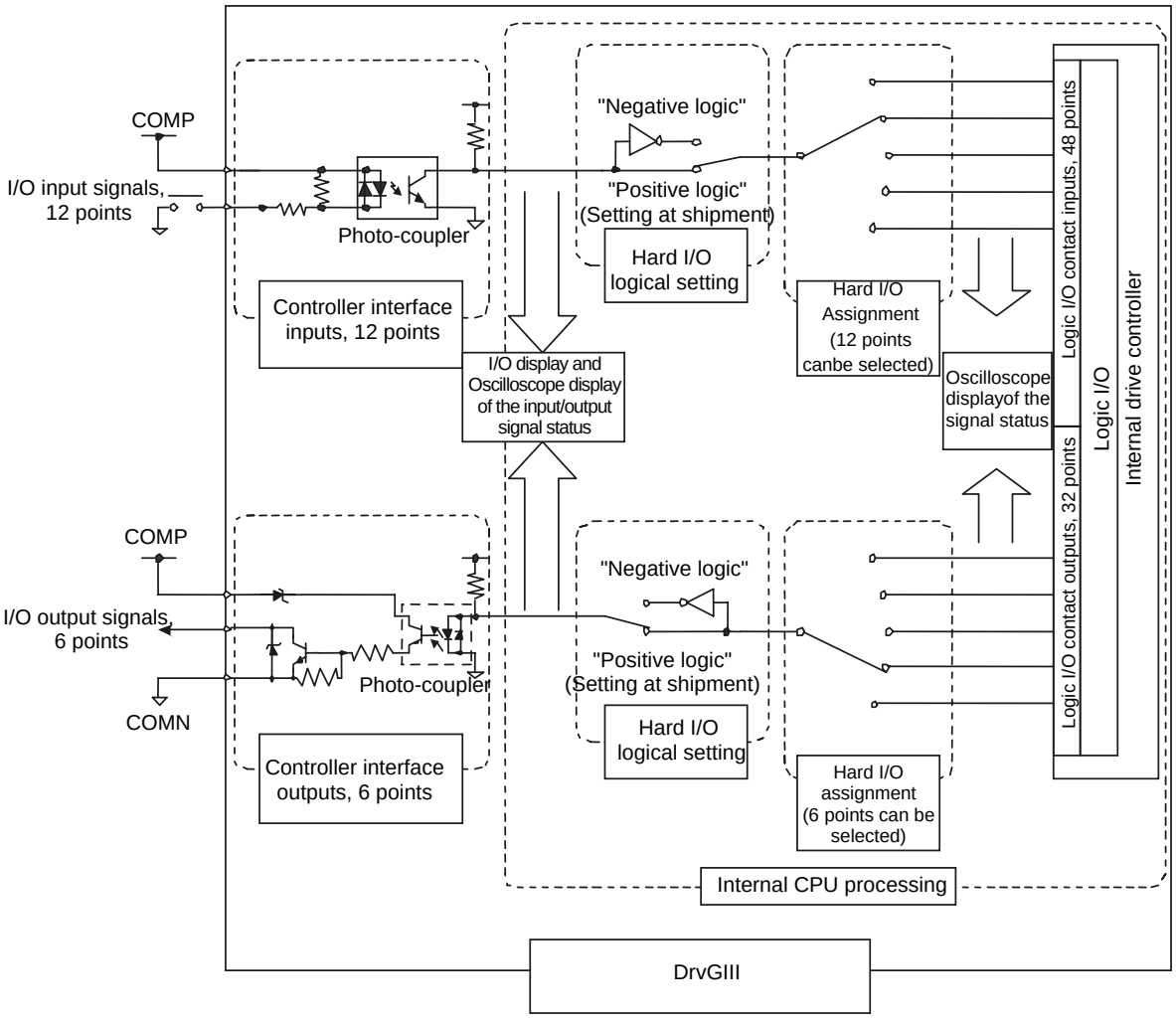
6. Operation

6.1 Common Basic Functions

6.1.1 I/O Signals

(1) Types of I/O Signals

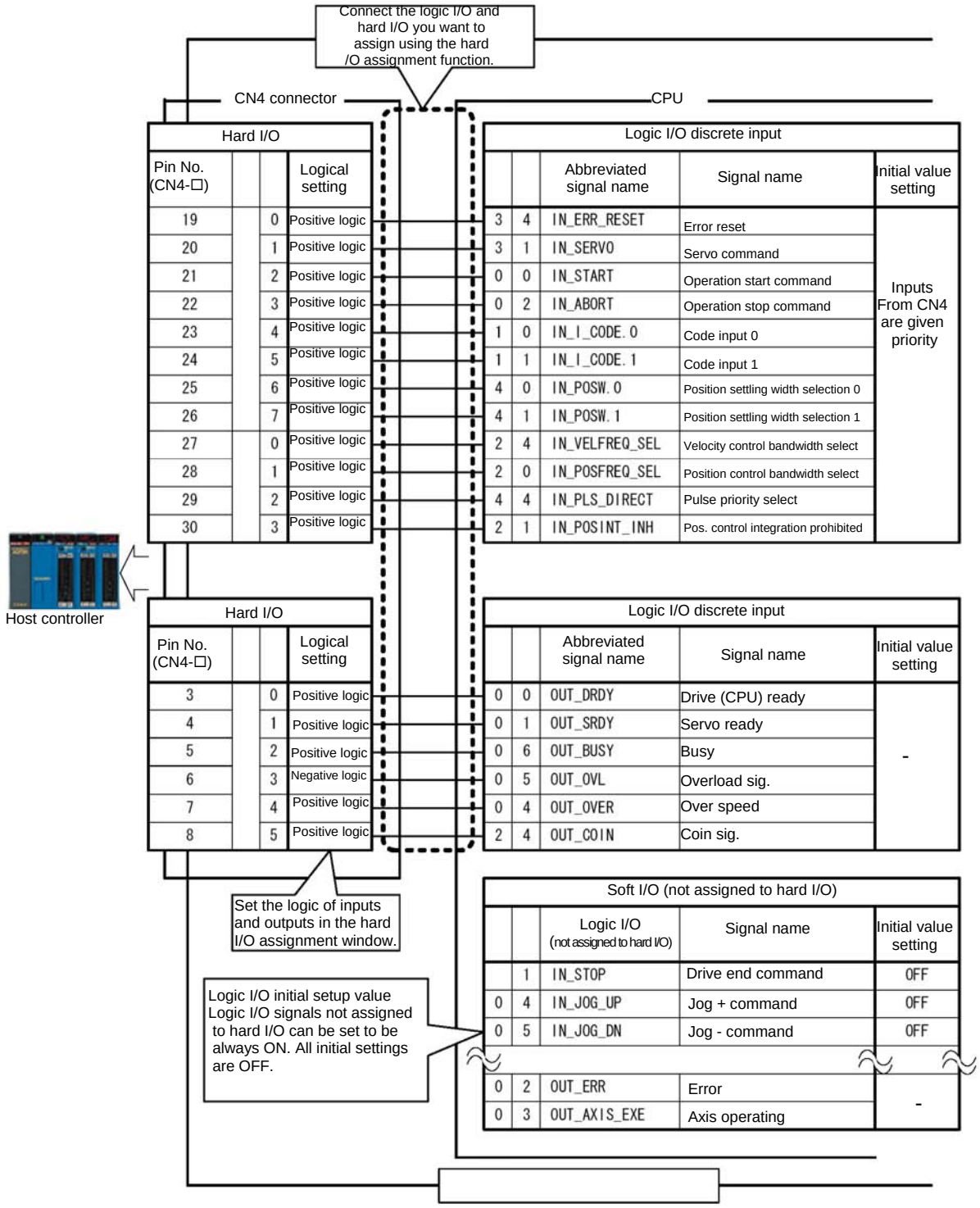
The I/O signals of the drive are configured as shown in the figure below. The I/O signals on CN4 are collectively called the physical (hard) I/O and are comprised of 12 inputs and 6 outputs. Upon shipment from the factory, they are assigned as shown in "Physical (Hard) I/O Assignment at Shipment," "Physical (Hard) I/O Logical Setting" and "Setting Status of Logic (Soft) I/O Initial Value Setting." The user can freely assign 12 inputs and 6 outputs from the hard I/O host signals (48 contact inputs and 32 contact outputs), called the logic I/O (using the hard I/O assignment function).



Configuration of I/O Signals

		Number of contact I/O
Logic (Soft) I/O	Number of input points	48 points
	Number of output points	32 points
Physical (Hard) I/O	Number of input points	12 points
	Number of output points	6 points

Physical (Hard) I/O Assignment at Shipment, Physical (Hard) I/O Logical Setting and Setting Status of Logic (Soft) I/O Initial Value Setting



■ Physical (Hard) I/O

Physical (hard) I/O refers to I/O signals on the controller interface (CN4). Hard I/O is comprised of 2 input blocks and 1 output block. Each block consists of 8 bits (8 different signal types).

● Hard I/O Assignment Function
It is possible to assign 12 inputs and 6 outputs of I/O signals freely from the group of logic I/O signals.
Perform the optimal assignment according to the application to avoid unnecessary signal wiring. See Section 6.1.1 (3), "Physical (Hard) I/O Assignment, Logic Setting Method" for how to set hard I/O and settings at shipment from the factory.
<Usage example>
It is preferable to use the logic I/O signal OUT_AREA, 0 (area signal 0), which at the time of shipment is not assigned to the hard I/O in the setting. The OUT_OVL (overload) signal, which will not be used, is removed from the assignment, and OUT_AREA, 0 (area signal 0) can be assigned instead.

● Hard I/O Logical Setting
It is possible to set the logic for each bit of I/O signals.
See Section 6.1.1 (3), "Physical (Hard) I/O Assignment, Logic Setting Method" for how to set the logic.
The I/O input logic of the controller interface is set at shipment from the factory so that a signal turns ON when current is conducted into the photo-coupler. The I/O output logic is set so that the transistor is turned ON when a signal turns ON. (Note that the only output signal whose output logic is set to negative logic at shipment from the factory in the hard I/O logical settings is the OUT_OVL signal.)

<Usage example>
When it is desired to turn the immediate stop ON with the IN_EMG (immediate stop) signal while current is conducted into the photo-coupler
⇒ Set the hard I/O logical setting to "positive logic."
When it is desired to turn the immediate stop ON while current is not conducted into the photo-coupler
⇒ Set the hard I/O logical setting to "negative logic."

■ Logic I/O

Logic I/O signals are host signals of hard I/O and comprised of 6 input blocks and 4 output blocks. Each block consists of 8 bits (8 different signal types). See Section 6.1.1 (2), "Types of Logic I/O" for the signal names and definition of each bit.

● Logic I/O Initial Value Setting
It is possible to fix the input status of signals that are not assigned to hard I/O inputs by setting their status to the initial value. This way, it is possible to reduce the number of points in the limited number of hard I/O points. See Section 6.1.1 (4), "How to Change Logic (Soft) I/O Initial Value Setting" for how to make this setting.

<Usage example>
It is desired to assign a new hard I/O input signal, but all the hard I/O points are used by assigned signals and there is no empty point.
The IN_SERVO (servo on) signal is always set to ON unconditionally after turning the power ON. Therefore, IN_SERVO is set to ON with the logic I/O initial value setting and not assigned to hard I/O.

■ I/O Signal Monitor Function

The "I/O display" and "oscilloscope" functions can be used to check signal status of I/O inputs/outputs.

● I/O Display
This function is used to display the status of hard I/O signals.

● Oscilloscope
The oscilloscope function installed in the utility software can be used to display waveforms of the #parameters/ #monitor values. The status of the hard I/O and logic I/O signals, velocity waveforms, position deviation waveforms, etc. can also be captured at the same time. See Section 8.5.1, "Oscilloscope" for how to use the oscilloscope. This function displays the input/output status of the hard I/O signals with monitor numbers #310 to #313 and the input/output status of the logic I/O signals with #314 to #317.

(2) Types of Logic I/O

The table below lists the types and functions of the logic I/O signals. Whether or not they function depends on the control mode and operation privilege.

List of Logic I/O Contact Input Signals (Block 0 ~ Block 1)

○: Frequently used signals
Δ: Signals assigned as necessary
No mark: Not applicable

Logic I/O Contact input		Abbreviated signal name	Signal name	Table data operation	Jog move	Position control mode	Velocity control mode	Torque/thrust control mode	Description
Block	bit								
Block 0	0	IN_START	Drive start command	○					Table data operation is started when this signal is turned ON.
	1	IN_STOP	Drive end command	Δ					When this signal is turned on, the current table operation is completed. The next table operation is not performed.
	2	IN_ABORT	Drive stop command	Δ					When this signal is turned ON, the execution of the current table data is immediately interrupted. If axis operation is being performed, the motor is decelerated and stopped. This signal is normally used for the following purposes. [1] To stop test operation [2] To stop execution of a table data operation
	3	(reserve)							(Reserved)
	4	IN_JOG_UP	Jog + command *		○				Jog operation is performed while these signals are turned ON.
	5	IN_JOG_DN	Jog - command *		○				
	6	IN_M_ANS	M answer	Δ					Assign this signal when the M function is used. This signal turns ON when an M answer is sent.
	7	(reserve)							(Reserved)
Block 1	0	IN_I_CODE.0	Code input 0	○					These signals are used in table data operation. Specify the table number to be executed in the binary format. Depending on the table number to be executed, it is possible to reduce the number of hard I/O points used by setting appropriate logic I/O input initial values.
	1	IN_I_CODE.1	Code input 1	○					
	2	IN_I_CODE.2	Code input 2	○					
	3	IN_I_CODE.3	Code input 3	○					
	4	IN_I_CODE.4	Code input 4	○					
	5	IN_I_CODE.5	Code input 5	○					
	6	(reserve)							
	7	(reserve)							

* To execute jog operation from the serial communication side, select "serial communication side" in the "selection of jog feed operation serial communication side" setting of parameter #110 [System setup register 1].

List of Logic I/O Contact Input Signals (Block 2)

○: Frequently used signals
Δ: Signals assigned as necessary
No mark: Not applicable

<table>
<tr><th colspan="2">Logic I/O Contact input</th><th rowspan="2">Abbreviated signal name</th><th rowspan="2">Signal name</th><th rowspan="2">Table data operation</th><th rowspan="2">Jog move</th><th rowspan="2">Position control mode</th><th rowspan="2">Velocity control mode</th><th rowspan="2">Torque/thrust control mode</th><th rowspan="2">Description</th></tr>
<tr><th>Block</th><th>bit</th></tr>
<tr><td rowspan="8">Block 2</td><td>0</td><td>IN_POSFREQ_SEL</td><td>Position control bandwidth select</td><td>Δ</td><td>Δ</td><td>Δ</td><td></td><td></td><td>Use this signal if there are large fluctuations in the load or it is desired to use different servo gains for different cases.
When this signal is turned ON, the position control band, position control integration time and position integral limiter #parameters are switched to their alternative values.
<table>
<tr><th></th><th colspan="2">IN_POSFREQ_SEL input status</th></tr>
<tr><th></th><th>OFF</th><th>ON</th></tr>
<tr><td>Position control bandwidth frequency</td><td>#8 [position control bandwidth #1]</td><td>#9 [position control bandwidth #2]</td></tr>
<tr><td>Position control integration time</td><td>#10 [Integral time for position control #1]</td><td>#11 [Integral time for position control #2]</td></tr>
<tr><td>Position integral limiter</td><td>#12 [Position integral limiting value #1]</td><td>#13 [position integral limiting value #2]</td></tr>
</table></td></tr>
<tr><td>1</td><td>IN_POSINT_INH</td><td>Pos. control integration prohibited</td><td>Δ</td><td>Δ</td><td>Δ</td><td></td><td></td><td>Integral action for position control is not performed while this signal is turned ON.</td></tr>
<tr><td>2</td><td>IN_POSINT_RST</td><td>Reset position control integrator</td><td>Δ</td><td>Δ</td><td>Δ</td><td></td><td></td><td>The integrator information is reset in position control when this signal is turned ON.</td></tr>
<tr><td>3</td><td>(reserve)</td><td></td><td></td><td></td><td></td><td></td><td></td><td>(Reserved)</td></tr>
<tr><td>4</td><td>IN_VELFREQ_SEL</td><td>Velocity control bandwidth select</td><td>Δ</td><td>Δ</td><td>Δ</td><td>Δ</td><td></td><td>Use this signal if there are large fluctuations in the load or it is desired to use different servo gains for different cases.
When this signal is turned ON, the velocity control band, velocity control integration time and velocity integral limiter #parameters are switched to their alternative values.
<table>
<tr><th></th><th colspan="2">IN_VELFREQ_SEL input status</th></tr>
<tr><th></th><th>OFF</th><th>ON</th></tr>
<tr><td>Velocity control band frequency</td><td>#2 [Velocity control bandwidth 1]</td><td>#3 [Velocity control bandwidth 2]</td></tr>
<tr><td>Velocity control integration time</td><td>#4 [Integral time for velocity control #1]</td><td>#5 [Integral time for velocity control #2]</td></tr>
<tr><td>Velocity integral limiting</td><td>#6 [Velocity integral limiting value #1]</td><td>#7 [Velocity integral limiting value #1]</td></tr>
</table></td></tr>
<tr><td>5</td><td>IN_VELINT_INH</td><td>Prohibit velocity control integral action</td><td>Δ</td><td>Δ</td><td>Δ</td><td>Δ</td><td></td><td>Integral action for velocity control is not performed while this signal is turned ON. It functions only when the "velocity control method setting" is set to "proportional integral control" in system setup register 1.</td></tr>
<tr><td>6</td><td>IN_VELINT_RST</td><td>Reset velocity control integrator</td><td>Δ</td><td>Δ</td><td>Δ</td><td>Δ</td><td></td><td>The velocity integrator information is reset in velocity control while this signal is turned ON. It functions only when the "velocity control method setting" is set to "proportional integral control" in system setup register 1.</td></tr>
<tr><td>7</td><td>(reserve)</td><td></td><td></td><td></td><td></td><td></td><td></td><td>(Reserved)</td></tr>
</table>

List of Logic I/O Contact Input Signals (Block 3)

○: Frequently used signals
Δ: Signals assigned as necessary
No mark: Not applicable

Logic I/O Contact input		Abbreviated signal name	Signal name	Table data operation	Jog move	Position control mode	Velocity control mode	Torque/thrust control mode	Description
Block	bit								
Block 3	0	IN_EMG	Immediate stop	Δ	Δ	Δ	Δ	Δ	See Section “6.1.4 Process Settings in Error State" for explanation about error processing when the immediate stop is performed.
	1	IN_SERVO	Servo command	○	○	○	○	○	The servo is turned ON when this signal is turned ON.
	2	IN_INTERLOCK	Interlock command	Δ	Δ				While this signal is turned ON, the velocity override value is set to zero. (When this signal is turned ON, positioning operation is interrupted and the motor is decelerated and stopped. Movement toward the target position is resumed when it is turned OFF again.)
	3	IN_OVERRIDE_SEL	Velocity override selection	Δ	Δ				This signal switches velocity override values. ON: The scale factor of #45 is selected. OFF: The scale factor of #44 is selected. Set this signal to off and set parameter #44 to 10000 (default setting) if the velocity override function is not used.
	4	IN_ERR_RESET	Error reset	Δ	Δ	Δ	Δ	Δ	All errors that have occurred at the time of the rising edge of this signal are reset, if they can be reset.
	5	(reserve)							(Reserved)
	6	(reserve)							(Reserved)
	7	(reserve)							(Reserved)

List of Logic I/O Contact Input Signals (Block 4 ~ Block 5)

○: Frequently used signals
Δ: Signals assigned as necessary
No mark: Not applicable

Logic I/O Contact input		Abbreviated signal name	Signal name	Table data operation	Jog move	Position control mode	Velocity control mode	Torque/thrust control mode	Description
Block	bit								
Block 4	0	IN_POSW.0	Coin width selection 0		Δ	Δ			This signal selects the coin width. The table below lists valid #parameters corresponding to the setting status of IN_POSW. When performing table data operation, the settling width set in the table data becomes valid and the input status from this signal is not reflected. Selected #parameter / IN_POSW. □ No. / Name / 2 / 1 / 0 #90 / Coin width #0 / OFF / OFF / OFF #91 / Coin width #1 / OFF / OFF / ON #92 / Coin width #2 / OFF / ON / OFF #93 / Coin width #3 / OFF / ON / ON #94 / Coin width #4 / ON / OFF / OFF #95 / Coin width #5 / ON / OFF / ON #96 / Coin width #6 / ON / ON / OFF #97 / Coin width #7 / ON / ON / ON
	1	IN_POSW.1	Coin width selection 1		Δ	Δ			
	2	IN_POSW.2	Coin width selection 2		Δ	Δ			
	3	(reserve)							(Reserved)
	4	IN_PLS_DIRECT	Pulse priority select			Δ			This signal should be set to off under normal circumstances. It is used in the pulse scaling priority function. When this signal is turned ON, the scaling function is bypassed.
	5	(reserve)							(Reserved)
	6	(reserve)							(Reserved)
	7	(reserve)							(Reserved)
Block 5	0	IN_PRM_WR_REQ							(Not used)
	1	IN_PRM_RD_REQ							
	2	IN_MON_A_CHNG_REQ							
	3	IN_MON_B_CHNG_REQ							
	4	(reserve)							(Reserved)
	5	(reserve)							(Reserved)
	6	(reserve)							(Reserved)
	7	(reserve)							(Reserved)

List of Logic I/O Contact Output Signals (Block 0 ~ Block 1)

○: Frequently used signals
Δ: Signals assigned as necessary
No mark: Not applicable

Logic I/O Contact input		Abbreviated signal name	Signal name	Table data operation	Jog move	Position control mode	Velocity control mode	Torque/thrust control mode	Description
Block	bit								
Block 0	0	OUT_DRDY	Drive (CPU) ready	○	○	○	○	○	This signal turns ON if no error occurs after turning the power ON. It is used in the sequence when the power is turned ON (see Section 6.1.6, “Signal Timing when Turning the Power ON”).
	1	OUT_SRDY	Servo ready	○	○	○	○	○	This signal turns ON when the servo is turned ON.
	2	OUT_ERR	Error	○	○	○	○	○	This signal turns ON if an error occurs.
	3	OUT_AXIS_EXE	Axis operating	Δ	Δ	Δ			This signal turns ON when the motor is being operated. Note that it does not function in the velocity control mode and the torque/thrust control mode.
	4	OUT_OVER	Over speed	Δ	Δ	Δ	Δ	Δ	This signal turns ON if an over speed error occurs.
	5	OUT_OVL	Overload signal	Δ	Δ	Δ	Δ	Δ	This signal turns ON if an overload error occurs. The hard I/O logical setting of this signal is set to "negative logic" at shipment from the factory. In this status, the output transistor is turned OFF if an overload error occurs.
	6	OUT_BUSY	Busy	Δ	Δ				This signal turns ON during table operation or while executing jog movement.
	7	OUT_JOG_EXE	Executing jog		Δ				This signal turns ON while executing jog movement.
Block 1	0	OUT_O_CODE.0	Code output 0	Δ	Δ	Δ	Δ	Δ	These signals output M codes in the binary format. OUT_M_EN is turned ON while an M code is being output.
	1	OUT_O_CODE.1	Code output 1	Δ	Δ	Δ	Δ	Δ	
	2	OUT_O_CODE.2	Code output 2	Δ	Δ	Δ	Δ	Δ	
	3	OUT_O_CODE.3	Code output 3	Δ	Δ	Δ	Δ	Δ	
	4	OUT_O_CODE.4	Code output 4	Δ	Δ	Δ	Δ	Δ	
	5	OUT_O_CODE.5	Code output 5	Δ	Δ	Δ	Δ	Δ	
	6	OUT_O_CODE.6	Code output 6	Δ	Δ	Δ	Δ	Δ	
	7	OUT_O_CODE.7	Code output 7	Δ	Δ	Δ	Δ	Δ	

List of Logic I/O Contact Output Signals (Block 2 ~ Block 3)

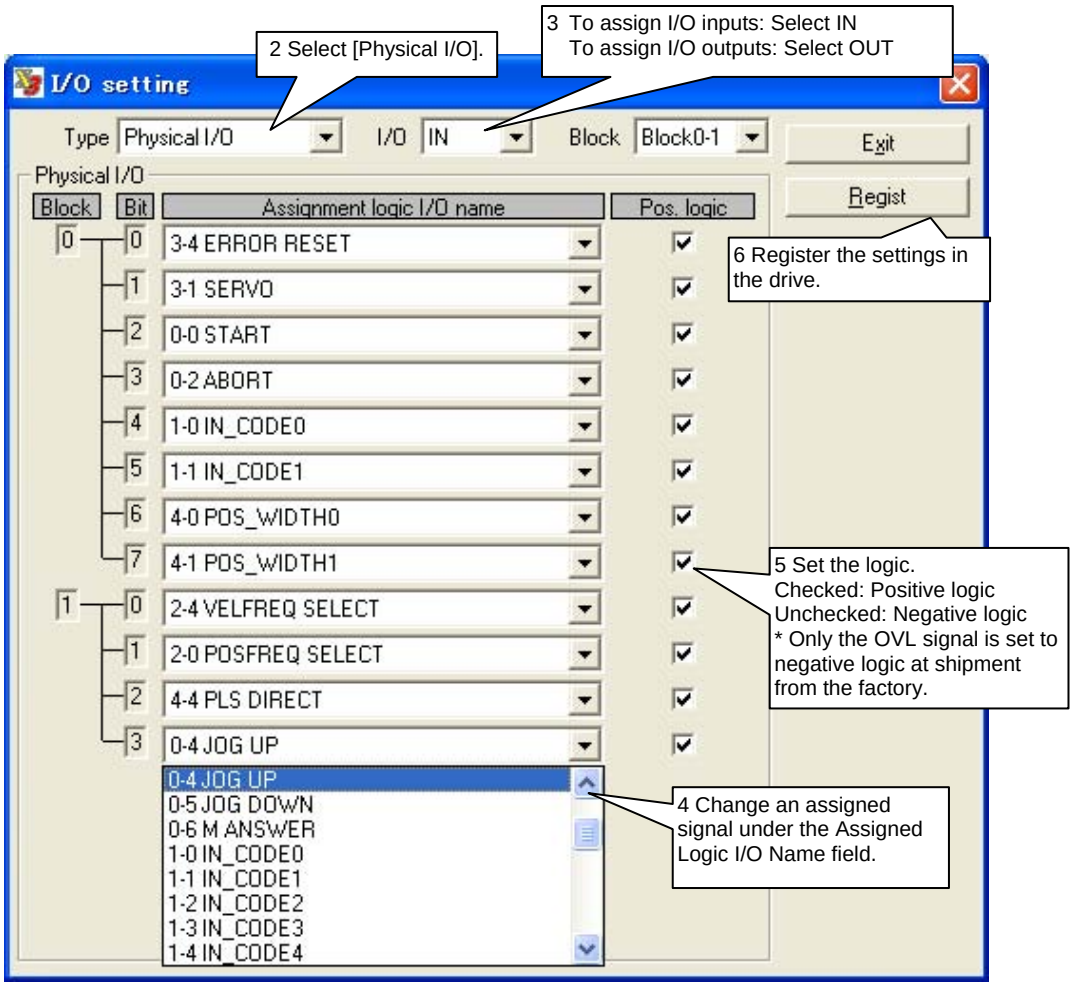
○: Frequently used signals
Δ: Signals assigned as necessary
No mark: Not applicable

Logic I/O Contact input		Abbreviated signal name	Signal name	Table data operation	Jog move	Position control mode	Velocity control mode	Torque/thrust control mode	Description
Block	bit								
Block 2	0	OUT_MODE_EXE	Operating	○					This signal is turned ON while executing table operation.
	1	OUT_M_EN	Outputting M code	Δ	Δ	Δ	Δ	Δ	Assign this signal when the M function is used. It turns ON while an M code is output using OUT_0_CODE.
	2	(reserve)							(Reserved)
	3	OUT_ORG_FINISH	Homing completed	Δ					This signal is turned ON until the power is shut down if homing is completed after turning the power ON. (This signal turns OFF once until homing is completed if homing is performed again.)
	4	OUT_COIN	Position settling signal	Δ		Δ			This signal turns ON when the position deviation is within the range specified by the coin width.
	5	OUT_POS	Positioning signal	Δ	Δ	Δ			This signal turns OFF when a position command is sent to the motor. The positioning signal turns ON when the position settling signal turns ON after the position command is completed if position settling wait is set to valid during table data operation.
	6	OUT_AREA.0	Area signal 0	Δ	Δ	Δ	Δ	Δ	This signal is used in the area signal function. It turns ON when area signal 0 is turned ON.
	7	OUT_AREA.1	Area signal 1	Δ	Δ	Δ	Δ	Δ	This signal is used in the area signal function. It turns ON when area signal 1 is turned ON.
Block 3	0	OUT_PRM_WR_END	#parameter writing completed						(Not used)
	1	OUT_PRM_RD_END	#parameter/ #monitor reading completed						(Not used)
	2	OUT_MON_A_CHNG_END	#parameter/ #monitor display A change completed						(Not used)
	3	OUT_MON_B_CHNG_END	#parameter/ #monitor display B change completed						(Not used)
	4	OUT_PRM_WR_OK	#parameter writing normal						(Not used)
	5	OUT_PRM_RD_OK	#parameter/ #monitor reading normal						(Not used)
	6	OUT_MON_A_CHNG_OK	#parameter/ #monitor display A change normal						(Not used)
	7	OUT_MON_B_CHNG_OK	#parameter/ #monitor display B change normal						(Not used)

(3) Physical (Hard) I/O Assignment, Logic Setting Method

Follow the procedure below to change the hard I/O assignment. Note that it is not allowed to assign the same logic I/O signal to several hard I/O signals. See the next page for the pin numbers of the controller interface corresponding to each block and bit.

STEP 1 Select [I/O] in Data Management of the utility software to display the I/O Setting window.
STEP 2 Select [Physical I/O] in Type.
STEP 3 Select [IN] to change I/O inputs in I/O, and select [OUT] to change I/O outputs.
STEP 4 Change an assigned signal in the Assigned Logic I/O Name field corresponding to the block/bit to be changed.
STEP 5 Change the logic setting as necessary.
STEP 6 Click the [Regist] button to register the settings in the drive.
Note that registration must be performed for each block.



TIP

The set logic and signal status have the following relationship.
<I/O inputs>
Positive logic: The current is conducted into the input photo-coupler when the conditions for the signal are to be satisfied.
(Example) IN_SERVO: The current is conducted into the photo-coupler to turn the servo ON.
<I/O outputs>
Positive logic: The output transistor switches ON when the conditions for the signal are satisfied.
(Example) OUT_DRDY: The output transistor switches ON when the drive is ready.

■ Table of Correspondence between Physical (Hard) I/O Block/Bit Numbers and Pin Numbers of the Controller Interface (CN4)

The table below lists the correspondence between the block numbers of hard I/O and the pin numbers of CN4.
At shipment from the factory, the hard I/O signals are assigned as listed in the table below.
The overload signal (OUT_OVL) is the only hard I/O that is set to negative logic at shipment.

[Hard I/O Contact Inputs]

Hard I/O contact input		Pin No. (CN4-□)	Corresponding logic I/O name *		Hard I/O logical setting *
Block	bit		Abbreviated signal name	Signal name	
Block0	0	19	IN_ERR_RESET	Error reset	Positive logic
	1	20	IN_SERVO	Servo command	Positive logic
	2	21	IN_START	Drive start command	Positive logic
	3	22	IN_ABORT	Drive stop command	Positive logic
	4	23	IN_I_CODE.0	Code input 0	Positive logic
	5	24	IN_I_CODE.1	Code input 1	Positive logic
	6	25	IN_POSW.0	Coin width selection 0	Positive logic
	7	26	IN_POSW.1	Coin width selection 1	Positive logic
Block1	0	27	IN_VELFREQ_SEL	Velocity control bandwidth select	Positive logic
	1	28	IN_POSFREQ_SEL	Position control bandwidth select	Positive logic
	2	29	IN_PLS_DIRECT	Pulse priority select	Positive logic
	3	30	IN_POSINT_INH	Pos. control integration prohibited	Positive logic

[Hard I/O Contact Output]

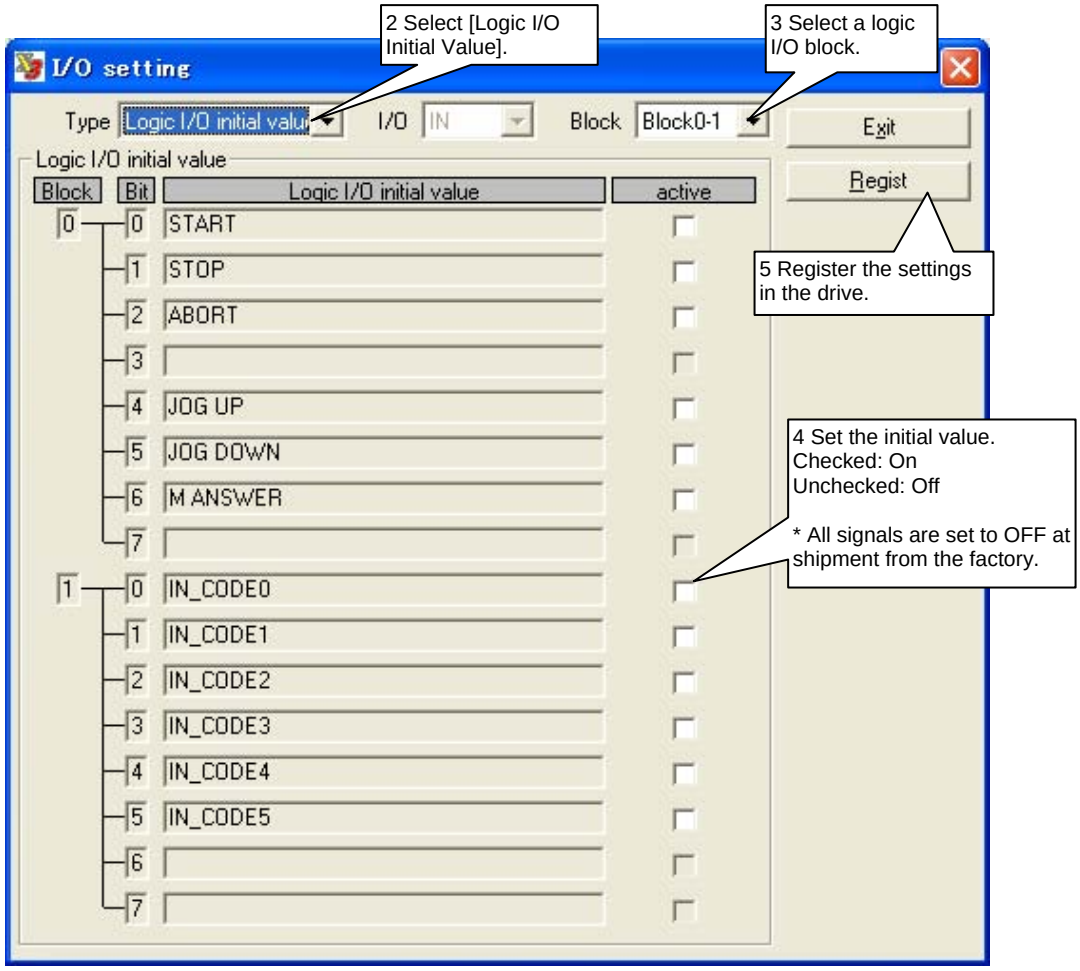
Hard I/O contact output		Pin No. (CN4-□)	Corresponding logic I/O name *		Hard I/O logical setting *
Block	bit		Abbreviated signal name	Signal name	
Block0	0	3	OUT_DRDY	Drive (CPU) ready	Positive logic
	1	4	OUT_SRDY	Servo ready	Positive logic
	2	5	OUT_BUSY	Busy	Positive logic
	3	6	OUT_OVL	Overload signal	Negative logic
	4	7	OUT_OVER	Over speed	Positive logic
	5	8	OUT_COIN	Position settling signal	Positive logic

* Default Setting

(4) How to Change Logic (Soft) I/O Initial Value Setting

Set the initial values for logic I/O inputs using the utility software.
At shipment from the factory, the initial values of all logic I/O inputs are set to off. To change the initial values of logic I/O inputs, perform the following operation.

STEP 1 Select [I/O] in Data Management of the utility software to display the I/O setting window.
STEP 2 Select [Logic I/O initial value] in Type.
STEP 3 Select the logic I/O block to be changed from [Block].
STEP 4 Check the check box under the Initial value setting field for each item to be changed (check the box to turn the signal ON).
STEP 5 Click the [Regist] button to register the settings in the drive.
Note that registration must be performed for each block.



6.1.2 #parameters/#monitors

The group of variables called #parameters/#monitors is expressed using the format #***. #parameters/#monitors are classified as listed in the table below according to their numbers.

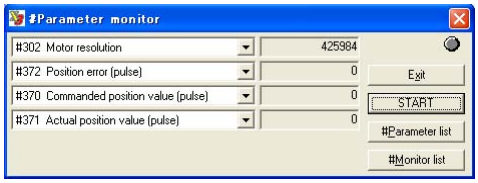
#parameter/ #monitor number (#***)	Classification	Writing/backup	Description
#0 ~ #99	#parameters	Possible	It is always possible to read and write these parameter values.
#100 ~ #109	#parameters	Possible	These are variables to which no definition is assigned. User can set them freely. It is always possible to read and write these parameter values. They are mainly used when conditional branching is used in table data operation.
#110 ~ #127	#parameters	Possible	It is always possible to read and write these parameter values. * The settings are restricted in functions when the power is cycled.
#300 ~ #427	#monitors	Not possible	#monitors output the status of the motor and drive, which are acquired by the drive. They can only be referenced (read) during table operation. Writing is not allowed.

All #parameters/#monitors are expressed using the format #***. The values can be referenced (read) during table data operation or using commands. Writing (changing setting) is allowed within the allowable setting range.

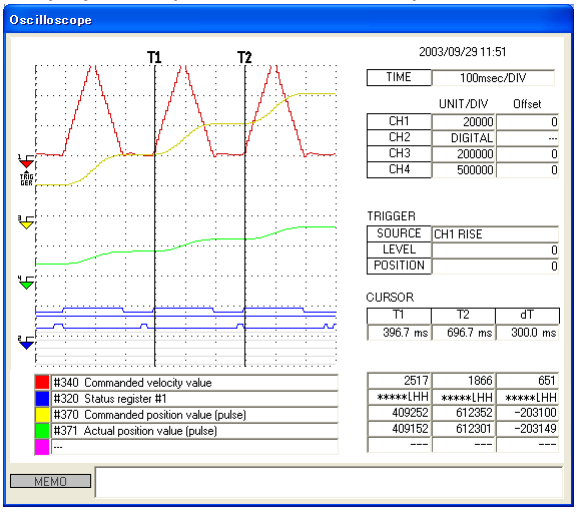
■ Status Output of #parameters/#monitors

#parameters/#monitors allows checking the status of the drive and motor using the #parameter/#monitor Display and Oscilloscope functions. It is also possible to operate the motor by referencing these #parameter/#monitor values in table data operation. See Appendix, "Detailed #parameters" and "Detailed #monitors" for the types and settings of #parameters/#monitors.

Display Example of the #parameter/#monitor Display Window



Display Example of the Oscilloscope Window



(1) #parameters

#parameters are used in various settings, including operation patterns of the motor and error processing, and adjustment of the control system. Change the setup values of #parameters as required. In addition to writing and checking setup values, it is possible to upload all the #parameters from the drive to a PC and download them from a PC to the drive.

■ Register Parameters

Register parameters are classified into two types: system setup registers and error setup registers. Several setup items can be expressed in one #parameter number by encoding the information in a 32-bit hexadecimal value.

#parameter number (#***)	#parameter name
#98	System setup register 2
#99	System setup register 3
#110	System setup register 1
#38	Error process setup register 1
#39	Error process setup register 2

<Setup example> #98 [System setup register 2]

Signal name	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	Actual position value filter	Enable velocity feedback filter	(Reserve)	Enable first lag compensation filter	Enable notch filter #2	Enable notch filter #1	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	(Reserve)	Disable M-function when an error occurs	Enable start up operation(motion control table operation)
Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Setup value	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0

In the case of the setting above
#98 [System setup register 2]: 00030002 (hexadecimal notation)

■ How to Write to #parameters

Values can be written to #parameters using one of the following three methods.

Method 1: Changing values in the #parameter window of the utility software
This method is mainly used at startup. This method is the easiest to use, as setup windows are provided, allowing direct access to each item.

Method 2: Changing values in the terminal window
This method is mainly used at startup. Enter the setup values of #parameters directly.

Method 3: Changing values by a table data operation
In this method, values of #parameters are changed by executing the table data operation prepared by the PLC in advance. See Section 6.4.9, "Parameter Change" for the detailed information.

Changing values of #parameters can refer to both "saving" and "registration." These two concepts are different in the following way.

Saving: This means changing #parameter values in RAM. Changed data returns to the status it had before changing once the power is turned OFF. Use this method when you want to change #parameter values temporarily.

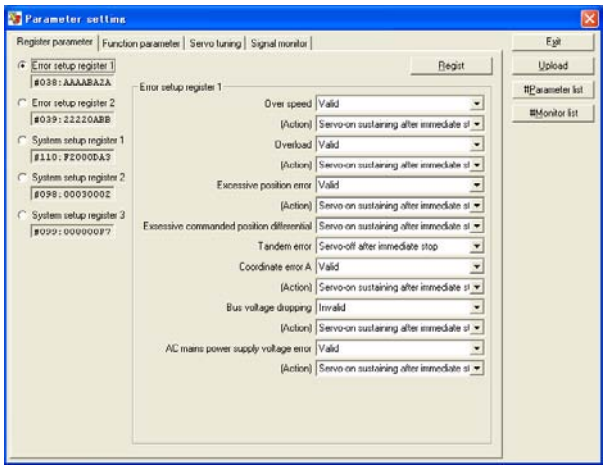
Registration: This means changing #parameter values in both the EEPROM and RAM. The changed settings are maintained even if the power is turned OFF. Use this method to commit the settings. Note that "registration" is not accepted while the motor is operating. Perform registration while the motor is stopped

* The drive loads the #parameters from the EEPROM into RAM once at startup. Afterward, the drive operates based on the #parameter settings in RAM.

When #parameters are registered, their values are written in the EEPROM. There is a limit on the allowable number of times the EEPROM can be written to (approximately 1 million times).
If this limit was exceeded, the EEPROM may be damaged and the drive may not start up.
If you select "specify registration" for #parameters in the #parameter change function during table operation, this limit may be exceeded depending on the pattern used.

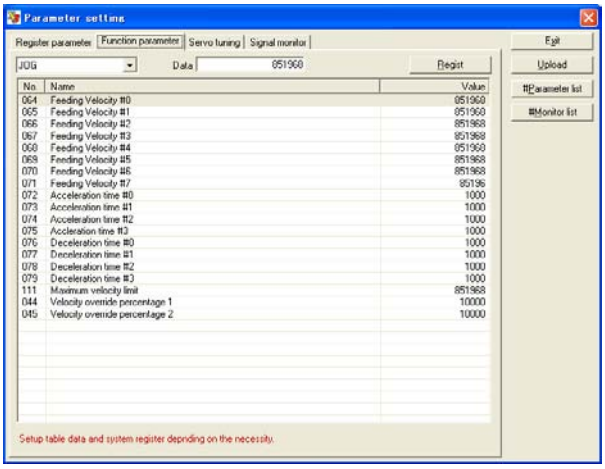
Method 1: How to change values in the #parameter window of the utility software

Click the [#parameter] button in the utility software to open the #parameter Setting window.
Select the appropriate setting window and change the necessary #parameter values.
Make sure to click the [Regist]button after changing values.
See Section 8.6.1, "#parameters" for the detailed explanation of the setting windows.



Register #parameter Setting Window

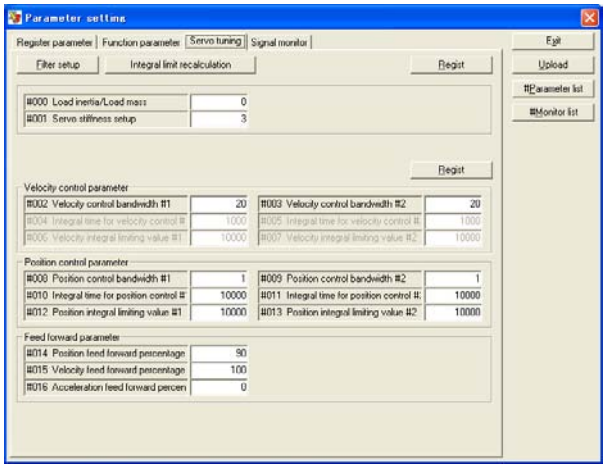
Use this window to change and register #parameter values.



Function #parameter Setting Window

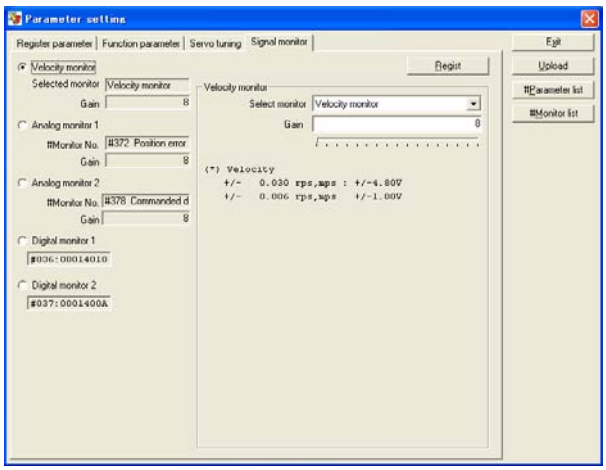
Use this window to change values of #parameters related to the following functions.

- Jog
- Homing
- Test operation
- Auto-tuning
- Incremental/absolute positioning move
- Basic settings



Servo Tuning Window

Use this window to adjust the servo.



Signal Monitor Terminal Setting Window

Use this window to select a waveform to be output using the analog monitor card and change the output gain.

* The analog monitor card R7041WC (optional) is required to use the signal monitor function.

Method 2: How to change values in the terminal window

Open the Terminal window of the utility software and enter the following in the input edit box in the #parameter window. Enter using single-byte alphanumeric characters.

To "save" a #parameter
#OOO = □□ ↵ (change the value temporarily)

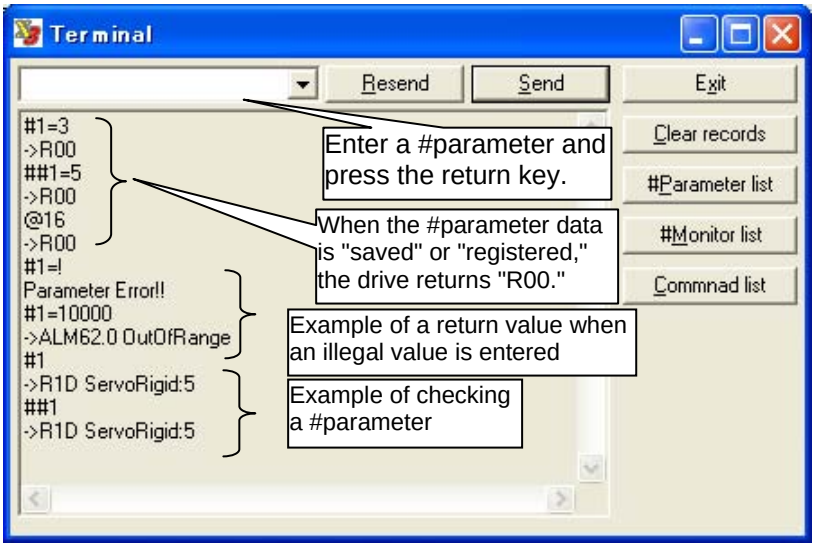
To "register" a #parameter
##OOO = □□ ↵ (register a #parameter in the EEPROM)

To "register" several "saved values" in a batch
@16 ↵ (register all data in the RAM to the EEPROM)

Entry examples:
#1=5 (saving)
##1=5 (registration)
@16 (register all #parameters that have been changed)

TIP

How to check #parameters
To check saved values or registered values of #parameters, enter the following in the input edit box; the relevant values are returned.
To check "parameter #1 saved value": #1↵
To check "parameter #1 registered value": ##1↵



Method 3: How to change values by a table data operation
See Section 6.4.9, "Parameter Change."

■ **How to Back up #parameters**
See the item in Section 8.7.4, "Backup."

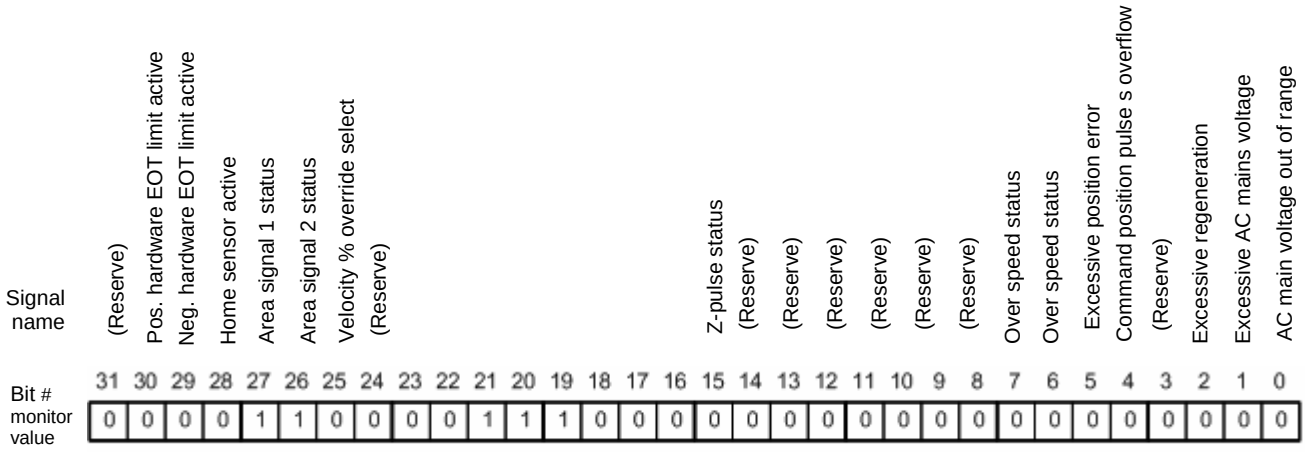
(2) #monitors

#monitors output the status of the motor and drive acquired by the drive.
They can be used to observe the conditions of the motor and drive using the #parameter/#monitor Display, Axis Signal Monitor and Oscilloscope functions, or operate the motor by referencing #monitor values in table data operation.
Writing to the monitors is not allowed.

■ Register Monitors

Register monitors can express several #monitor settings in one #monitor number by encoding the information in a 32-bit hexadecimal value (see the table below). Moreover, it is possible to display the status with status registers by clicking [Axis Signal Monitor] in the utility software.

#monitor number (#***)	#monitor name
#300	Drive version
#301	Motor specifications
#310 ~ #313	Physical (Onboard) input/output blocks
#314 ~ #317	Logic (Virtual) input/output blocks
#320 ~ #322	Status register



6.1.3 Operation Privilege

Two types of interfaces, a controller interface and a serial interface, are provided. For the serial interface, the utility software, an operation display panel (optional) and an operation display pendant (optional) are available.
The items that can be operated are different for these two types of interfaces, but the main operations are possible via both interfaces. Note, however, that if the user is operating the system via one of the interfaces and an operation command contrary to that is given via another interface, devices connected to the interfaces being operated can no longer manage the correct status. In order to prevent such situations, it should be selected which interface will have the operation privilege before the interfaces are used. The table below lists the relationship between the items that can be operated via each interface and operation modes.

Main Operation Privilege and Functions that can be Instructed

○: Can be instructed
X: Operation not allowed
-: Operation not allowed regardless of the operation mode

Command name / Operated device	Main operation privilege: Serial interface side		Main operation privilege: Controller interface side	
	Serial interface	Controller interface	Serial interface	Controller interface
M function	-	○	-	○
Jog move command	Select an operation privilege by setting the jog feed selection, RS side selection bit of parameter #110 [System setup register 1].			
Abort	○	○	○	○
Stop	○	x	x	○
Start	○	x	x	○
Reset velocity control integrator	-	○	-	○
Prohibit velocity control integral action	-	○	-	○
Velocity control bandwidth select	-	○	-	○
Reset position control integrator	-	○	-	○
Pos. control integration prohibited	-	○	-	○
Position control bandwidth select	-	○	-	○
Error code acquisition	○	-	○	-
Error reset	○	○	○	○
Error reset with record clear	○	-	○	-
Velocity override selection	-	○	-	○
Interlock	-	○	-	○
Servo command	○	x	x	○
Immediate stop command	-	○	-	○
Pulse priority select	-	○	-	○
Coin width selection	-	○	-	○
Home offset position setting	○	x	○	○ *
Coordinate system setting	○	x	○	○ *
Integral limiter self-adjustment	○	x	○	○ *
#parameter writing	○	-	○	-
#parameter/#monitor reading	○	-	○	-

*1: Can be instructed using table data

(1) How to Select Operation Privilege

The main operation privilege is always set to the controller interface when the power is turned ON.

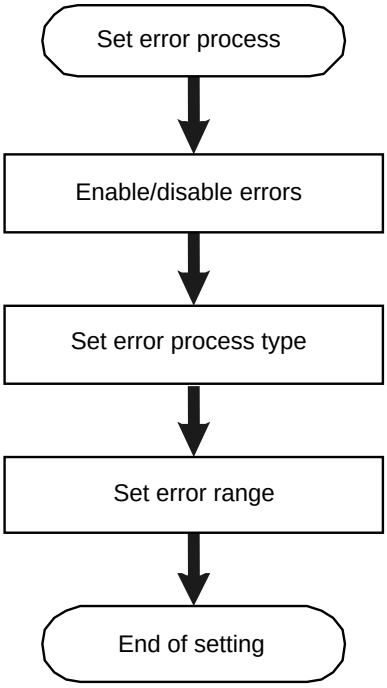
[1] There are three ways to switch the main operation privilege from the controller interface side to the serial communication side.
Method 1: It can be switched when opening the Operation window in the utility software.
Method 2: It can be switched by the switch button in the Operation window.
Method 3: It can be switched by issuing the command @5:0 from the terminal window.

[2] There are two ways to switch the operation privilege from the RS communication side to the controller interface side.
Method 1: It can be switched by the switch button in the Operation window in the utility software.
Method 2: It can be switched by issuing the command @5:1 from the terminal window.

When opening the Operation window from the utility software, a message box asking whether or not to select the serial communication side appears if the main operation privilege is on the controller side.
Note that the main operation privilege is not returned to the original setting automatically when the Operation window is closed. Make sure to switch the privilege back to the controller interface if it is necessary to continue operating the system via the controller interface.

6.1.4 Process Settings in Error State

The way an error is processed varies depending on the error code (see Appendix 3, "Detailed Main Error Codes"). Moreover, for some errors, it is possible to select how the drive behaves when an error occurs.
Specify the correct form of error process according to the specifications of the device, and set #parameters by referring to Section 2.7, "Stop Function in Error State."
Regarding errors for which error process types can be set, see the tables in the next page, "#parameters Related to Error Process" and "Error Process Types."
The parameters for setting error process are released under the condition that the customer bears all responsibility in the event of unanticipated behavior.



Enabling/disabling errors

If errors are set to invalid, an error is not generated even when the error conditions are satisfied.

Setting of error process type

In the velocity control mode and torque/thrust control mode, analog command inputs are interrupted and the velocity instruction value or torque instruction value to the drive is set to zero after an error occurs, regardless of the setting.

Setting of error range

Set the velocity and position ranges in which errors are generated.

#parameters Related to Error Process

Error name	Error code	Error valid/ invalid setting	Error process type setting	Error range setting
Over speed	24.0	Error process setup register 1	Error process setup register 1	
Overload	22.1 22.2	Error process setup register 1	Error process setup register 1	-
Excessive position deviation	23.0	Error process setup register 1	Error process setup register 1	#18 (Forward direction) #19 (Reverse direction)
Excessive position command difference value	31.0	Always valid	Error process setup register 1	-
Coordinate system error A	16.1	Error process setup register 1	Error process setup register 1	-
Bus voltage drop	20.3	Error process setup register 1	Error process setup register 1	-
Main power supply error	21.0	Error process setup register 1	Error process setup register 1	-
Hardware EOT	42.0 43.0	Error process setup register 2	Error process setup register 2	Set to generate an error at the position of the proximity sensor.
Software EOT	44.0 45.0	Error process setup register 2	Error process setup register 2	#42 (Forward direction) #43 (Reverse direction)
Monitor pulse error	18.0	Error process setup register 2	Error process setup register 2	-
Interface immediate stop	46.2	Error process setup register 2	Error process setup register 2	-

Error Process Types

Error process type	Behavior
Decelerate and stop, and maintain servo ON	The drive instructs the motor to decelerate and stop. The servo is kept turned ON after stopping.
Decelerate and stop, and turn servo OFF	The drive instructs the motor to decelerate and stop. The servo is turned OFF after stopping.
Stop abruptly, and maintain servo ON	The drive stops the motor abruptly and keeps the servo turned ON. The deceleration time is determined by #80 [Deceleration time for immediate stop].
Stop abruptly, and turn servo OFF	The drive stops the motor abruptly and turns the servo OFF. The deceleration time is determined by #80 [Deceleration time for immediate stop].
Turn servo OFF immediately	The drive turns the servo OFF immediately.

! DANGER

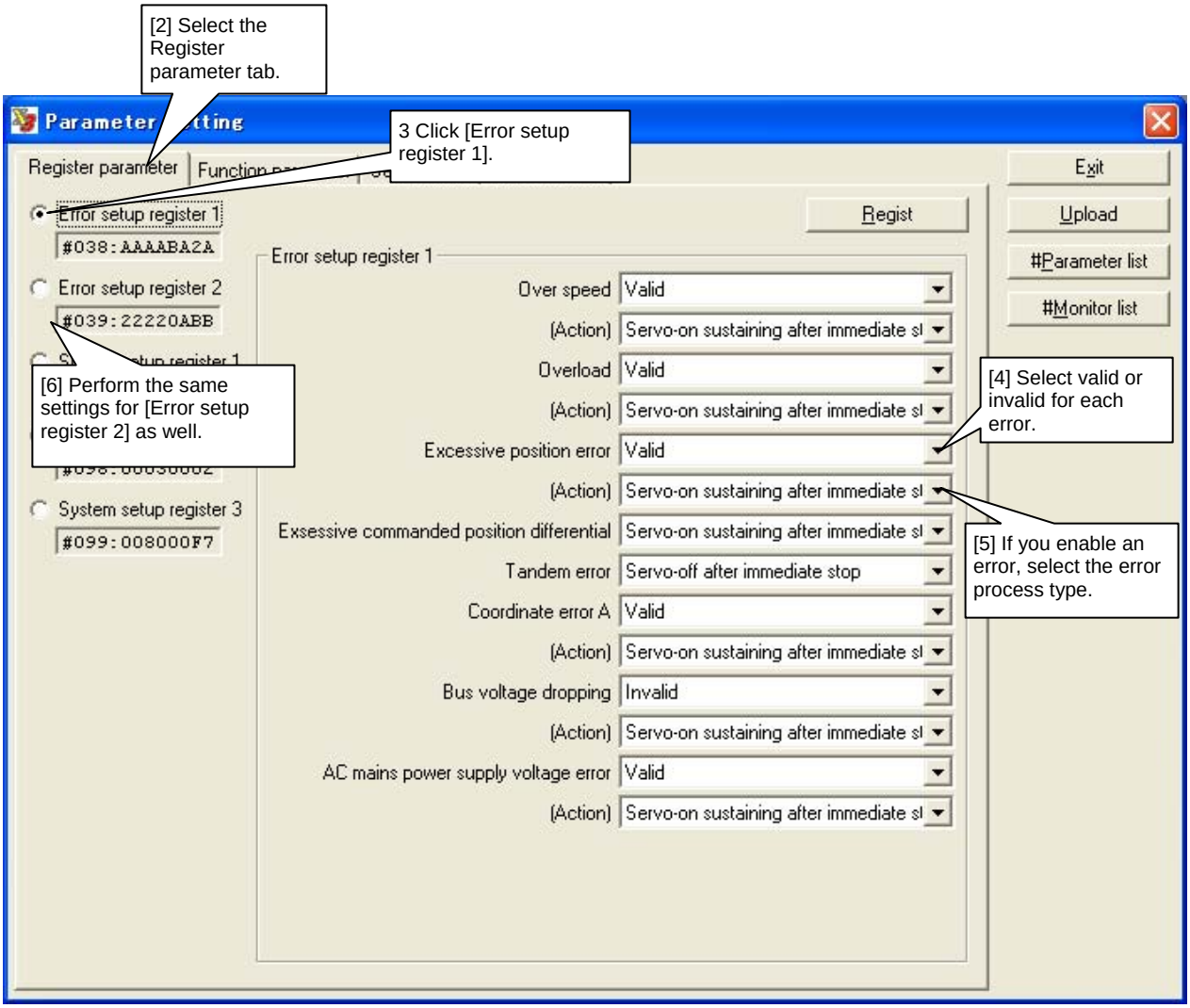
If you select "Turn servo OFF immediately," the motor may run freely. Make sure to take steps to secure the safety, such as using an external brake system.

! DANGER

Even if the motor is set to perform servo deceleration in the case of a given error, the servo is immediately turned off if the following errors occur before the error or during servo deceleration. If any such error should occur, servo deceleration can no longer be used.
4.0 Watch dog error
15.* Encoder error
20.1 Overvoltage
20.2 IPM fault, current transformer detection
20.4 Low voltage (servo-off level)
20.5 A-phase, B-phase actual current monitoring
25.* Regeneration error
30.0 Servo not ready

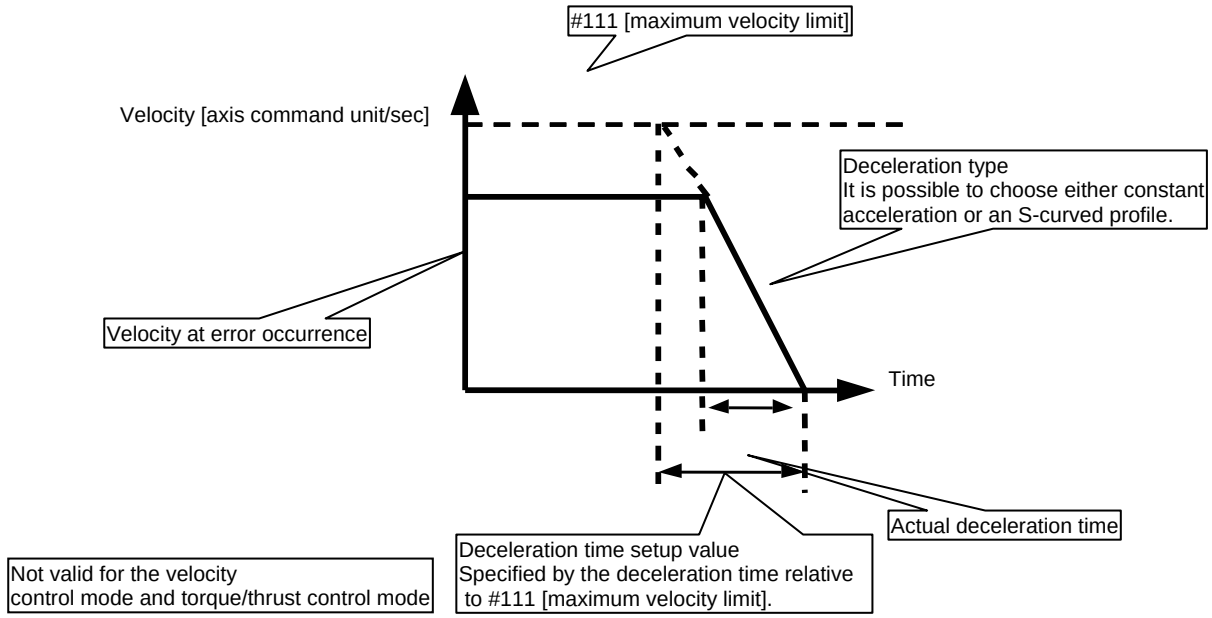
(1) #parameter Settings

STEP 1 Select [#parameter] from the main menu of the utility software.
STEP 2 Select the Register parameter tab.
STEP 3 Select [Error setup register 1] to display the setting window.
STEP 4 Select valid or invalid for each error.
STEP 5 If you are setting an error to valid, select the error process type.
STEP 6 Perform the same settings for [Error setup register 2] as well.
STEP 7 Click the [Regist] button when the settings have been completed.



Stop Method at Error Occurrence in Each Control Mode

			Control by the built-in controller		Control by an external controller		
			Table data operation	Jog operation	Position control mode	Velocity control mode	Torque/thrust control mode
Deceleration method	Immediate stop	Deceleration time	Set by #80 [Deceleration time for immediate stop].	Set by #80 [Deceleration time for immediate stop].	Set by #80 [Deceleration time for immediate stop].	The inputs are shut down immediately after an error occurs, and the velocity command to the drive is set to 0.	The inputs are shut down immediately after an error occurs, and the torque/thrust command to the drive is set to 0.
		Deceleration profile	Deceleration profile set in table data	Deceleration type set using #parameter system setup register 3	Decelerate at constant acceleration		
	Deceleration and stop	Deceleration time	Deceleration time set in table data	Deceleration time set using #parameter system setup register 3	Set using #76 [Deceleration time #0].		
		Deceleration profile	Deceleration profile set in table data	Deceleration type set using #parameter system setup register 3	Decelerate at constant acceleration (Trapazoidal)		



TIP

Guidelines for setting abrupt stop deceleration time (#80)

Set the deceleration torque to 100% and calculate the shortest time that can be achieved for decelerating to a stop.
(Use the formula below for the calculation.)
Moreover, multiply the value achieved for constant acceleration by 1.5 and enter this for the S-curved acceleration/deceleration profile.

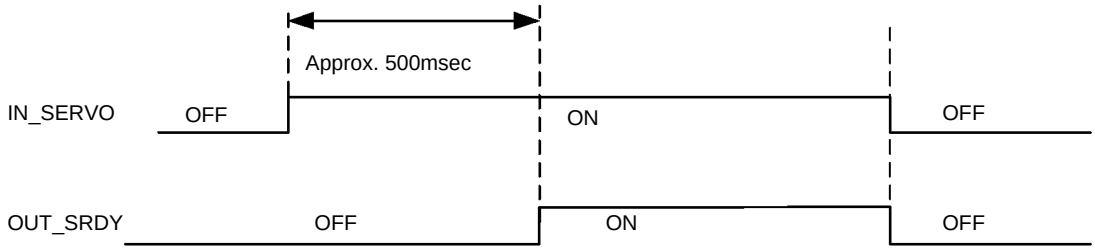
$$t = \frac{(MS + ML) * v}{F}$$

t: Deceleration time [sec]
MS: Slider weight (See Section 2.1, "Standard Specifications") [kg]
ML: Load weight [kg]
v: Velocity [rps]
F: Maximum motor thrust [N]

6.1.5 Methods of Issuing Servo-ON Commands

There are two ways to turn the servo ON: turning the IN_SERVO signal of the controller interface ON and sending the servo-on command via a serial interface. See Section 6.1.6, "Signal Timing when Turning the Power ON" for how to shift the servo status when IN_SERVO is turned ON at the time of turning the power ON.

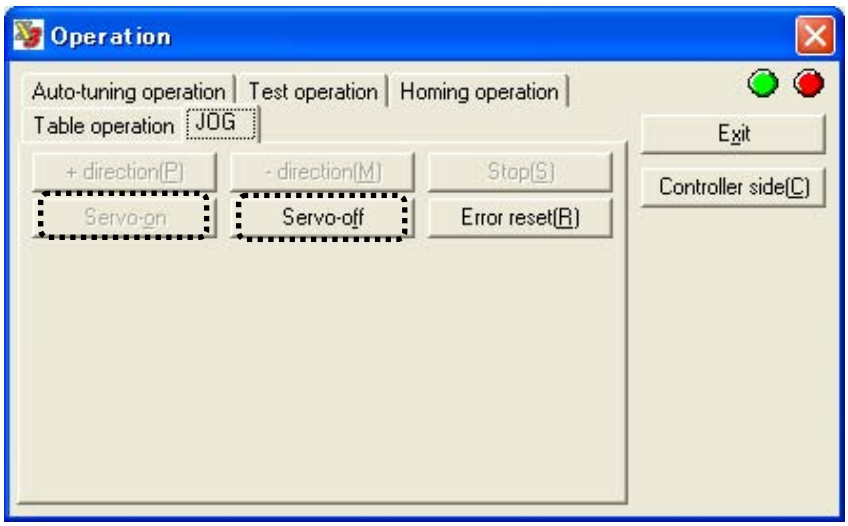
(1) Issuing Servo Commands via the Controller Interface



Note: If the servo is not adjusted, the motor maintains a very low torque even when the servo is turned ON.

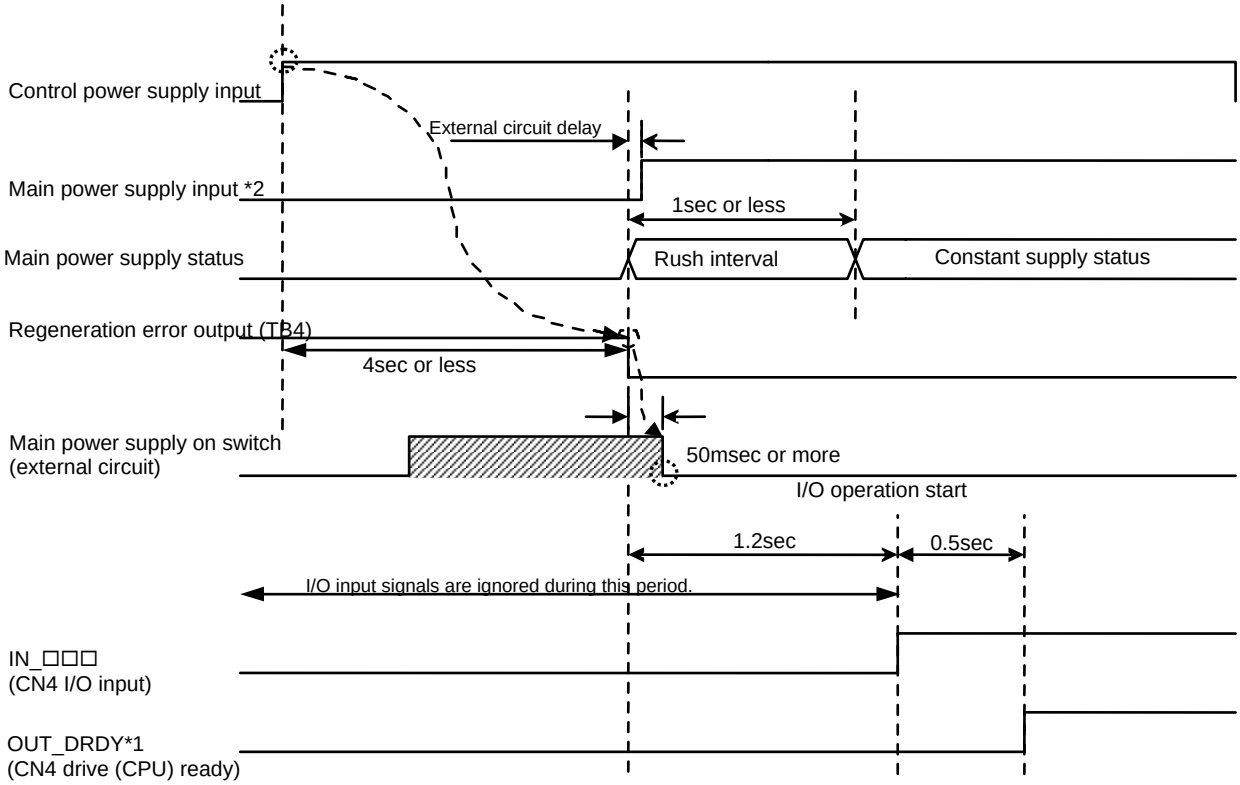
(2) Issuing Servo Commands from the Utility Software

The servo is turned ON by clicking the [Servo-ON] button in the Operation window in the utility software. Press the [Servo-OFF] button to turn the servo OFF.

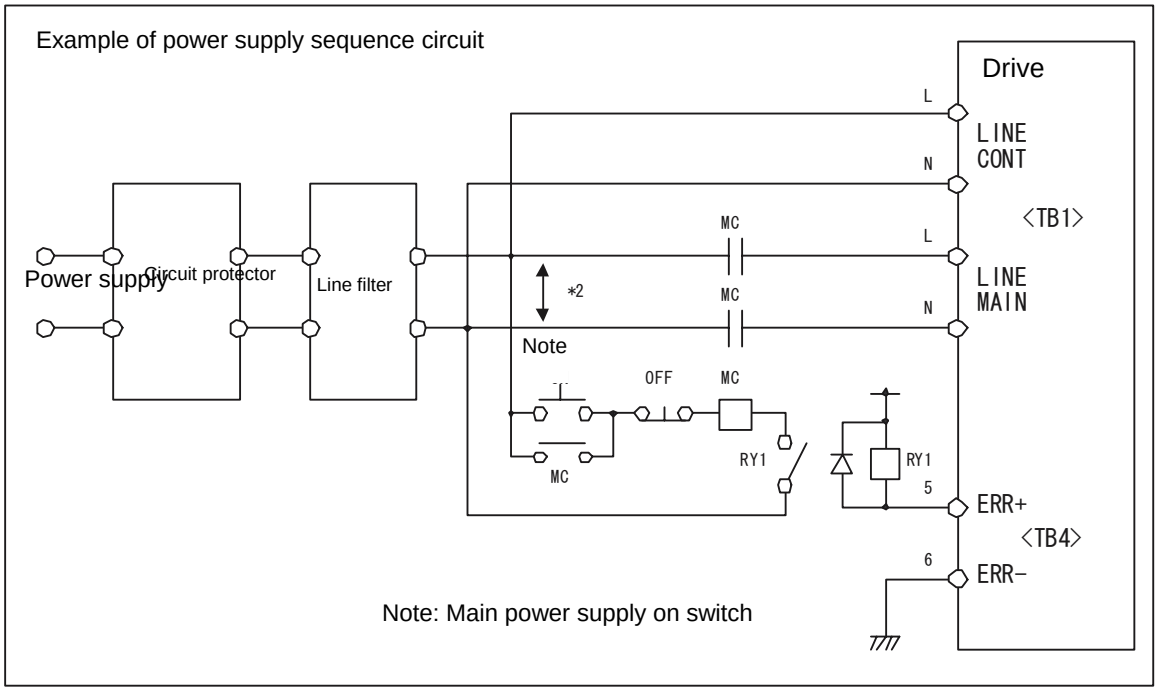


6.1.6 Signal Timing when Turning the Power ON

Make sure that the signals observe the sequence shown in the following timing diagram when the power is turned ON.

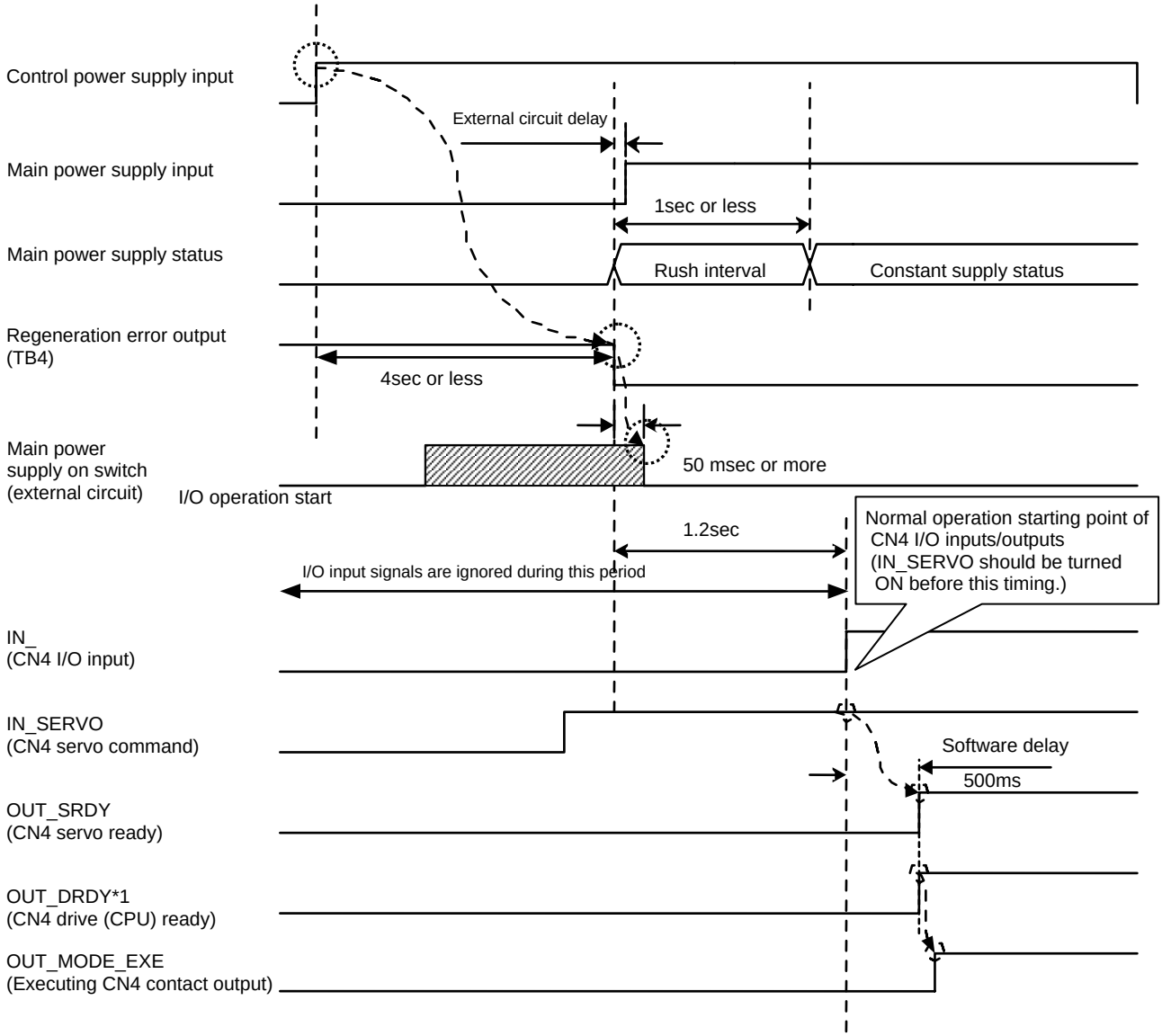


*1 Waveform when the logic setting is positive and no error occurs when the power is turned ON
*2 The timing diagram shows the timing for the circuit configuration shown in the figure below.



● Sequence at Startup Operation

To start up using table data operation, make sure the signals observe the sequence shown in the following timing diagram when the power is turned ON.



6.1.7 Coordinate Systems
(1) Linear Coordinate System

There are the following restrictions on the coordinate range of the linear coordinate system.

Command unit:
Limit value on the + side: The smaller value of 2147483647 x #112/#113 and 999999999

Limit value on the - side: The greater value of -2147483647 x #112/#113 and –999999999

Pulse:
Limit value on the + side: The smaller value of 2147483647 #113/#112 and 999999999

Limit value on the - side: The smaller value of -2147483647 #113/#112 and -999999999

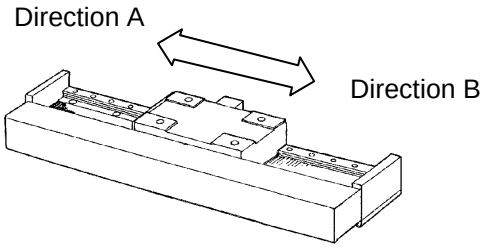

TIP

When using the linear coordinate system, a software EOT error occurs if the command unit instruction value exceeds the coordinate system limit range (ERR44.0: + direction software EOT, ERR45.0: - direction software EOT).

(2) Setting the Forward Direction of Coordinate Systems

It is possible to reverse the rotation direction of the motor and the torque output direction in the torque/thrust control mode.

<Setting method>
STEP 1 Select [#parameter] from the main menu of the utility software.
STEP 2 Open the Register parameter tab and then the System Setup Register 1 panel.
STEP 3 Set the rotation direction in Coordinate System Forward Direction Setting from the System Setup Register 1 panel.



In this manual, the direction of the slider movement is explained by viewing the slider from the encoder side, as shown in the figure below;
Left side: Direction "A"
Right side: Direction "B"

Rotation Direction Corresponding to the Coordinate System Forward Direction Setting Status (Output Torque Direction in the Torque/Thrust Control Mode)

	Coordinate system forward direction setting: Forward direction		Coordinate system forward direction setting: Backward direction	
	Direction A	Direction B	Direction A	Direction B
Jog move	IN_JOG_UP	IN_JOG_DN	IN_JOG_DN	IN_JOG_UP
Table data operation	+ direction	- direction	- direction	+ direction
Position control mode	+ direction	- direction	- direction	+ direction
Velocity control mode	Positive voltage	Negative voltage	Negative voltage	Positive voltage
Torque/thrust control mode	Positive voltage	Negative voltage	Negative voltage	Positive voltage

Coordinate system forward direction setting is preset to "Valid" at shipment from the factory.

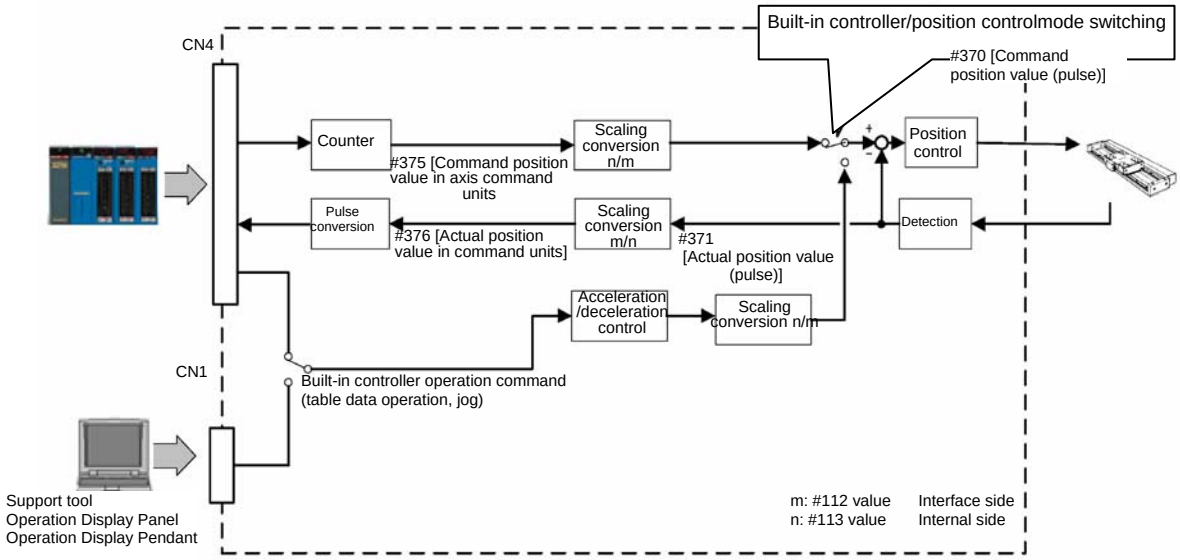
(3) Scaling Conversion

By using the scaling conversion function, it is possible to set the ratio of the amount of motor movement relative to the instructed amount from the controller interface or the utility software freely.
The unit system consists of two types of coordinate systems: the command unit coordinate system and pulse unit coordinate system.
The command unit coordinate system is used for representing signals transferred between the PLC and drive, and the pulse unit coordinate system is used for representing signals transferred between the drive and motor.
The conversion rate of these two unit systems is set in scaling conversion.
The scaling conversion is given by the following formula.
When the scaling conversion setting data is changed, the rate of the feedback pulse signal also changes accordingly.

Scaling Conversion Formula

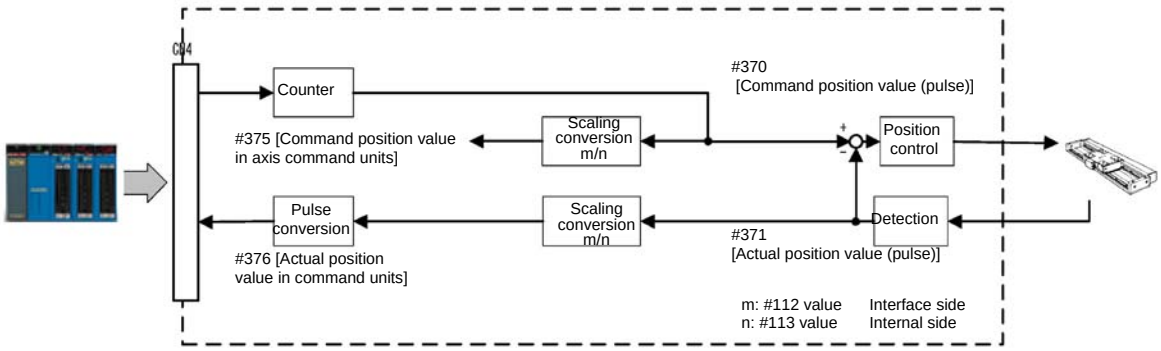
$$\text{Pulse unit} = \frac{\text{\#113 [Scaling data ratio numerator (on the pulse)}}{\text{\#112 [Scaling data ratio denominator (on the command unit)}} \times \text{command unit(s)}$$

When operating with the built-in controller (OUT_BUSY ON)
When not operating with the built-in controller (OUT_BUSY OFF) and the discrete input IN_PLS_DIRECT is OFF



The value of #370 [pulse position command value] is generated by converting the scale of #375 [command unit command value].

When not operating with the built-in controller (OUT_BUSY OFF) and the discrete input IN_PLS_DIRECT is ON



The value of #375 [Command position value in axis command units] is generated by converting the scale of #370 [Command position value (pulse)].

<Default Setting Values of Scaling Data>

The table below lists the default scaling data setting values. Set the values appropriately, in accordance with the system used.

Table of Default Scaling Data

Encoder resolution	#113 [Scaling data ratio numerator (on the pulse)]	#112 [Scaling data ratio denominator (on the command unit)]
0.5 [μm]	2000000	1000000
0.25 [μm]	4000000	2000000
0.05 [μm]	20000000	10000000

If #112 or #113 is changed, the changed data becomes valid the next time the power supply to the drive is turned ON.

6.1.8 Basic Control Modes

(1) Types of Basic Control Modes

It is possible to control the drive and motor either by an external controller or the built-in controller. The table below lists the available types of operations.
Operations controlled by the built-in controller can be performed in any control modes (see the next page).

Operation			Reference section	Description of operation	Command method	Control method	
						Position control	Velocity control
Controller built into the drive	Jog		6.3	The motor performs jog movement.	Command via I/O inputs from the controller interface or the	Integral proportional control or proportional integral control	Proportional control Proportional integral control
	Table data operation	Homing	6.4.5	The motor moves to return to the home position.			
		Auto-tuning	6.4.3	Used for servo tuning.			
		Test operation	6.4.4	Used for servo tuning.			
		Incremental positioning move	6.4.7	The motor performs incremental (relative position) positioning.			
		Absolute positioning move	6.4.6	The motor performs absolute (absolute position) positioning movement.			
External controller	Position control mode		6.5.1	The position is controlled.	Command via pulse train from the controller interface		
	Velocity control mode		6.5.2	The velocity is controlled.	Command via analog voltage from the controller interface	Invalid	
	Torque/thrust control mode		6.5.3	The torque/thrust is controlled.			Invalid

Control Modes and Input Commands

Control mode	Input command		
	Built-in controller (jog, table data operation)	A_CMD analog command input	PUA_IN, SDB_IN position command pulse input
Position control mode	Execute commands from the built-in controller.	Command is set to invalid.	Pulse train control is performed.
Velocity control mode		Velocity control is performed.	Commands are set to invalid.
Torque/thrust control mode		Torque/thrust control is performed.	

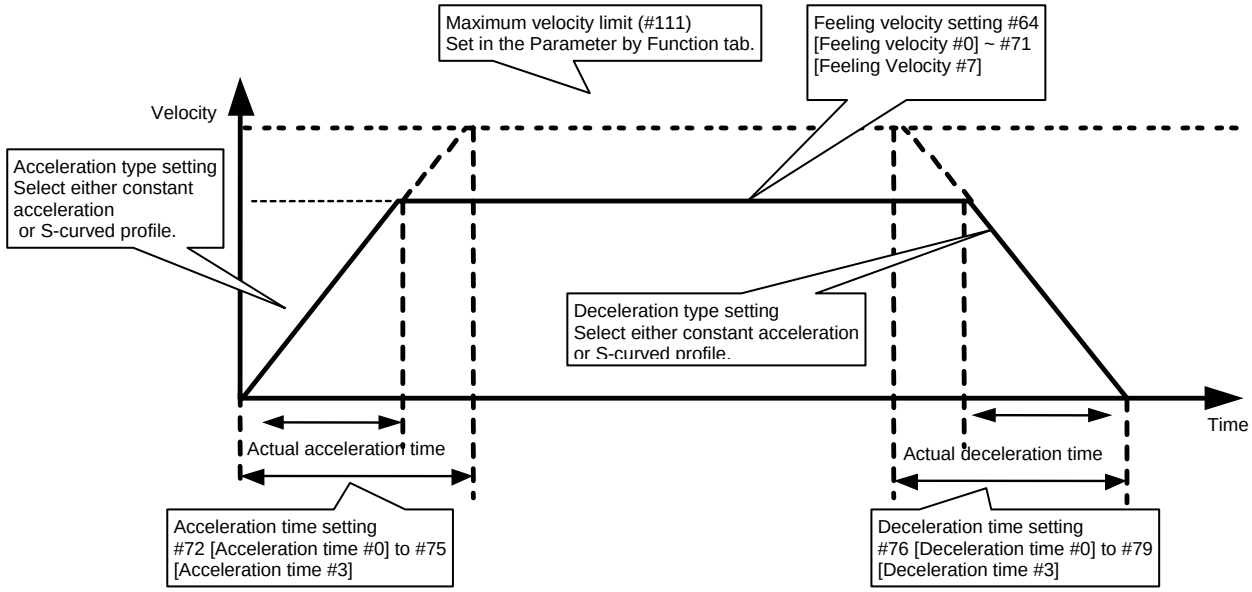
If a command is sent using the built-in controller while the drive is controlled by pulse train or analog voltage inputs, the control being performed using pulse train/analog voltage is immediately interrupted, and the operation instructed by the built-in controller is carried out. The control with pulse train/analog voltage is resumed immediately after the operation instructed by the built-in controller is completed. Pulse train/analog voltage inputs entered while the operation instructed by the built-in controller is carried out are ignored.

(2) Selecting Control Modes

STEP 1 Select [#parameter] from the utility software.
STEP 2 Select System Setup Register 1.
STEP 3 Select a control mode.
STEP 4 Select a control method.

6.1.9 Velocity Profile

When the built-in controller is used to control the drive and motor (in jog move and table data operation), the acceleration time, deceleration time, feed velocity, acceleration type and deceleration type are saved/registered individually by corresponding #parameters.
Moreover, by using the velocity override function, it is possible to change the velocity in real time while moving (real-time velocity override function).
The maximum velocity of the motor can be specified by #111 [Maximum velocity limit], but the upper velocity limit is restricted by the motor's intrinsic velocity limit value (see Section 2.1, "Standard Specifications"). The restricted value is displayed in #305 [User defined maximum velocity].



Velocity Profile Setup Items

	Jog move	Table data operation (absolute positioning, incremental positioning and homing)
Deceleration type	Select either constant acceleration or S-curved profile in system setup register 3.	Select either constant acceleration or S-curved profile in table data.
Acceleration type	Select either constant acceleration or S-curved profile in system setup register 3.	Select either constant acceleration or S-curved profile in table data.
Deceleration time	It is possible to save/register up to 4 settings in the Function parameter tab (#76 [Deceleration time #0] ~ #79 [Deceleration time #3]). Select one of the #parameters (#76 [Deceleration time #0] ~ #79 [Deceleration time# 3]) in system setup register 3.	It is possible to save/register up to 4 settings in the Function parameter tab (#76 [Deceleration time #0] ~ #79 [Deceleration time #3]). Select one of the #parameters (#76 [Deceleration time #0] ~ #79 [Deceleration time #3]) in table data.
Acceleration time	It is possible to save/register up to 4 settings in the Function parameter tab (#72 [Acceleration time #0] ~ #75 [Acceleration time #3]). Select one of the #parameters (#72 [Acceleration time #0] ~ #75 [Acceleration time #3]) in system setup register 3.	It is possible to save/register up to 4 settings in the Function parameter tab (#72 [Acceleration time# 0] ~ #75 [Acceleration time #3]). Select one of the #parameters (#72 [Acceleration time #0]to #75 [Acceleration time #3]) in table data.
Feed velocity	It is possible to save/register up to 8 settings in the Function parameter tab (#64 [Feeling Velocity #0] ~ #71 [Feeling Velocity # 7]). Select one of the #parameters (#64 [Feeling Velocity # 0] ~ #71 [Feeling Velocity # 7]) in system setup register 3.	It is possible to save/register up to 8 settings in the Function parameter tab (#64 [Feeling Velocity #0] ~ #71 [Feeling Velocity #7]). Select one of the #parameters (#64 [Feeling Velocity #0] ~ #71 [Feeling Velocity #7]) in table data.

(1) Function Explanation

Feed velocity (#64 [Feeding velocity #0] ~ #71 [Feeding velocity #7])
Set the feed velocity. Depending on the moving distance and acceleration/deceleration time, the actual velocity may not reach the set feed velocity. Set a value smaller than the value of #305 [User defined maximum velocity].

Acceleration/deceleration time (#72 [Acceleration time #0] ~ #75 [Acceleration time #3]/#76 [Deceleration time #0] ~ #79 [Deceleration time #3])
Set the acceleration time/deceleration time relative to the maximum velocity.
The fact that the acceleration time/deceleration time is set relative to the maximum velocity means that if an operation that does not reach the maximum velocity is carried out, the actual acceleration/deceleration time will be different from the set acceleration/deceleration time. Moreover, because the acceleration/deceleration time is set in this way, it is possible to set the same acceleration without changing the acceleration/deceleration time even if the feed velocity is changed.

Guidelines for setting acceleration/deceleration time

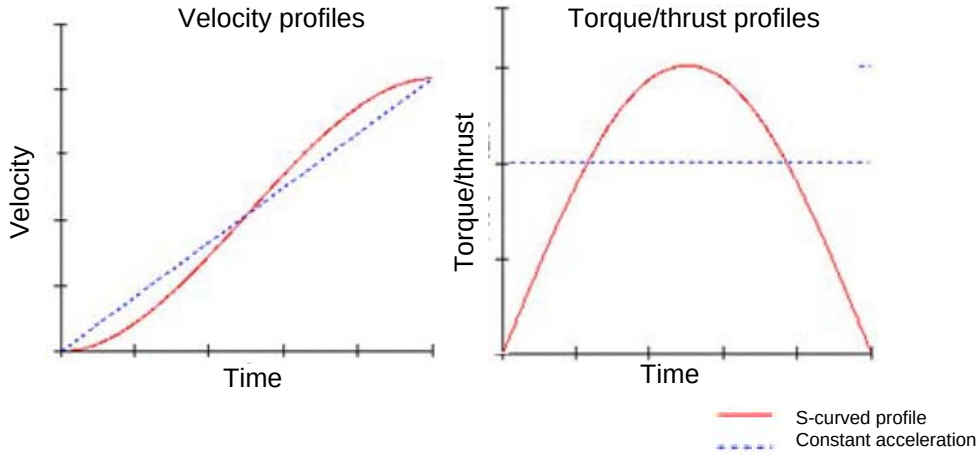
Use the following formula to calculate the acceleration/deceleration time to be set.
(In the case of an S-curved acceleration/deceleration profile, the acceleration/deceleration time should be set to approximately 1.5 times the value calculated from the formula below.)

$$t = \frac{(MS + ML) * v}{0.8 * (F - Fx)}$$

t: Deceleration time [sec]
MS: Slider weight (See Section 2.1, "Standard Specifications") [kg]
ML: Load weight [kg]
v: Velocity [m/s]
F: Maximum motor thrust [N]
Fx: Disturbance thrust in the direction opposite the motor's output thrust [N]

Acceleration/deceleration type
Set the acceleration/deceleration type using system setup register 3 in the case of jog and homing and using table data in the case of incremental positioning move and absolute positioning move.
Select either constant acceleration or S-curved profile for the acceleration/deceleration type. The figures below show the velocity characteristics and torque characteristics of each type. If you select constant acceleration, fast acceleration is possible, but the motor tends to induce larger vibrations into the mechanical system. If you select an S-curved acceleration/deceleration profile, the movement becomes smooth and the vibrations induced in the mechanical system can be reduced. For this reason, the settling time is shorter in most cases, but the acceleration/deceleration time becomes longer.

Velocity and Acceleration Profiles for Each Acceleration Type



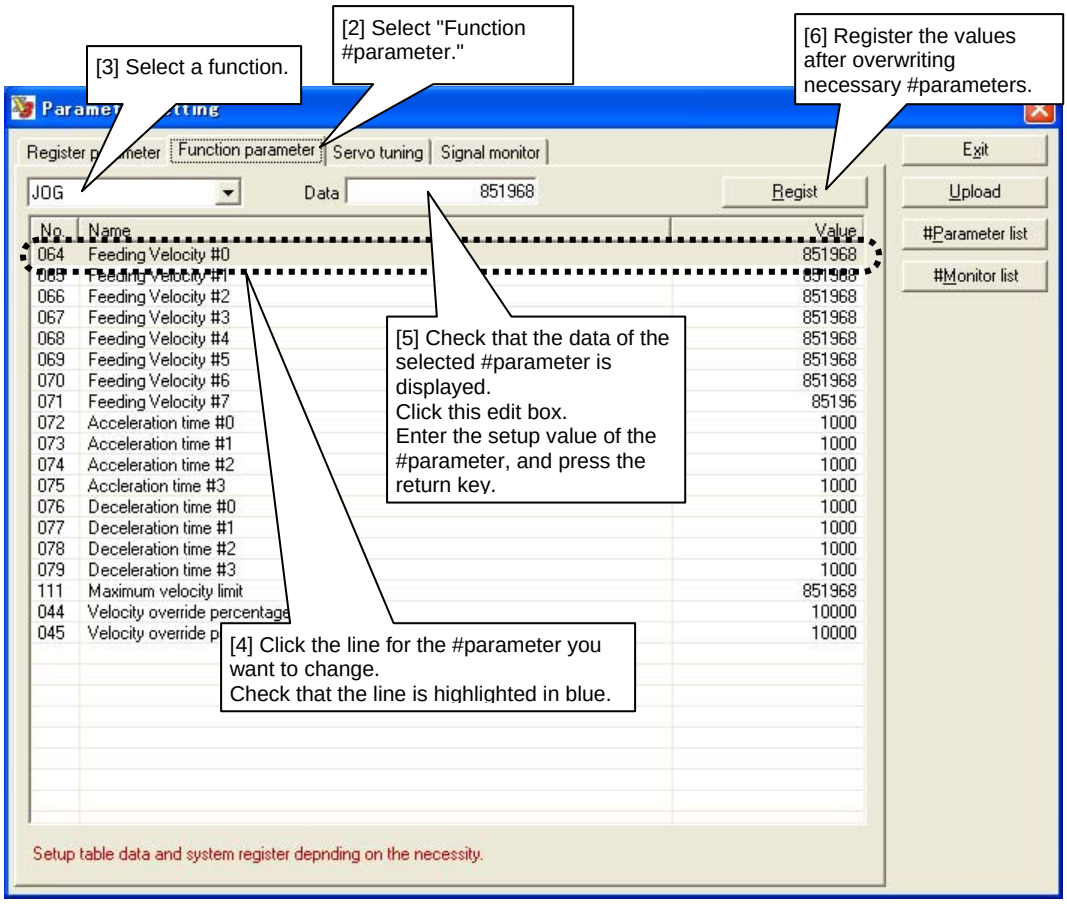
CAUTION

If the maximum value of the torque/thrust profile exceeds the maximum torque of the motor, a position deviation is generated, which may cause instability phenomena such as hunting in the control.
See "Guidelines for setting acceleration/deceleration time" and set the acceleration/deceleration time correctly.

(2) #parameter Setting

STEP 1 Select [#parameter] from the main menu of the utility software.
STEP 2 Click "Function #parameter" to display the setting window.
STEP 3 Select the function you want to set.
STEP 4 Click the #parameter you want to set.
STEP 5 Enter the setup value in the Data edit box, and press the return key.
STEP 6 Overwrite all the #parameters you want to set, and click the [Regist] button to register the #parameters.

Setting Window for Velocity Profile Related #parameters



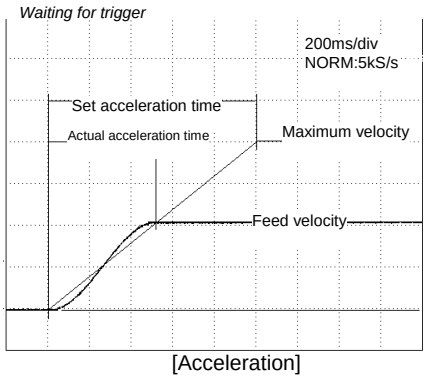
STEP7 Select #parameters.
Velocity profile related #parameters to be used are set in the System setup register 3 window in the case of jog move and each table data window in the case of table data operation.

■ Velocity Override/Interlock Function

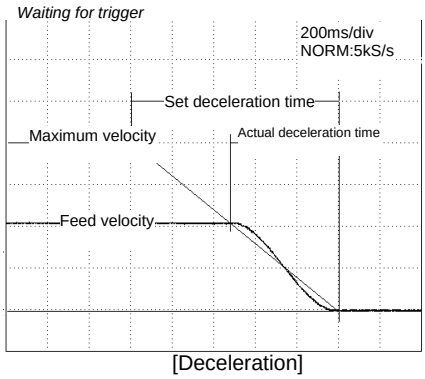
The velocity override function allows changing the feed velocity in real time.
In order to use this function, set the velocity override percentage using #parameters (#44 and #45) and select the velocity override by the IN_OVERRIDE_SEL signal of the controller interface. The velocity override value can be set by a #parameter in the range from 0% to 200% in increments of 0.01%. See the table below for the feed velocity corresponding to the IN_OVERRIDE_SEL selection.
Note that if you set the IN_INTERLOCK signal of the controller interface to ON, the velocity override percentage is set to 0 regardless of the status of IN_OVERRIDE_SEL and the override percentage #parameters (#44 and #45) (the motor will decelerate and stop).
Note that if a value exceeding 100% is specified, the velocity while moving may exceed the maximum velocity and an error may occur (ERR31.0: Excessive position command difference, ERR24.0: Over speed).
These functions are valid for all table data operations and jog moves.

Interlock IN_INTERLOCK	Velocity override selection IN_OVERRIDE_SEL	Feed velocity
OFF	OFF	Velocity override percentage 1 (#44) x feed velocity
	ON	Velocity override percentage 2 (#45) x feed velocity
ON	OFF	0
	ON	

[S-curved profile]

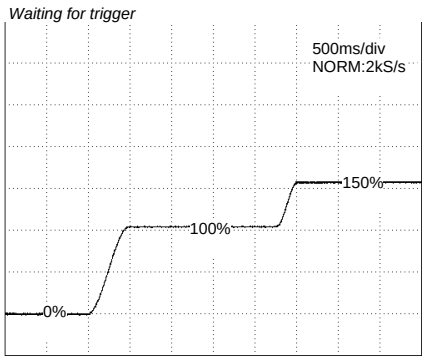


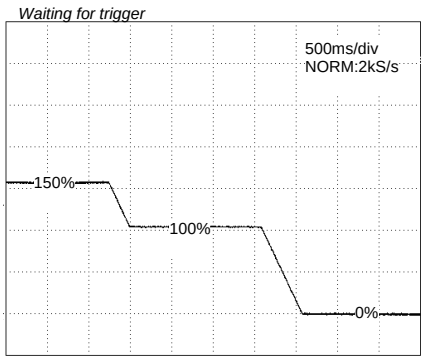
[Acceleration]



[Deceleration]

The resulting feed velocity while moving becomes the velocity obtained by multiplying the specified velocity with the velocity override value.
If the velocity override value is changed while moving, the motor accelerates with the same acceleration profile and rate as specified by the acceleration settings of Table "Velocity Profile Setup Items" in Section 6.1.9, "Velocity Profile" if it is increased, and decelerates with the same deceleration profile and rate as specified by the deceleration settings of Table "Velocity Profile Setup Items" in Section 6.1.9, "Velocity Profile" if it is decreased.

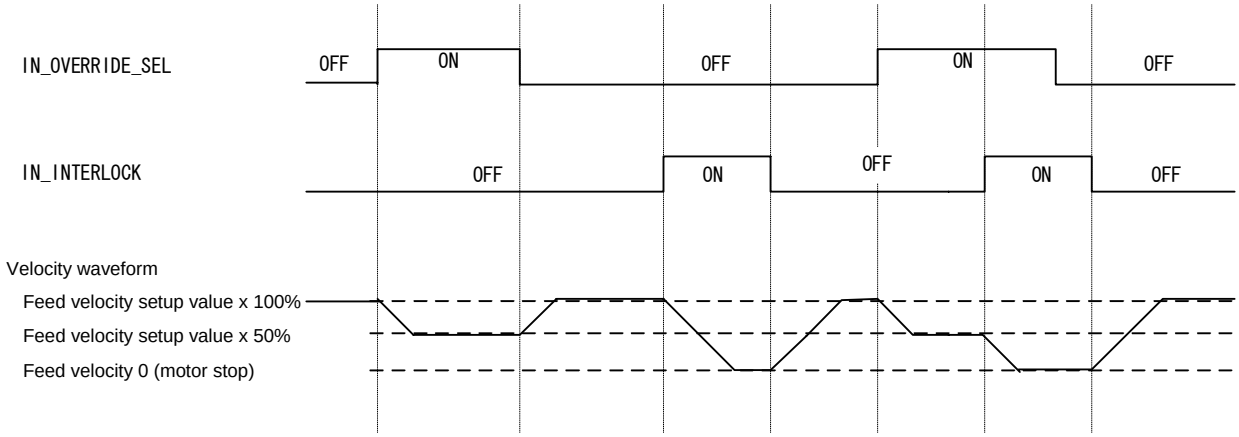




[Acceleration: S-curved profile, Deceleration: Constant acceleration]

<Sequence example>

#44 = 10000 [1/100%]: Velocity override percentage 1 = 100%
#45 = 5000 [1/100%]: Velocity override percentage 2 = 50%



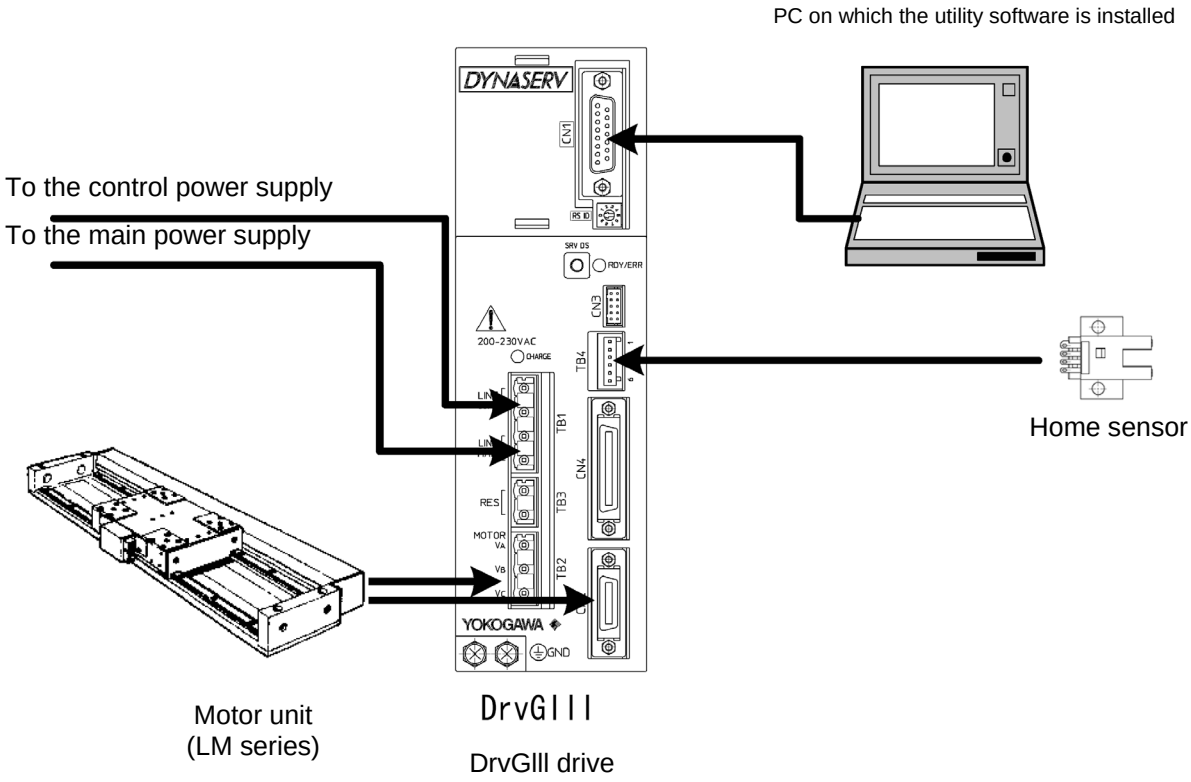
6.2 Initial Operation Test

After wiring is completed, perform an initial operation test.
Unless specifically noted, you should always conduct an initial operation test without changing #parameters, hard I/O assignment and logic I/O initial value setting from the time of shipment from the factory before using the drive and motor for the intended application.

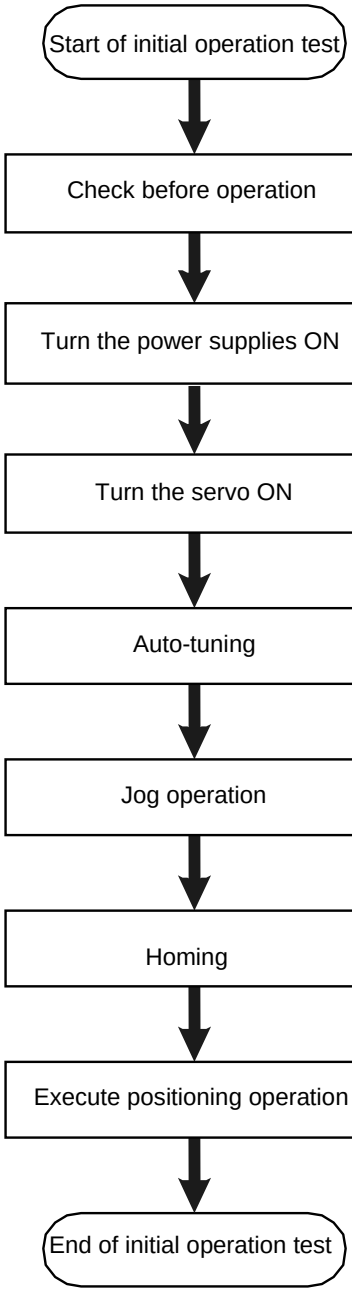
6.2.1 Initial Operation Test Using the Utility Software

Perform an initial operation test using the utility software without load.
The controller interface is not wired.

■ Connection



■ Initial Operation Test Procedure



(1) Check before operation
Check that the motor is properly installed and wired.

(2) Turning the power supplies on
Turn the power supplies ON to check that an error does not occur.

(3) Turning the servo ON
Turn the servo ON.

(4) Auto-tuning
Perform auto-tuning to adjust the gains of the position and velocity control loops.

(5) Jog operation
Perform jog operation.

(6) Homing
Perform homing.

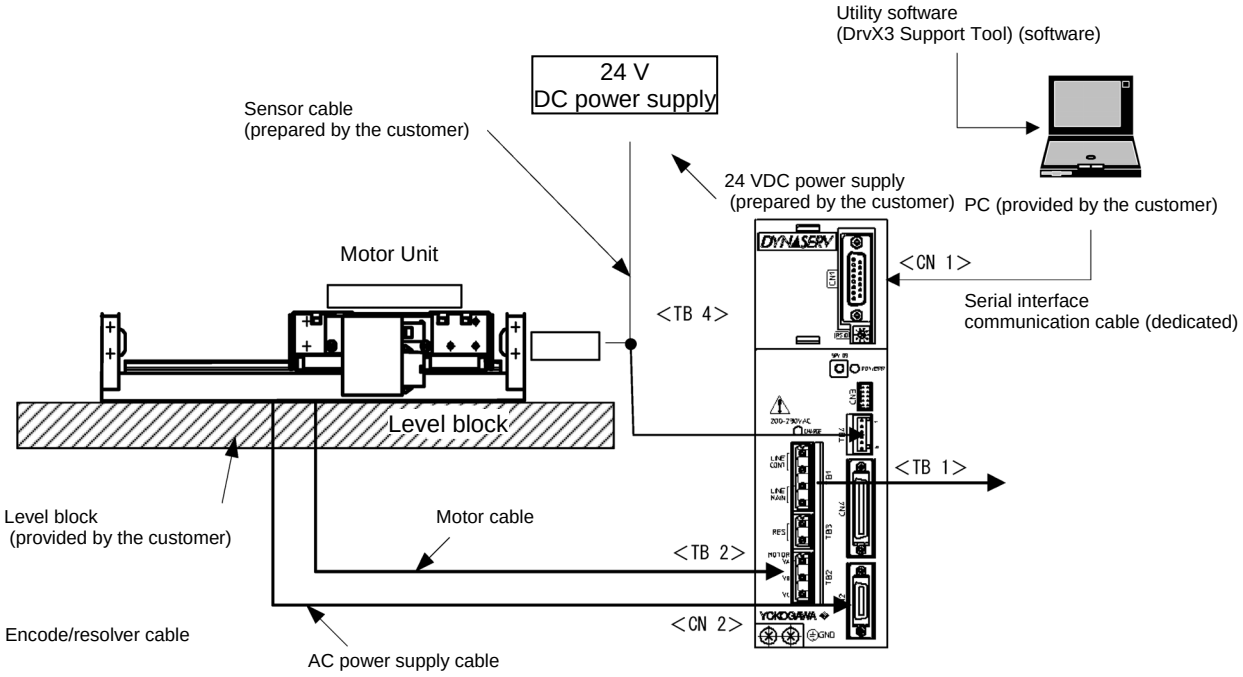
(7) Executing positioning operation
Execute positioning operation using the utility software.

(1) Check before Operation

■ Items to be Prepared

- Motor, drive, home sensor, DC power supply
- PC on which the utility software is installed
- Level block for fixing the motor
- Various cables

■ Installation and Wiring

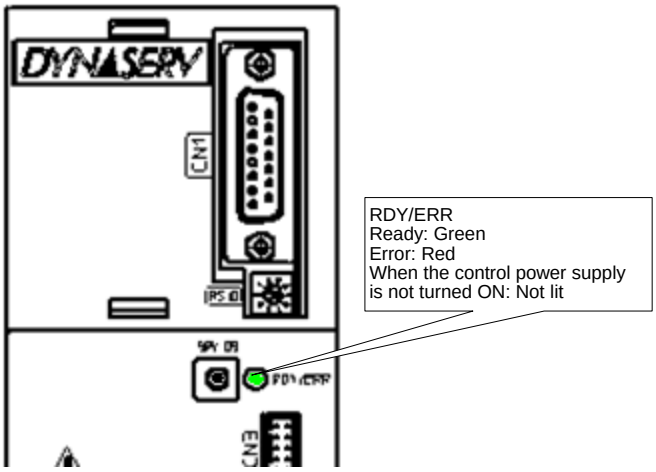


■ Items to be Checked

	Check
• Is the motor unit fixed to the level block?	☐
• Is the motor interfering mechanically with peripheral components?	☐
• Is the AC power supply cable properly wired (LINE and GND)?	☐
• Is the motor cable properly wired (VA, VB, VC and GND)?	☐
• Is the encode/resolver cable properly wired?	☐
• Is the home sensor properly wired?	☐
• Is the serial interface communication cable properly wired?	☐

(2) Turning the Power Supplies ON

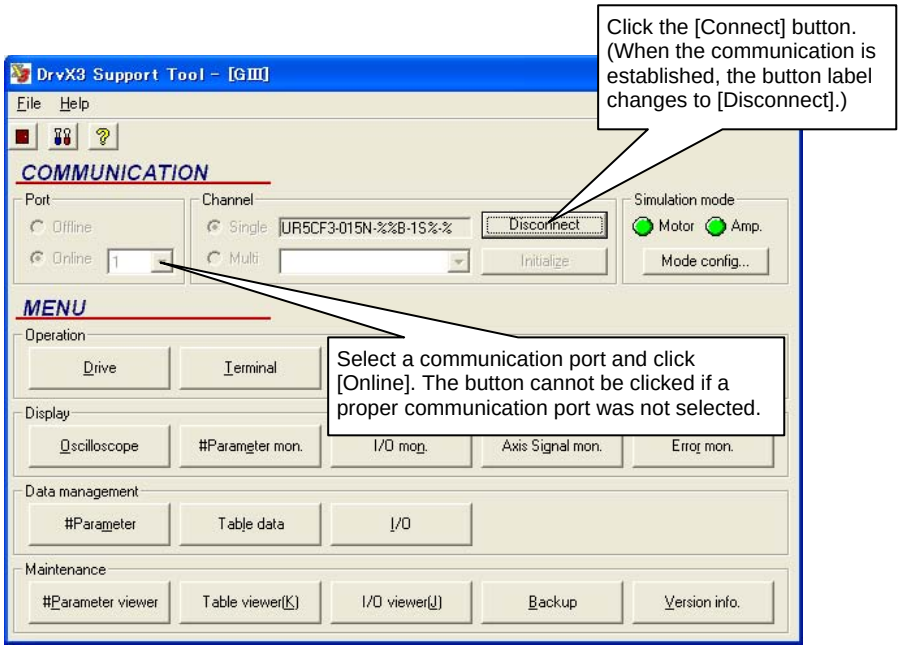
Turn both the main and control power supplies ON. After turning the power supplies ON, check that the RDY/ERR LED on the DrvGIII front panel turns ON in green. If it turns ON in red, an error has occurred. Check the error code and take an action to solve the problem.



(3) Turning the Servo ON

■ Online Operation

STEP 1 Start the utility software.
STEP 2 Select the connection port number (specify the COM port number of the PC).
STEP 3 Select [Online] in Communication Port.
STEP 4 Establish communication between the drive and a PC by clicking the [Connect] button.

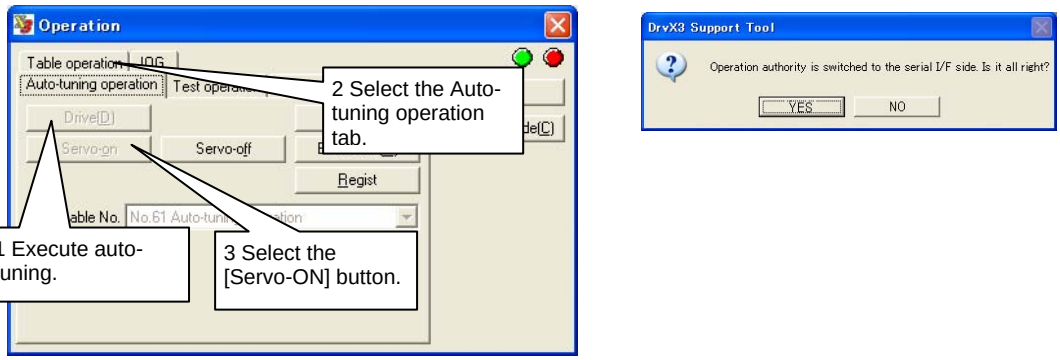


■ Servo ON Operation

STEP 1 Select [Operation] from Control.
(Click the [Yes] button when the message shown in the figure below is displayed.)
STEP 2 Select the Auto-tuning operation tab.
STEP 3 Select the [Servo-ON] button.

TIP

The servo is turned OFF while the SRV DS switch on the front panel of the drive is pressed. It is advisable to place a finger on the SRV DS switch when instructing to turn the servo ON; that way, you can turn the servo OFF immediately if instability or oscillations occur.



(4) Auto-tuning

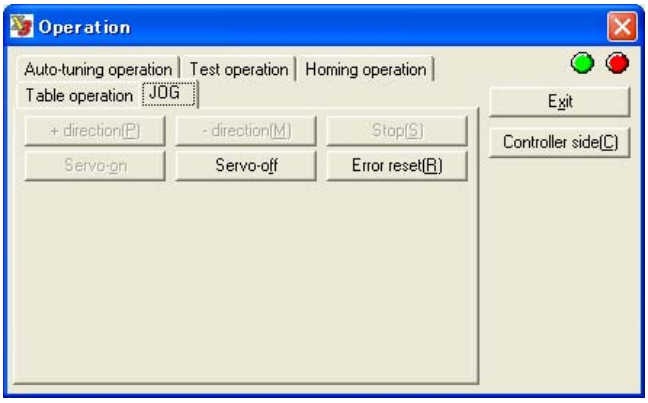
Auto-tuning is started by clicking the [Drive] button. After the auto-tuning is completed, click the [Regist] button to write the data resulting from the auto-tuning to the drive.

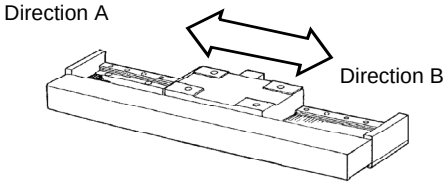
CAUTION

When the motor is started, it moves in direction A. Be sure there is no mechanical interference with the motor (the motor may move up to about 40 mm).
Check the wiring (encoder cable and motor cable) if the motor begins to vibrate or oscillate during auto-tuning. The motor may vibrate if it is installed on a platform that is not rigid enough, or if the motor is not securely fixed as well.

(5) Jog Move

STEP 1 Select the Jog tab from the Operation window.
* Click the [Servo-ON] button to turn the servo ON if it was turned OFF.
STEP 2 Execute jog move using the [+ direction], [- direction] and [Stop] buttons.





Direction of motor movement

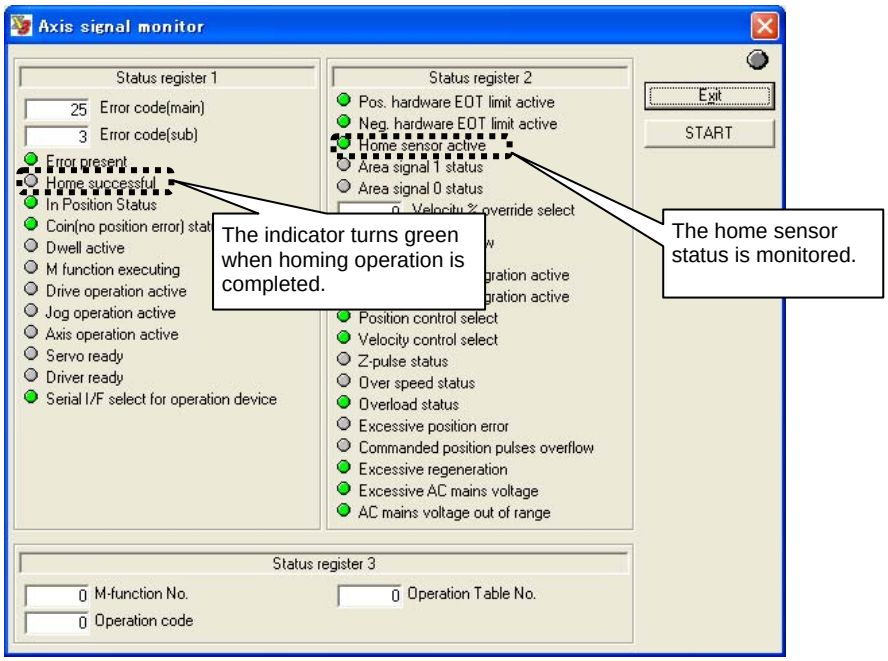
TIP

At the time of shipment from the factory, the direction of motor movement is set so that the plus (+) direction corresponds to direction A and the minus (-) direction corresponds to direction B.

(6) Homing

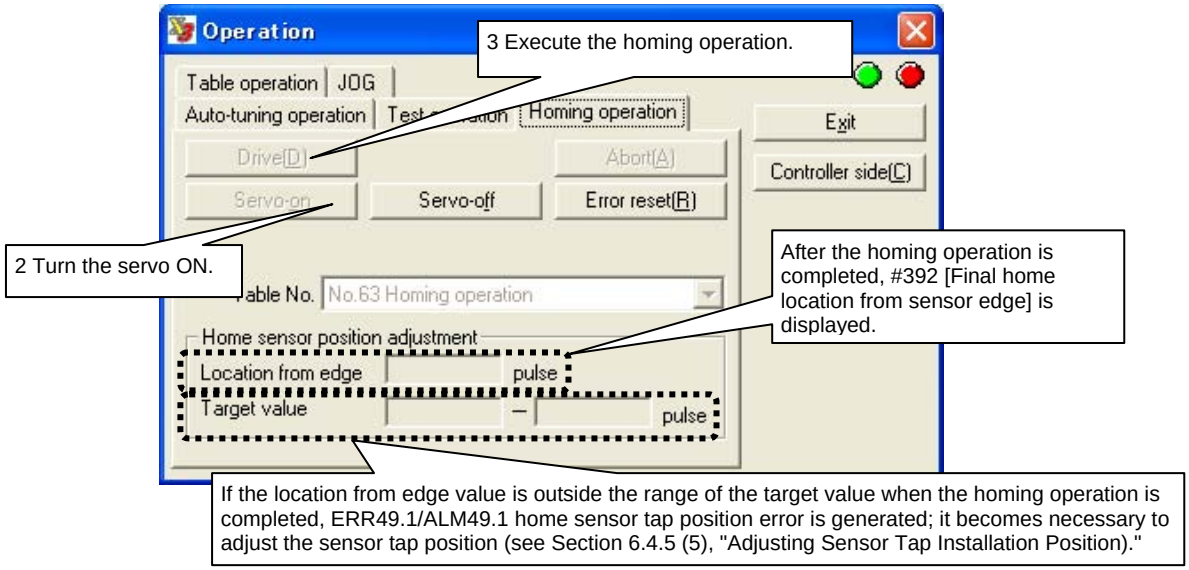
■ Checking On/Off Status of the Home sensor

STEP 1 Select [Axis signal monitor] from Display of the utility software, and start the monitor by clicking the [START] button.
STEP 2 Turn the servo OFF if it was turned ON (servo ready).
STEP 3 Move the motor manually and check [Z-pulse status] of the Axis signal monitor window.
Check that the indicator turns ON when the home sensor is within the designated area. If the sensor is not properly connected, it is turned ON regardless of the position of the motor.
STEP 4 Stop the monitor by clicking the [STOP] button.



■ Executing Homing Operation

STEP 1 Select the Homing operation tab in the Operation window.
STEP 2 Turn the servo ON if it was turned OFF by clicking the [Servo-ON] button.
STEP 3 Execute the homing operation by clicking the [Drive] button.

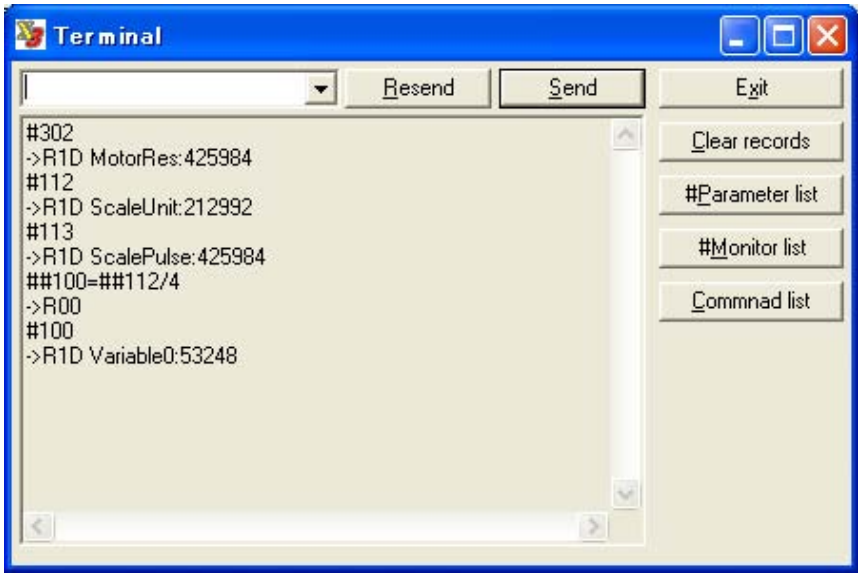


(7) Executing Sample Table Data Operation

Execute an incremental positioning move using the sample table data (table number 7) for table data operation.

■ Setting the Amount of Movement

STEP 1 Close the Operation window.
STEP 2 Open the Terminal window from the Control window.
STEP 3 Check that the following parameter/monitor values have not been changed since shipment from the factory in the Terminal window. (See the table below for the values for each motor model.)
#302 [Motor resolution]
#112 [Scaling data ratio denominator (on the command unit)]
#113 [scaling data ratio numerator (on the pulse)]



Scaling Data Values at Shipment from the Factory

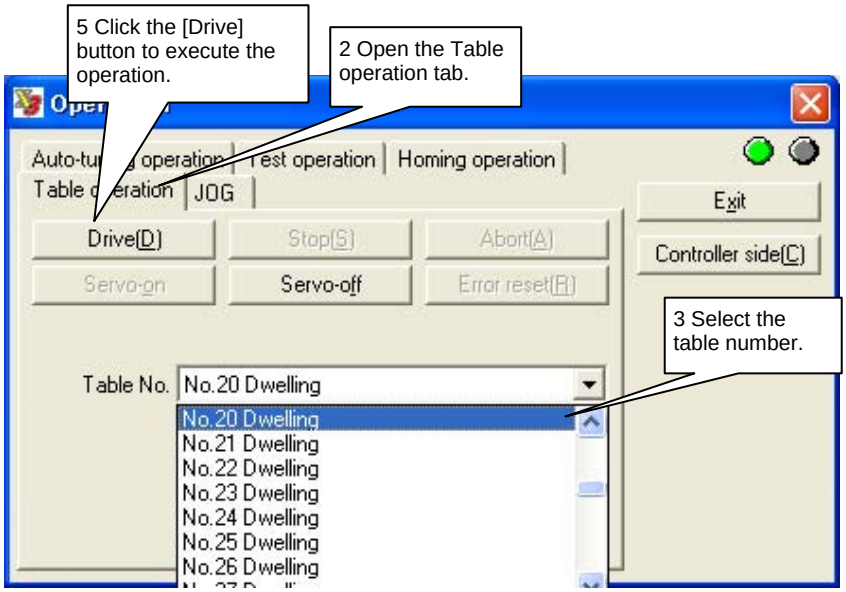
Encoder resolution	#113 [scaling data ratio denominator (on the pulse)]	#112 [Scaling data ratio numerator (on the command unit)]
0.5 [μm]	2000000	1000000
0.25 [μm]	4000000	2000000
0.05 [μm]	20000000	10000000

STEP 4 Step 4. In table number 6, the value of #100 [Variable 0] is set as the amount of movement. To move 10 mm, enter the following in the Terminal window.

STEP 5 Close the Terminal window.

■ Executing the Sample Table Data Operation

STEP 1 Open the Operation window from the Control window.
STEP 2 Select the Table operation tab.
STEP 3 Select "No. 07 INC positioning" in the Table Number box.
STEP 4 Turn the servo ON if it was turned OFF by clicking the [Servo-ON] button.
STEP 5 Click the [Drive] button to start the incremental positioning operation move.

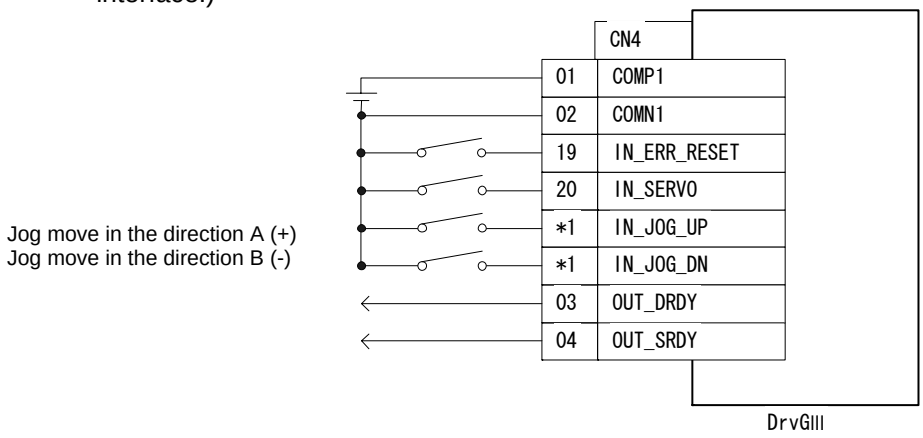


6.3 Jog Move

When you execute the jog move command in the idle status, it is possible to move the motor in direction A (+) or B (-). The acceleration/deceleration time, acceleration/deceleration type and jog feed velocity can be specified individually.

(1) Wiring Example

The figure below shows an example when the command is sent from the controller interface. (Proceed to (2) Parameter Settings for how to perform a jog move operation via a serial interface.)



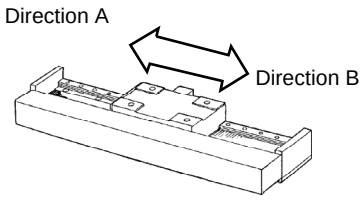
*1: These I/O signals are not assigned in the settings at shipment from the factory. Assign them using the hard I/O assignment function (see Section 6.1.1).

(2) Parameter Settings

STEP 1 Select [#parameter] from [Data Management] of the utility software.
STEP 2 Select "System setup register 1" to display the setting window.
STEP 3 Check the direction in the Coordinate system forward direction setting.
The settings and the directions have the following relationship.

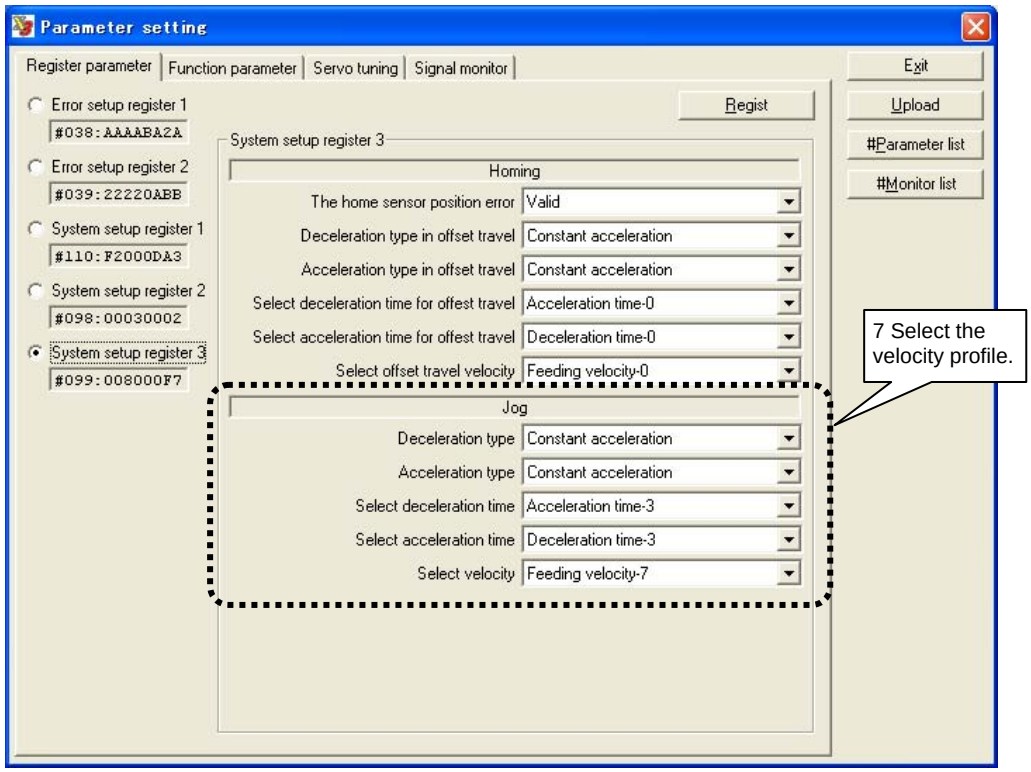
Coordinate Command Direction Setup and Directions of the Motor movement

		Jog move command	
		IN_JOG_UP (+ direction)	IN_JOG_DN (- direction)
Status of coordinate Command Direction Setup	Forward direction	Direction A	Direction B
	Reverse direction	Direction B	Direction A



Note: This #parameter also effects the direction in operations other than jog move.

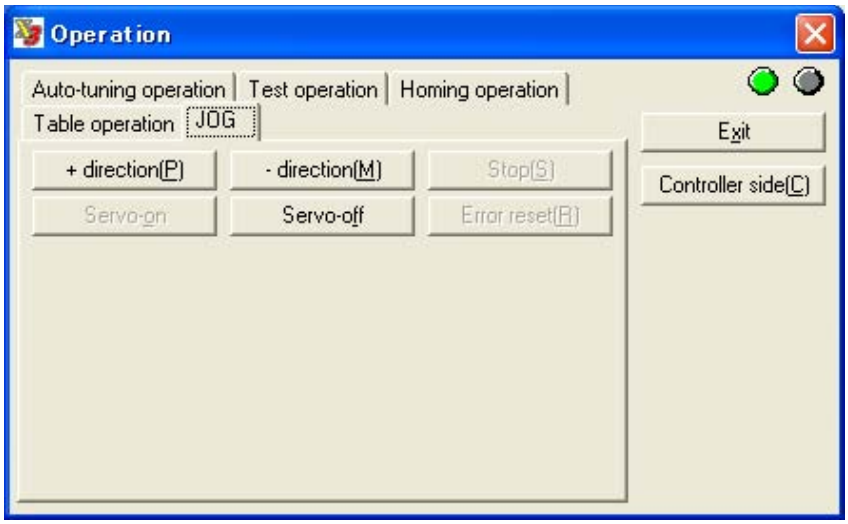
STEP 4 In "Jog feed operation, serial Interface side selection," Select [Valid] to instruct the jog move operation from the utility software and [Invalid] to instruct the jog move operation from the controller interface.
STEP 5 Register the #parameters by clicking the [Regist] button.
STEP 6 Specify the feed velocity, acceleration time, deceleration time, acceleration profile and deceleration profile in the Function #parameter window (see Section 6.1.9 for the detailed explanation of the velocity profile).
STEP 7 Select the feeding velocity, acceleration time, deceleration time, acceleration profile and deceleration profile in the System setup register 3 window.



(3) Jog Operation Method (Utility Software)

Complete the servo tuning before you start jog operation.

STEP 1 Select [Operation] in the utility software.
STEP 2 Select the Jog tab in the Operation menu.
STEP 3 Click the [Servo-ON] button to turn the servo ON.
STEP 4 Click a button ([+ Direction] or [- Direction]) corresponding to the direction in which you want to start jog move.



(4) Jog Operation Method (Controller Interface)

The table below shows the correspondence between jog move commands and rotation directions.

IN_JOG_DN (- direction)	IN_JOG_UP (+ direction)	Jog move command
OFF	OFF	Stop command
	ON	+ direction jog move command
ON	OFF	- direction jog move command
	ON	Stop command

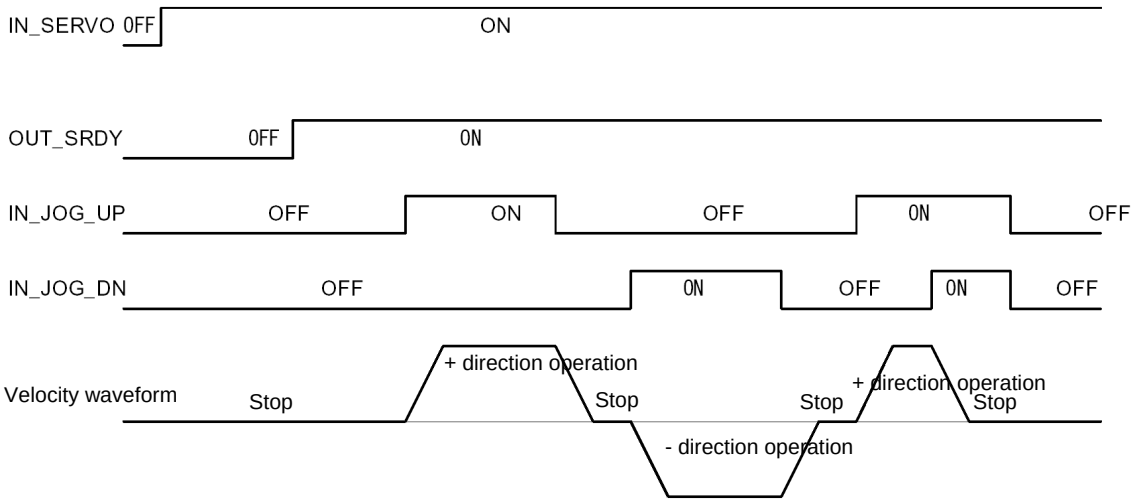
■ **Starting Jog Move**

STEP 1 Turn IN_SERVO ON.
STEP 2 Check that OUT_SRDY is turned ON.
STEP 3 Turn IN_JOG_UP ON to move in the + direction, or turn IN_JOG_DN ON to move in the - direction.

■ **Stopping Jog Move**

Turn IN_JOG_UP OFF if moving in the + direction, or turn IN_JOG_DN OFF if moving in the - direction.

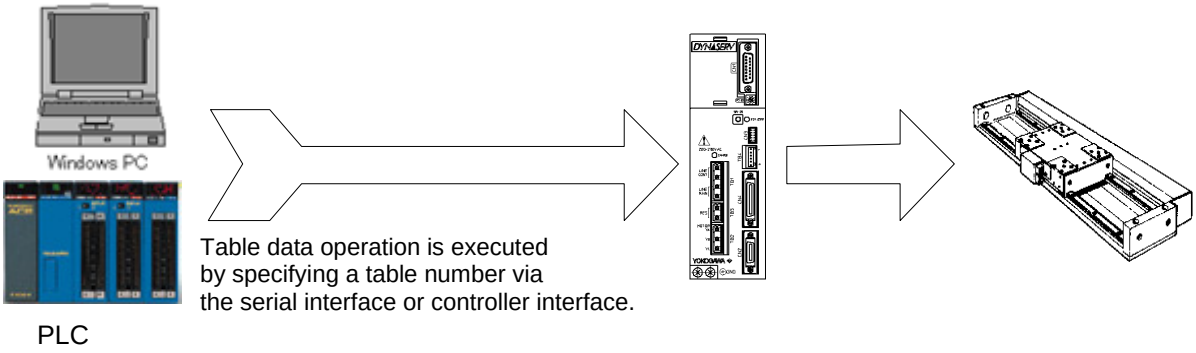
■ **Example of Jog Move Timing**



6.4 Table Data Operation

6.4.1 Table Data Operation

Table data operation employs the controller built into the drive, which is used for servo tuning, homing and positioning operations. The types of operations (operation codes) are listed in the table below.
By combining supplementary tables, it is possible to branch to prescribed operations when given conditions are satisfied as well as change #parameters.
Data written in table data includes operation register, operation data 0 and operation data 1, which are created using the utility software. Table data operation can be started via either the serial interface or controller interface.
Moreover, use of the "continue function" that concatenates several tables allows continuous movement. It is possible to specify table data No.'s 0 to 63. Operation codes have been determined for No.'s 60 to 63 in advance; the operation data can be changed, but the operation register cannot be changed.



Operation Codes and Actions

	Operation code	Action
Table related to homing	Homing	The motor moves to return to the home position using the built-in controller.
Table related to adjustment	Auto-tuning	Used for adjusting the servo
	Test operation	Used for adjusting the servo. Useful when auto-tuning cannot be performed or when performing manual tuning while checking the step response of the system (to a position command with a frequency of 2.5 Hz) using the oscilloscope function.
Table related to positioning	Incremental positioning move	The motor performs incremental (relative position) positioning.
	Absolute positioning move	The motor performs absolute (absolute position) positioning movement.
Supplementary table	Dwell	Used to set the dwell time (wait time)
	Parameter change	Used to change #parameters
	Conditional branch	Used to change the branching target according to the specified condition
	Command	Used to issue some of the @commands

Operation Code of Each Table

Table number	Action setting	Continue after execution setting
0 ~ 58	Can be selected freely in the utility software	Valid
59	Can be selected freely in the utility software *	
60	Test operation (cannot be changed)	Invalid
61	Auto-tuning (cannot be changed)	
62	Reserve (cannot be changed)	
63	Homing (cannot be changed)	

* Assigned as the starting number when the startup operation function is used. It is treated in the same way as table No.'s 0 to 58 if this function is not used.

List of Operation Codes Set at Shipment from the Factory

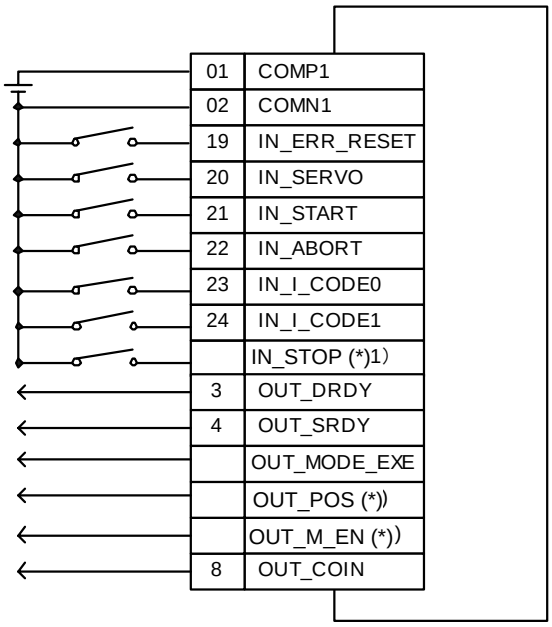
Table number	Default operation code setting
0	Test operation
1	Auto-tuning
2	Blank
3	Homing
4	Sample program 1 (absolute positioning)
5	Blank
6	Sample program 2 (incremental positioning)
7~39	Blank
40~57	Sample program 3 (example of slightly complex operation pattern)
58~59	Blank
60	Test operation (cannot be changed)
61	Auto-tuning (cannot be changed)
62	Dwell (0 msec) (cannot be changed)
63	Homing (cannot be changed)

Note: See Appendix for the detailed explanation of the sample programs.

TIP

If a command is sent by the built-in controller while the drive is controlled via pulse train or analog voltage inputs, the control being performed via pulse train/analog voltage is immediately interrupted and the operation commanded by the built-in controller is carried out. The control via pulse train/analog voltage is resumed immediately after the operation instructed by the built-in controller is completed. Pulse train/analog voltage inputs to be entered while executing operation by the built-in controller are ignored.

(1) Example of Wiring

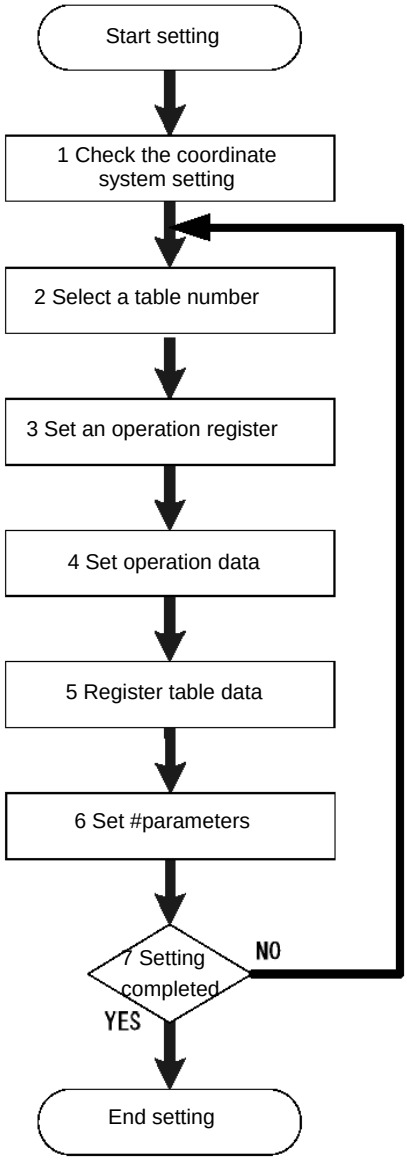


* These I/O signals are not assigned in the settings at shipment from the factory. Assign them using the hard I/O assignment function.

Note: In this wiring example, table data No.'s 0 to 3 can be started.
If you want to start table data operation with other table numbers, assign IN_I_CODE [2..7] as necessary using the hard I/O assignment function.

(2) Table Data Setting Procedure

Set up the table data operation according to the following sequence.



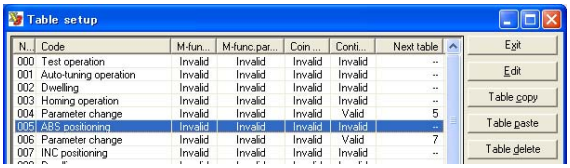


Table number selection window

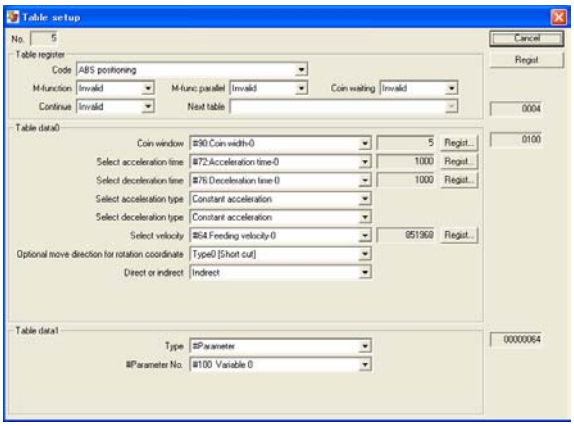


Table setting window

Use this window to select an table register, set a code and register the table data.

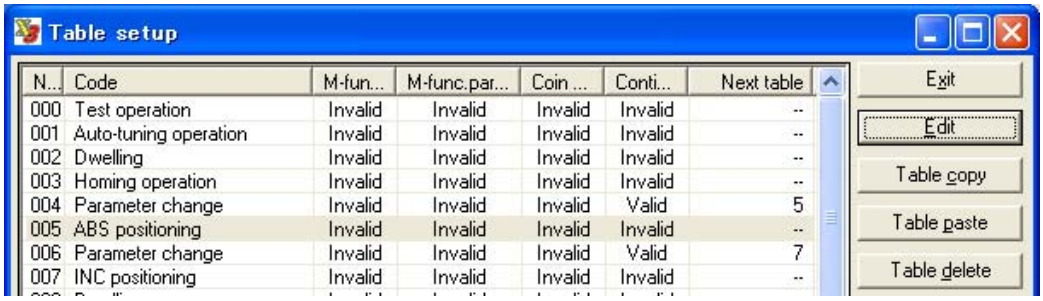
STEP 1 Checking the coordinate system setting

Check that the three setting items related to the coordinate system to be used, selection of rotation coordinate system/linear coordinate system, rotation direction and scaling, are specified correctly. See Section 6.1.7 for more information.

STEP 2 Selecting a table number

1 Click the [Table Data] button in the utility software.

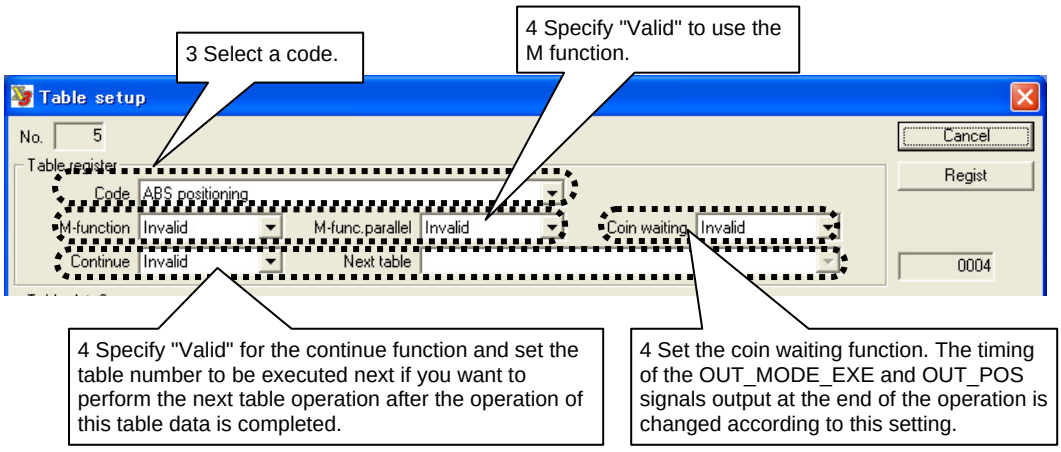
2 Select the table data you want to edit and click the [Edit] button. The setup window appears.



STEP 3 Setting a table register

Select an table register in the setup window.

Then set the operation code, M function, coin waiting function and continue function for the selected operation register.



STEP 4 Setting table data

The setting items for table data vary depending on the operation code. See the explanation sections for each operation (6.4.3 to 6.4.11).

STEP 5 Registering table data

Click the [Regist] button to commit the edited settings.

Click the [Cancel] button to discard the edited settings; the table data is not changed.

STEP 6 Setting #parameters

Set #parameters as necessary. See the explanation sections for each operation, 6.4.3 to 6.4.11.

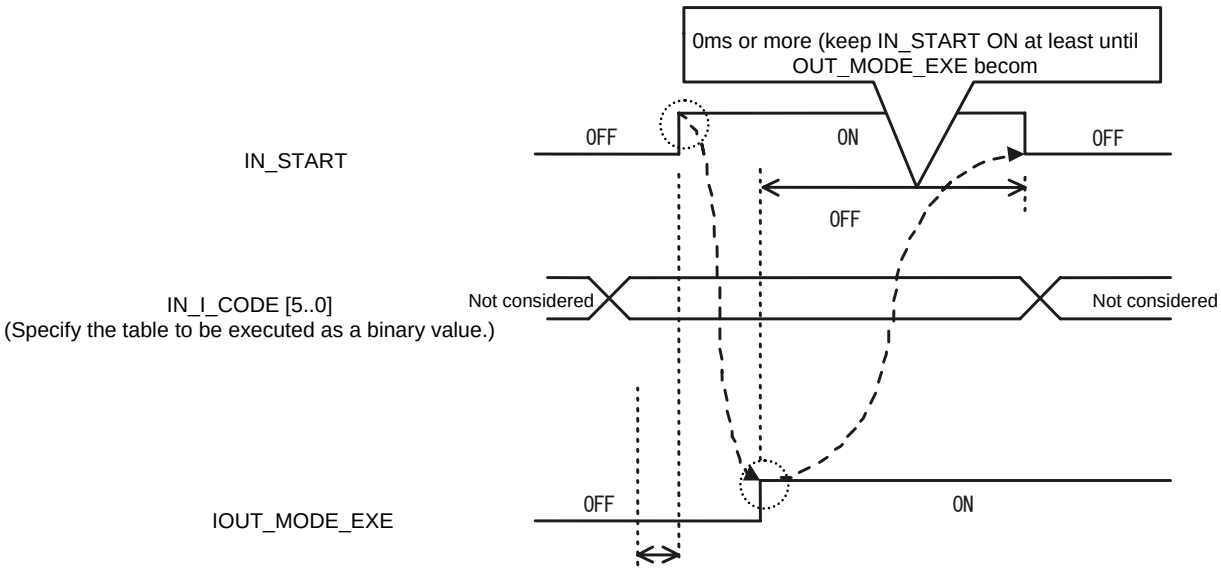
(3) How to Perform Table Data Operation (Control Interface)

This method is valid when the controller interface has the main operation privilege according to the operation mode.
Table data operation cannot be executed if an error has been encountered in the drive or the servo is turned off.

■ How to Start up

Complete servo tuning before starting the operation.

STEP 1 Enter the table number you want to execute in IN_I_CODE [5..0].
STEP 2 Set the status of IN_START to ON to execute the table data set with IN_I_CODE [5..0].
STEP 3 Check that the status of OUT_MODE_EXE has become ON and turn IN_START OFF.
STEP 4 When the operation is completed, the status of OUT_MODE_EXE becomes OFF.
If the continue function is used, the status of OUT_MODE_EXE becomes OFF after all the table operations are completed.
While IN_START is ON, the status of OUT_MODE_EXE is kept ON even after the operation is completed.

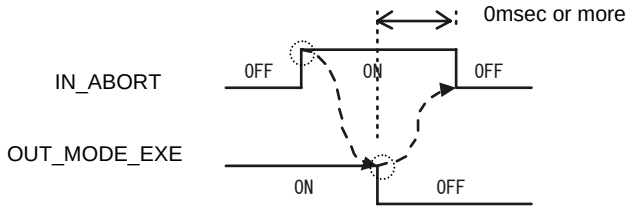


Depends on the selection of operation start high-velocity signal processing interface:
Valid: Signal-to-signal skew time or more
Invalid: 0 [msec] or more

■ Pausing/Ending Operation

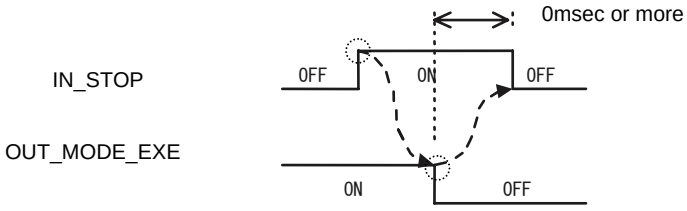
● IN_ABORT

The IN_ABORT command interrupts table data operation.
Use this command to end a test operation or to interrupt an operation and decelerate and stop the motor. Even during an operation involving movement, this command immediately decelerates and stops the motor, and terminates the operation.
When it is turned ON, a command to stop operation is issued.
If the M function is being executed, it interrupts the execution and stops the operation.



● IN_STOP

Use this command only when the continue function is set to valid.
If you issue the IN_STOP command, table data operation is ended at the same time as the operation of the table data currently being executed is completed.
When it is turned ON, a command to stop operation is issued.
If the M function is being executed, OUT_MODE_EXE turns OFF after the M function is completed.

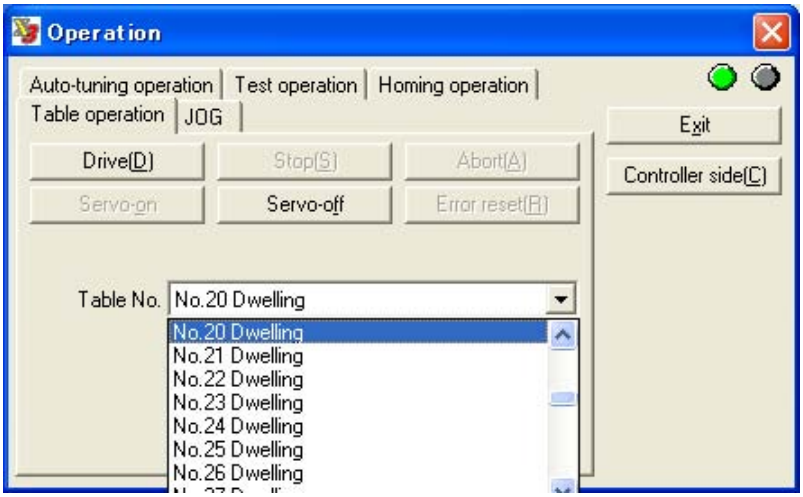


(4) How to Perform Table Data Operation (Utility Software)

■ Table Data Operation Window

Complete servo tuning before starting the operation.

STEP 1 Select [Operation] in the utility software.
STEP 2 Select the Table operation tab in the Operation menu.
STEP 3 Click the [Servo-ON] button to turn the motor's servo ON.
STEP 4 Select the table number of the table data you want to execute.
STEP 5 Click the [Drive] button to execute the selected table data.

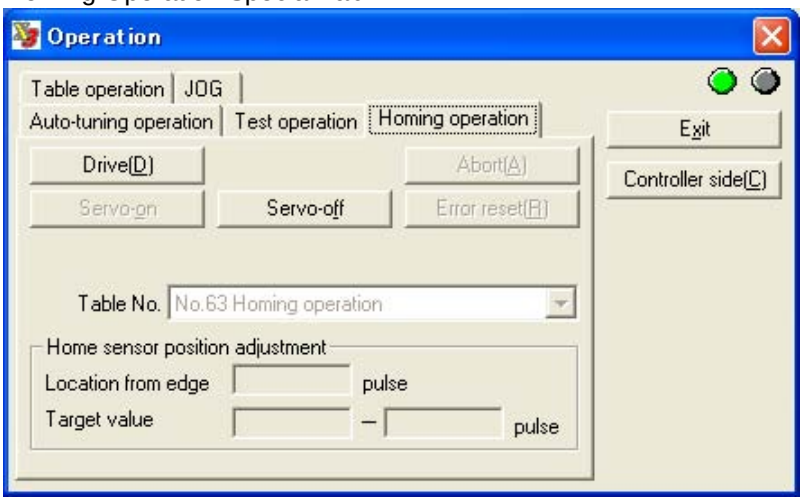


■ Special Tab for Each Operation

A special tab is prepared for homing, test operation and auto-tuning. Select an operation in the Operation menu. The table below shows the table number executed when each of the special tabs is selected.

Operation tab	Table number
Test operation	60
Auto-tuning	61
Homing	63

Homing Operation Special Tab



6.4.2 Setting Operation Register

The following functions are set commonly for table data operations. They are called operation setup registers.
The settings should be specified for each table data.
(1) Setting of code
(2) Setting of the M function
(3) Setting of the coin waiting function
(4) Setting of the continue function

(1) M Function

This signal is used for sequence operation, in order to coordinate the operation of other devices interlocked with positioning operation of the direct drive motor.
The table below shows the relationship between settings of the M function and output timings of OUT_M_EN.
If OUT_M_EN is turned ON, the table number of the table data currently being executed is output to OUT_0_CODE.
If IN_M_ANS is turned ON, OUT_M_EN is turned off and the table data operation currently being executed is ended. (If the continue function is set to valid, the next table data operation is executed.)
See the next page for a sequence example.

States of Operation Register Setting and Types of M Code Executed

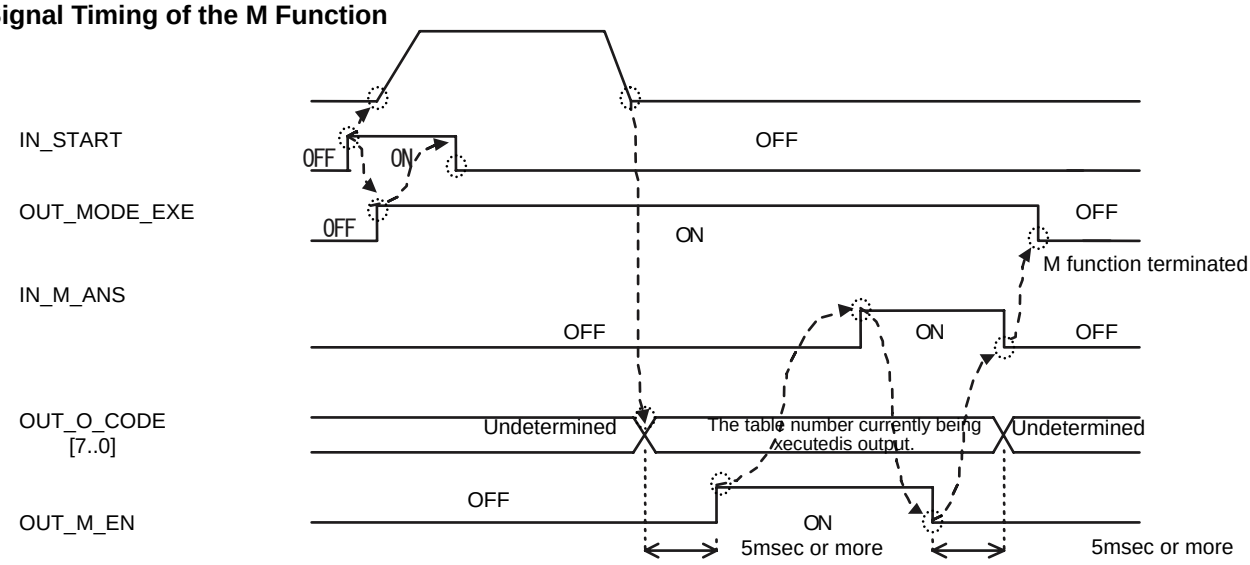
M function	Parallel M function	Action of M function
Valid	Valid	OUT_M_EN turns ON at the same time as the start of table data operation.
	Invalid	OUT_M_EN turns ON at the timing when the table data operation currently being executed is completed. If the coin waiting function is set to valid, OUT_M_EN turns ON after OUT_COIN turns ON.
Invalid	Valid	The M function is not executed.
	Invalid	The M function is not executed.


TIP

If OUT_M_EN is not assigned with the hard I/O assignment function, the M function is not executed even if the M function is set to valid with the operation register at executing table data operation.

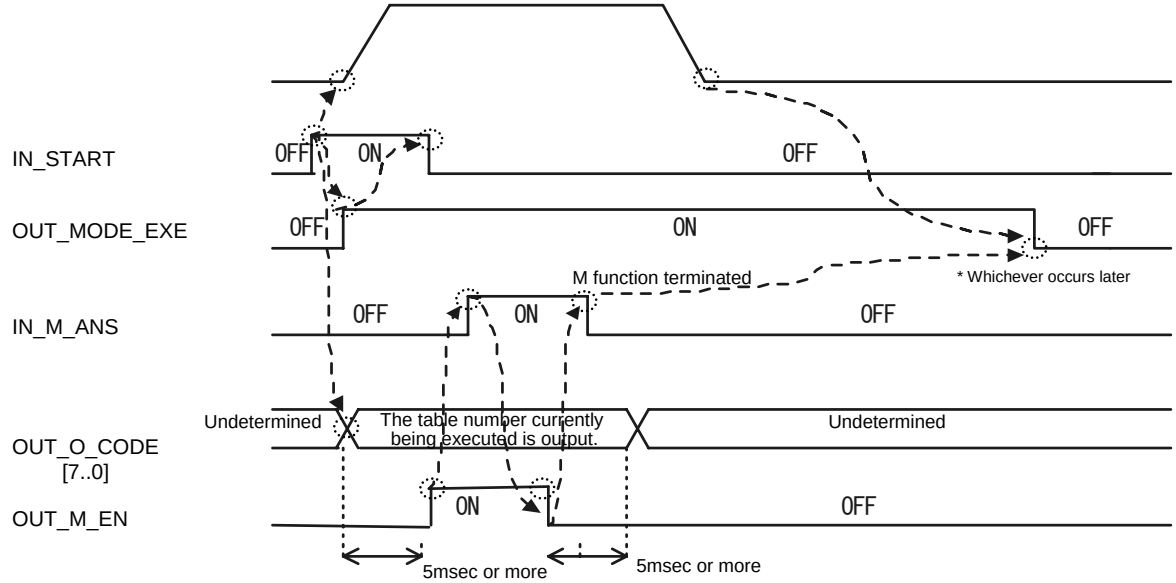
Make sure that the signals observe the following sequence when using the M function. When the OUT_M_EN signal turns ON, the table number currently being executed is output to OUT_0_CODE [7..0] as a binary value. The M function is terminated when IN_M_ANS turns ON while OUT_M_EN is being output.

● **Signal Timing of the M Function**



* If IN_M_ANS is not assigned, the M function is automatically terminated after OUT_M_EN turns ON for 10msec.

● **Signal Timing of the Parallel M Function**



* If IN_N_ANS is not assigned, the M function is automatically terminated after OUT_M_EN turns ON for 10msec.

TIP

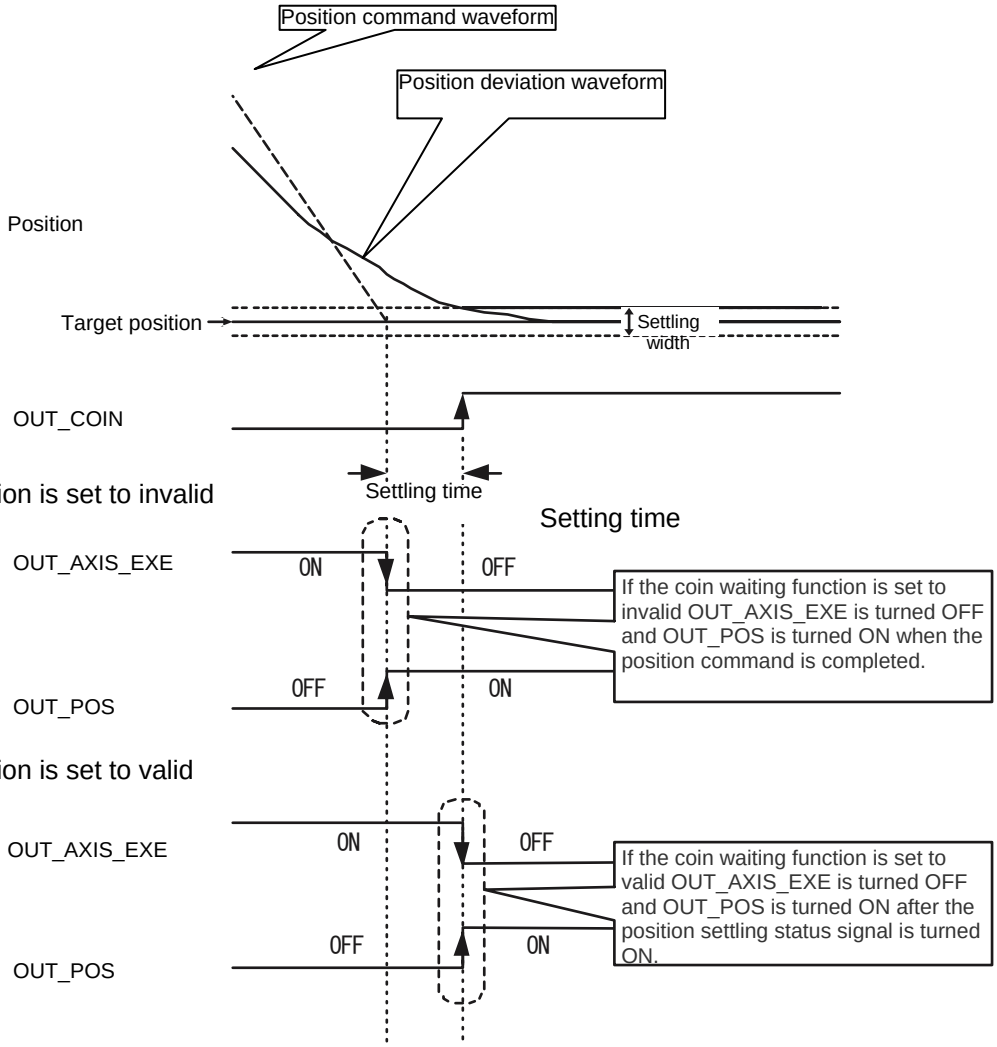
Operation of the M function at error occurrence
If [Stop the M function at error] is set to [Valid] in [System register 2] of the #parameter window, the execution of the M function stops when an error occurs. If it is set to [Invalid], the execution of the M function continues even if an error occurs.

(2) Setting Coin Waiting to Valid / Invalid

The timing at which the OUT_MODE_EXE and OUT_POS signals are output at the completion of an operation varies depending on the setting of the coin waiting function. See Section 6.6, "Position Settling Signal" for the explanation related to the positioning settling signal.

Invalid: The OUT_MODE_EXE signal is turned OFF at the same time as table data operation is completed. It turns OFF as soon as the position command is completed even if the position settling signal is turned OFF.
The OUT_POS signal is turned ON at the same time as the position command for a table data operation involving movement is completed.

Valid: The OUT_MODE_EXE signal is turned OFF after table data operation is completed and the position settling signal (OUT_COIN) is turned ON.
The OUT_POS signal is turned ON after table data operation involving movement is completed and the position settling signal (OUT_COIN) is turned ON.

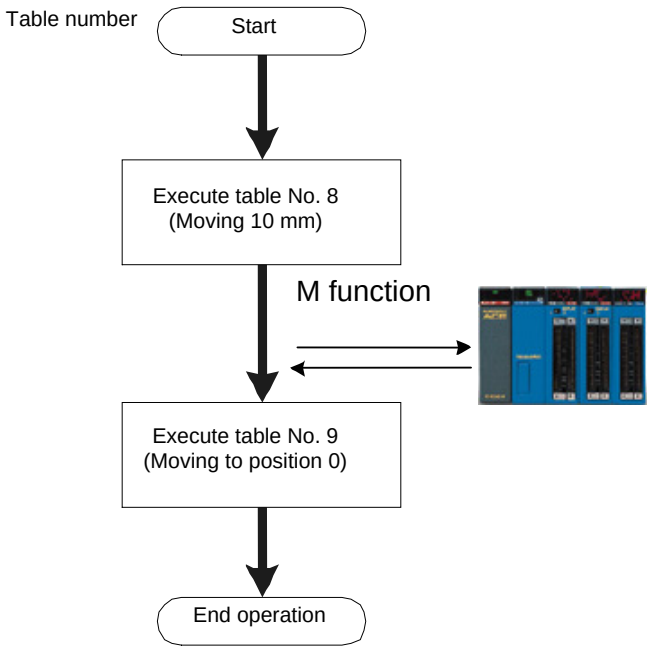


(3) Continue Function

This function is used to perform two or more table data operations consecutively.
In the table setting window, enable [Continue after execution] and select the table numbers to be executed subsequently from [Next table number].

When operating using the continue function, the OUT_MODE_EXE signal is not turned OFF when the operation switches to the next table data.

■ Usage Example 10 mm Reciprocal Movement



<Table Data Setting>

Table No.	No.8	No.9
Setting of operation register		
Operation code	Absolute positioning	Absolute positioning
M function	Valid	Invalid
Parallel M function	Invalid	Invalid
Settling wait	Valid	Valid
Continue after execution	Valid	Invalid
Next table number	No.9	-
Setting of operation data 0		
Acceleration type	Constant acceleration	Constant acceleration
Deceleration type	Constant acceleration	Constant acceleration
Value setting	Direct	Direct
Setting of operation data 1		
Target position setting	20000	0

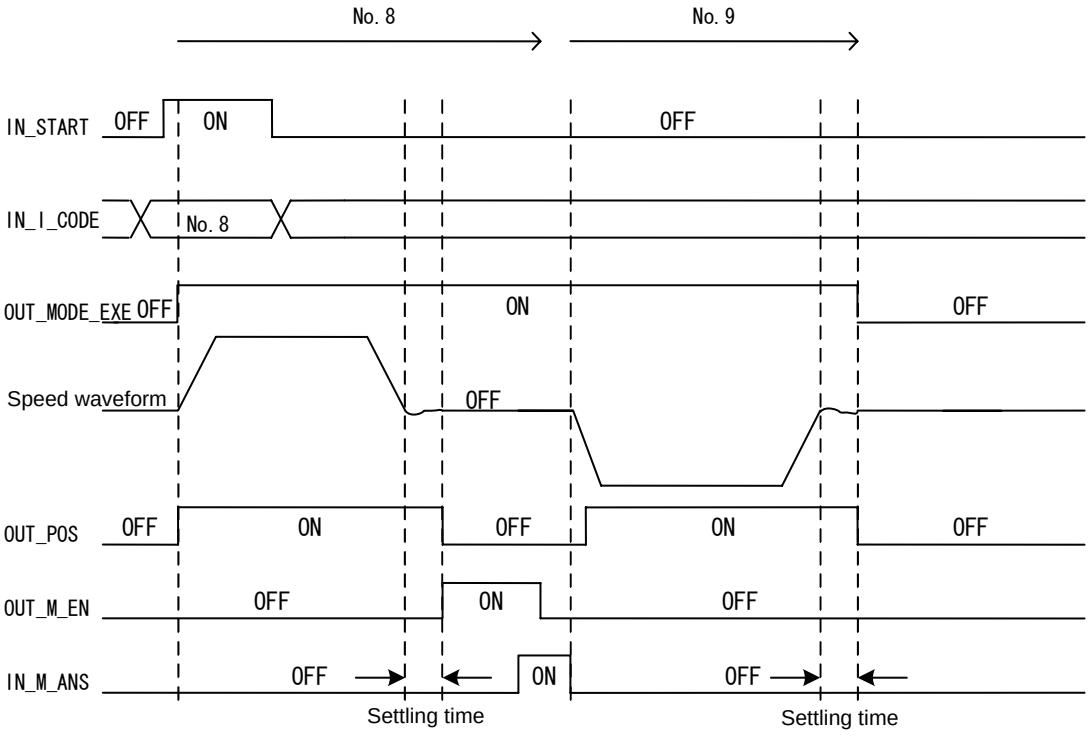
<#parameter Setting>

#112	Scaling data ratio numerator (on the command)	2000000
#113	Scaling data ratio numerator (on the pulse)	4000000

TIP

The usage example above shows a case where the resolution specification is 0.25 μm. The amount of movement set by the parameters above is 20 mm in case the resolution specification is 0.5 μm and 2 mm in case the resolution specification is 0.05 μm.

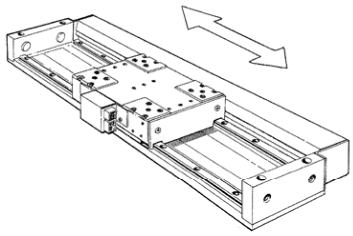
<Timing chart>



6.4.3 Auto-tuning Operation

To tune the servo properly it is necessary to register the load weight in #0 [Load inertia/Load mass]. When auto-tuning is performed, the load weight is estimated and control #parameters are set automatically. Perform the auto-turning operation at system startup or when the load weight changes significantly.

The motor reciprocates several times, and the load weight is estimated.



The estimated load weight is automatically registered in #0.

The control #parameters corresponding to #1 [Servo stiffness setup] (see the table below) are set automatically.

Position feed forward, velocity feed forward, acceleration feed forward and various filters are not adjusted

■ #parameters Set Automatically by Auto-Tuning

The #parameters set automatically by auto-tuning vary depending on the specified control mode, control method and states of IN_POSFREQ_SEL and IN_VELFREQ_SEL (see the table below).

#parameters Set Automatically by Auto-Tuning

#1 [servo stiffness setup]	#parameters automatically set by auto-tuning			
	Position control parameter (*1)		Velocity control parameter (*2)	
	Position control bandwidth #8/#9	Position integral limiting value #12/#13	Velocity control bandwidth #2/#3	Velocity integral limiting value #6/#7(*3)
13	39	A value that specifies the maximum torque that may be output by the integrator in the controller to remove a small position deviation (the value changes depending on the motor model, load inertia and servo rigidity setting value).	150	A value that specifies the maximum torque that may be output by the integrator in the controller to remove a small velocity deviation (the value changes depending on the motor model, load inertia and servo rigidity setting value).
12	38		140	
11	36		130	
10	34		120	
9	32		110	
8	30		100	
7	28		90	
6	26		80	
5	24		70	
4	22		60	
3	19		50	
2	16		40	
1	14		30	
0	9		20	
-1	8		15	
-2	6		12	
-3	5		10	

Servo stiffness (response)

Higher

Default setting

Lower

*1 Set to #8 and #12 if IN_POSFREQ_SEL is OFF and to #9 and #13 if it is ON.
*2 Set to #2 and #6 if IN_VELFREQ_SEL is OFF and to #3 and #7 if it is ON.
*3 Set only when the velocity control method is set to proportional integral control in system setup register 1 (0 is set in the case of proportional control).

(1) How to Set Auto-Tuning Operation

Set the data according to the flowchart showing the procedure for creating table data in Section 6.4.1, "Table Data Operation." See the following for how to set operation data and #parameters, corresponding to steps 4 and 6 in the flowchart.

■ Setting Operation Data

No operation data is used for the auto-tuning operation

■ Setting #parameters Related to Auto-tuning

● Setting Auto-tuning Operation Width

STEP 1 Select [Data Management], [#parameter] and then [Function parameter] from the utility software.
STEP 2 Select the Auto-tuning tab from the Parameter by Function window.
STEP 3 Check that the auto-tuning operation width is sufficiently narrower than the movable range required for normal operation.
STEP 4 Set and register #parameters.

● Selecting Control Mode and Control Method

The #parameters set by auto-tuning vary depending on the control mode and control method. Perform auto-tuning after registering the control mode and control method used with the corresponding #parameters.
STEP 1 Select [#parameter] and then [Register parameter] in the utility software.
STEP 2 Select [System setup register 1].
STEP 3 Select a control mode.
STEP 4 Select a control method with [Position control method setting].
STEP 5 Select a control method with [Velocity control method setting].
STEP 6 Set and register #parameters.

● Setting of Other #parameters

See the table on the next page for the #parameters related to auto-tuning.
Change the setup values of the #parameters as necessary.

The operation direction of auto-tuning is the + direction with respect to the position before starting the operation. Nonetheless, secure sufficient space in the - direction as well before starting the operation.

Make the auto-tuning operation width narrower if a sufficient movable range cannot be secured. Note, however, that the weight estimation accuracy may become lower if the auto-tuning operation width is made narrower.

If the auto-tuning operation cannot be performed, calculate the load weight and enter the value of the load weight directly in the applicable #parameter.

#parameters Related to Auto-tuning Operation

#parameter No.	#parameter name	Description
#51	Operation range under auto-tuning mode	This parameter specifies the auto-tuning operation width. This parameter can be used without changing the initial value under normal circumstances. Make this value larger (two to five times) if the auto-tuning is not completed normally, and perform the auto-tuning again. At shipment from the factory, this parameter is set to a value equivalent to 2% of the rated velocity. Example: If the rated velocity is 2000 [mm/s] 0.02 x 2000 [mm/s] → 40 [mm]
#52	Maximum acceleration/deceleration time under auto-tuning	This parameter can be used without changing the initial value set at shipment from the factory under normal circumstances.
#53	Initial acceleration/deceleration time under auto-tuning	This parameter can be used without changing the initial value set at shipment from the factory under normal circumstances.
#1	Servo stiffness setup	This parameter specifies the servo rigidity after the auto-tuning operation. Make this value smaller if the auto-tuning is not completed normally, or if oscillation or instability occurs.
#54	Repetition number for auto-tuning	This parameter can be used without changing the initial value set at shipment from the factory (#54 = 6) under normal circumstances.

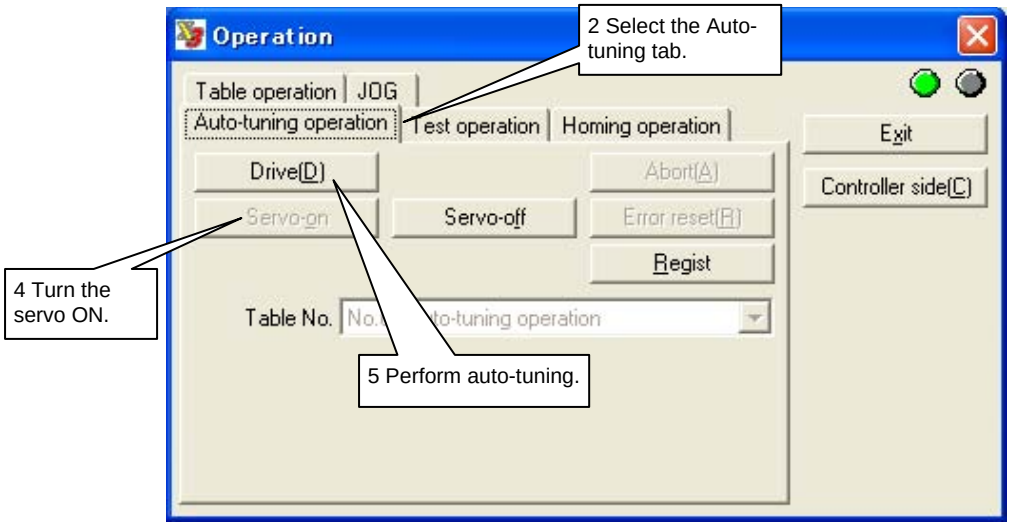
#parameters Set Automatically after Executing Auto-tuning Operation

#parameter No.	#parameter name	Description
#0	Load inertia/Load mass	The load weight value is set automatically in this parameter after auto-turning is performed. If the load weight value is known, it is acceptable to write the value of the load weight directly in this #parameter without performing the auto-tuning operation.
#2 or #3	Velocity control bandwidth #1 or Velocity control bandwidth #2	This parameter is set automatically after auto-tuning. The velocity control band frequency is set automatically in the #parameter selected by IN_VELFREQ_SEL according to the setting status of #1 [servo stiffness setup].
#8 or #9	Position control bandwidth #1 or Position control bandwidth #2	This parameter is set automatically after auto-tuning. The position control band frequency is set automatically in the #parameter selected by IN_POSFREQ_SEL according to the setting status of #1 [servo stiffness setup].
#6 or #7	Velocity integral limiting value #1 or Velocity integral limiting value #2	This #parameter is used only when the velocity control method is set to proportional integral control in system setup resister 1. It is automatically set in the #parameter selected by IN_VELFREQ_SEL when auto-turning is performed. This value specifies the maximum thrust that may be output by the integrator in the controller to remove a small velocity deviation (in which the value varies with the motor model, load weight and servo-stiffness setup value).
#12 or #13	Position integral limiting value #1 or Position integral limiting value #2	This limiter restricts the amount of position integration of the position control loop. This #parameter is used only when the control mode is set to position control and the velocity control method is set to proportional control in system setup register 1. It is automatically set in the #parameter selected by IN_POSFREQ_SEL when the auto-tuning operation is performed. The value specifies the maximum thrust that can be output by the integrator in the controller to remove a small velocity deviation (in which the value varies with the motor model, load weight and servo-stiffness setup value).

(2) How to Perform Auto-tuning

■ Starting from the Auto-tuning Dedicated Operation Window

STEP 1 Select [Operation] from [Control] in the utility software.
STEP 2 Select the Auto-tuning tab from the Operation window.
STEP 3 Move the motor to the position at which the auto-tuning should be started.
STEP 4 Click the [Servo-ON] button.
STEP 5 Click the [Drive] button to start the auto-tuning operation.
STEP 6 To store the #parameter values set automatically, click the [Regist] button.

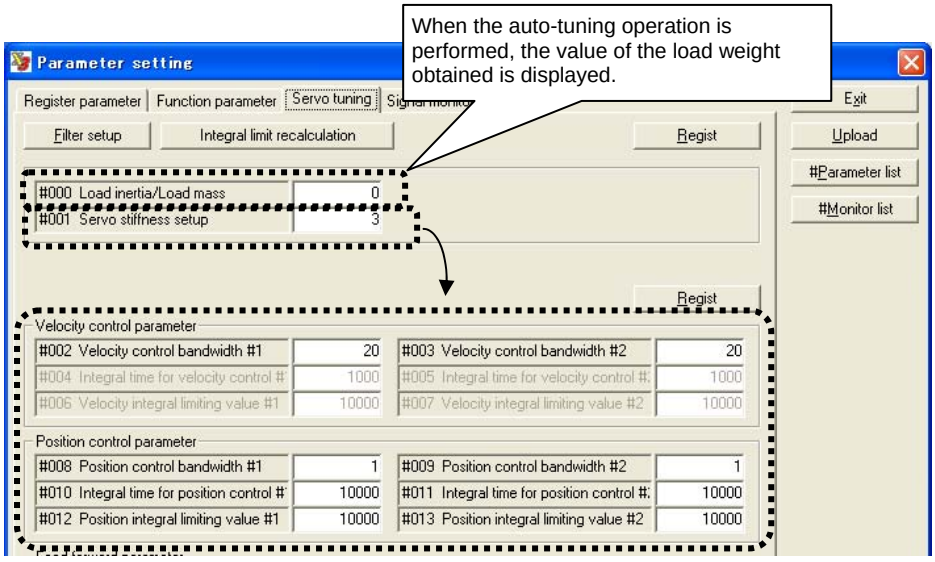


WARNING

The operation direction of auto-tuning is the + direction with respect to the position before starting the operation. Ensure that there is sufficient space in the direction. Secure sufficient space in the - direction as well, as overshoot may occur.

CAUTION

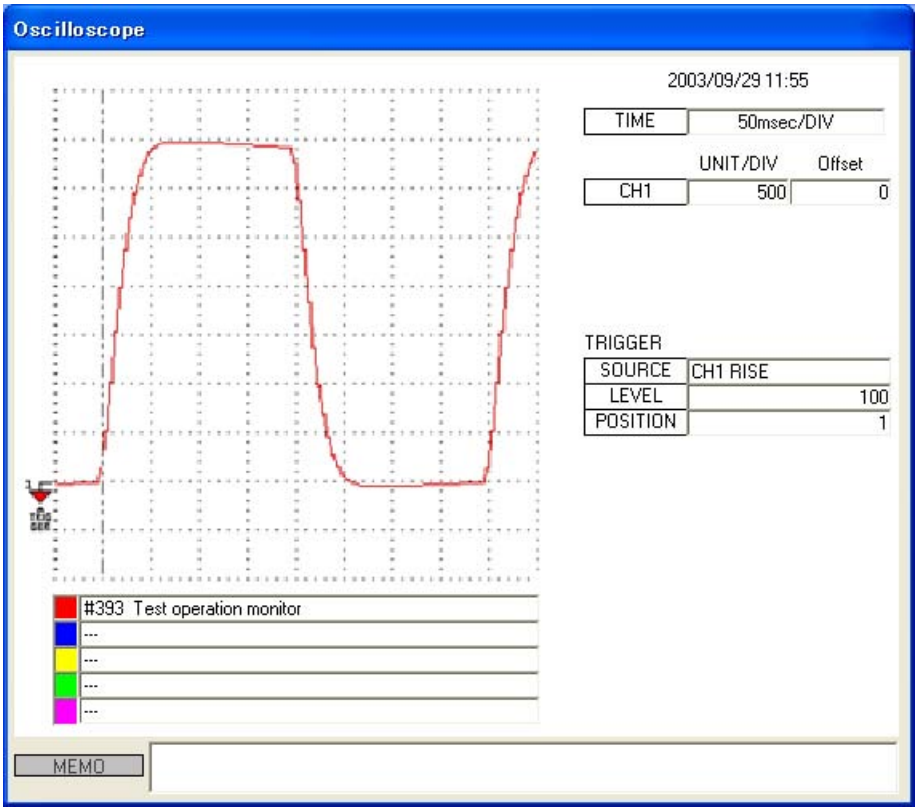
Do not change the states of the IN_POSFREQ_SEL and IN_VELFREQ_SEL signals during the auto-tuning operation. It will prevent obtaining correct settings.



6.4.4 Test Operation

It is possible to observe step response characteristics by performing a test operation.

When you perform the test operation, a rectangular wave-shaped position command signal with a frequency of 2.5Hz is issued to be used for adjusting the control part.
Observe the waveform with parameter #393 [Test operation monitor] using the oscilloscope function of the utility software.
During the test operation, position feed forward, velocity feed forward and acceleration feed forward are internally set to 0.
Settling wait is not performed at the end of the test operation.



(1) How to Set Test Operation

Set the data according to the flowchart showing the procedure for creating table data in Section 6.4.1, "Table Data Operation." See the following for how to set operation data and #parameters, corresponding to steps 4 and 6 in the flowchart.

■ Setting Operation Data

No operation data is used for the test operation.

■ Setting #parameters Related to Test

● Setting Test Operation Width

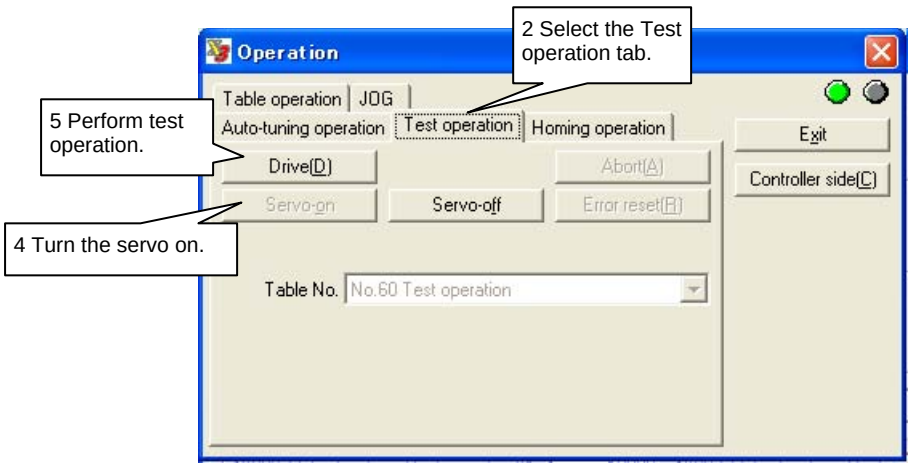
STEP 1 Select [Data Management], [#parameter] and then [Function parameter] from the utility software.
STEP 2 Select the Test Operation tab from the Parameter by Function window.
STEP 3 Check that #50 [Operation range under test mode] is sufficiently narrower than the movable range required for normal operation. If the test operation width is set too large, the motor cannot complete the response and errors such as excessive position deviation occur.
STEP 4 Set and register #parameters.

● Setting of Other #parameters

See the table on the next page for #parameters related to test operation.
Change the setup values of the #parameters as necessary.

(2) How to Perform Test Operation (Utility Software)

STEP 1 Select [Operation] from [Control] in the utility software.
STEP 2 Select the Test Operation tab from the Operation window.
STEP 3 Move the motor to the position at which the test operation should be started.
STEP 4 Click the [Servo-ON] button.
STEP 5 Click the [Drive] button to start the test operation.
STEP 6 Select [Oscilloscope] from [Display] to display the test operation response on the oscilloscope. (See Chapter 8 for how to set the oscilloscope. For the response to be displayed, select [Test operation] from EASY SETTING.)
STEP 7 Select [#parameter] from [Data Management], and set #parameters (servo tuning) in the [Servo Tuning] window.



(3) How to Perform Test Operation (Control Interface)
See Section 6.4.1 (3), "How to Perform Table Data Operation (Control Interface)."

#parameters Related to Test Operation

#parameter No.	#parameter name	Description
#50	Operation range under test mode	Set test operation width. Use this parameter without changing the initial value under normal circumstances.

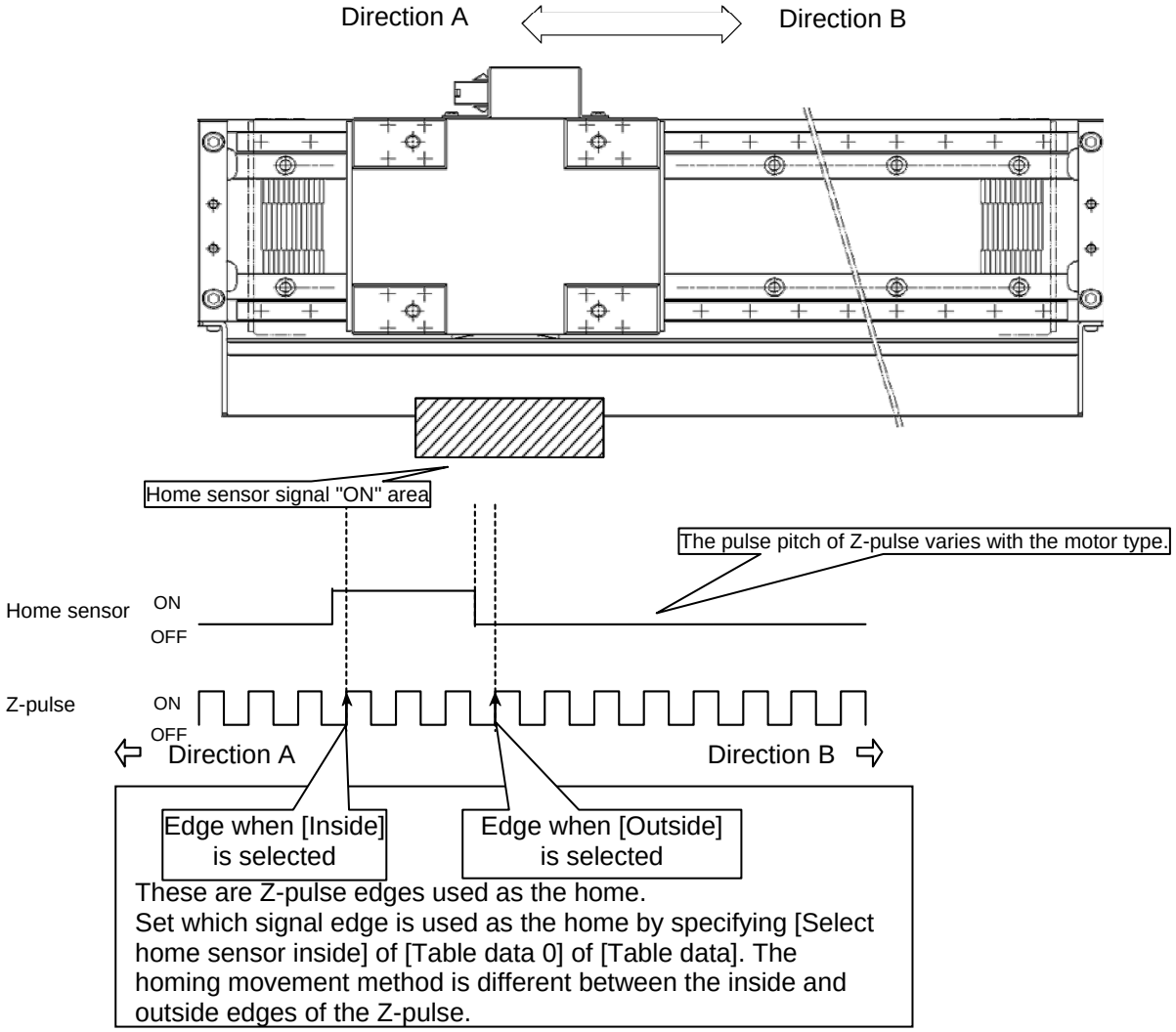
#parameters Related to Servo Tuning

#parameter No.	#parameter name	Description
#0	Load inertia/Load mass	The value of the load weight is set automatically in this parameter after the auto-turning operation. If the load weight value is known, it is acceptable to write the load weight value directly in this #parameter without performing the auto-tuning operation.
#2 or #3	Velocity control bandwidth #1 or Velocity control bandwidth #2	This parameter is set automatically after auto-tuning. The velocity control band frequency is set automatically in the #parameter selected by IN_VELFREQ_SEL according to the setting status of #1 [servo stiffness setup].
#4 or #5	Integral time for velocity control #1 or Integral time for velocity control #2	This #parameter is used only when the control mode is velocity control and the velocity control method is set to proportional integral control. The valid parameter is switched by the status of the IN_VELFREQ_SEL I/O input. If the IN_VELFREQ_SEL I/O input is turned off, #4 [Integral time for velocity control #1] is selected. If it is turned ON, #5 [Integral time for velocity control #2] is selected.
#6 or #7	Velocity integral limiting value #1 or Velocity integral limiting value #2	This #parameter is used only when the velocity control method is set to proportional integral control in system setup resister 1. It is automatically set in the #parameter selected by IN_VELFREQ_SEL when auto-turning is performed. This value specifies the maximum thrust that may be output by the integrator in the controller to remove a small velocity deviation (in which the value varies with the motor model, load weight and servo-stiffness setup value).
#8 or #9	Position control bandwidth #1 or Position control bandwidth #2	This parameter is set automatically after auto-tuning. The position control band frequency is set automatically in the #parameter selected by IN_POSFREQ_SEL according to the setting status of #1 [servo stiffness setup].
#10 or #11	Integral time for position control #1 or Integral time for position control #2	This #parameter is used only when the control mode is position control and the position control method is set to proportional integral control. The valid parameter is switched by the status of the IN_POSFREQ_SEL I/O input. If the IN_POSFREQ_SEL I/O input is turned off, #10 [Integral time for position control #1] is selected. If it is turned ON, #11 [Integral time for position control #2] is selected.
#12 or #13	Position integral limiting value #1 or position integral limiting value #2	This limiter restricts the amount of position integration of the position control loop. This #parameter is used only when the control mode is set to position control and the velocity control method is set to proportional control in system setup register 1. It is automatically set in the #parameter selected by IN_POSFREQ_SEL when the auto-tuning operation is performed. The value specifies the maximum thrust that can be output by the integrator in the controller to remove a small velocity deviation (in which the value varies with the motor model, load weight and servo-stiffness setup value).

6.4.5 Homing

Homing can be performed in two ways: either using the host positioning controller or by table data operation.
To perform homing using the host positioning controller, see Section 6.4.10, "Homing Using the PLC." When performing homing by table data operation, the motor is moved in order to establish a coordinate system according to the pre-defined home search method.
This section explains how to perform homing by table data operation.

When performing homing via table data operation, the motor is first moved to the home position determined by the home sensor and Z-pulse, and is then moved an additional amount according to the value set in parameter #56 [Offset distance from home position]. Then, at that position the coordinate value in command units is set in the setup value of parameter #57 [Coordinate value in command units after homing].
The homing operation is processed in the order described in Section 6.4.5 (1), "Homing Operations."
It is possible to set the acceleration/deceleration profile used for the movement. Velocity override also functions in real time.



(1) Homing Operations

Homing is performed in the order from step 1 to step 8.

STEP 1 EOT search movement

This step is only performed when [Hardware EOT limit active in homing operation] is set to [Enable] for the table data. The motor is moved in the direction opposite the homing direction until the EOT sensor is detected, whereupon the motor moves in the direction of the home sensor. It is thus possible to prevent the motor from entering an area in which operation is prohibited.
Moreover, if [Enables the home sensor during EOT search] is set to [Enable] for the table data, the hard EOT search movement is stopped, and the operations in STEP 2 and onward are performed in case the home sensor is detected during the hard EOT search movement.

STEP 2 Home sensor search movement

The motor is moved until the home sensor is detected in the homing direction.
If [Enable home sensor] is set to [Disable] for table data, the home sensor search movement is not performed. Set it to [Enable] under normal circumstances.

STEP 3 Moving outside the home sensor area

This is a preliminary movement carried out before performing step 4, the first home detection movement. The motor is moved in direction B until it passes the home sensor area regardless of the setting of the #parameter for determining the coordinate system's forward direction.
If the home sensor is at the edge of the movable range in direction A, it is possible to avoid performing this operation and prevent the motor from moving in direction A upon detection of the motor proximity signal by setting [Select home sensor inside] to [Outside].

STEP 4 First home detection movement

The motor moves in direction B until it detects the rising edge of the Z-pulse, regardless of the setting of the #parameter for determining the coordinate system's forward direction.
If [Select home sensor inside] is set to [Inside] with table data:
The motor stops upon detection of the rising edge of the first Z-pulse after the motor enters the ON area of the home sensor.
If [Select home sensor inside] is set to [Outside] with table data:
The motor stops upon detection of the rising edge of the first Z-pulse after the motor leaves the ON area of the home sensor in direction B.

STEP 5 Second and onward home detection movement (preliminary movement)

The motor moves in direction A for the amount set in #55 [Overshoot distance in homing operation] relative to the Z-pulse edge.

STEP 6 Second and onward home detection movement (Z-pulse edge search movement)

The motor is moved in direction B until the Z-pulse edge is detected.

After STEP 6 is completed, the operations of STEPs 5 and 6 are repeated for the number of times set by #58 [Z-Pulse sensing iterations during homing].
The final home position is determined by averaging the data obtained during all the home detection movements.

STEP 7 Home movement

The motor is moved to the detected Z-pulse edge position. In the case of a motor equipped with software Z-pulse, correction movement is performed twice as well.

STEP 8 Home offset movement

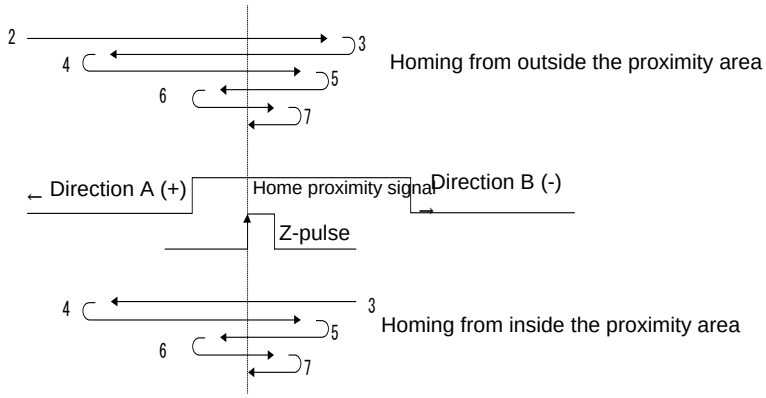
The motor is moved an amount given by the value set in parameter #56 [Offset distance from home position]. Then, at that position the coordinate value in command units is set in the setup value of parameter #57 [Coordinate value in command units after homing].

Step No.	Operation	Execution condition	Operation overview	Moving direction	Acceleration/deceleration type	Acceleration/deceleration time	Feed velocity
1	EOT search movement	Performed only when [Hardware EOT limit active in homing operation] is set to [Enable] for table data	The motor decelerates and stops after detecting the hardware EOT signal.	Opposite to the homing direction (set in table data)	Set by "acceleration type"/"deceleration type" in the table data	Set by "acceleration time selection"/"deceleration time selection" in the table data	#60 [Homing EOT sensor search velocity]
2	Home sensor search movement	Performed when [Enable] is selected for [Enable home sensor]	The motor decelerates and stops after detecting the home sensor signal.	Homing direction set in table data			#61 [Home sensor search velocity in homing operation]
3	Moving outside the home sensor area	Always performed	Depends on #parameter [homing, select home sensor inside] Inside: The motor decelerates and stops after moving outward from the home sensor area. Outside: The motor performs step 4 without stopping after passing through the home sensor area.	Depends on #parameter [homing, select home sensor inside] Inside: Direction A Outside: Direction B			#62 [Initial Z-pulse search velocity]
4	First home detection movement	Always performed	The motor searches for the rising edge of the Z-pulse, and decelerates and stops	Direction B (cannot be changed)			#62 [Initial Z-pulse search velocity]
5	Second and onward home detection movement (preliminary movement)	Repeated for the number of times set by #58 [Z-Pulse sensing iterations during homing]	The motor moves in the right direction from the home position for the amount set in #55 (overshoot), and then decelerates and stops.	Direction A (cannot be changed)			#62 [Initial Z-pulse search velocity]
6	Second and onward home detection movement (Z-pulse edge search movement)		The motor searches for the rising edge of the Z-pulse, and decelerates and stops	Direction B (cannot be changed)			#63 [Z-pulse search velocity after 2nd iteration]
7	Home movement	Always performed	The motor stops after moving to the home position.	Home direction			#62 [Initial Z-pulse search velocity]
8	Home offset movement	Performed if the amount of home offset movement is different from 0	The motor moves to the offset coordinate position set in #56.	#56 > 0: Forward direction #56 < 0: Reverse direction	System setup register 3	System setup register 3	System setup register 3

EOT search movement is set to invalid until the motor settles during homing. All other steps are Valid.
The settling width can be set in the homing table.

- Operation example 1 -

The numbers in the figure indicate step numbers.



(Initial value settings)

<Table operation data 0, 1>

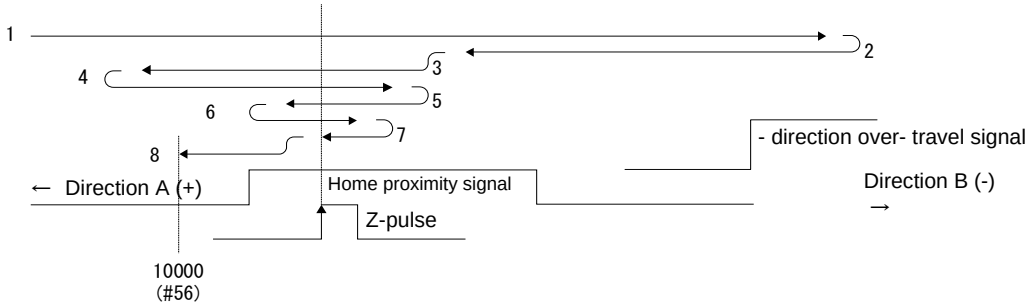
Homing direction	- direction
Hardware EOT limit active in homing operation	Disable
Select home sensor inside	Inside
Enable home sensor	Enable
Enables the home sensor during EOT search	Invalid

<#parameter>

- Parameter by Function
  Homing, amount of home offset movement — #56 = 0
- System setup register 1
  Coordinate system forward direction setting — Forward direction

- Operation example 2 -

Numbers in the figure indicate step numbers.



<Table operation data 0, 1>

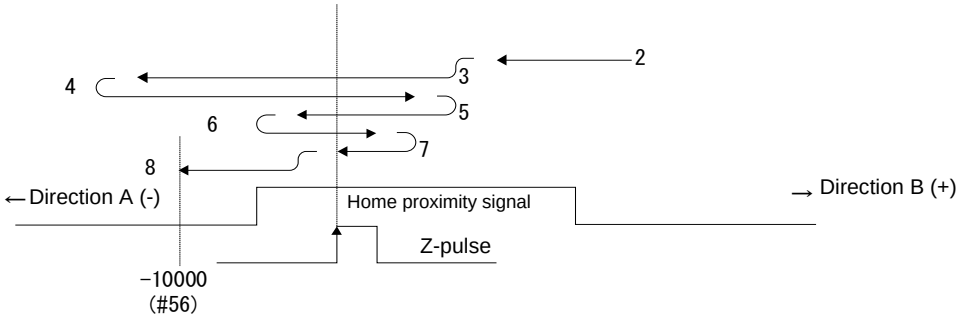
Homing direction	+ direction
Hardware EOT limit active in homing operation	Enable
Select home sensor inside	Inside
Enable home sensor	Enable
Enables the home sensor during EOT search	Invalid

<#parameter>

- Parameter by Function
  Homing, amount of home offset movement — #56 = 10000
- System setup register 1
  Coordinate system forward direction setting — Forward direction

- Operation example 3 -

The numbers in the figure indicate step numbers.



<Table operation data 0, 1>

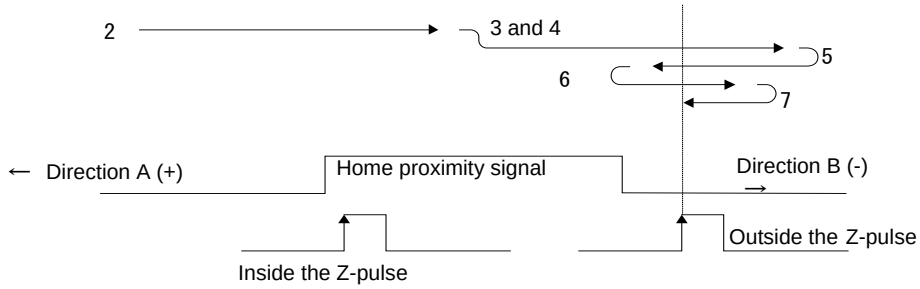
Homing direction	- direction
Hardware EOT limit active in homing operation	Disable
Select home sensor inside	Inside
Enable home sensor	Enable
Enables the home sensor during EOT search	Invalid

<#parameter>

• Parameter by Function Homing, amount of home offset movement	#56 = 10000
• System setup register 1 Coordinate system forward direction setting	Reverse direction

- Operation example 4 -

The numbers in the figure indicate step numbers.



<Table operation data 0, 1>

Homing direction	- direction
Hardware EOT limit active in homing operation	Disable
Select home sensor inside	Outside
Enable home sensor	Enable
Enables the home sensor during EOT search	Invalid

<#parameter>

• Parameter by Function Homing, amount of home offset movement	0
• System setup register 1 Coordinate system forward direction setting	Forward direction

(2) How to Set Homing Operation

Set the data according to the flowchart showing the procedure for creating table data in Section 6.4.1, "Table Data Operation." See the following for how to set operation data and #parameters, corresponding to steps 4 and 6 in the flowchart.

■ Setting Operation Data

Set operation data to be used for the homing operation as necessary by referring to the list of homing table operation data (explained later).

■ Setting #parameters Related to Homing

See #parameters related to the homing function for the items to be set.

● Setting of Parameter by Function

STEP 1 Select [Data Management], [#parameter] and then [Function parameter] from the utility software.
STEP 2 Select the Homing operation tab.
STEP 3 Set #parameters as necessary.

● Setting of system setup register

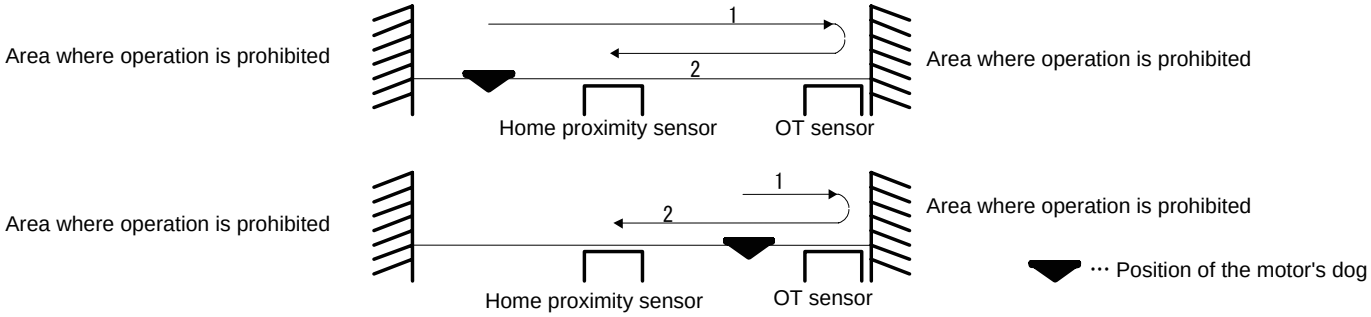
STEP 1 Select [Data Management], [#parameter], [Function parameter] and then [Register #parameter 3] from the utility software.
STEP 2 Set #parameters as necessary.

■ Points of Note when Setting #parameters according to the System

Set #parameters using the following pattern as reference when there are system restrictions, such as when there are restrictions on the homing direction and the home sensor is at the edge of the movable range.

● When using hardware EOT

It is possible to perform homing regardless of the position of the dog relative to the home sensor, by selecting [Hardware EOT limit active in homing operation].

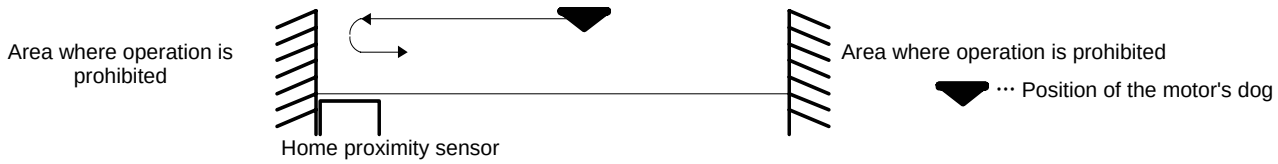


<Setting items>

Set [Hardware EOT limit active in homing operation] to [Enable] in [Operation data 0] of [Table Data].

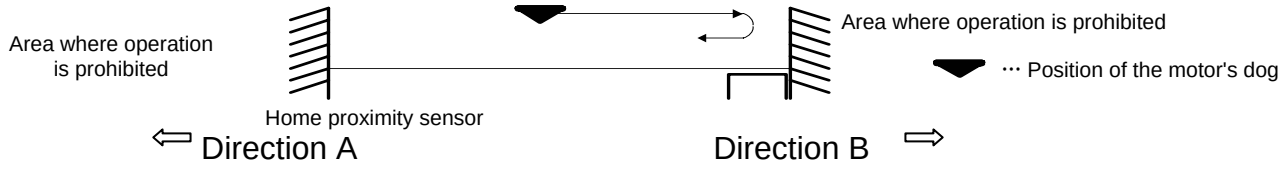
● **When the Home Sensor is Mounted at the Edge of the Movable Range**

When the home sensor is at the edge of direction A



<Setting item>
Set [Select home sensor inside] to [Outside] in [Operation data 0] of [Table Data].

When the home sensor is at the edge of the movable range in the direction B

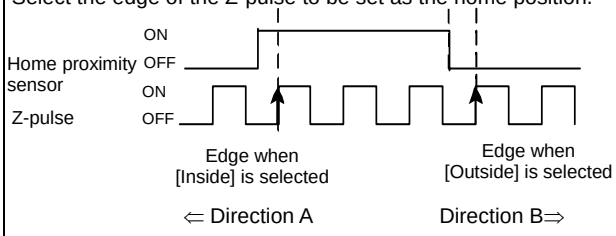


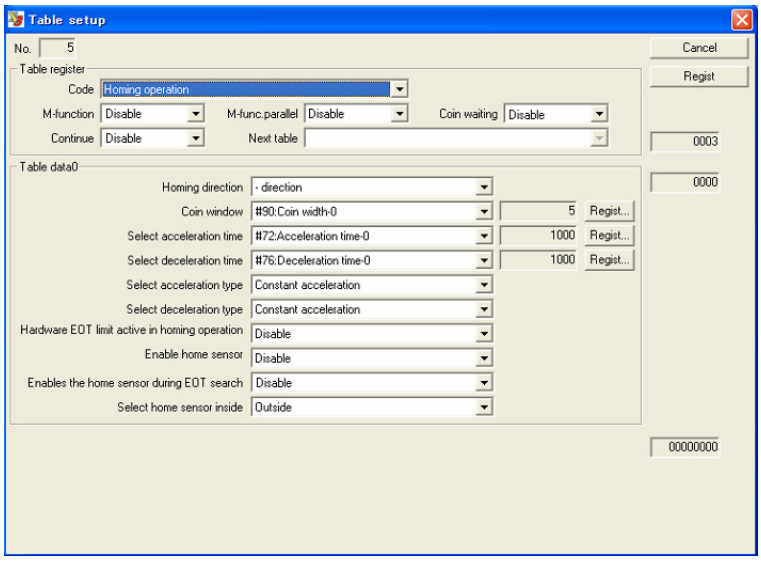
<Setting item>
Set [Select home sensor inside] to [Inside] in [Operation data 0] of [Table Data].

WARNING

If the homing velocity is high, the motor may enter the area where operation is prohibited; be careful to avoid such situations.

List of Homing Operation Data 0

Name	Description	Default setting of table numbers 3 and 63
Homing direction	Set the homing direction at homing operation	- direction
Coin width	Select the settling width at homing operation from coin widths 0 to 7 (#90 ~ #97).	Position settling width 0
Select acceleration time	Select the acceleration time from acceleration times 0 to 3 (#72 ~ #75).	Acceleration time 0
Select deceleration time	Select the deceleration time from deceleration times 0 to 3 (#76 ~ #79).	Deceleration time 0
Select acceleration type	Select either "constant acceleration" or "S-curved profile."	Constant acceleration
Select deceleration type	Select either "constant acceleration" or "S-curved profile."	Constant acceleration
Hardware EOT limit active in homing operation	Set to [Enable] to perform hard EOT signal search movable using the EOT sensor (connected to TB4) at the start of homing movement. Set to [Disable] if the EOT sensor is not used.	[Disable]
Enable home sensor	Specify [Enable] under normal circumstances. If it is set to [Disable], home sensor search movement is not performed. The home position is set to the position at which the rising edge of the Z-pulse is detected.	[Enable]
Enables the home sensor during EOT search	Only valid when [Hardware EOT active] is set to [Valid]. This parameter specifies whether or not to switch to home search movement if the home sensor is detected during hardware EOT signal search movement during the homing operation.	[Invalid]
Select home sensor inside	Select the edge of the Z-pulse to be set as the home position.  	[Inside]



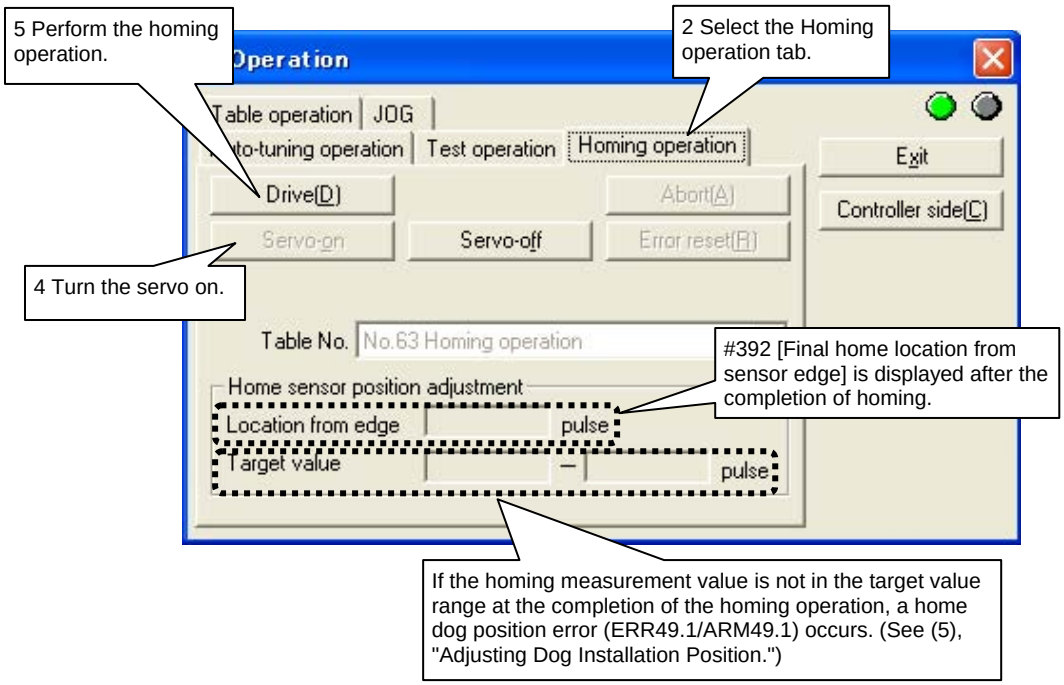
#parameters Related to the Homing Function

#parameter No.	#parameter name	Description
#60	Homing EOT sensor search velocity	Only valid when [Enable] is selected for [Homing, hardware EOT limit active in homing operation]
#61	Home sensor search velocity in homing operation	Set the velocity to be used when searching for the home sensor during the homing operation. Use the initial value under normal circumstances.
#62	Initial Z-pulse search velocity	Use the initial value under normal circumstances.
#63	Z-pulse search velocity after 2nd iteration	Use the initial value under normal circumstances.
#55	Overshoot distance in homing operation	Use the initial value under normal circumstances.
#58	Z-Pulse sensing iterations during homing	Use the initial value under normal circumstances.
#56	Offset distance from home position	Enter the amount of home offset. The offset movement is only performed for the amount specified by this #parameter after homing, and the position is set as the origin of the coordinate system.
#57	Coordinate value in command units after homing	Use the initial value under normal circumstances (#57 = 0). This parameter specifies the command unit command coordinate value after the completion of homing.
System setup register 3	Homing, home offset movement feed velocity selection	It is not necessary to set this parameter if #56 = 0. This parameter sets the feed velocity at which the motor should move to the offset position after the completion of homing operation.
System setup register 3	Homing, enable dog position error	Use the initial value under normal circumstances (Enabled).

(3) How to Perform Homing Operation (Utility Software)

STEP 1 Select [Operation] from [Control] in the utility software.
STEP 2 Select the Homing Operation tab from the Operation window.
STEP 3 Move the motor to the position at which the homing should be started.
STEP 4 Click the [Servo-ON] button.
STEP 5 Click the [Drive] button to start the homing operation.
STEP 6 If the home dog position error (error code: 49.1) occurs, the relationship between the home sensor position and dog position is not appropriate. Adjust the dog position so that the homing measurement value is within the target value range, reset the error, and perform the homing operation again.

* Table data No. 63 is executed from the Homing window. The M function, continue function, and coin waiting function cannot be set.



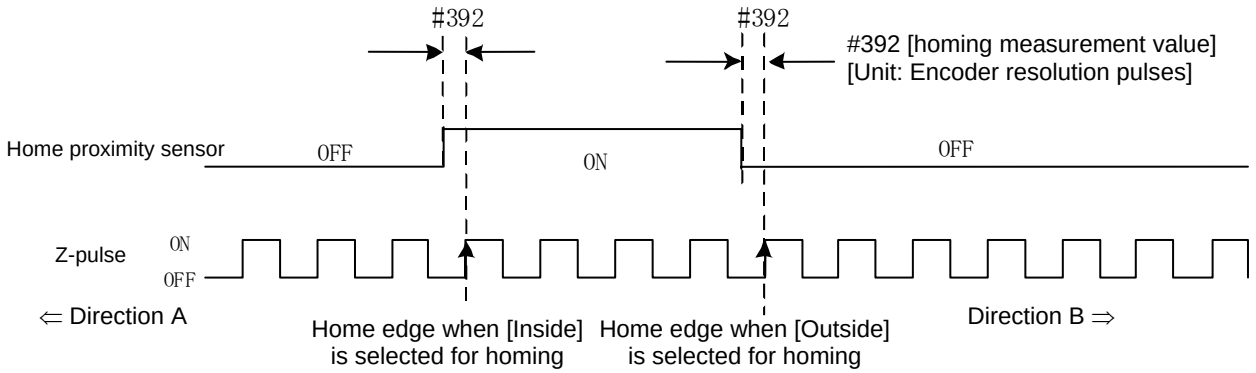
(4) How to Perform Homing Operation (via Command from the Controller Interface)
See Section 6.4.1 (3), "How to Perform Table Data Operation (Control Interface)."

TIP

When turning the Power ON, OUT_ORG_FINISH signal is on OFF state.
The OUT_ORG_FINISH signal is turned OFF when the power is turned ON. It turns ON when the homing operation is completed. After that, this signal does not turn OFF until the power is turned OFF, regardless of whether the servo is turned ON or OFF. However, the signal is turned OFF at the start of homing and is turned ON when the operation is complete.

(5) Adjusting Dog Installation Position

In order for the homing movement to be completed normally, it is necessary that the distance between the ON area of the home sensor and the Z-pulse edge is within a certain range set based on monitor #306 [Z-pulse interval].
At the first home detection movement, the distance (number of pulses) from the edge of the home sensor to the first edge of the Z-pulse is measured after the motor goes through the home sensor area, and this value is set in monitor #392 [homing measurement value]. An error or alarm is generated if this value does not satisfy the following expressions. In case an error or alarm is generated, adjust the home sensor dog position and perform the homing movement again, and repeat the operations until the homing operation is completed normally.



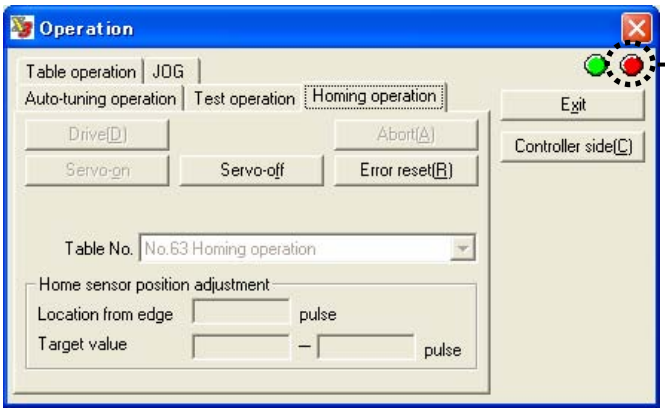
[Software Z-pulse]

#392 value	<	0.05 x #306 value			Error (error code 49.1)
0.05 x #306 value	≤	#392 value	<	0.1 x #306 value	Alarm
0.1 x #306 value	≤	#392 value	≤	0.4 x #306 value	Normal
0.4 x #306 value	<	#392 value	≤	0.45 x #306 value	Alarm
0.45 x #306 value	<	#392 value			Error (error code 49.1)

Drive resolution	Z-pulse interval	Normal range of #392 [Final home location from sensor edge]
0.5 [μm]	8192	819 ~ 3276
0.25 [μm]	8182	819 ~ 3276
0.05 [μm]	40960	4096 ~ 16384

TIP

If a home dog position error alarm is generated during startup or homing operation, it is recommended to adjust the dog position to within the normal range, even though this alarm status does not affect the homing accuracy.
In the alarm status, the homing result display indicator lamp on the Operation window of the utility software lights in yellow (see the figure below).
The alarm status can be checked by the utility software but is not output to the controller interface.



Homing result display indicator lamp
Green: Normal range
Yellow: Homing alarm range
Red: Homing error

6.4.6 ABS (Absolute) Positioning Move

In this operation, the motor is moved to the specified position by entering an absolute position relative to the home position in table data.

(1) How to Set Absolute Positioning Move

Set the data according to the flowchart showing the procedure for creating table data in 6.4.1, "Table Data Operation." See the following for how to set operation data and #parameters, corresponding to steps 4 and 6 in the flowchart.

■ Setting Operation Data

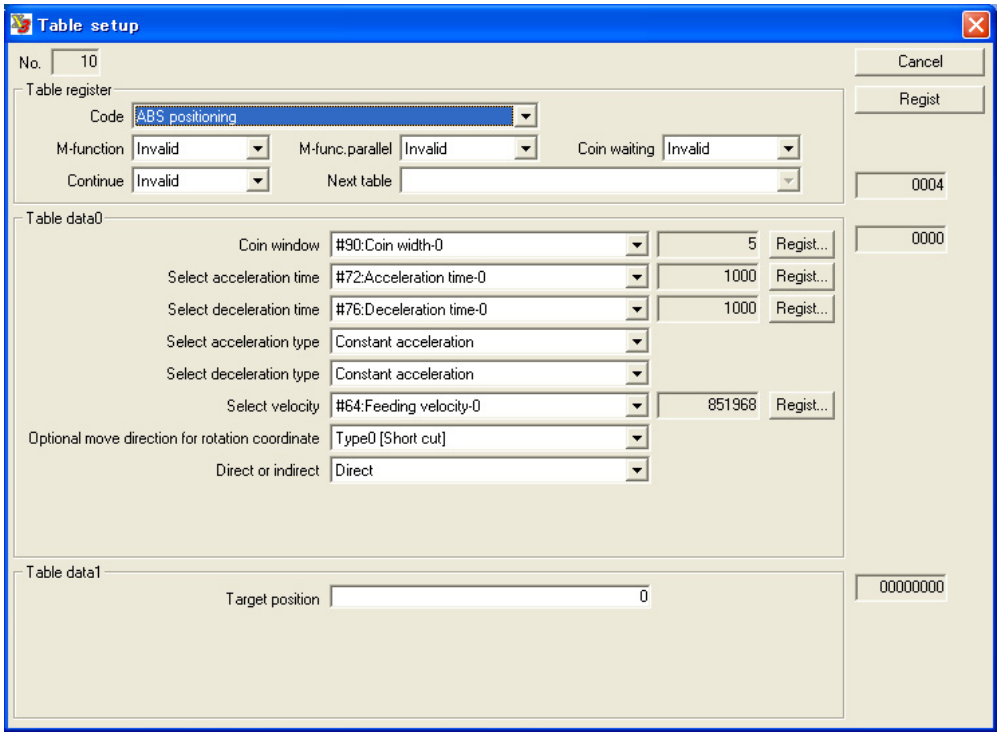
STEP 1 Select the settling width from #parameters 90 to 97 [position settling width].
The setup value of #parameters [Coin window] can be changed by selecting [INC/ABS move] in [Function parameter] of [#parameter].

STEP 2 Set the acceleration/deceleration time.
Select the acceleration/deceleration time from #parameters (#72 to #79).
The setup value of #parameters [acceleration/deceleration time] can be changed by selecting [INC/ABS move] in [Function parameter] of [#parameter].

STEP 3 Select either constant acceleration or S-curved profile as the acceleration type/deceleration type.

STEP 4 Select the feed velocity.

STEP 5 If [Direct] is selected for [Direct or indirect], enter the target position in [Table data 1].
If [Indirect] is selected for [Direct or indirect], enter the parameter or #monitor number to be used as the target position in [Table data 1].



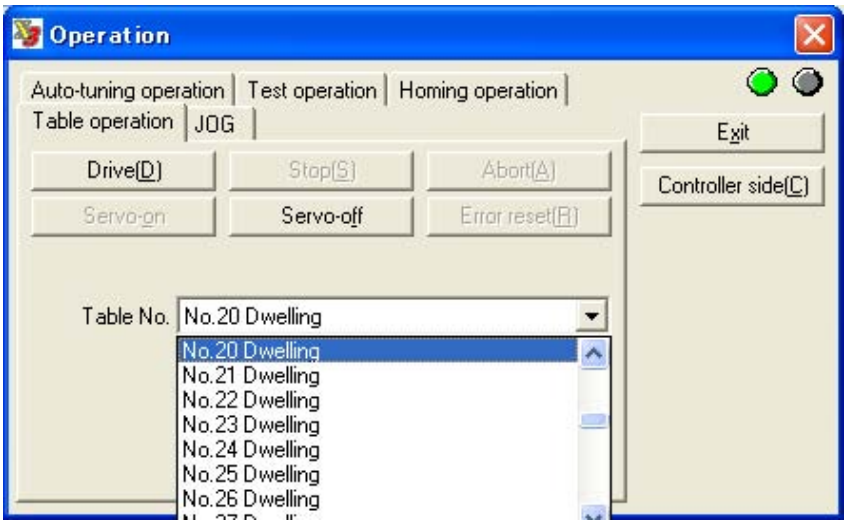
■ Setting #parameters Related to Absolute Positioning Move

● Setting #parameters Related to Absolute Positioning Move

STEP 1 Select [Data Management], [#parameter] and then [Function parameter] from the utility software.
STEP 2 Select [ABS/INC move] from [Function parameter].
STEP 3 Set the feed velocity, acceleration time, deceleration time, position settling width, maximum velocity and velocity override percentage.
STEP 4 Set and register #parameters.

(2) How to Perform Table Data Operation (Utility Software)

STEP 1 Select [Operation] in the utility software.
STEP 2 Select the Table operation tab in the Operation menu.
STEP 3 Click the [Servo-ON] button to turn the motor's servo ON.
STEP 4 Select the table number whose operation you want to execute.
STEP 5 Click the [Drive] button to execute the selected table data.



(3) How to Perform Absolute Positioning Move (Controller Interface)
See Section 6.4.1 (3), "How to Perform Table Data Operation (Control Interface)."

Absolute Positioning Move Operation Data 0 and 1

Name	Description	Default Setting
Coin width	Select the coin width from coin windows 0 to 7 (#90 to #97).	Position settling width 0
Select acceleration time	Select the acceleration time from acceleration times 0 to 3 (#72 ~ #75).	Acceleration time 0
Select deceleration time	Select the deceleration time from deceleration times 0 to 3 (#76 ~ #79).	Deceleration time 0
Select acceleration type	Select either "constant acceleration" or "S-curved profile."	Constant acceleration
Select deceleration type	Select either "constant acceleration" or "S-curved profile."	Constant acceleration
Select velocity	Select the feed velocity from feed velocities 0 to 7 (#64 ~ #71).	Constant acceleration
Direct or indirect	If [Direct] is selected: The target position is set in operation data 1. The unit is axis command unit. If [Indirect] is selected: Select #parameter/#monitor and #parameter/#monitor numbers in operation data 1. The value of the selected #parameter/#monitor is set as the target position. The unit is axis command unit.	0 (Disabled)

6.4.7 INC (Incremental) Positioning Move

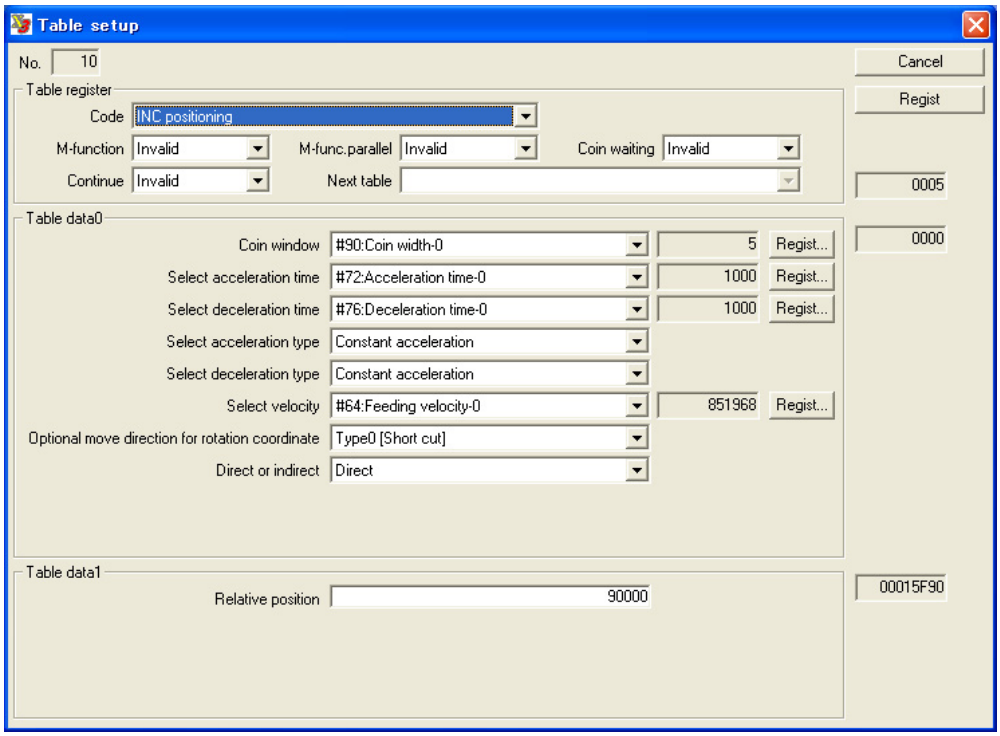
In this operation, the motor is moved to the specified position by entering a position relative to the current position command value in table data.

(1) How to Set Incremental Positioning Move

Set the data according to the flowchart showing the procedure for creating table data in Section 6.4.1, "Table Data Operation." See the following for how to set operation data and #parameters, corresponding to steps 4 and 6 in the flowchart.

■ Setting Operation Data

STEP 1 Select the settling width from #parameters 90 to 97 [position settling width].
The setup value of #parameters [Coin window] can be changed by selecting [INC/ABS move] in [Function parameter] of [#parameter].
STEP 2 Set the acceleration/deceleration time.
Select the acceleration/deceleration time from #parameters (#72 to #79).
The setup value of #parameters [acceleration/deceleration time] can be changed by selecting [INC/ABS move] in [Function parameter] of [#parameter].
STEP 3 Select either constant acceleration or S-curved profile as the acceleration type/deceleration type.
STEP 4 Select the feed velocity.
STEP 5 If [Direct] is selected for [Direct or indirect], enter the relative target position in [Table data 1].
If [Indirect] is set for [Direct or indirect], enter the #parameter or #monitor number to be used as the relative target position in [Table data 1].



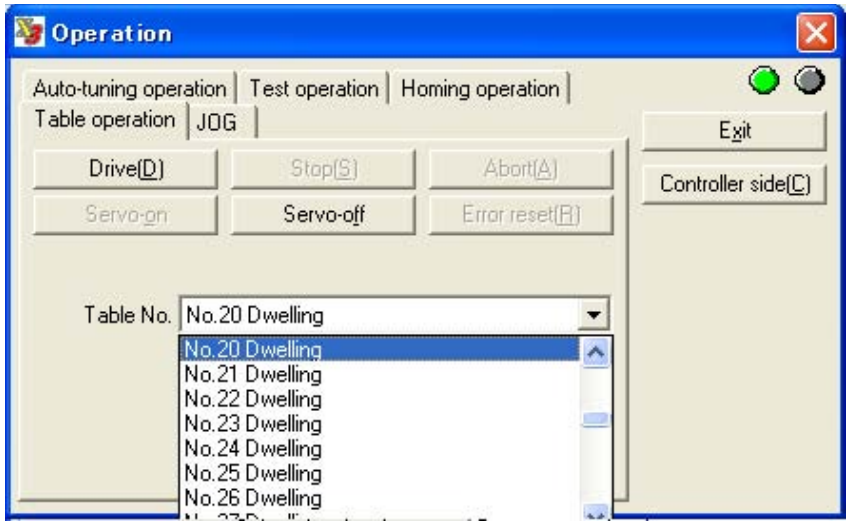
■ **Setting #parameters Related to Increment Positioning Move**

● **Setting #parameters Related to Increment Positioning Move**

STEP 1 Select [Data Management], [#parameter] and then [Function parameter] from the utility software.
STEP 2 Select [ABS/INC move] from [Function parameter].
STEP 3 Set the feed velocity, acceleration time, deceleration time, position settling width, maximum velocity and velocity override percentage.
STEP 4 Set and register #parameters.

(2) How to Perform Table Data Operation (Utility Software)

STEP 1 Select [Operation] in the utility software.
STEP 2 Select the Table Operation tab in the Operation menu.
STEP 3 Click the [Servo-ON] button to turn the motor's servo ON.
STEP 4 Select the table number of the table data you want to execute.
STEP 5 Click the [Drive] button to execute the selected table data.



(3) How to Perform Increment Positioning Move (Controller Interface)

See Section 6.4.1 (3), "How to Perform Table Data Operation (Control Interface)."

Increment Positioning Move Operation Data 0 and 1

Name	Description	Default Setting
Coin width	Select the settling width at homing operation from coin widths 0 to 7 (#90 ~ #97).	Position settling width 0
Select acceleration time	Select the acceleration time from acceleration times 0 to 3 (#72 ~ #75).	Acceleration time 0
Select deceleration time	Select the deceleration time from deceleration times 0 to 3 (#76 ~ #79).	Deceleration time 0
Select acceleration type	Select either "constant acceleration" or "S-curved."	Constant acceleration
Select deceleration type	Select either "constant acceleration" or "S-curved."	Constant acceleration
Select velocity	Select the feed velocity from feed velocities 0 to 7 (#64 ~ #71).	Constant acceleration
Direct or indirect	If [Direct] is selected: The relative target position is set by operation data 1. The unit is axis command unit. If [Indirect] is selected: Select #parameter/#monitor and #parameter/#monitor numbers in operation data 1. The value of the selected #parameter/#monitor is set to the relative target position. The unit is axis command unit.	0 (Disabled)

6.4.8 Dwell

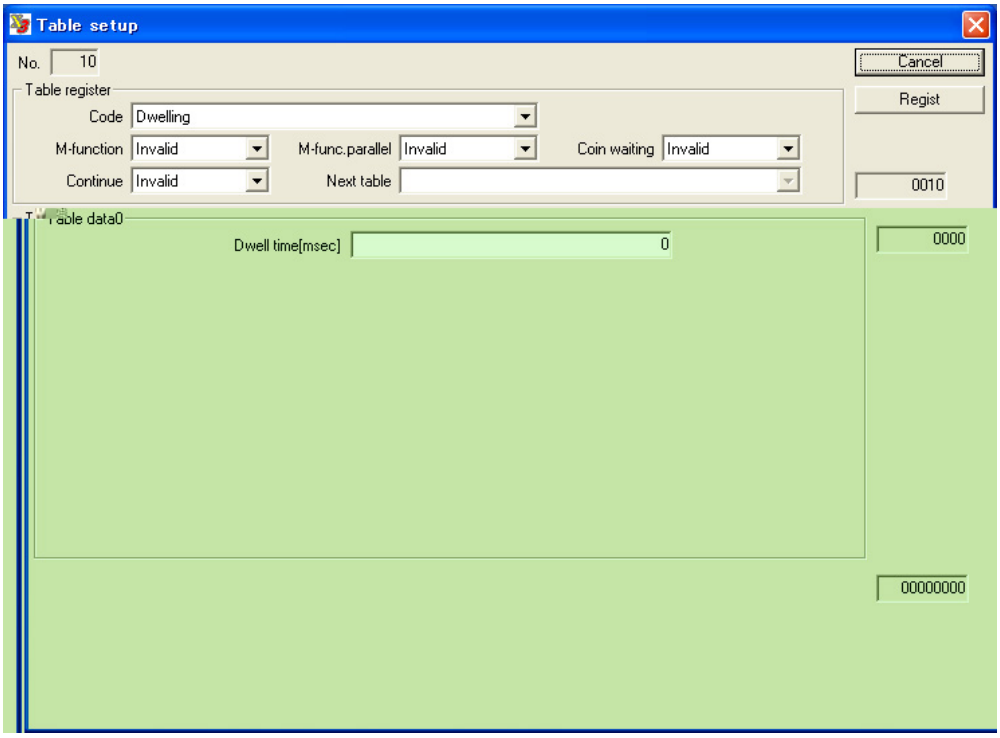
The dwell time provides a means for making the motor wait for a specified amount of time before executing a new command.
The dwell time that can be set is in the range from 0 to 65,535msec and can be entered in increments of 1msec.
Normally, it is used as a pause time when performing a continue after execution operation where two or more tables are concatenated.

(1) How to Set Dwell

Set the data according to the flowchart showing the procedure for creating table data in Section 6.4.1, "Table Data Operation." See the following for how to set operation data and #parameters, corresponding to steps 4 and 6 in the flowchart.

■ Setting Operation Data

STEP 1 Select [Table Data] from the main menu in the utility software.
STEP 2 Double-click the table number you want to specify.
STEP 3 Set the dwell time (wait time) in the Setting window. (The setting unit is msec.)
STEP 4 Select the M function, coin waiting function and continue function as necessary.

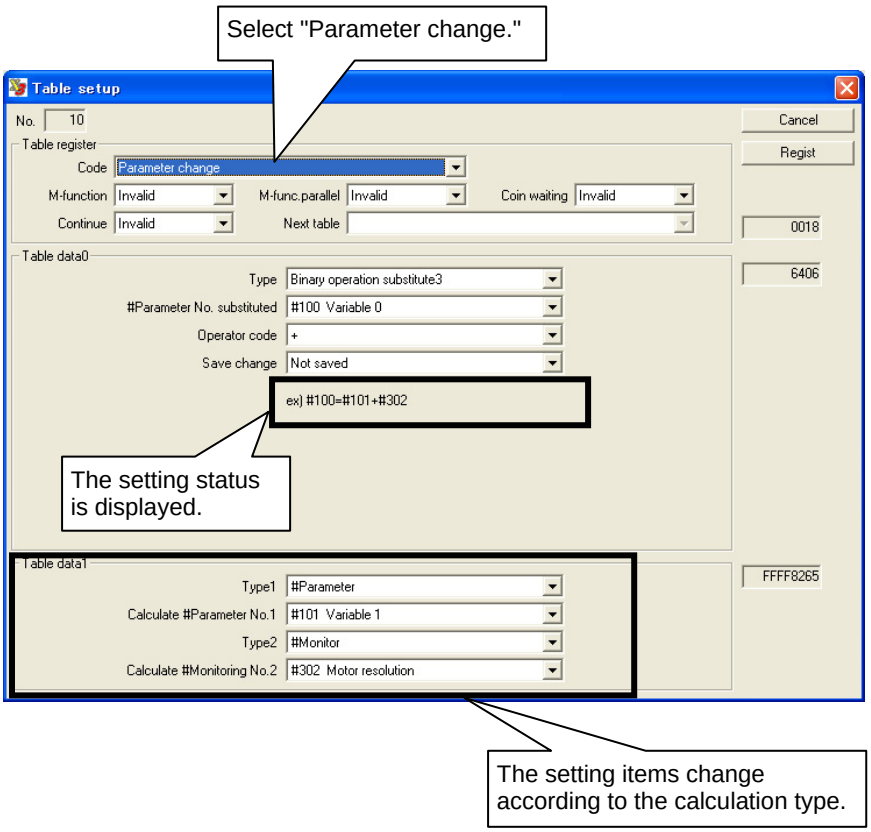


6.4.9 Parameter Change

It is possible to change the values of #parameters during table operation. This function is mainly used to change the feed velocity parameter sequentially and set a #parameter value in one of the variables (#100 to #109), for instance to use it as a counter to count the number of operations during table operation.
See the sample table included in the drive at shipment from the factory for specific ways to use this function (see Appendix "Details of #parameters").

(1) How to Set Parameter Change

This function is set using the utility software. Select [Parameter change] in [Code] in the Table Setting window and specify necessary items. The setting items in [Table data 1] change according to the calculation type selected in [Table data 0].



(2) Common Setting Items

● Type

Specify the calculation type if new values are assigned to #parameters. See the next section for more information.

● Changed #parameter number

Specify the #parameter whose value is to be changed on the left side.

● Operator code

Specify an operator for operation/assignment. The setting is ignored in the case of direct or indirect assignment. The following types of operators are provided.

Operator name	Operator symbol	Type of operation that can be specified
Addition	+	Binary operation
Subtraction	-	Binary operation, unary operation
Multiplication	*	Binary operation
Division	/	Binary operation
Remainder at division	%	Binary operation
Bit AND	&	Binary operation
Bit EXOR	^	Binary operation
Bit OR	|	Binary operation
Bit NOT	~	Unary operation

List of Operators that can be Specified

● Specify registration

Select [Do not regist] if the #parameter whose value should be changed is a normal #parameter stored in RAM. Select [Regist] if it is a #parameter to be registered in the EEPROM. (Select [Do not regist] if the parameter is used temporarily, for instance if it is used as a counter.)

When #parameters are registered, their values are written in the EEPROM. There is a limit on the allowable number of times the EEPROM can be written to (approximately 1 million times).
If this limit is exceeded, the EEPROM may be damaged and the drive may not start up.
If you select "specify registration" for #parameters in the "#parameter change function" during table operation, this limit may be exceeded depending on the pattern used.

(3) Explanation of Each Operation Type

With the parameter change function, it is possible not only to change the values of the specified #parameters to simple values, but also to results of calculation operations.

■ Direct Assignment

The value (signed 32-bit value) specified by operation data 1 is assigned directly to the specified target #parameter. At this point, the setting of operator code is ignored.

Examples: #100 = 123
#100 = -123
##100 = 123

■ Indirect Assignment

The value of the #parameter/#monitor number specified by table data 1 is assigned to the specified target #parameter. The specified #parameter number is a #parameter in RAM. At this point, the setting of operator code is ignored.

Example: #100 = #101

■ Unary Operation Assignment 1

The value (signed 32-bit value) specified by table data 1 is assigned directly to the specified target #parameter after carrying out an operation. Only "subtraction (-)" and "bit NOT (~)" can be specified as the operator. If an operator that cannot be used is specified, the specification is rejected and a "50.5 not executable error" is generated.

Example: #100 = ~123

■ Unary Operation Assignment 2

The value of the #parameter/#monitor number specified by table data 1 is assigned to the specified target #parameter after carrying out an operation. Only "subtraction (-)" and "bit NOT (~)" can be specified as the operator. If an operator that cannot be used is specified, the specification is rejected and a "50.5 not executable error" is generated.

Example: #100 = ~#101

■ Binary Operation Assignment 1

The result of an operation between the direct value (signed 24-bit value) and the value of the #parameter/#monitor number specified by table data 1 is assigned to the specified target #parameter. If an operator that cannot be used is specified, the specification is rejected and a "50.5 not executable error" is generated.

Example: #100 = 123 + #101

■ Binary Operation Assignment 2

The result of an operation between the value of the #parameter/#monitor number and the direct value (signed 24-bit value) specified by table data 1 is assigned to the specified target #parameter. If an operator that cannot be used is specified, the specification is rejected and a "50.5 not executable error" is generated.

Example: #100 = #101 + 123

■ Binary operation substitution 3

The result of an operation between the values of the two #parameter/#monitor numbers specified by table data 1 is assigned to the specified target #parameter. If an operator that cannot be used is specified, the specification is rejected and a "50.5 not executable error" is generated.

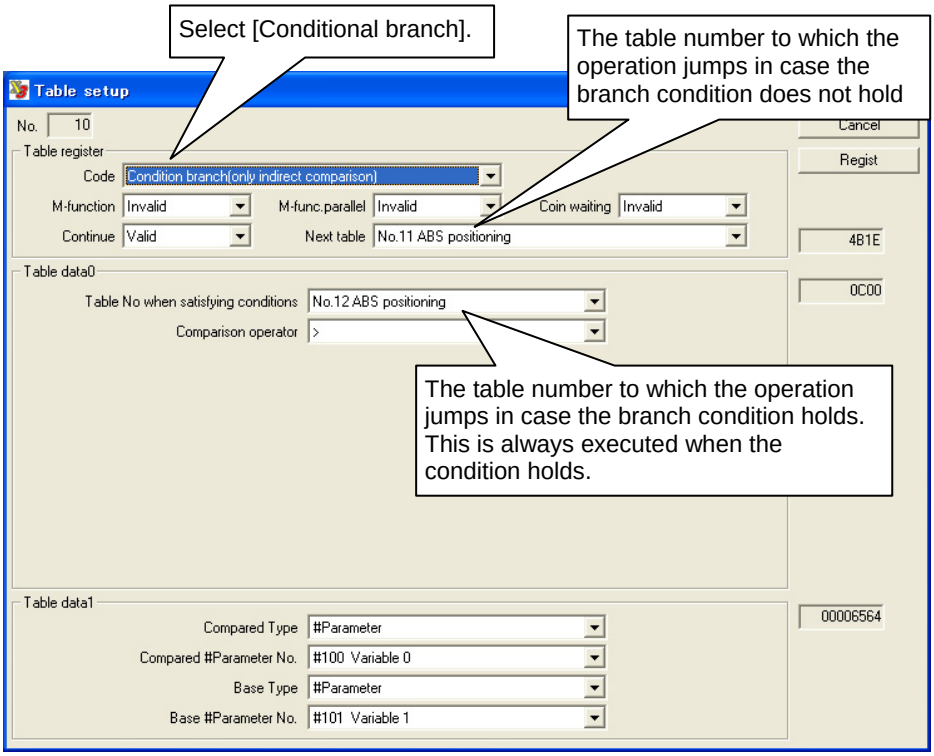
Example: #100 = #101 + #102

6.4.10 Conditional Branch

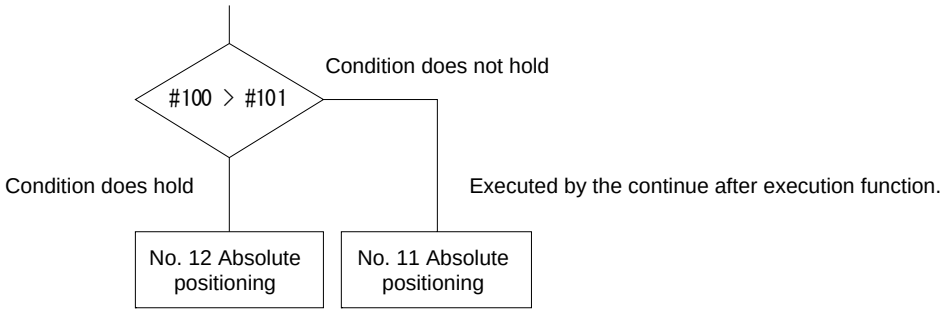
The conditional branch function is used to change the flow of operation according to a given condition. The conditional branch function is thus not an actual function by itself.
It supports only indirect comparison between #parameter/#monitor values. If it is desired to compare a #parameter/monitor value with a fixed value, it is necessary to set the value in question in a variable #parameter.
See the sample table default setting for specific ways to use this function (see Appendix "Details of #parameters").

(1) How to Set Conditional Branch

This function is set using the utility software. Select [Conditional branch] in [Code] in the Table setup window and specify necessary items.



Note: If settings are made as shown in the example above, the operation sequence can be represented using the flowchart below.



(2) Comparison Operator Codes

The table below lists comparison operators that can be specified.

Operator symbol	Name
>	Greater than
<	Smaller than
≥	Greater than or equal to
≤	Smaller than or equal to
=	Equal
≠	Not equal
&&	Logical multiplication
||	Logical addition
&	Bit AND
^	Bit EXOR
|	Bit OR

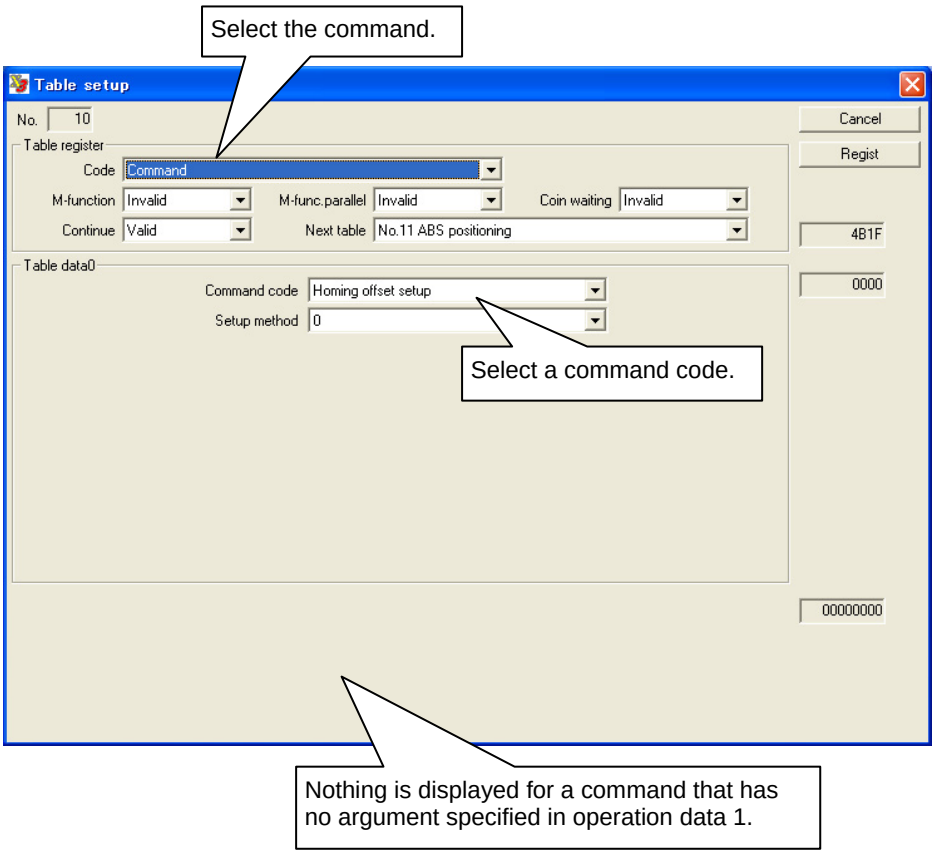
List of Comparison Operators

6.4.11 Command

By using the command function, it is possible to execute some of the @commands that can be issued from the serial interface (see Section 8.4.2, for the explanation about the @commands).

(1) How to Set Command

This function is set using the utility software. Select the command in [Code] in the Table setup window and specify necessary items.



(2) Details of Commands

■ Home Offset Position Setting

The home offset position setup command is used to automatically calculate the value of parameter #56 [homing, amount of home offset movement] in such a way that the current motor position is set as the position after the completion of subsequent homing operations. The value of #56 parameter is, at this point, set to the following value:
#56 = Actual position value in command units + value set in #56
It has the same function as the @10 command.

Use this command after a homing operation is completed with parameter #57 [command unit command value after homing completion] set to 0. If the command is issued when the parameter is other than 0, the setting will not be made correctly. Make sure to execute this command after performing a homing operation.

■ Integral Limiter Self-adjustment

The integral limiter self-adjustment command is used to recalculate and set the values of the velocity integral limiter and position integral limiter set on the side selected by the controller interface (1 or 2).

The following #parameters are re-set according to the logic I/O input status.

IN_VELFREQ_SEL	OFF: #6 [velocity integral limiter value 1]
	ON: #7 [velocity integral limiter value 2]
IN_POSFREQ_SEL	OFF: #12 [position integral limiter value 1]
	ON: #13 [position integral limiter value 2]

#parameters to be re-set must be #parameters in RAM. Save the values of the registered parameters in the EEPROM as necessary.
This command has the same function as the @14 command of the serial interface.

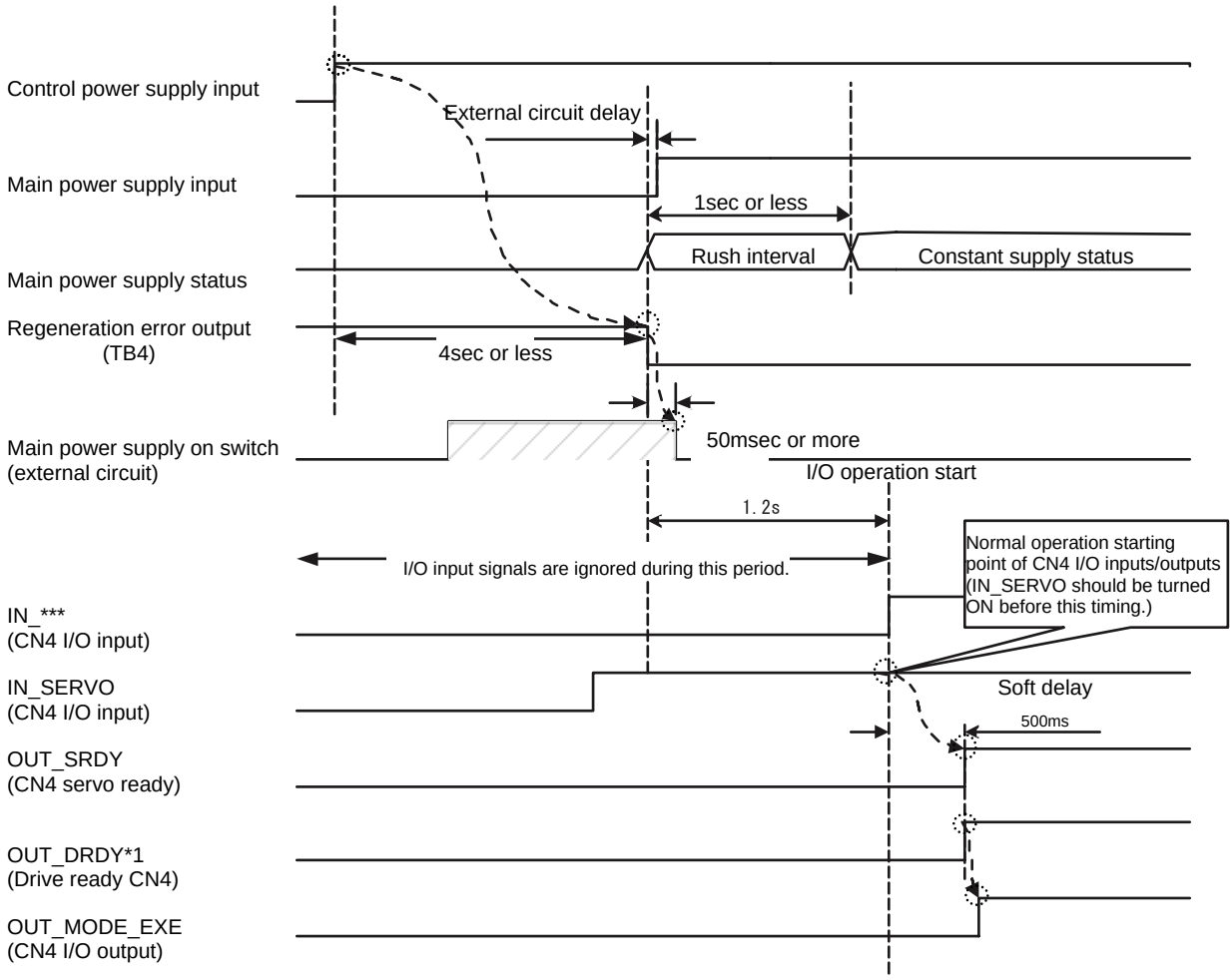
6.4.12 Startup Operation

Startup operation is a function that allows executing table data automatically immediately after turning the power ON. It is necessary to enable the startup operation in the parameter settings in order to use this operation.

(1) How to Set Startup Operation

STEP 1 Select [Parameter] in the utility software.
STEP 2 Select [System setup register 2].
STEP 3 Select [Startup Operation] to [Enable].
STEP 4 Click the [Regist] button.
STEP 5 Create startup table in table data No. 59.

● Sequence of Startup Operation
Use the following timing diagram as a reference for the sequence when the power is turned ON.

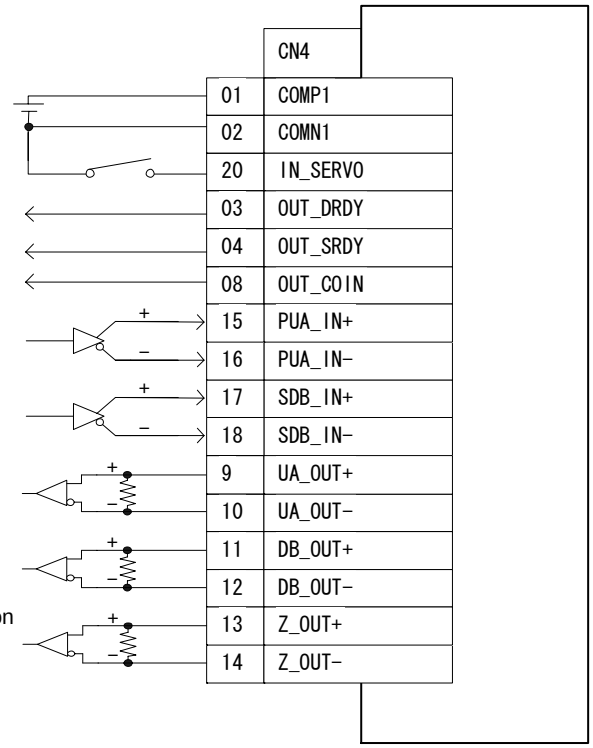


6.5 Control Using the PLC

6.5.1 Position Control Mode

In this mode, the position of the motor is controlled using pulse train command signals.

(1) Example of Wiring



Pulse trains are entered from the host controller to perform positioning movement.

Encoder pulses (feedback pulses) are output.

A Z-pulse output used when performing a homing operation from the host controller.

The DrvGIII employs two types of position command pulse inputs: the differential input specification and the open collector input specification. Check which type your controller uses by checking the product model and suffix code.

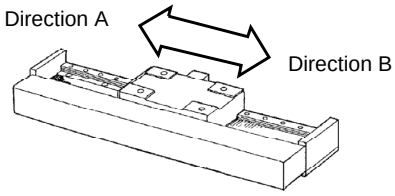
(2) #parameter Setting

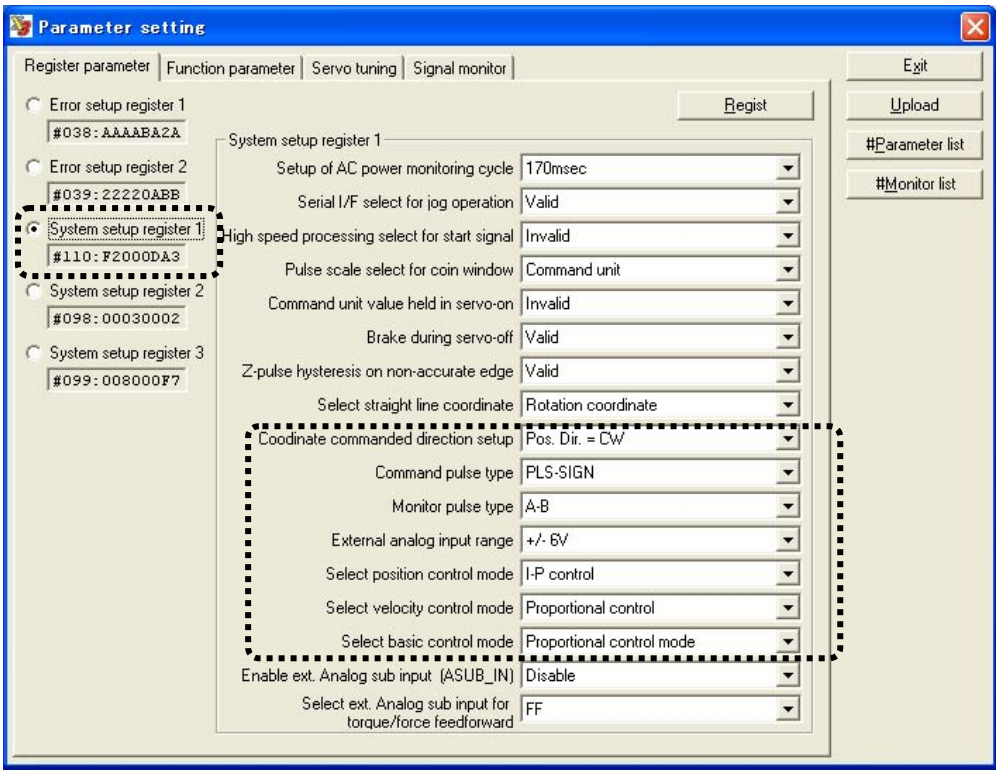
It is necessary to set #parameters for this mode. In this case, set the #parameters for the I-PD control mode (position control: integral-proportional, velocity control: proportional), which is suited for the LINEARSERV.

STEP 1 Select the Register parameter tab from [#parameter] in the utility software.
STEP 2 Select [System setup register 1].
STEP 3 Select [Position control mode] for [Select basic control mode].
STEP 4 Select [Proportional control] for [Velocity control mode].
STEP 5 Select [Integral-proportional control] for [Position control mode].
STEP 6 Check the direction of movement relative to the pulse command in [Coordinate command direction setup].
The settings and the direction of movement have the following relationship.

Coordinate Command Direction Setups and Motor's Direction of Movement

		Motor pulse command	
		+ direction	- direction
Status of coordinate command direction setup	Forward direction	Direction A	Direction B
	Reverse direction	Direction B	Direction A





STEP 7 Select [Command pulse type].
There are three types of command pulses (PLS-SIGN input, UP-DOWN input and A-B input). See the table below for the specification of each command pulse type.

PLS-SIGN Command Type

Signal name	Definition	Wiring	Motor's direction of movement		Precaution
			+ direction	- direction	
PUA_IN+	Position command pulse 1	CN4-15	PLS Minimum High level time: 150 ns min		■ The signals are active High (current is conducted to the drive photo-coupler). ■ PLS should be set to Low when the motor is stopped. ■ There are two types of pulse commands: the differential input specification and the open collector input specification.
PUA_IN-		CN4-16			
SDB_IN+	Position command pulse 2	CN4-17	SIGN 3 μs min 3 μs min		
SDB_IN-		CN4-18			
Maximum command frequency	Differential input specification		2MPPS		
	Open collector input specification		200kPPS		

UP-DOWN Command Type

Signal name	Definition	Wiring	Motor's direction of movement		Precaution
			+ direction	- direction	
PUA_IN+	Position command pulse 1	CN4-15	UP Minimum High level time: 150ns min		■ The signals are active High (current is conducted to the drive photo-coupler). ■ Both UP and DOWN should be set to Low when the motor is stopped. ■ There are two types of pulse commands: the differential input specification and the open collector input specification.
PUA_IN-		CN4-16			
SDB_IN+	Position command pulse 2	CN4-17	DOWN 6 μs min		
SDB_IN-		CN4-18			
Maximum command frequency	Differential input specification		2MPPS		
	Open collector input specification		200kPPS		

A-B Command Type

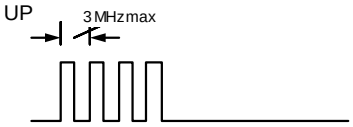
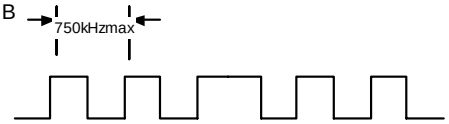
Signal name	Definition	Wiring	Motor's direction of movement		Precaution
			+ direction	- direction	
PUA_IN+	Position command pulse 1	CN4-15	A		■ The signals are active High (current is conducted to the drive photo-coupler). ■ There are two types of pulse commands: the differential input specification and the open collector input specification.
PUA_IN-		CN4-16			
SDB_IN+	Position command pulse 2	CN4-17	B 300 μs min		
SDB_IN-		CN4-18			
Maximum command frequency	Differential input specification		500 kPPS		
	Open collector input specification		200 kPPS		

TIP

Model: □□□□G3-□□□□-□□□-□■□

Types of interfaces
S: Differential input/without velocity, torque and thrust inputs
T: Differential input/with velocity, torque and thrust inputs
U: 5V open collector/input limiting frequency 200 KHz

STEP 8 Select a current position pulse output.
Set this output when you want to output encoder signals to the PLC.
Select [Monitor pulse type].
There are two types of monitor pulses (UP-DOWN input, A-B input).
See the table below for the specification of each monitor pulse type.
The encoder home signal is independent of these settings.

<table>
<tr><td colspan="3">Actual position pulse output type</td><td colspan="2">(UP, DOWN)</td><td colspan="2">(A, B)</td></tr>
<tr><td rowspan="2">Signal name</td><td rowspan="2">Definition</td><td rowspan="2">Wiring</td><td colspan="4">Motor's direction of movement</td></tr>
<tr><td>+ direction</td><td>- direction</td><td>+ direction</td><td>- direction</td></tr>
<tr><td>UA_OUT+</td><td rowspan="2">Actual position pulse 1</td><td>CN4-9</td><td rowspan="2">UP
  </td><td rowspan="2"></td><td rowspan="2">A
  </td><td rowspan="2"></td></tr>
<tr><td>UA_OUT-</td><td>CN4-10</td></tr>
<tr><td>DB_OUT+</td><td rowspan="2">Actual position pulse 2</td><td>CN4-11</td><td rowspan="2">DOWN
  </td><td rowspan="2"></td><td rowspan="2">B
  </td><td rowspan="2"></td></tr>
<tr><td>DB_OUT-</td><td>CN4-12</td></tr>
<tr><td colspan="3">Maximum output frequency</td><td colspan="2">3 Mpps</td><td colspan="2">750 kpps</td></tr>
</table>

(3) Servo Tuning

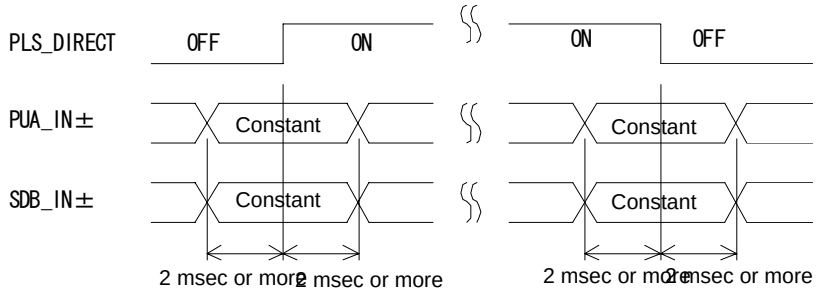
Perform auto-tuning (see Section 6.4.3).
Note: If you cannot adjust the servo properly with auto-tuning, see Chapter 7, "Adjustment."

(4) Operation

To operate the motor using pulse train commands, the following conditions must be satisfied.
OUT_BUSY: OFF
OUT_DRDY: ON
OUT_SRDY: ON

(5) Pulse Scaling Priority

If IN_PLS_DIRECT is turned ON, the amount of motor movement relative to one command pulse from the PLC connected to the controller interface becomes 1 / (motor resolution) regardless of the scale setting.
It is possible to make the amount of motor movement larger even at a low pulse rate using the scale setting. This, however, will make the amount of movement in response to one pulse command from the PLC larger and the motor may not be able to be moved to the desired position. In this case, it is possible to switch to perform positioning with the maximum resolution using the position command weighting function.
Do not change the status of PLS-SIGN, UP-DOWN and A-B for 2msec before and after switching "PLS_DIRECT" (OFF to ON, or ON to OFF).



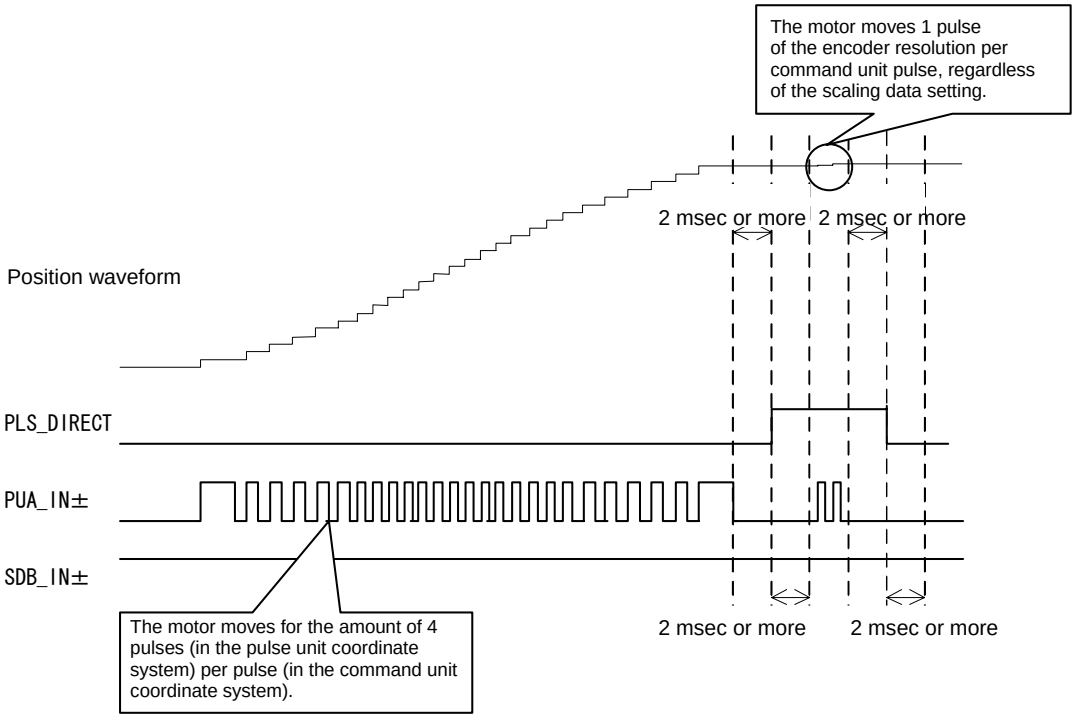
<Example using pulse scaling priority>

#parameter setting

#112 [scaling data (command unit coordinate system)] = 2000000

#113 [scaling data (pulse unit coordinate system)] = 4000000

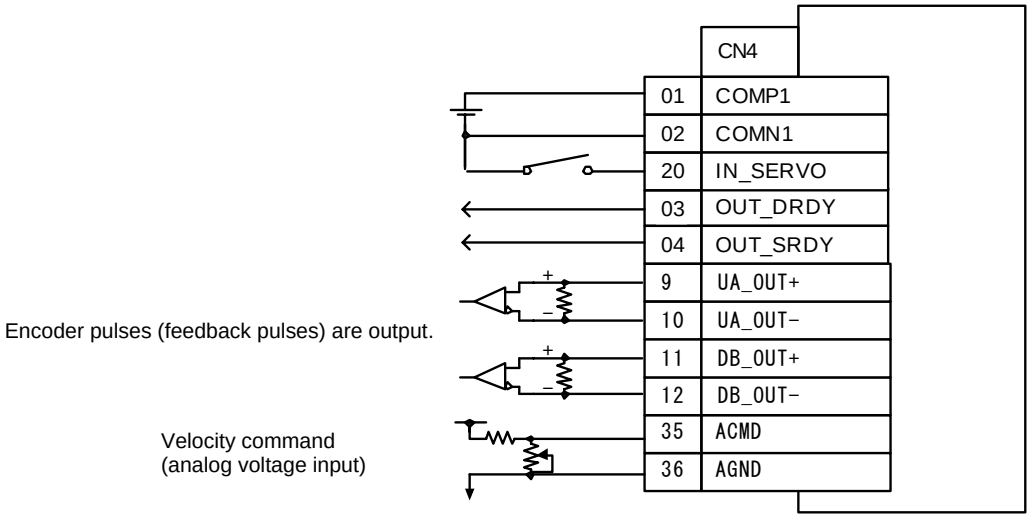
#system setup register 1, command pulse type = PLS-SIGN



6.5.2 Velocity Control Mode

In this mode, the velocity of the motor is controlled using analog voltage command signals. Either ±10V or ±6V can be selected for the command voltage by setting #parameters.

(1) Example of Wiring

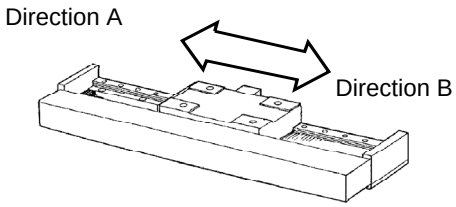


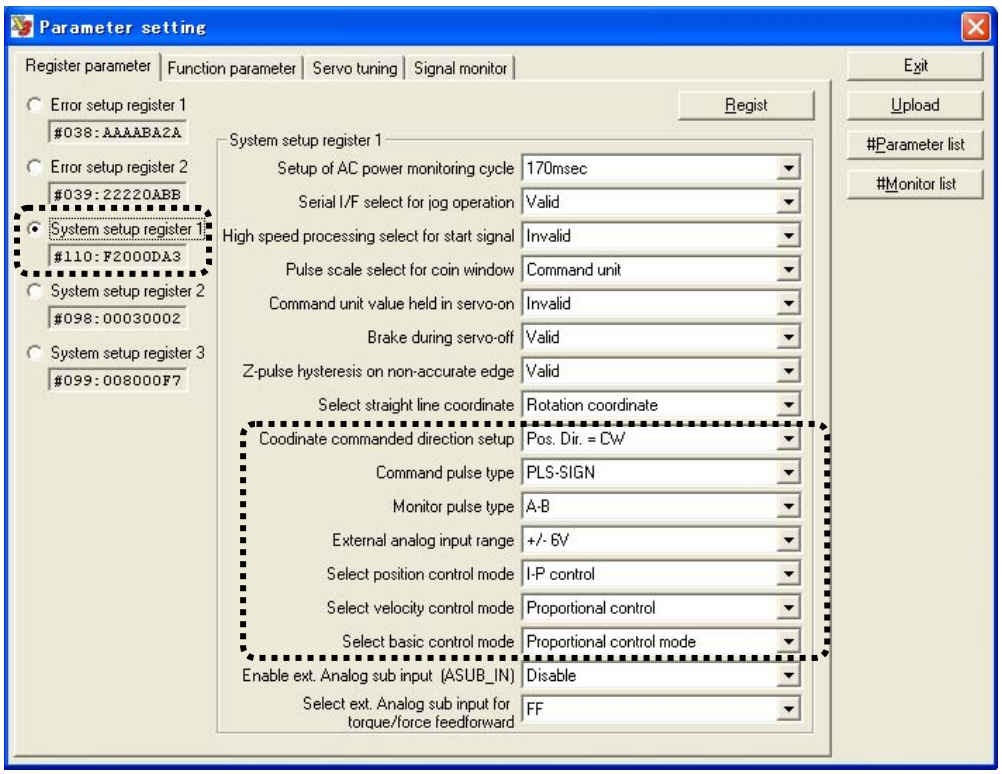
(2) #parameter Setting

STEP 1 Select [#parameter] from [Data Management] in the utility software.
STEP 2 Select [System setup register 1].
STEP 3 Select [Velocity control mode] for [Select basic control mode].
STEP 4 Select a command voltage range in [External analog input range] (select either ±10V or ±6V).
STEP 5 Specify the velocity relative to the command voltage range (6V or 10V) specified in [External command input range] with #121 [external velocity input sensitivity]. (The unit of #121 is set to 1/100% of the rated velocity.)
STEP 6 Select [Proportional-integral control] or [Proportional control] for [Velocity control mode].
STEP 7 Check the direction of movement relative to the input voltage in [Coordinate command direction setup].
STEP 8 The settings and the direction of movement have the following relationship.

Coordinate Command Direction Setups and Motor's Direction of Movement

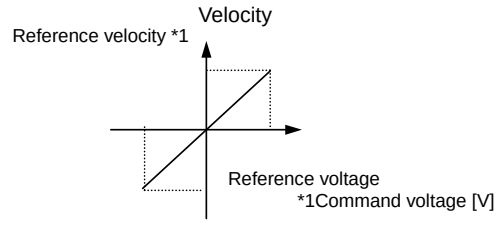
		Command voltage	
		+ direction	- direction
Status of coordinate command direction setup	Forward direction	Direction A	Direction B
	Reverse direction	Direction B	Direction A





* The settings in system setup register 1 are set/registered in #110.

■ **Command Voltages and Velocities**

Signal	Signal name	Wiring	
ACMD_IN+	Analog command input + (velocity command)	CN4-35	 The reference velocity and voltage are obtained by the following formulas. Reference velocity = Rated velocity x #121 [external velocity input sensitivity] x 0.0001 [m/s] Reference voltage = Select either±6V or±10V according to the external command input range of system setup register 1
ACMD_IN-	Analog command input - (analog ground)	CN4-36	

■ **Adjusting External Analog Command Offset**

The motor may rotate slowly even if the analog command voltage is set to 0V. This occurs if there is a voltage offset in the analog command voltage.
Adjust parameter #81 [external analog command offset] so that the offset is removed. This value is added to the value obtained by A/D conversion of the external analog command, and then processed as the velocity command signal sent to the motor.

(3) Servo Tuning

Perform auto-tuning.
Note: If the servo cannot be adjusted properly with auto-tuning, see Chapter 7, "Adjustment."

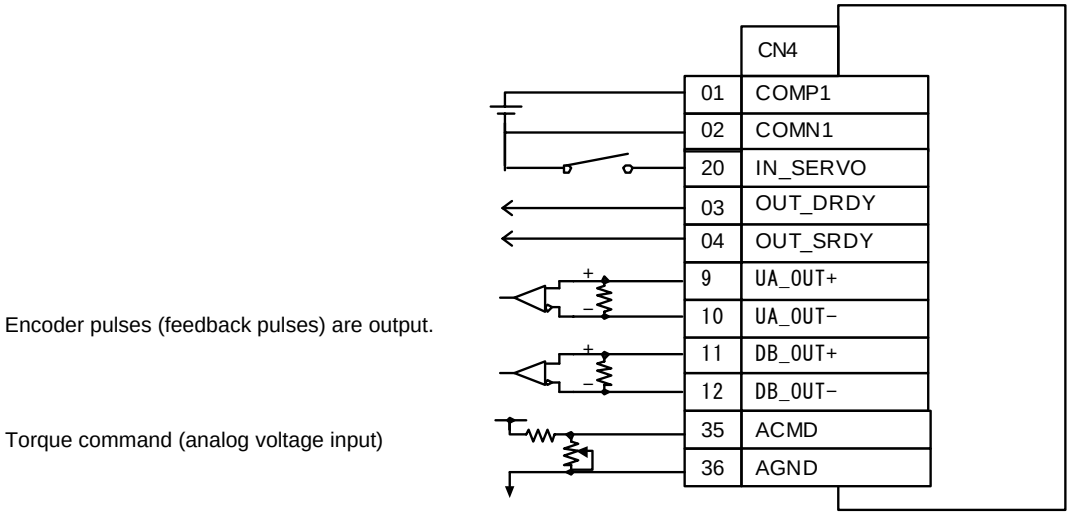
(4) Operation

To operate the motor in the velocity control mode, the following conditions must be satisfied.
OUT_BUSY: OFF
OUT_DRDY: ON
OUT_SRDY: ON

6.5.3 Torque/thrust Control Mode

In this mode, the torque or thrust of the motor is controlled by analog voltage command signals from an external controller. Either ±10V or ±6V can be selected for the command voltage.

(1) Example of Wiring



WARNING

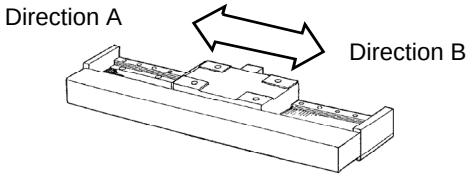
In the torque/thrust control mode, the motor must be properly controlled by the PLC. If it is not controlled, the motor may easily become unstable. Make sure to check its safety when you operate the motor.

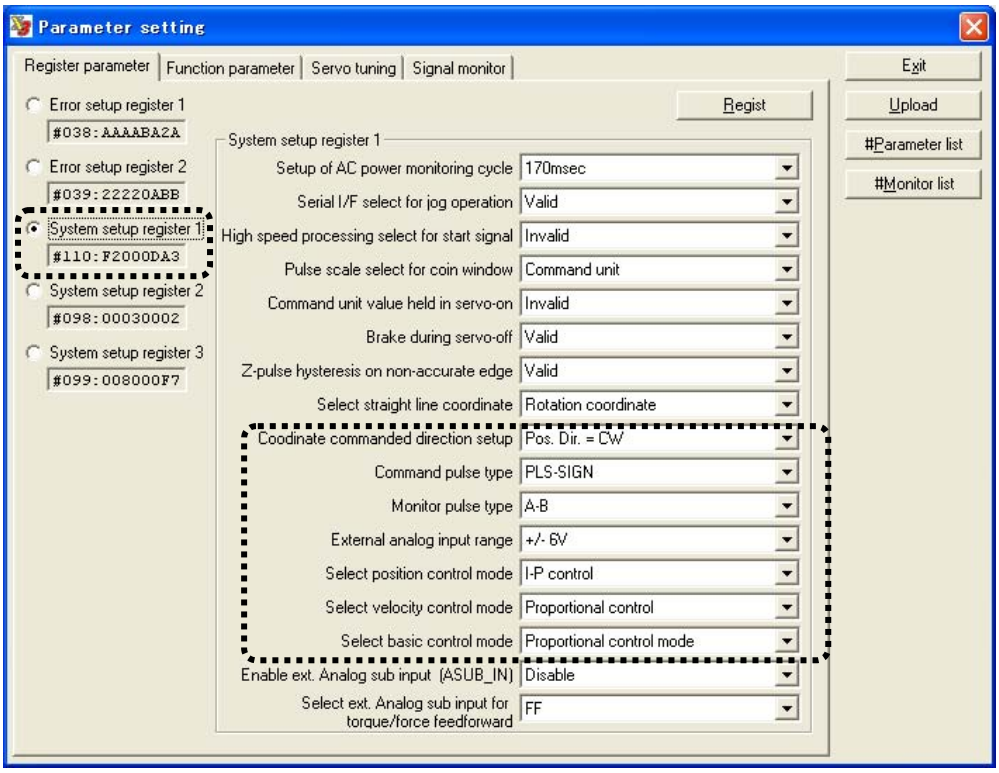
(2) #parameter Setting

STEP 1 Select the [#parameter] from [Data Management] in the utility software.
STEP 2 Select [System setup register 1].
STEP 3 Select [Torque/thrust control mode] in [Select basic control mode].
STEP 4 Select a command voltage range in [External command input range] (select either±10V or±6V).
STEP 5 Specify the thrust relative to the command voltage range (6V or 10V) specified in [External command input range] with #122 [External torque/force input sensitivity]. (The unit of #122 is set to 1/100% of the maximum thrust.)
STEP 6 Check the thrust output direction relative to the input command voltage in [Coordinate command direction setup].
STEP 7 The settings and the thrust output direction have the following relationship.

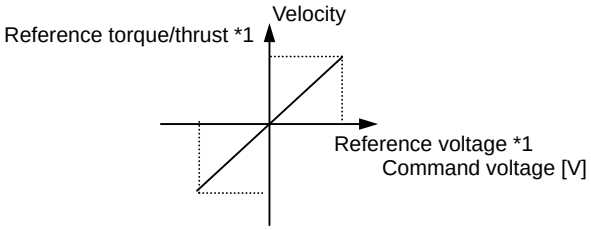
Coordinate Command Direction Setups and Motor's Direction of Movement

		Command voltage	
		+ direction	- direction
Status of coordinate command direction setup	Forward direction	Generate thrust in direction A	Generate thrust in direction B
	Reverse direction	Generate thrust in direction B	Generate thrust in direction A





■ **Command Voltages and Output Thrust**

Signal	Signal name	Wiring	
ACMD_IN+	Analog command input + (torque/thrust command)	CN4-35	
ACMD_IN-	Analog command input - (analog ground)	CN4-36	The reference torque/thrust and voltage are obtained in the following formulas. Reference torque/thrust = Maximum thrust x #122 [External torque/force input sensitivity] x 0.0001 [N] Reference voltage = Select±6V or±10V by the external command input range of system setup register 1

■ **Adjusting External Analog Command Offset**

The motor may rotate slowly even if the analog command voltage is set to 0V. This occurs if there is a voltage offset in the analog command voltage.
Adjust parameter #81 [External analog command offset] so that the offset is eliminated. This value is added to the value obtained via A/D conversion of the external analog command, and then processed as the torque/thrust command signal sent to the motor.

(3) Servo Tuning

Adjust the mechanical resonance filter as necessary.

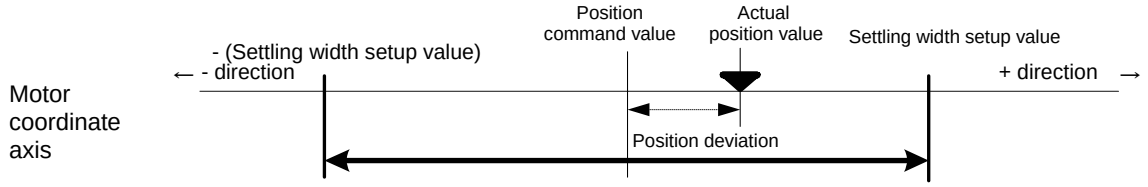
(4) Operation

To operate the motor in the torque/thrust control mode, the following conditions must be satisfied.
OUT_BUSY: OFF
OUT_DRDY: ON
OUT_SRDY: ON

6.6 Position Settling Signal

■ Position Settling Signal (OUT_COIN)

The position settling signal is used for notifying the PLC whether or not the motor is in the proximity of the command position.
This signal is turned ON when (position command value - current position value) is within the settling width set by the parameter (see the figure below). The settling width should be set according to the required accuracy of the device. If the position deviation is small or the settling width is set large, this signal may be turned ON even while the motor is operating. Moreover, chattering may occur when the motor is close to stopping. If chattering occurs, it is possible to set #29 [Cycle count for coin signal activation] so that the settling signal is not turned ON until after the motor position settles.



Area where OUT_COIN is turned ON

When the motor is controlled in the position control mode, the position settling width parameter to be applied varies depending on the status setting of the I/O inputs IN_POSW.0 to IN_POSW.2.
In table data operation, it is possible to select which position settling width parameter to apply for each table data.

TIP

Even when the motor is controlled by a table data operation, the position settling width set for the position control mode becomes valid as soon as the motor is not performing table data operation.

I/O Input States and Selected Coin width Parameters in the Position Control Mode

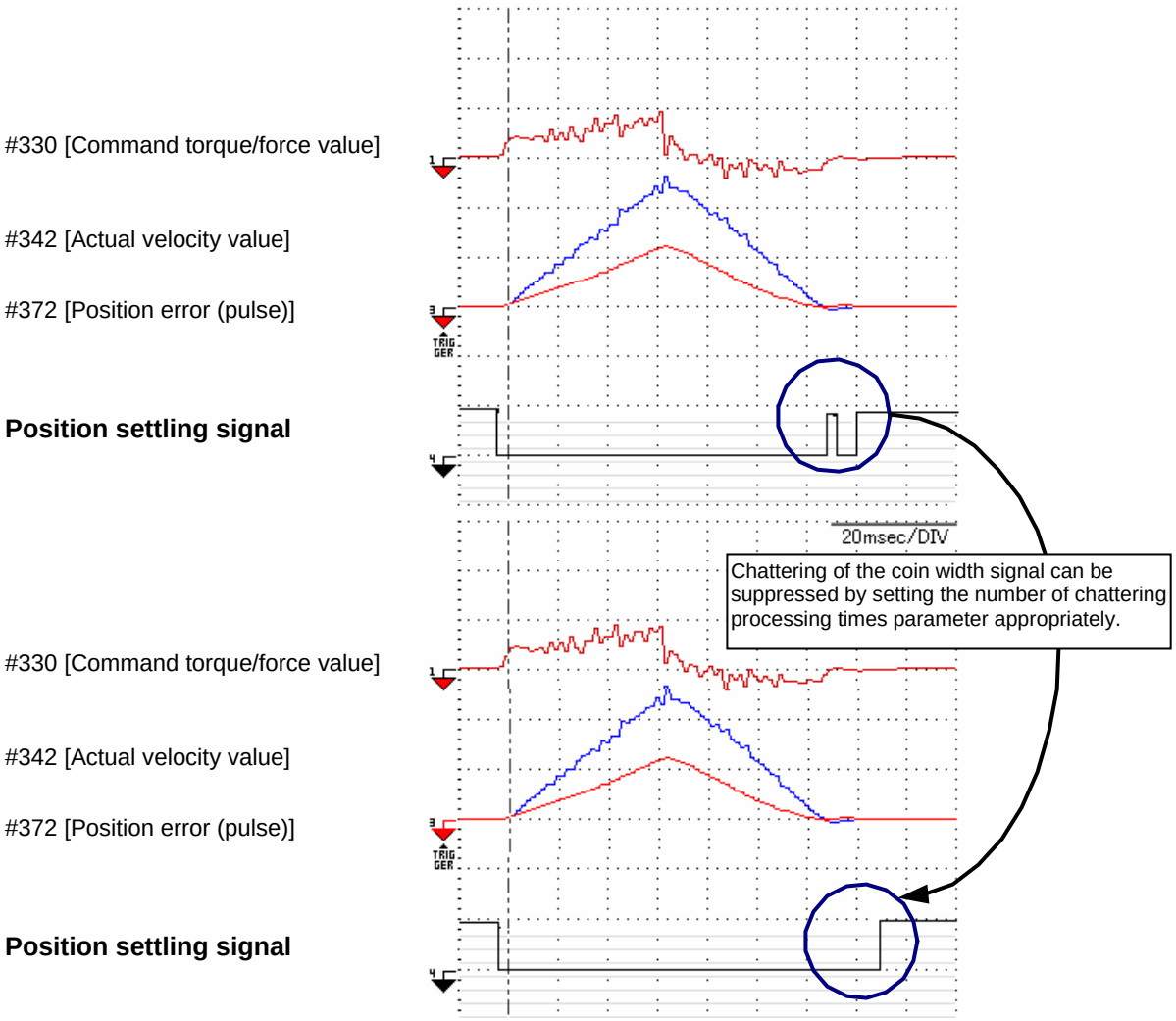
Parameter		Selection of I/O input coin width		
No.	Name	IN_POSW.2	IN_POSW.1	IN_POSW.0
#90	Coin width #0	OFF	OFF	OFF
#91	Coin width #1	OFF	OFF	ON
#92	Coin width #2	OFF	ON	OFF
#93	Coin width #3	OFF	ON	ON
#94	Coin width #4	ON	OFF	OFF
#95	Coin width #5	ON	OFF	ON
#96	Coin width #6	ON	ON	OFF
#97	Coin width #7	ON	ON	ON

TIP

Selection of unit setting
Select whether the unit of the coin width parameters (#90 to #97) is set to pulse unit or command unit in system setup register 1.

■ Cycle Count for Coin Signal Activation

The position settling status signal is turned ON if the condition where the absolute value of the position deviation is equal to the coin width or less continues for the duration specified by the setup value of parameter #29 [Cycle count for coin signal activation]. Set the number of chattering processing times large if chattering occurs in the position settling signal (OUT_COIN) due to overshoot at position settling caused by the conditions of servo tuning, etc. This way, an absolute position settling indication can be obtained. The position settling signal is immediately turned OFF if the absolute value of the position deviation exceeds the coin width.



Parameters Related to the Position Settling Signal

Parameter number	Parameter name	Description
#90 ~ #97	Coin width	The OUT_COIN signal is turned ON when the position deviation is within the setup value range of this parameter. Set this parameter according to the required accuracy of the device. While performing table data operation, the coin width set by the parameter selected at creating table data becomes valid. Under other conditions, the coin width is set by entering a coin width number in IN_POSW.0 to IN_POSW.2 as a binary value. This means that if IN_POSW.0 to IN_POSW.2 are all turned OFF, the setup value of #90 is selected.
#28	Actual position value filter frequency	This parameter is valid only when the current position value filter is set to valid in system setup register 2. The current position value is filtered by a linear low-pass filter. This parameter is used for the purpose of preventing chattering of the COIN signal. Using the filter does not cause any changes to the motor operation, but may cause the output of the OUT_COIN signal to be delayed.
#29	Cycle count for coin signal activation	This parameter is used to prevent chattering of the OUT_COIN signal. The position settling status signal is turned ON if the position deviation is in the range set by the coin width for duration of (setup value of #29) x 1 [msec].
#110 bit17	System setup register 1, settling width unit pulse selection	This parameter selects the unit of the settling width set by the parameter. 0: Command unit, 1: Pulse unit

Monitors Related to the Position Settling Signal

Parameter number	Parameter name	Description
#372	Position error (pulse)	This monitor monitors the amount of position deviation. The pulse position deviation is the value obtained by subtracting the current pulse position value from the pulse position command value.

Inputs/Outputs Related to the Position Settling Signal

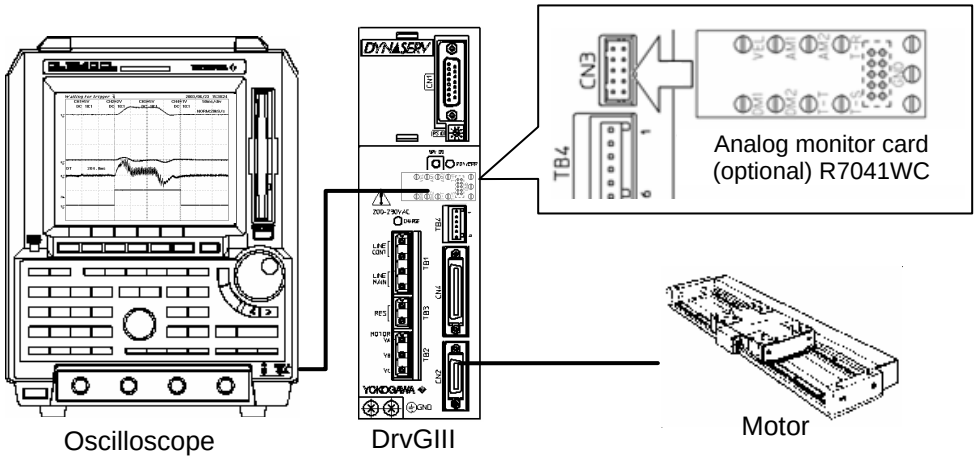
Name	Logic I/O	Hard I/O	Monitor (*2)	Description
Position settling status output (OUT_COIN)	Block2 Bit6	CN4-8	#320 status register 1, bit 16	This output is turned ON when the position deviation is within the setup range. It is turned ON as far as the position deviation is in the setup range, even if the motor is still operating.
Positioning status output (OUT_POS)	Block2 Bit5	(*1)	#320 status register 1, bit 17	This output can only be used when the control mode is set to the position control mode. Positioning control refers to a status where no acceleration/deceleration command is issued to move the motor.
Busy signal (OUT_BUSY)	Block1 Bit6	CN4-5	---	This signal turns ON during table data operation and jog movement. If the position coin waiting function is set to "enable" in table data, the OUT_BUSY signal turns OFF after the position of the motor settles.
Operating (OUT_MODE_EXE)	Block2 Bit0	(*1)	#320 status register 1, bit 12	This signal turns ON during table data operation (when an operation started with IN_START is being executed). If the position coin waiting function is set to "valid" in table data, the OUT_MODE_EXE signal turns OFF after the position of the motor settles.
Axis operating OUT_AXIS_EXE	Block0 Bit3	(*1)	#320 status register 1, bit 10	This signal turns ON while the motor is operating. Note that it does not function in the velocity control mode and the torque/thrust control mode. If the position coin waiting function is set to "valid" in table data, the OUT_AXIS_EXE signal turns OFF after the position settles.

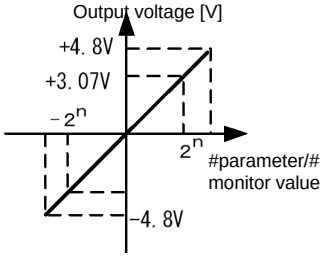
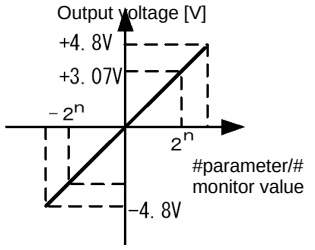
*1: These signals are not assigned to hard I/O at shipment from the factory.
*2: The status can also be checked with the Axis Signal Monitor, Parameter Monitor and Oscilloscope functions of the utility software.

6.7 Signal Monitor Function

*The R7041WC analog monitor card (optional) is required to use the signal monitor function.

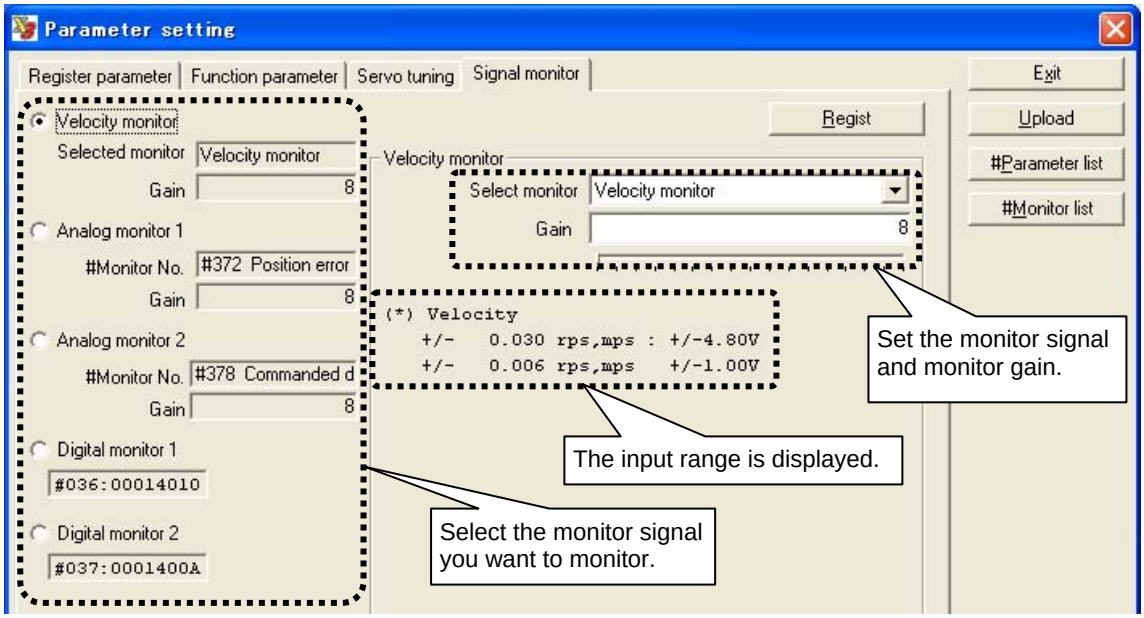
By using the analog monitor card, it is possible to observe velocity and monitor waveforms generated inside the drive using an oscilloscope.



Signal	Signal name	Wiring	Output signal level	Remarks
VEL	Velocity monitor	CN3-1		■ This signal outputs the velocity waveform as an analog voltage signal. It is also possible to output an AC-coupled waveform. The output range can be adjusted using the utility software. Gain setup range ±3.07V VS ±2 raised to the nth power (8 ≤ n ≤ 24) Maximum output: 4.8V
AM1	Analog monitor 1	CN3-2		■ These signals output selected #parameter/#monitor values (#0 to #427) as analog voltage signals. The output range can be adjusted using the utility software. Gain setup range ±3.07V VS ±2 raised to the nth power (8 ≤ n ≤24) Maximum output: 4.8V
AM2	Analog monitor 2	CN3-3		
DM1	Digital monitor 1	CN3-4	Output voltage If the value is 1: Approx. 5V If the value is 0: Approx. 0V	■ These signals select #parameter/#monitor values (#0 to #427) and bit numbers, and output as digital voltage signals.
DM2	Digital monitor 2	CN3-5		
GND	Ground	CN3-10	---	■ This is a common ground pin for signal monitoring.

(1) Parameter Setting

STEP 1 Select the [#parameter] from [Data Management] in the utility software.
STEP 2 Select the Signal Monitor Terminal tab and select a terminal whose setting you want to change.
STEP 3 Select a monitor signal.
STEP 4 Adjust the monitor gain (except for digital monitor signals).
* At this point, the output range relative to the gain setting is displayed.
STEP 5 Click the [Regist] button.



<Example of output waveform>

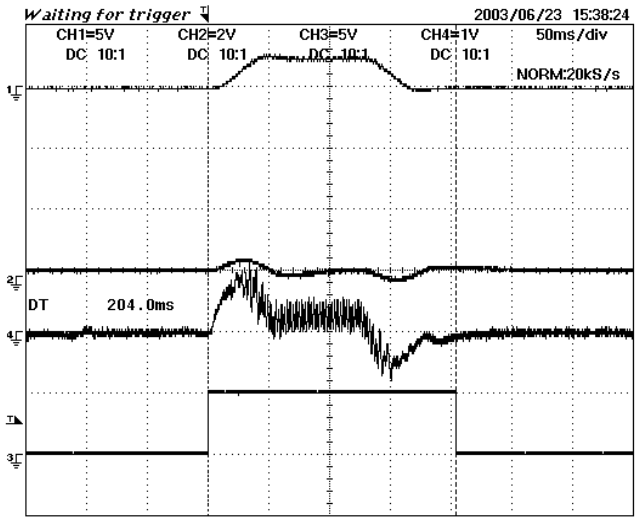
Output waveform at positioning operation

VEL speed waveform

AM1 #372 [Position error (pulse)] waveform

AM2 #325 [Command current value] waveform

DM1 #320 [Status register #3, bit 12 operation being executed] waveform

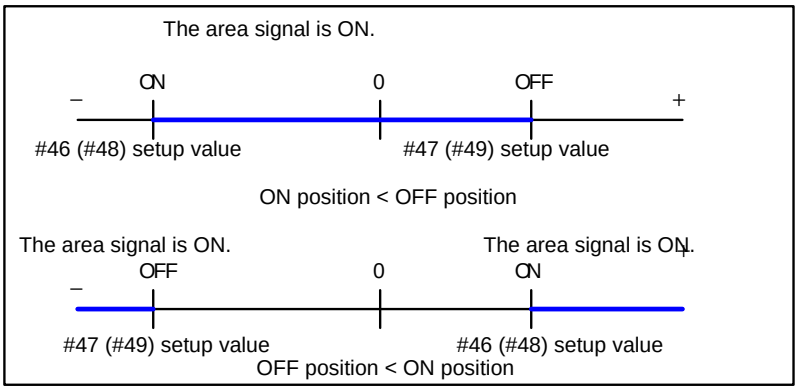


#parameters Related to the Signal Monitor Function

Parameter number	Parameter name	Description
#30	Velocity monitor select	This parameter switches between different types of velocity monitor output. 0: Velocity monitor 1: Velocity monitor AC (waveform from which frequency components of 1Hz or less are eliminated)
#31	Velocity monitor gain	This parameter sets the monitor gain in the velocity monitor. If the setup value is n, the gain is ±3.07V VS 2 raised to the nth power. The maximum output voltage is ±4.8V.
#32	Analog monitor select #1	This monitor selects what should be output to analog monitor 1. Set the #parameter/#monitor number you want to observe.
#33	Analog monitor gain #1	This parameter sets the monitor gain in analog monitor 1. If the setup value is n, the gain is ±3.07V VS 2 raised to the nth power. The maximum output voltage is ±4.8V.
#34	Analog monitor select #2	This monitor selects what should be output to analog monitor 2. Set the #parameter/#monitor number you want to observe.
#35	Analog monitor gain #2	This parameter sets the monitor gain in analog monitor 2. If the setup value is n, the gain is ±3.07V VS 2 raised to the nth power. The maximum output voltage is ±4.8V.
#36	Digital monitor 1select #1	This monitor selects what should be output to digital monitor 1. Set the #parameter/#monitor number and bit number you want to observe.
#37	Digital monitor select #2	This monitor selects what should be output to digital monitor 2. Set the #parameter/#monitor number and bit number you want to observe.

6.8 Area Signal

Two area signal channels are provided. When a position range is specified by certain parameter values in advance, these signals indicate whether or not the motor position is within the indicated range. The status is output to the OUT_AREA_0 and OUT_AREA_1 signals of the controller interface and parameter #321 [Status register 2 (bits 26 and 27)] of the utility software.
The area signal range is set by specifying the coordinate value at which the signal is turned ON in parameters #46 [Area signal 0 ON] and #48 [Area signal 1 ON] in command units, and specifying the coordinate value at which the signal is turned OFF in parameters #47 [Area signal 0 OFF] and #49 [Area signal 1 OFF] in command units. The figure below shows how the signal output in response to motor position #376 [Actual position value in command units] changes depending on whether the coordinate value to be turned on is greater than the coordinate value to be turned off.



■ Parameter Setting

STEP 1 Select [Terminal] from [Control].
STEP 2 Set the parameters for the area signal range in the Terminal window.

■ Hard I/O Assignment Setting

STEP 1 Select [I/O] from [Data Management] in the utility software.
STEP 2 Assign area signal 0 or area signal 1 in the hard I/O contact output assignment window.

6.9 Torque/thrust Control Function

Select this function when you want to restrict the output torque. The torque can be restricted by using a parameter (#59 [Torque/Force limit percentage]) or by applying an analog voltage to the analog auxiliary input of the controller interface.
The actual limit value is the lower of the limit value set by parameters or the limit value set by the analog auxiliary inputs.

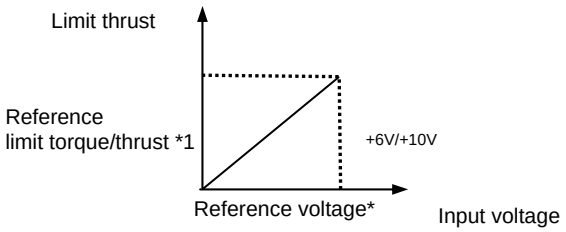
■ How to Restrict Torque by Parameter #59 [Torque/Force Limit Percentage]

STEP 1 Select the [Terminal] from [Control].
STEP 2 Set the limit value in the text box of the Terminal window.
The setting unit is [1/100%]. 100% allows the maximum output torque.

■ How to Restrict Torque/thrust by Analog Voltage

In order to restrict the torque/thrust by analog voltage input, set system setup register 1 so that the external analog auxiliary signal input is used and select the torque/thrust control function.

STEP 1 Select the [#parameter] from [Data Management] in the utility software.
STEP 2 In [System setup register 1], set [Use external analog auxiliary signal input] to [Use]. (It is set to "Not used" at shipment from the factory.)
STEP 3 In [System setup register 1], set [External analog auxiliary input torque/thrust FF selection] to [Torque/thrust control].
STEP 4 Click the [Regist] button.
STEP 5 Referring to the table below, input the torque limit signal via the analog auxiliary input.
* The torque limit functions in real time.

<table>
<tr><th>Signal</th><th>Signal name</th><th>Wiring</th><th></th></tr>
<tr><td>ASUB_IN+</td><td>Analog auxiliary input + (torque/thrust control)</td><td>CN4-33</td><td rowspan="2"> 

*
The reference limit torque/thrust and voltage are obtained by the following formulas.
Reference limit torque/thrust =
Maximum thrust x #122 [External torque/force input sensitivity] x 0.0001 [N]
Reference voltage = Select ±6V or ±10V according to the external command input range of system setup register 1</td></tr>
<tr><td>ASUB_IN-</td><td>Analog auxiliary input + (analog ground)</td><td>CN4-34</td></tr>
</table>

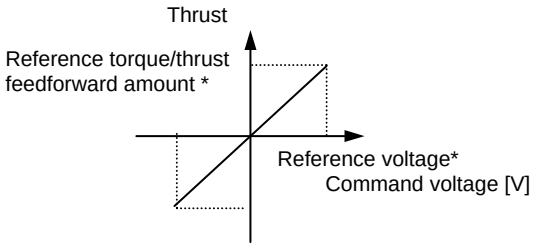
6.10 Torque/thrust Feedforward Function

In the velocity control mode, torque/thrust feedforward is not generated inside the drive. It is, however, possible to input a torque/thrust feedforward input signal as an analog voltage via the controller interface. This function is only valid in the velocity control mode.

■ Parameter Setting

Set system setup register 1 so that the external analog auxiliary signal input is used, and select the torque/thrust feedforward function.

STEP 1 Select the [#parameter] from [Data Management] in the utility software.
STEP 2 Open [System setup register 1].
STEP 3 Set [Use external analog auxiliary input (A_SUB_IN)] to [Use].
STEP 4 Set [External analog auxiliary input torque/thrust feedforward selection] to [Torque/thrust feedforward]. ([Torque/thrust control] is set at shipment from the factory.)
STEP 5 Select either [±6V] or [±10V] in [External analog input (ACMD_IN, ASUB_IN) range].
STEP 6 Register the parameters.
STEP 7 Referring to the table below, input the torque/thrust feedforward signal via the analog auxiliary input.

Signal	Signal name	Wiring	
ASUB_IN+	Analog auxiliary input + (torque/thrust feed forward amount)	CN4-33	 * The reference torque/thrust feedforward amount and voltage are obtained by the following formulas. Maximum thrust x #122 [External torque/force input sensitivity] x 0.0001 [N] Reference voltage = Select ±6V or ±10V according to the external command input range of system setup register 1
ASUB_IN-	Analog auxiliary input + (analog ground)	CN4-34	

6.11 Homing Using the PLC

The PLC performs homing using the Z-pulse output from the controller interface. When homing is executed by the PLC, it is not necessary to connect the home sensor to the drive.

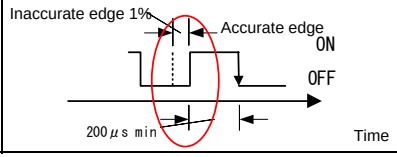
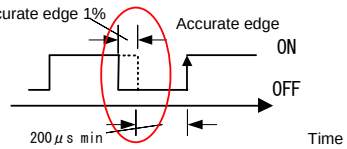
■ Z-pulse Generation Method and Pulse Interval

The Z-pulse is output several times while the motor performs one reciprocal movement.
The pulse interval varies with the drive model (see table below).
The pulse is generated by calculating the position detection signal with the drive. The period in which the Z-pulse is turned ON is 200 μsec or longer.
The Z-pulse has an accurate edge and an inaccurate edge (see the Z-pulse output timing). Be sure to set the accurate edge to the home position.

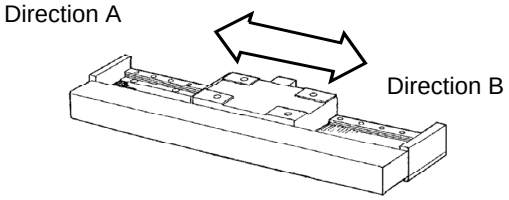
Drive resolution	Z-pulse interval	Z-pulse ON duty
0.05 [μm]	40960	4096 ~ 16384
0.05 [μm]	8192	819 ~ 3276
0.5 [μm]	8192	819 ~ 3276

■ Z-pulse Output Timing

The Z-pulse is output as shown in the figure below.
Set the accurate edge to the home position. The position of the accurate edge varies with the direction of movement.

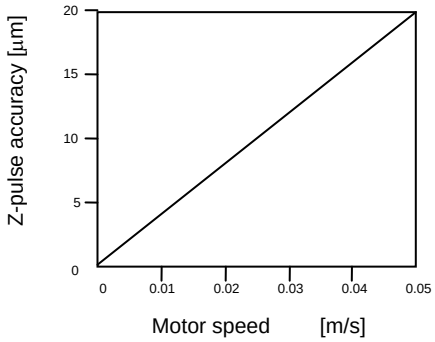
	Direction A	Direction B
Z_OUT±		

The hysteresis is 1% of the Z-pulse interval.



■ Velocity Dependent Accuracy of the Z-pulse

The accuracy of the Z-pulse depends on the motor velocity. Its characteristics are shown below.

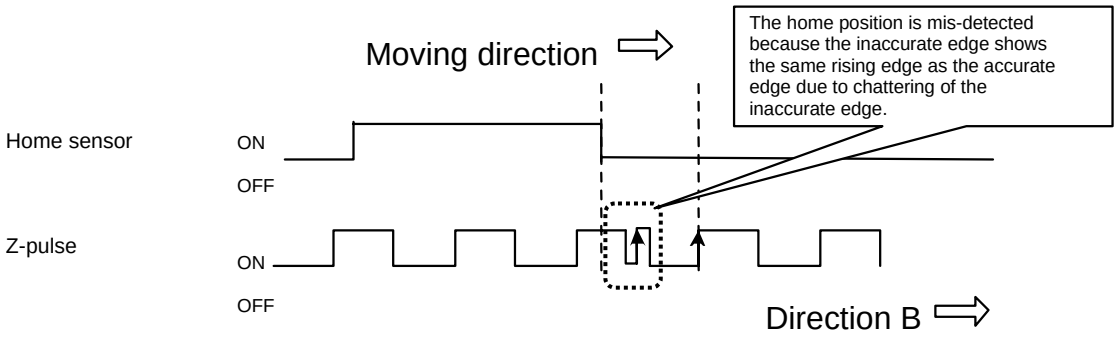


■ Adjustment of Home Dog Position

● Chattering of the Z-pulse

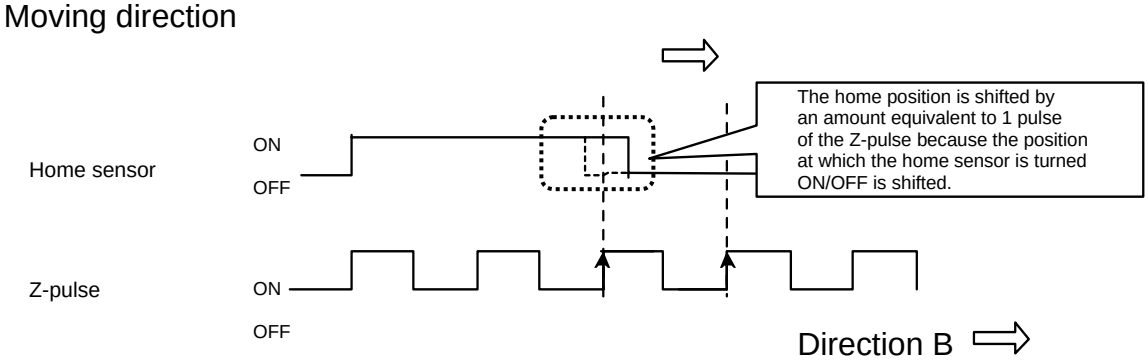
The Z-pulse may be subject to chattering when the motor moves at a low velocity. The motor may mis-detect the home position due to this chattering at the inaccurate edge. Therefore, it is advisable to detect the accurate edge without going through the position of the inaccurate edge at homing.

Example: When the homing direction is B (accurate edge: rising edge).



● Detection Accuracy of Home Sensor Output

If the home sensor is turned ON/OFF near the accurate edge, the home position may be shifted by an amount equivalent to 1 pulse of the Z-pulse due to the accuracy of the sensor.

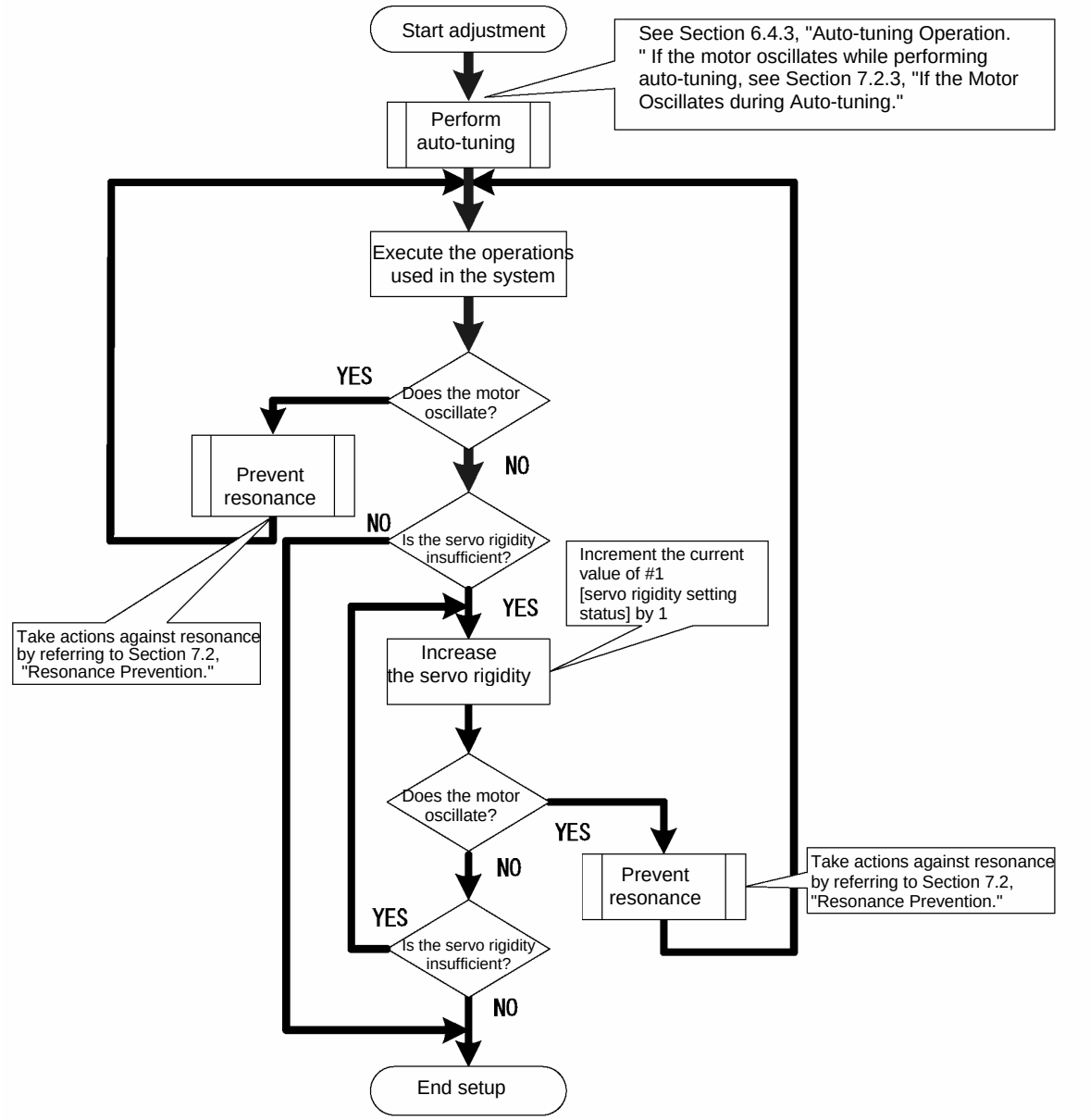


7. Tuning

7.1 How to Tune the Servo

■ Adjustment of #parameters Related to Control

When you tune the servo, set #parameters related to the position and velocity control loops in good balance to prevent oscillation, vibration and runaway. Typically, the servo can be adjusted by performing auto-tuning, which estimates load inertia, and automatically adjust #parameters related to control.
The flowchart below shows an example of how the servo can be adjusted.
If the motor oscillates while adjusting the servo, take actions by referring to "Main Causes of Motor Oscillation and Actions to be Taken" on the next page.



CAUTION

If the setting of the control system is inappropriate, the motor may begin to oscillate or even become unstable in some cases. Take enough precautions with respect to the motor's operation range and its safety when you tune the servo.

Main Causes of Motor Oscillation and Actions to be Taken

	Type of vibration	Phenomenon at oscillation	Cause of oscillation and action to be taken
Low-frequency oscillation	Hunting	■ Vibration frequency: up to several Hz ■ Operation angle: several degrees to several tens of degrees (run out of control in some cases)	■ Cause of Oscillation Oscillation occurs when the ratio between the position control frequency bandwidth and the velocity control frequency bandwidth is inappropriate The motor may oscillate if the velocity control bandwidth is less than 3 times the position control bandwidth. Oscillation may also occur if the inertia moment value estimated by auto-tuning is not appropriate or if there are large load fluctuations (1.5 times or more). ■ Action to be Taken • Repeat auto-tuning several times and check the inertia value afterward. Check that the accuracy of the inertia value estimated by auto-tuning is 20% or less in repeated auto-tuning operations. • Lower the setup value of #0 [servo stiffness setup].
	Windup		■ Cause of Oscillation The motor may oscillate if the value of the position integral limiter is too large; the position deviation becomes too large and the control system becomes unstable. ■ Action to be Taken Adjust the "integral limiter value."
High-frequency oscillation	Phase shift oscillation	■ Vibration frequency: several tens of Hz to 200Hz ■ Operation angle: up to several degrees	■ Cause of Oscillation • If the frequency at which the phase of the velocity output signal lags 180° behind the phase of the velocity input signal (180° phase shift) is denoted fr, the motor oscillates with a frequency of fr when fr < fv. • Oscillation may occur if various filters use the same frequency or the velocity control bandwidth and the filter frequency bandwidth are the same. ■ Action to be Taken Lower the setup value of #1 [servo stiffness setup].
	Resonance	■ Vibration frequency: several tens of Hz to 2kHz ■ Operation angle: up to a few degrees	■ Cause of Oscillation • The motor may oscillate if disturbance from the mechanical resonance of the load enters into the velocity control loop. In many cases, there are several resonance frequencies. ■ Action to be Taken • Set the mechanical rigidity of the device higher (see Section 7.2.1, "Prevention of Mechanical Resonance"). • Dampen the gain at the resonance point by filtering (see Section 7.2.2, "Filters").

7.2 Resonance Prevention

7.2.1 Prevention of Mechanical Resonance

The LINEARSERV drives the load directly without using reduction gears. Mechanical resonance characteristics of the load and the mounting surface may cause disturbances to the velocity control loop, causing the velocity control system to resonate.

In general, resonance phenomena can be prevented by the following three countermeasures.

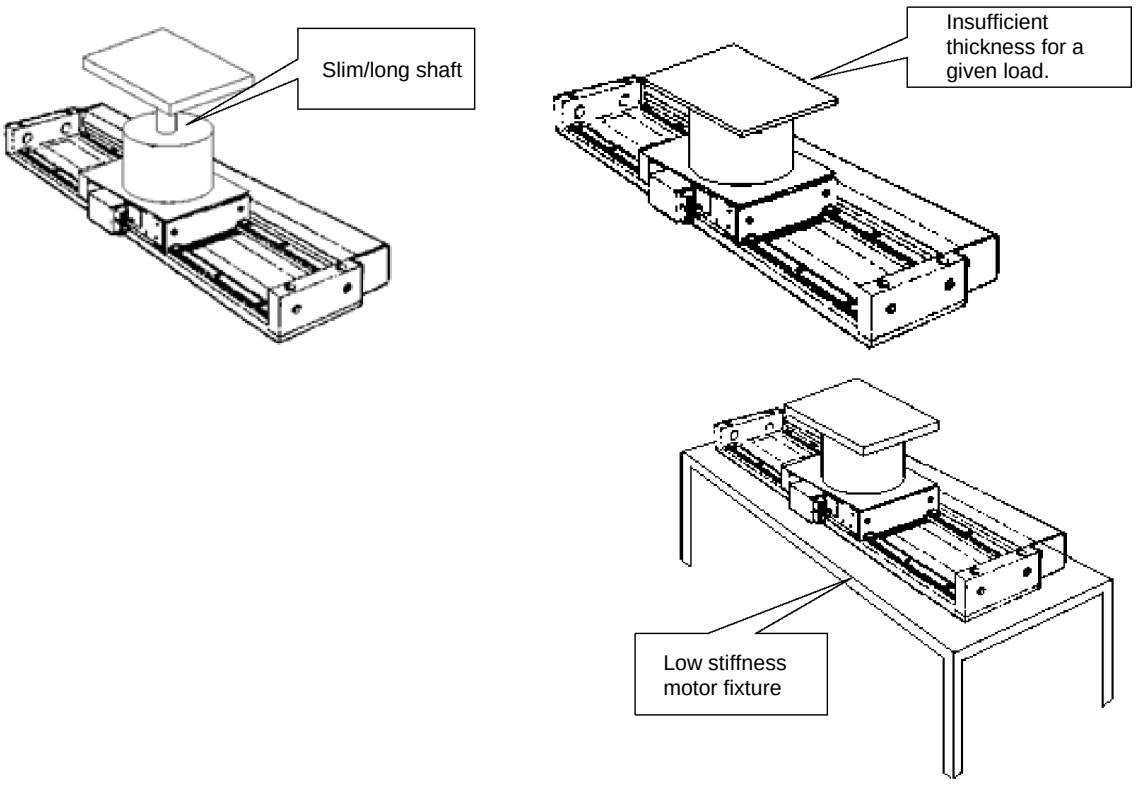
(1) Increase the rigidity of the mechanical system and the resonance frequency and decrease the peak gain value at the resonance points.
(2) Lower the servo rigidity (position control bandwidth and velocity control bandwidth).
(3) Insert a filter (first-order lag compensator, notch filter, velocity feedback filter) and lower the peak gain value of the resonance.

Each countermeasure has the following effects.

(1) If the rigidity of the mechanical system is increased, the servo rigidity becomes higher and the control system stabilizes.
(2) If the servo rigidity is lowered, the resonance is improved, but the response becomes slower. Settling takes longer in the case of the position control mode.
(3) If a filter is inserted, the servo rigidity can be set high with countermeasure (2) and the response is likely to be improved. However, the usage of the filter causes an extra phase shift, and the control system may become unstable. Use this countermeasure with care.

Increase the mechanical rigidity as much as possible first, and then perform the countermeasures involving the servo rigidity and filter.

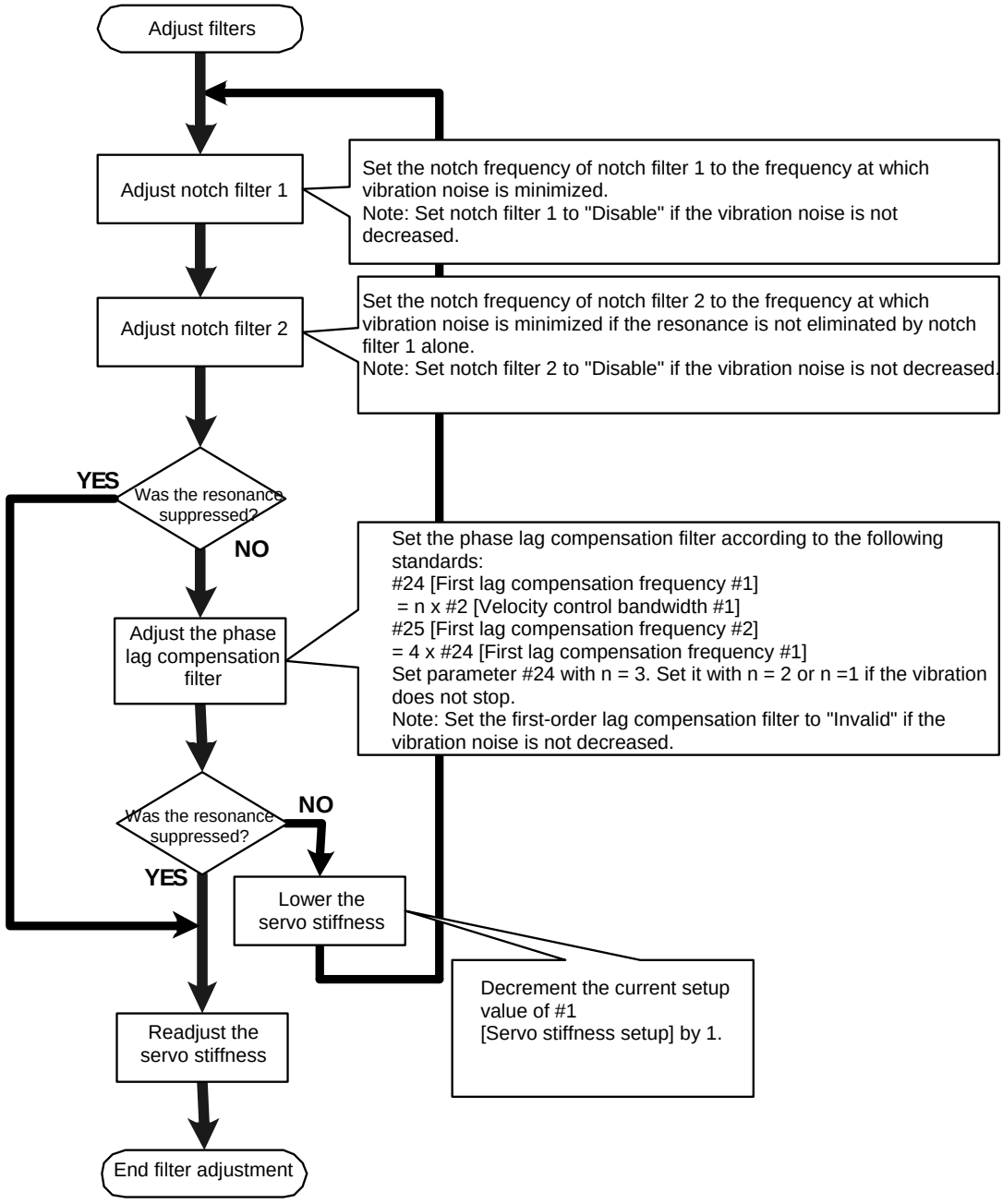
Example of structure with low mechanical rigidity



7.2.2 Filters

(1) Procedure for Tuning Filters

Set filters using the flowchart below as reference.



CAUTION

If the setting of the control system is inappropriate, the motor may begin to oscillate or even become unstable in some cases. Take enough precautions with respect to the motor's operation range and its safety when you adjust the servo.

(2) Types and Characteristics of Filters

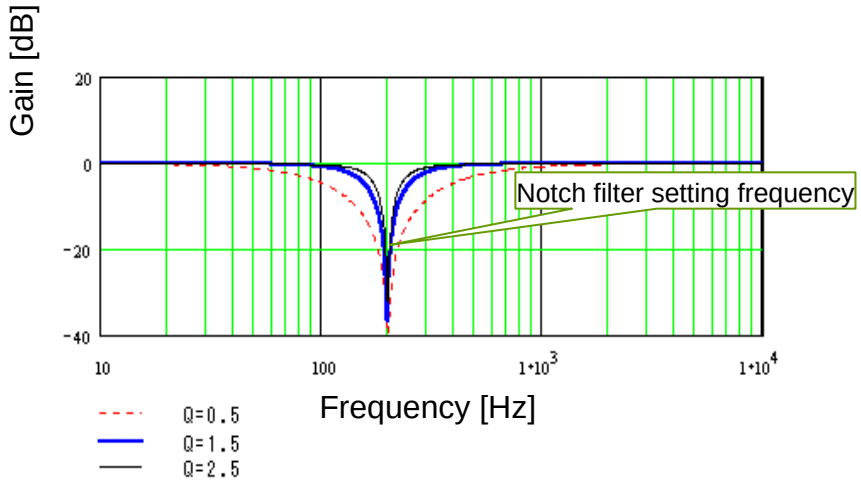
The three types of filters listed in the table below are provided for resonance countermeasures. Use them for their respective best purposes according to the characteristics of the resonance.

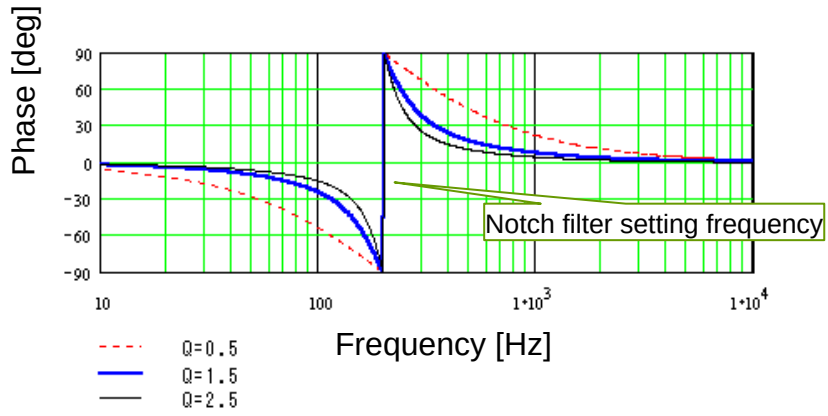
Characteristics of Various Filters

	Application	Precaution
Phase lag compensation filter	This is a first-order delay filter. Since it can adjust the bandwidth frequency and amount of damping, it can suppress the amount of phase shift better than the velocity feedback filter.	Oscillation caused by phase shift tends to occur if the velocity control bandwidth and the frequency setting of the first-order compensator filter are close to one another.
Notch filter	This filter can significantly dampen the gain at any frequency. Use this filter when there is resonance with a high peak gain in a narrow frequency band. * The notch filters are provided for two channels.	Resonance remains in case the resonance gain is high in a wide frequency band.
Velocity feedback filter	This is a first-order delay filter that allows lowering the gain at high frequencies dramatically. Use this filter when there are several resonance points among the high frequencies.	Since the phase shifts up to 90 degrees when this filter is used, phase shift oscillation tends to occur.

■ Notch Filters 1 and 2

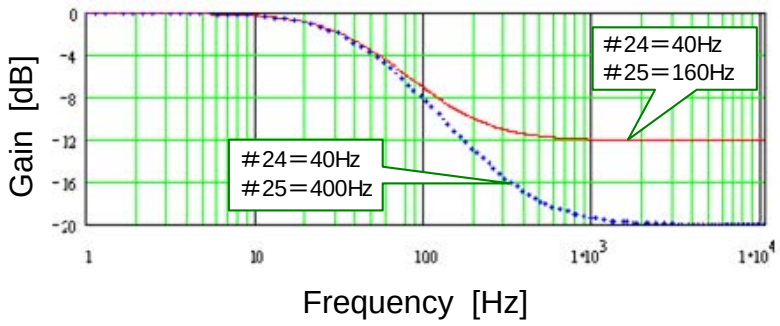
Notch filters decrease the gain value to almost zero at a certain frequency. Moreover, by changing the Q value, it is possible to make the filter characteristics sharp or gradual. The range of frequencies that can be set is from 50 to 1500Hz and the Q value can be set in the range from 0.1 to 5.0 (the default value is 1.5).
The notch filters are provided for two channels.
The figures below show the frequency characteristics of the notch filters.

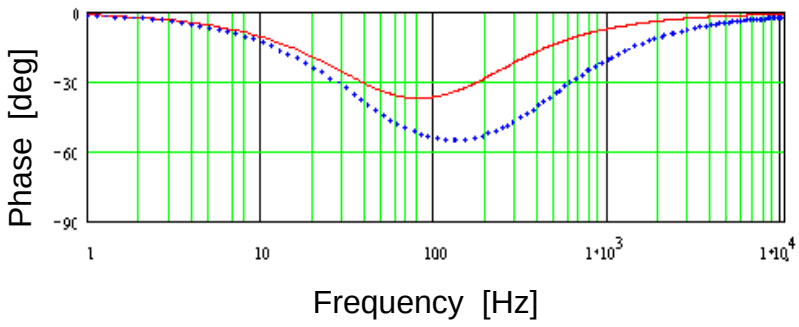




■ Phase Lag Compensation Filter

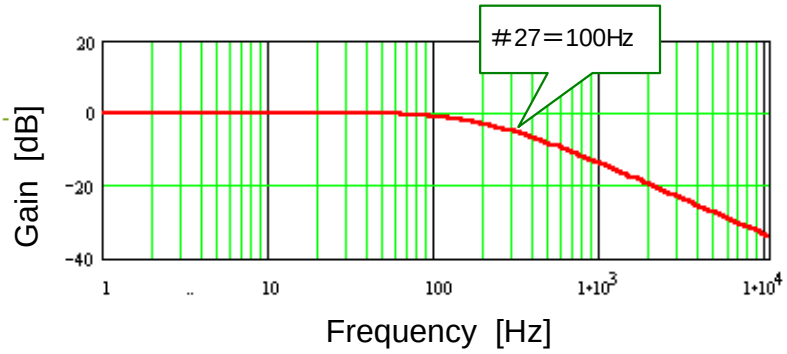
The phase lag compensation filter is a first-order delay filter. Set the -3 dB bandwidth frequency in #24 and set the frequency at which the maximum damping gain becomes +3 dB in #25.
Compared to the velocity feedback filter, the frequency of the maximum damping gain can be set freely for this filter. It can thus minimize the amount of phase lag.
Moreover, this filter is effective when the resonance frequency is high in a wide range.
However, compared to the notch filters, the damping amount is small; it is not suitable when the gain of the resonance peak is high.
The figures below show the frequency characteristics of the phase lag compensation filter.

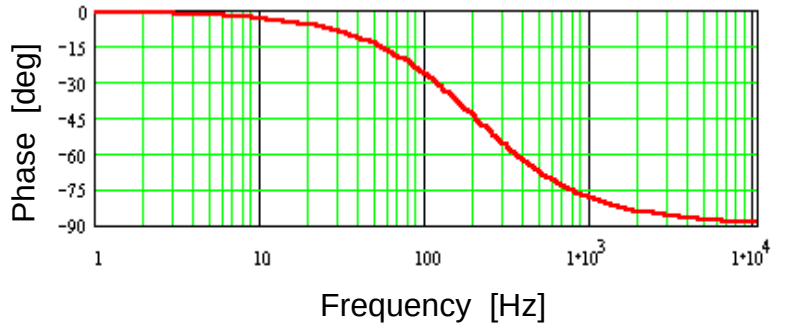




■ Velocity Feedback Filter

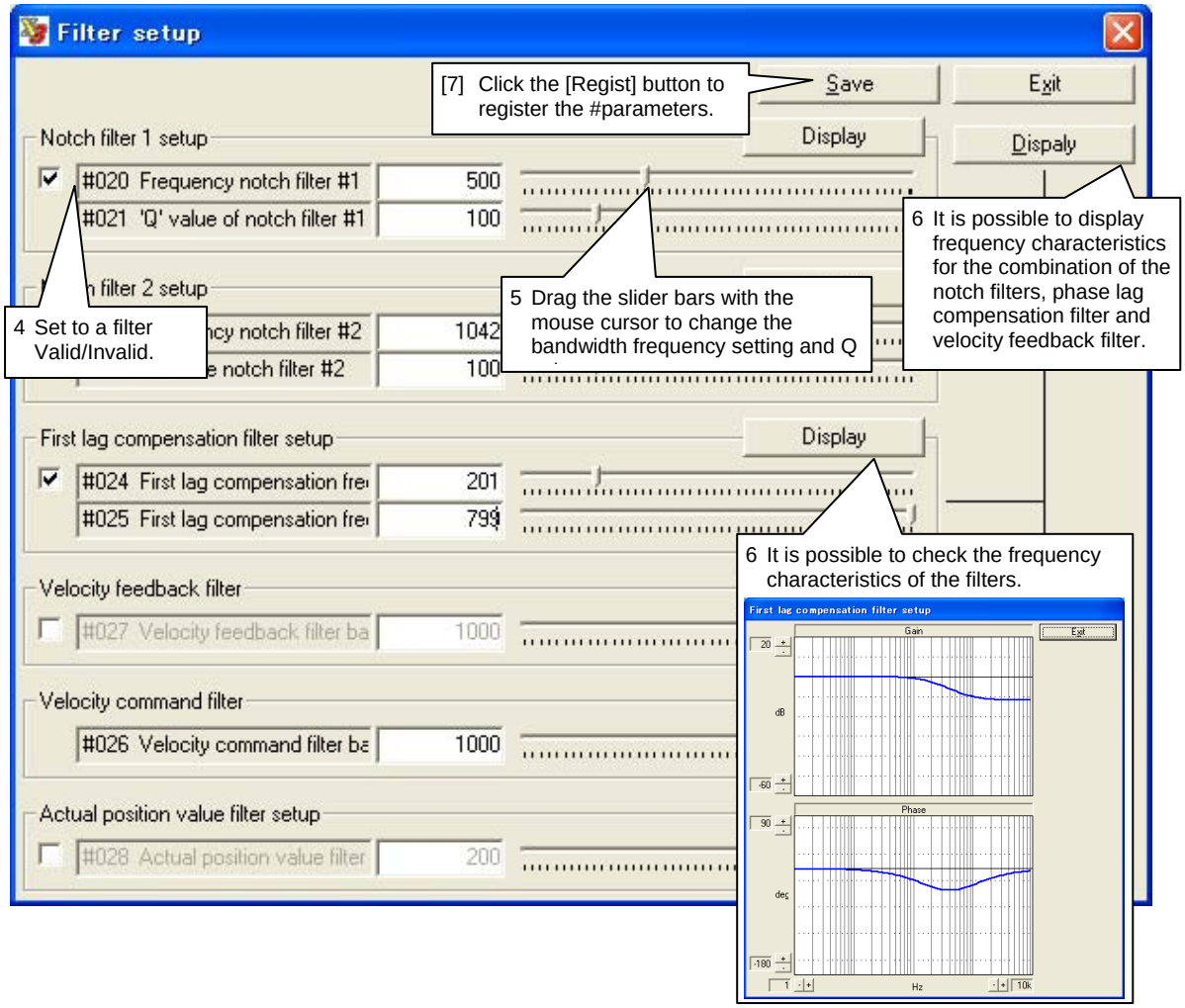
The velocity feedback filter is a first-order delay filter. The gain of the filter becomes -3 dB at the specified bandwidth frequency. The bandwidth frequency can be set in the range from 50 to 1000Hz. Care must be taken because the phase is shifted up to 90 degrees.





(3) How to Set #parameters

STEP 1 Select the [#parameter] from the Main Menu window of the utility software.
STEP 2 Select [Servo Tuning].
STEP 3 Select [Filter] to display the following window.
STEP 4 Click the filter you want to enable.
STEP 5 Adjust the filter bandwidth frequency and Q value by dragging the slider bars with the mouse cursor.
STEP 6 Select [Display] to check the filter characteristics.
STEP 7 Click the [Regist] button to register the filter settings.

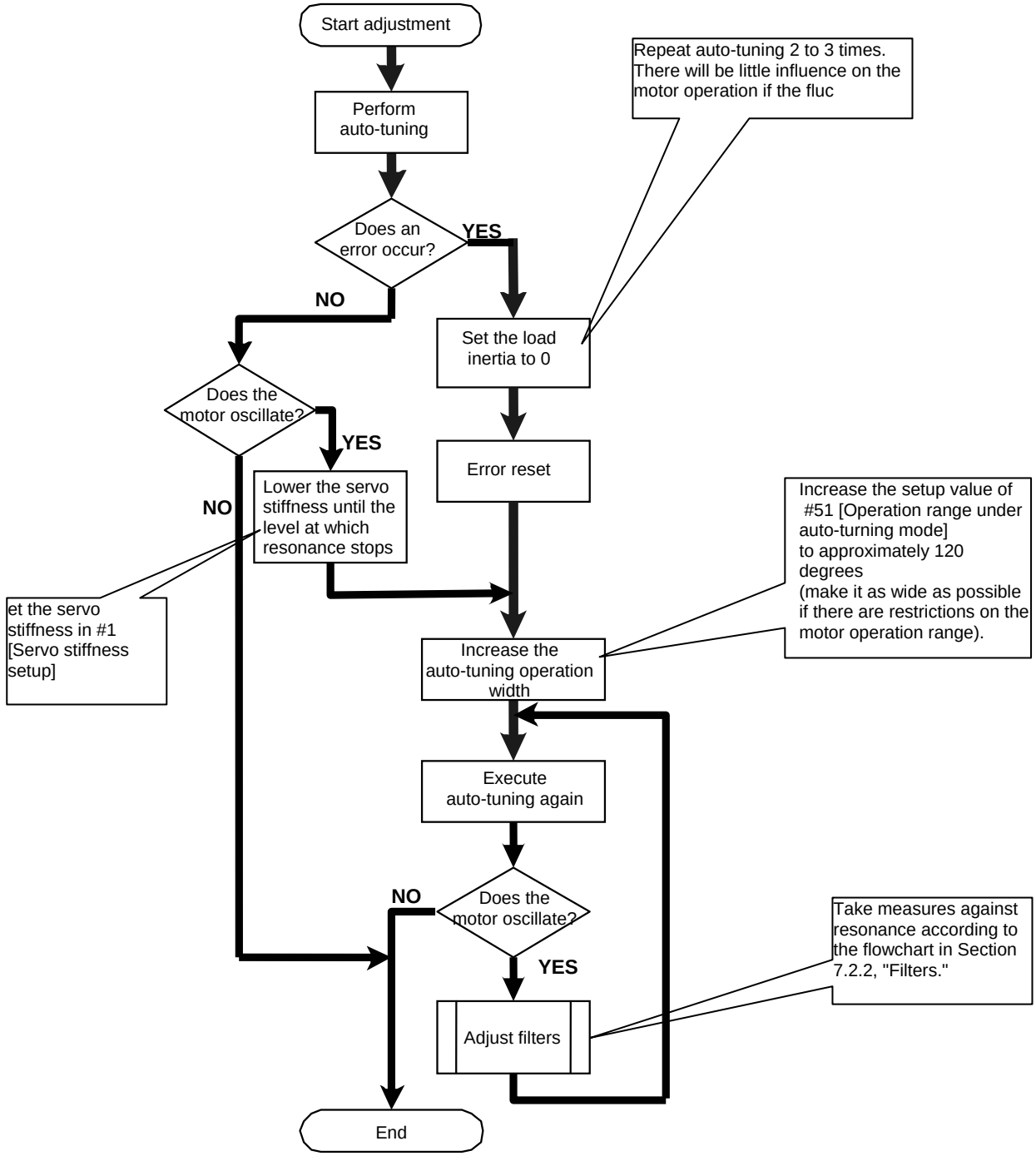


CAUTION

If the setting of the control system is inappropriate, the motor may begin to oscillate or even become unstable in some cases. Take enough precautions with respect to the motor's operation range and its safety when you adjust the servo.

7.2.3 If the Motor Oscillates during Auto-tuning

Perform auto-tuning again according to the procedure shown in the following flowchart if the motor oscillates while performing auto-tuning.
See Section 6.4.3, "Auto-tuning Operation" for how to perform this operation and how to set #parameters.



TIP

If auto-tuning cannot be completed normally even if you try the adjustment above, it may be suspected that the mechanical rigidity of the system is very low. Try to modify the system to increase the mechanical rigidity.

8. Utility Software

This chapter describes the software used to operate the DrvGIII series (hereafter called the utility software) on a PC.

8.1 Introduction

8.1.1 Operating Conditions

- Hardware

Processor:	Celeron 300MHz (equivalent) or higher, or Pentium III 500MHz or higher is recommended.
Memory:	64MB minimum
Hard disk capacity:	10MB minimum
Serial port:	1 port exclusive

- Operating systems
  Windows 98 Second Edition, Windows Me, Windows NT Workstation 4.0, Windows 2000 Professional and Windows XP have been verified as to their compatibility.
  Windows 2000 Professional or higher is recommended.

- Display
  Resolution 800 x 600 or higher, 256 color display minimum

- Communication cable
  A dedicated cable is required for connection. Either prepare a cable according to the connection diagram shown in the next section, or purchase a manufactured cable.

- Serial port setting
  Normally no setting is required as the serial port is controlled on the application side. However, if a special converter or other device is used, set the serial port as follows if necessary.

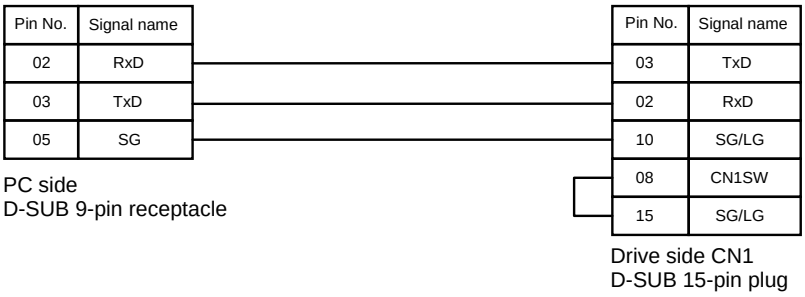
Communication speed:	38,400 bits/sec
Data bits:	8
Parity:	None
Stop bit:	1
Flow control:	None

- Operation verified RS485 card
  Manufactured by Interface Co., Ltd.
  PCI card: PCI-4142PE

8.1.2 Communication Cable

Prepare a communication cable according to the connection method used. RS-232C cables and RS-485 cables, which are mainly used for multi-channel communications, can be used as communication cables, depending on the communication method used.

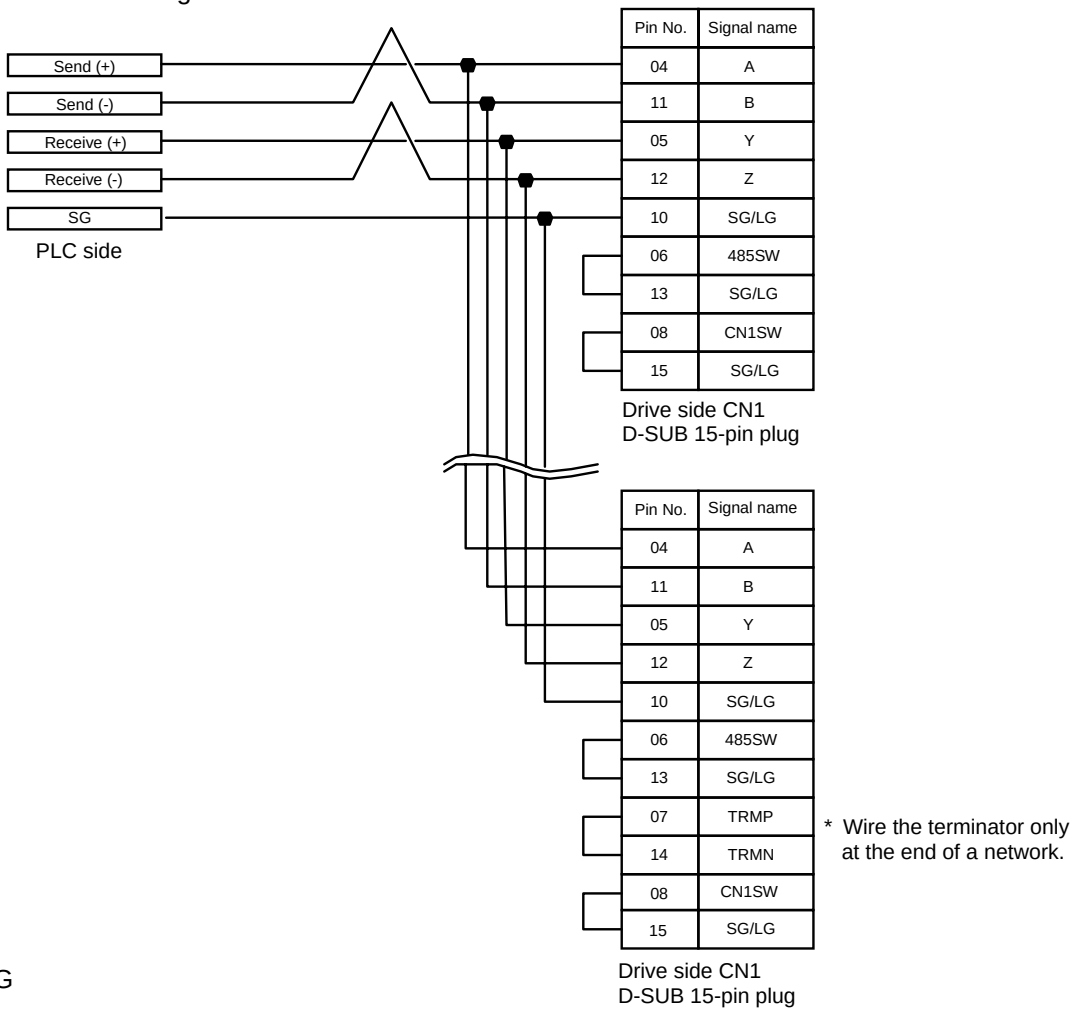
● Cable Wiring when RS-232C Cables are Used



WARNING

Do not connect anything to unspecified pins.
An erroneous connection may damage the drive and the PC.

● Cable Wiring when RS-485 Cables are Used



WARNING

Do not connect anything to unspecified pins.
An erroneous connection may damage the drive and the PC.

8.1.3 Installing and Uninstalling

- Installing
  Start setupj.exe, and follow the instructions given by the installer.
- Uninstalling
  Be sure to execute from [Control Panel] - [Add or Remove Programs].

■ Description of Main File Extensions Defined by the Utility Software.

*.prm	For saving #parameter settings
*.ioc	For saving I/O settings
*.tbl	For saving operation tables
*.wha	For backing up all user data in the drive in batch mode
*.cnd	For oscilloscope display setting data and waveform data
*.csv	For internal settings of the utility software
*.pdf	For Help

8.2 Overview

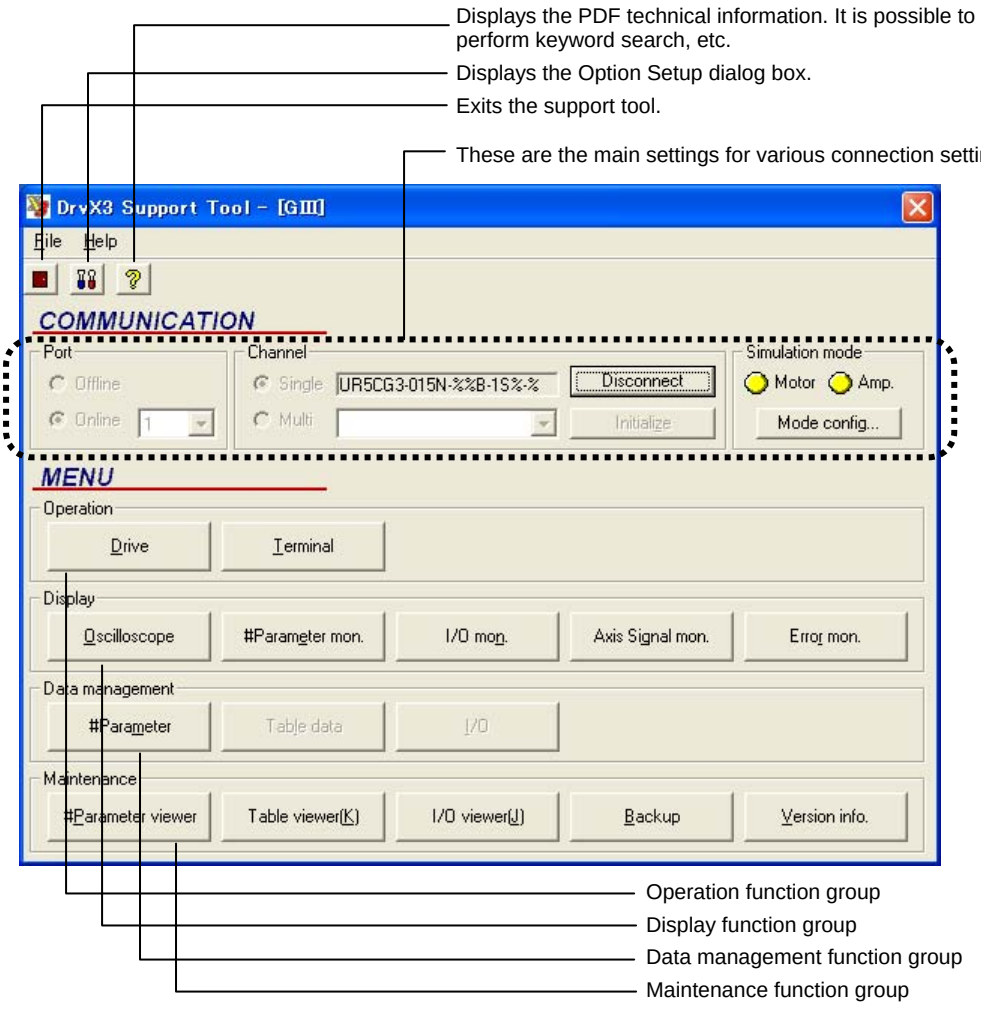
8.2.1 Function Groups

The utility software is divided into the following function groups:

[Main Settings]	A function group that sets up the connection method between the drive and the utility software prior to connecting as well as the operating mode of the drive
[Operation]	A function group that instructs operations to the motor connected
[Display]	A function group that acquires and displays information from the drive
[Data Management]	A function group that reads, edits and writes the setup data in various drives
[Maintenance]	A function group pertaining to maintenance such as backing up the information in the drive onto the PC side or writing the backup information into the drive

● Exclusive Control of Each Dialog Box

Exclusive control is used to display dialog boxes in each function group. Dialog boxes of different groups can be operated simultaneously; however, dialog boxes within the same group cannot be operated simultaneously. Also, the Maintenance function group cannot be operated with other groups simultaneously.



8.2.2 Function List

■ Main Settings

● Language Selection
It is possible to switch between Japanese and English. The language switching takes place after [Disconnect] is selected once.

● Online/Offline Selection
Select [Online] to actually connect to the drive, and select [Offline] to browse or edit the drive data without connecting to the drive. When offline, operations such as creating table data, browsing waveform data using the oscilloscope function, and browsing backup data can be performed.

● Connection Port Selection
Select the COM port number of the PC used.

● Single/Multichannel Selection
If two or more drives are connected via RS485, select the drive station number to be connected after selecting multichannel connection. Only one drive can be connected at a time during multichannel communication using the utility software.

● Operating Mode Setting (motorless operation/powerless operation setting)
This setting is used when the drive's built-in emulation function is used to check the motor operation while the motor is not actually connected.

● Host Communication Cycle Setting
This sets a basic cycle when connecting the drive and a PC in series. Communication may be stabilized by setting this to a larger value if the communication load on the PC side is heavy. Normally set this to 10ms.

■ Operation Group

● Drive
The operation group function issues operating commands to the drive.

● Terminal
The operation group function references and changes command inputs and parameters in text format.

■ Display Group

● Oscilloscope
This group function displays the drive status as if operating an actual oscilloscope.

● #parameter monitor
This group function displays the specified #parameter values continuously.

● I/O monitor
This group function displays the hard I/O status continuously.

● Axis Signal monitor
This group function displays the information pertaining to axis operation continuously.

● Error monitor
This group function acquires the current error information of the drive and past error record continuously.

■ Data Management Group

● #Parameter
This group function sets up the required main parameters for the drive. The parameters are classified by purpose.

● Table data
This group function creates and changes operation table data.

● I/O
This group function assigns hard I/O, performs logical settings, and the initial value settings of logic I/O.

■ Maintenance Group

● Parameter viewer
This group function backs up the #parameters that are currently being set in the drive, and performs restore operation using the files saved.

● Table viewer
This group function backs up the table data that is currently being set in the drive, and performs restore operation using the file saved.

● I/O viewer
This group function backs up the I/O that is currently being set in the drive, and performs restore operation using the file saved.

● Backup
This group function backs up all user data (data whose settings can be changed by users) that is currently being set in the drive, and performs batch restore operation using the file saved.

● Version information
The connected drive information, contact information and other information are displayed.

■ Help Display

This displays Help in Adobe Acrobat PDF. It is possible to perform keyword search, etc.

8.3 Required Settings Prior to Connecting

Perform the basic settings of the utility software according to the actual operating environment before connecting to the drive. The previous settings are used when the utility software is started again from the second time on, so there is no need for setting up the utility software again.

8.3.1 Connecting and Reconnecting

The status where the utility software and corresponding drive are connected via host communication is called [Connected state]. The communication status between the utility software and the drive is always monitored in order to improve reliability. Therefore, to use this utility software, start with [Connect] and end with [Disconnect] after completing an operation. [Disconnect] is automatically executed when the utility software is closed, so it is not necessary to select it.

If the power is cycled after the power to the drive side is disconnected when using the utility software, or if the communication cable is disconnected, [Connect] is disconnected. In this case, it is necessary to execute [Connect] again. However, the connection may be recovered simply by pressing the [Initialize Communication] button. In such a case, please note that the utility software runs as if the drive prior to the disconnection is being connected, because the drive information is not acquired again.

8.3.2 Communication Settings

■ Connection Port Selection

By choosing [Communication Port] - [Online], select the number of the serial port to be actually connected to the drive among the serial ports installed to the PC.
At this time, if the specified port is found on the PC and the correct drive is connected to that port, a motor model code is displayed, notifying the connection valid status.

■ Connection Format Selection

● Single Channel Connection
This is a basic connection method. A dedicated cable is used to perform communication by connecting one serial port to one drive. Select [Single] from [Connection Method] in option settings, and execute [Connect].

● Multichannel Connection
The multichannel connection function is used to connect one serial port to multiple drives connected in a multidrop RS485 communication.
Select [Multi] from [Connection Method] in option settings, and execute [Connect]. The utility software acquires the information of all drives currently being connected. The result is displayed in a pull-down box, so execute [Connect] after selecting a desired drive ID.
Be aware that the utility software and the drive are always performing one to one communication even when two or more drives are connected. If it is necessary to communicate with a drive of other station, execute [Disconnect] once, and then change the drive ID and reconnect.

● Offline Connection
Parts of the utility software function can be used without connecting a port to the drive by selecting [Offline] in communication port settings.
Part of the maintenance function and oscilloscope function can be used offline. Files pertaining to existing drives can be browsed.

■ Communication Cycle Setting

The sets up the minimum communication gap when communicating continuously between the drive and the PC. This setting is reflected by specifying [Communication cycle setting] in option settings. The initial value is set to 10msec, and normally it is not necessary to change the value. If the utility software is used on a PC with insufficient CPU memory, communication may be stabilized by setting a greater value here. However, be aware that if a value other than 10msec is specified, the oscilloscope function cannot be used.

8.3.3 Other Settings

■ Motor Type Selection

Select [DYNASERV] if the type of the motor to be connected is a rotary motor, and [LINEARSERV] if it is a linear motor.

■ Language Selection

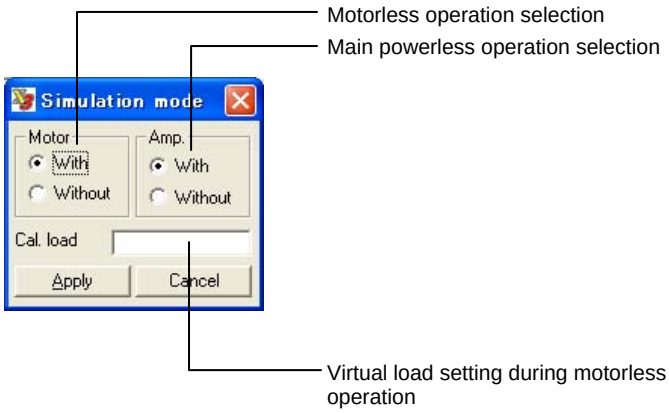
It is possible to select Japanese display or English display using [Option…] on the [File] menu. The language set here is used at the next startup. The language switching is possible only if it is done before executing [Connect] with the drive. Execute [Disconnect] first before switching the display language.

■ Operation Mode Setting

It is possible to set motorless operation or main powerless operation that uses the emulation function in the drive. It is possible to check parameters, table operation and other operations using only the drive without actually connecting the motor together with the oscilloscope function provided.
The unit of virtual load to be set is 1/1000kgm^2 for a rotary motor, and 1/1000kg for a linear motor.
If the drive has already reconnected the utility software in the motorless operating state, it starts as the motorless operating state. Once a motorless operation is set, the emulation state is maintained until the power to the drive's main unit is cycled.

WARNING

If main powerless operation is executed, the main power supply error detection function will not work. Be sure to check that the main power supply voltage exceeding the rating is not input before operating.

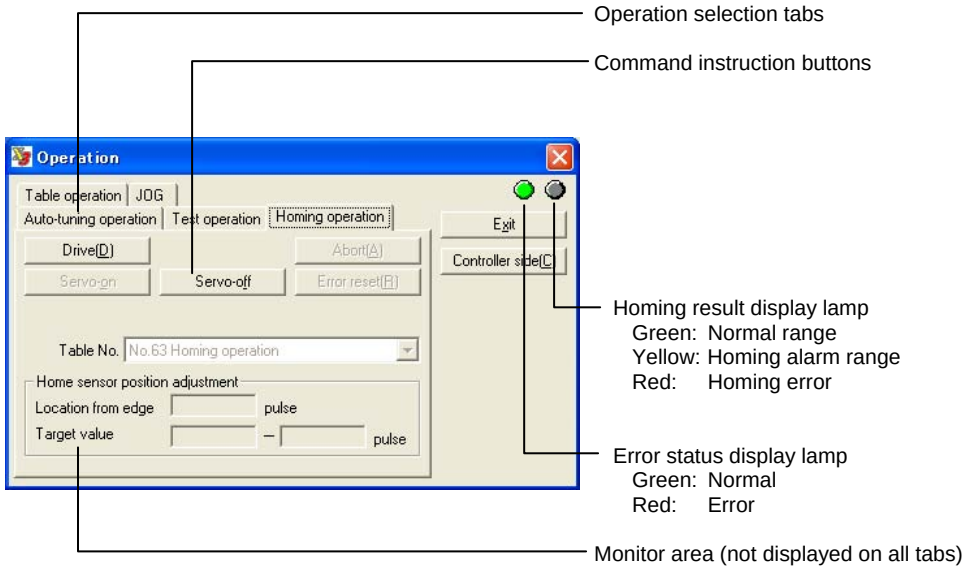


8.4 Details of the Operation Group Function

This section mainly describes the Operation group that has the function to issue operation commands to the drive.

8.4.1 Operation

The Operation group has the functions for instructing operations to the motor from the utility software. Select a tab suited for the target operation, and issue a command.
If you wan to change the parameter group pertaining to the target operation, start the Parameters dialog box of the Data Management group at the same time and change parameters, or if you want to monitor the status of the monitor, start the dialog box of the Display group at the same time and monitor the status.
If the controller side has the main operation privilege of the connected drive when this dialog box is opened, there is an inquiry as to whether or not the operation privilege will be granted to the serial interface side. Check security and switch accordingly.



TIP

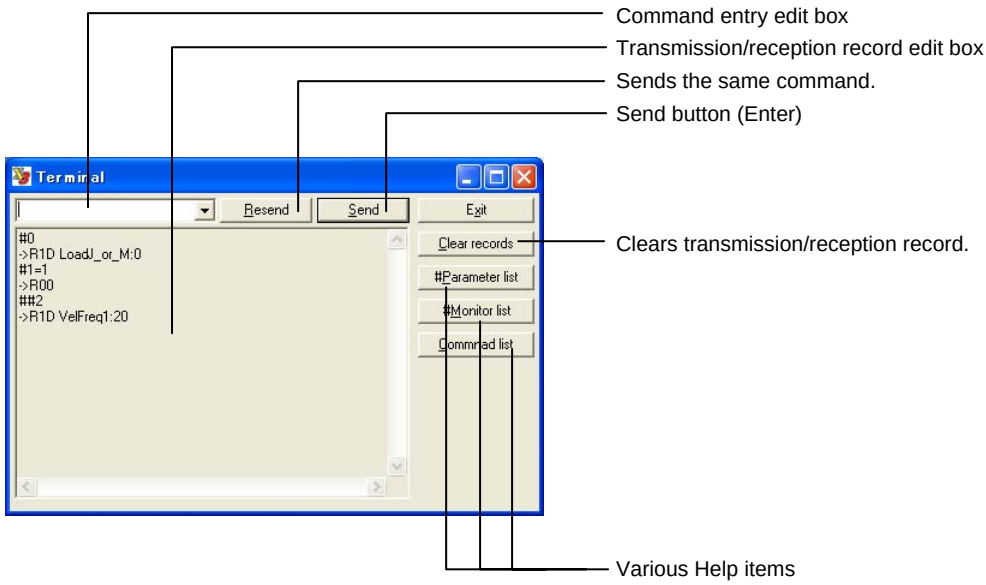
"Having the main operation privilege" signifies that a specific interface has the privilege to issue operation commands.

8.4.2 Terminal

The utility software has been designed to enable a series of drive control without a need for the operator to directly enter cumbersome commands from the terminal.
However, if this utility software is used by persons familiar with the drive, or if special operations are required, it may be more beneficial to use [Terminal].
Most of the commands that are used by other dialog functions are embedded in [Terminal] as [Character string commands] that can easily be understood by users. Therefore, parts of other dialog functions can be realized by using [Terminal] even with manual entry.

! DANGER

If the terminal function is used together with other dialog functions, some commands may conflict. Especially if you are issuing operation commands from the terminal, please be aware that the motor may perform unexpected operations.



(1) Character String Command Method

Enter a command in the format described later into the command entry edit box from the keyboard. The command is issued to the drive being connected when the [Enter] key is pressed. Replies from the drive are displayed in the transmission/reception record edit box. Replies consist of immediate replies, replies at the completion of processing, and replies after the issuance of the stop command.

(2) Command Character String/Reply Character String Format

● @Command Format
The following commands are used to operate the drive. The number of arguments is predetermined for each command number. A column (:) is used to delimit arguments.

Command name	No.	Argument	Format (example)
Abort	1	0	@1
Stop	2	0	@2
Start	3	1	@3:10 (10: Table No.)
Error reset	4	0	@4
Switch main operation privilege	5	1	@5:0
Servo ON/OFF	8	1	@8:0 (0: Servo-off/1: Servo-on.)
Set origin offset position	10	1	@10:90000 (90000: Offset pos. value)
Jog move command	11	1	@11:1 (1: + direction/0: Stop/-1: - direction)
Set coordinate system	13	1	@13:10000
Self-adjust differential limiter	14	0	@14
Write updated parameters	16	0	@16
Error reset with record clear	19	0	@19
Reset all	90	1	@90:password * Password: [2003]
Reset drive software	96	0	@96

● Format of #parameter and ##parameter Operation Commands

• Parameter reference (examples)

#1:	References the content of parameter No.1
##1:	References the content of parameter No. 1 that is already written (in EEPROM)

• Parameter substitution (examples)

#100=1:	Substitutes value 1 for parameter No. 100
#100=habcd:	Substitutes 0xABCD in hexadecimal notation
##100=-1:	Substitutes -1 for the parameters already written (in EEPROM)
#100=#101:	Substitutes the content of parameter No. 101 for parameter No. 100

• Parameter calculation substitution

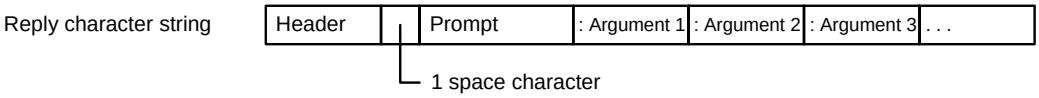
#100=1+1:	Substitutes the calculation result of two numeric values for parameter No. 100
#100=#101+1:	Substitutes the calculation results of a referenced value (#101) and numeric value for parameter No. 100
##100=#101+#102:	Substitutes the calculation results of two referenced values for parameter No. 100 already written

[Operators that can be used]

Addition (+), subtraction (-), multiplication (*), division (/), reminder at division (%), bit AND (&), bit OR (|)

● Reply Character String Format

The reply character string consists of the following:



The reply character string is classified into the following:

	Header structure	□ section	■ section	Description
General	R□■	No. of arguments	Argument representation method See Note..	Normal reply character string for a transmission character string The number of arguments changes according to the reply content.
Error	ERR □□. ■	Error/alarm code (main)	Error/alarm code (sub)	Reply character string when an error/warning occurs with respect to a transmission character string Arguments do not always exist.
Alarm	ALM □□. ■			

Note: Argument representation method in ■ section for general replies

- O: No argument
- D: Decimal notation character string
- B: Binary notation (8 digits, 16 digits, 32 digits)
- H: Hexadecimal notation (2 digits, 4 digits, 8 digits)
- S: Character string
- Z: Other than the above (character string, etc.)

Examples of reply character strings are as follows:

```
R00
R1D ServoRigid:3
R1H StatusReg1:039B00C1
ERR25.3 RegenError
ALM66.0 IlgDevice
```

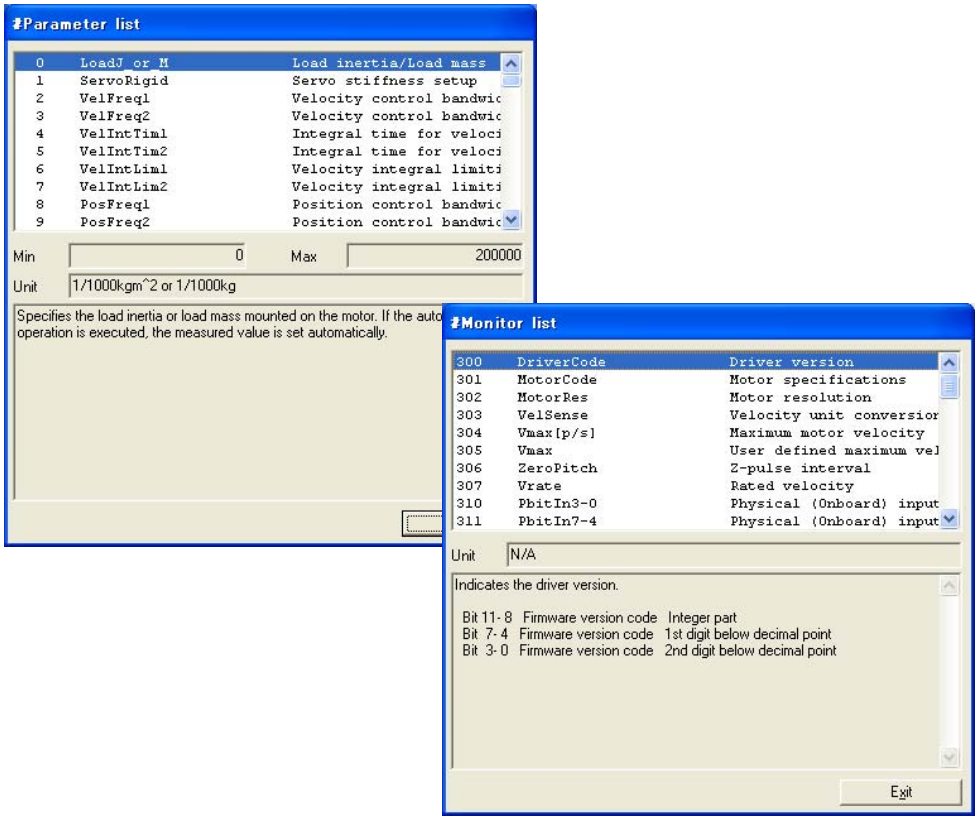
■ Useful Operations

● Reusing Transmission Record

The record of the commands previously sent is displayed again in the command entry area by operating the Up/Down keys on the keyboard. The same command can be instructed repeatedly by pressing the [Enter] key.

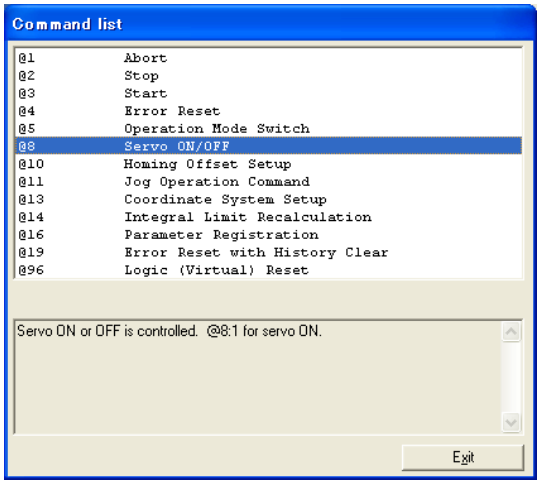
● Parameter list/Monitor list display

The parameter list and monitor list dialog boxes can be displayed during terminal operation. More detailed information is displayed by selecting each parameter using the mouse.



● Command list display

The command list dialog box can be displayed during terminal operation.



8.5 Details of the Display Group Function

This section describes the Display group that has the function for mainly displaying the drive information.

8.5.1 Oscilloscope

The oscilloscope function implemented by the utility software acquires the #parameter/#monitor information, which is updated inside the drive in a sequential manner, in time series.
Also, its operation system has been designed according to an actual oscilloscope. The oscilloscope window consists of a main dialog box, a setup dialog box, and a waveform display dialog box.

Compared to other functions, the oscilloscope function requires more CPU power of a PC. If this function is used, please use a PC that at least satisfies [Recommended conditions]. Also, see items in “Troubleshooting.”

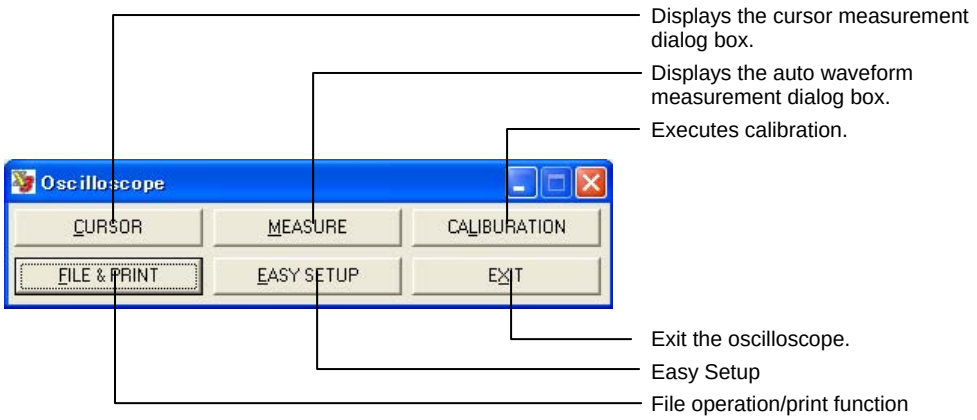
■ Specification

Item	Specification
No. of input channels	4 (CH1 ~ CH4)
Highest sample rate	10kS/s
Trigger source	Analog trigger: CH1, CH2, CH3, CH4 Digital trigger: Any of bit 0 to bit 7 of monitor data
Trigger function	Edge trigger: Trigger at the edge of a single trigger source
Trigger mode	Auto: Loads a buffered waveform sequentially at less than 100msec/div Normal: Loads a waveform only when triggered Single: Loads only once when triggered
Trigger slope	Rising, falling
Trigger position	10-point position of 0div to 9div within a waveform display frame
DC offset setup range	Up to 10 times the ±UNIT/div setting (e.g., range of ±10000 with a setting of 1000 UNIT/div)
Time setup range	1ms/div to 5s/div
Graph refresh cycle	100ms to 1s
No. of display waveforms	Analog display: 4CH Digital display: 8 x 4CH
No. of waveform configuration data	100
Waveform calculation	Calculation of +, -, *, and / among channels, and waveform display
Cursor measurement	Measures the values and time of the vertical cursor and horizontal cursor, the difference between the cursors, and the time difference
Auto waveform measurement	Measures the time, maximum value, minimum value, average value and effective value between the cursors of any one waveform
Calibration	Automatic sets up the vertical axis, time axis, etc.
Screen hardcopy	Prints the Waveform Display dialog box window to the printer connected
File function	Saves and browses the waveform data measured. Saves and reloads the measurement conditions.
Easy setup	Simply sets typical representative measurement conditions

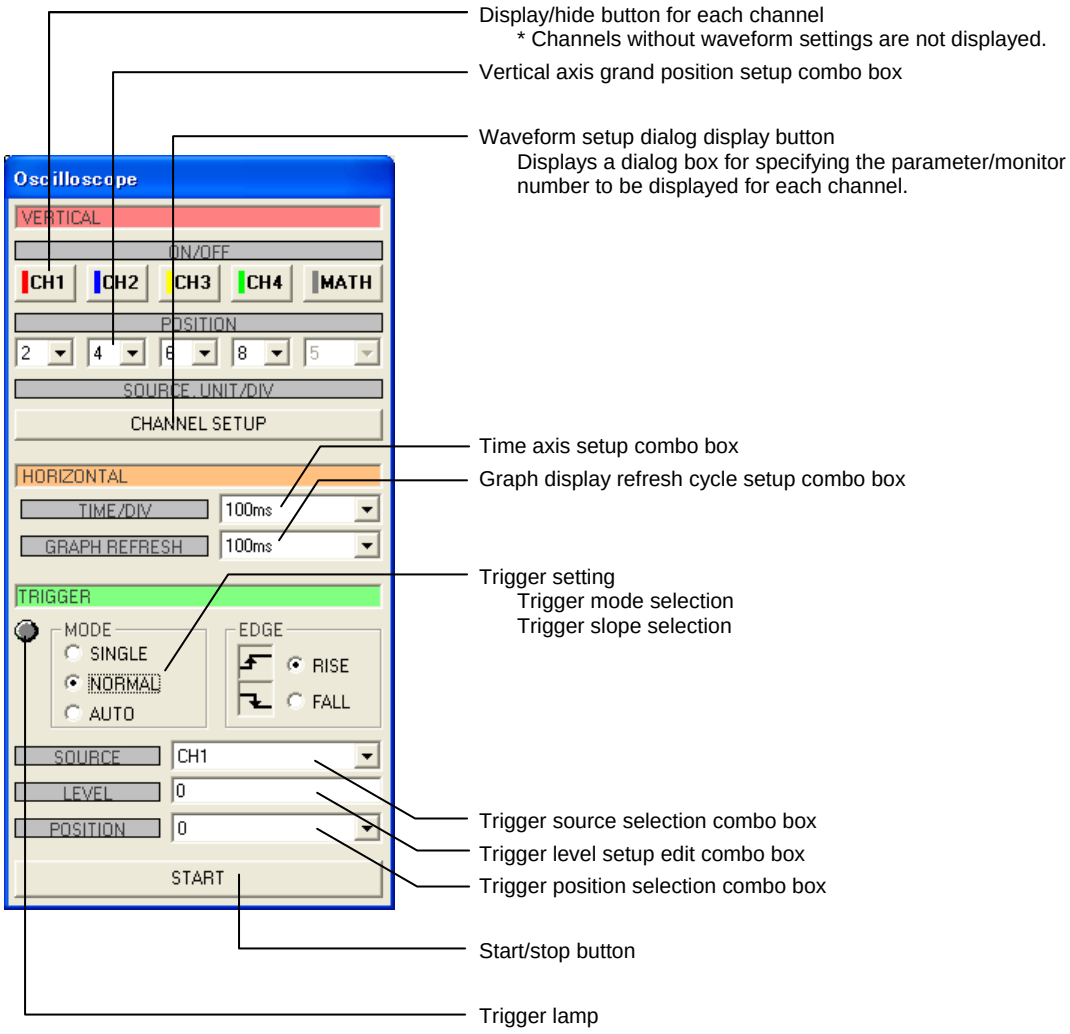
(1) Names and Usage of Component Parts

■ Operation Keys

● Main Dialog Box

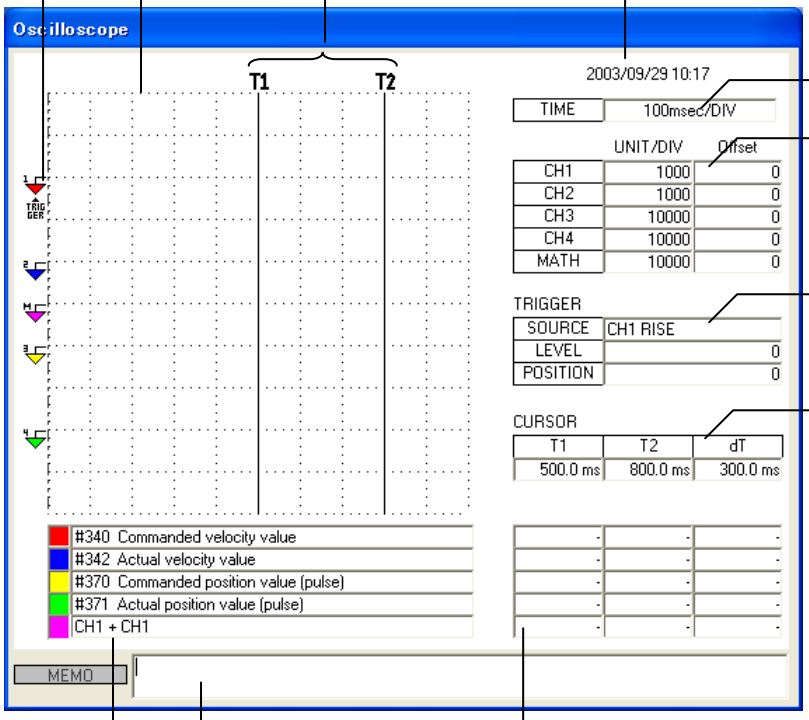


● Setup Dialog Box



■ Screen Display

● Waveform Display Dialog Box



Grand position display icon (for each channel)
Trigger channel display icon
This icon is displayed for a channel that has been set in the trigger source.
Offset display icon
This icon is displayed for a channel for which an offset has been set.

Trigger position display

Cursor

Date and time

Time axis setting

Each channel vertical axis setting

Trigger setting

Cursor reading value

Value for each channel

Edit box for memo
Use this as a memo such as writing measurement conditions.

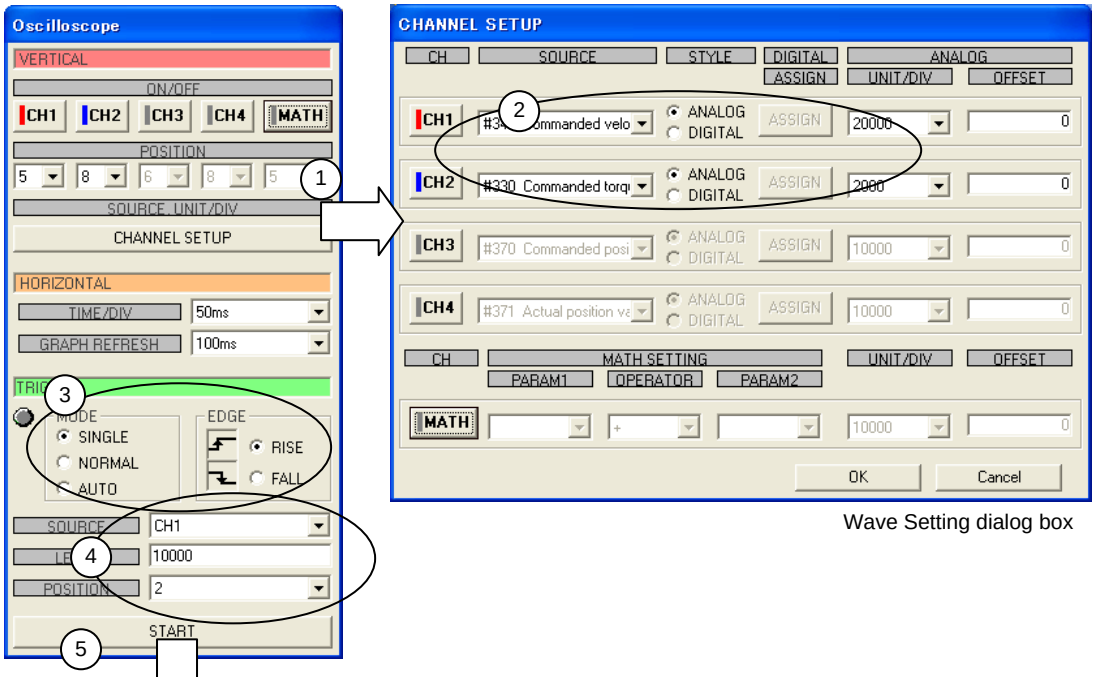
Channel setup information
This displays at which parameter/monitor number each channel is set.

(2) Basic Usage

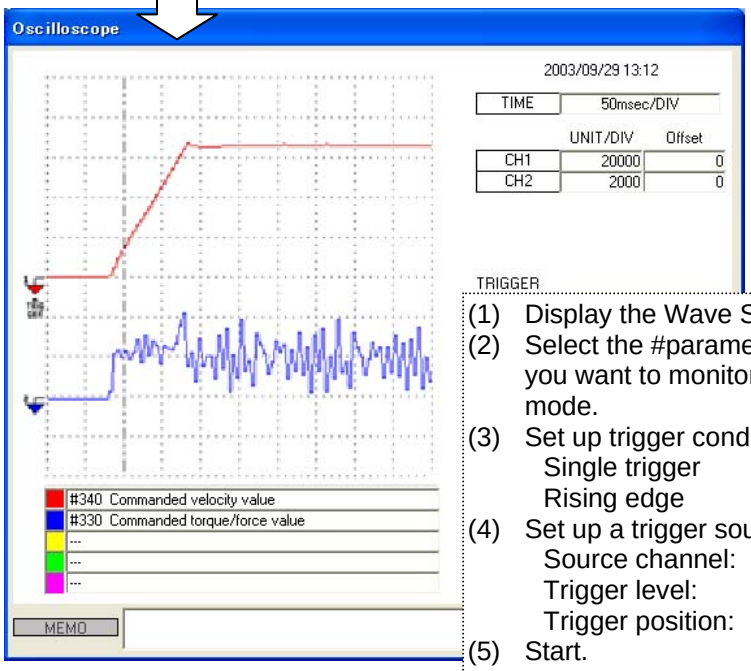
The basic usage is the same as for a general oscilloscope. The following describes the actual operating procedure using a basic usage as an example.

■ Loading a Waveform with a Single Trigger

The following describes the procedure for loading a waveform with the most basic single trigger.



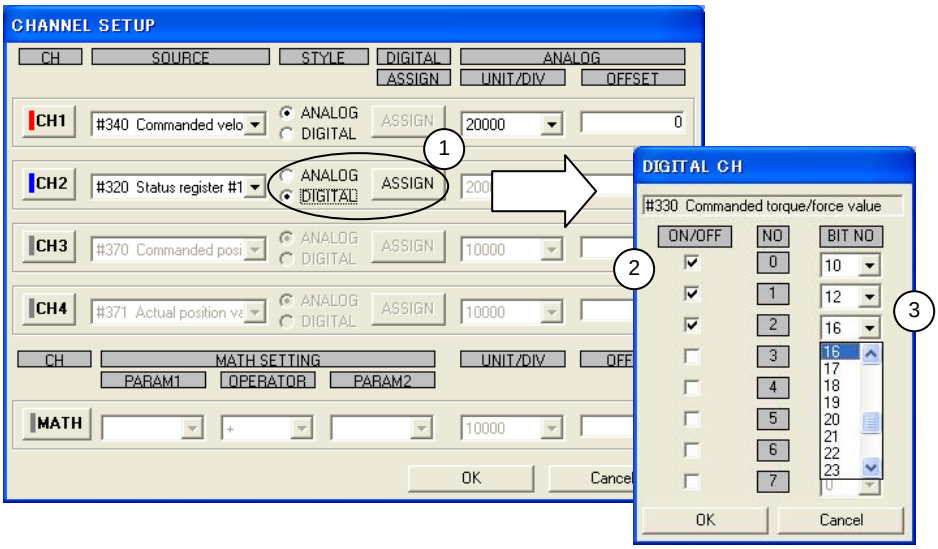
Wave Setting dialog box

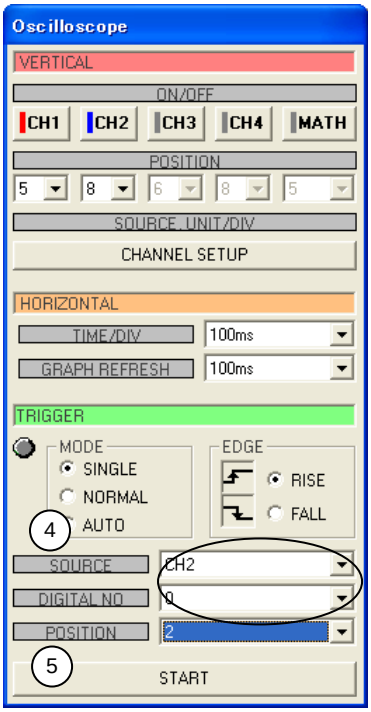


(1) Display the Wave Setting dialog box.
(2) Select the #parameter/#monitor number you want to monitor. Select an analog mode.
(3) Set up trigger conditions.
  Single trigger
  Rising edge
(4) Set up a trigger source.
  Source channel: 1
  Trigger level: 10000 UNIT/div
  Trigger position: 2
(5) Start.

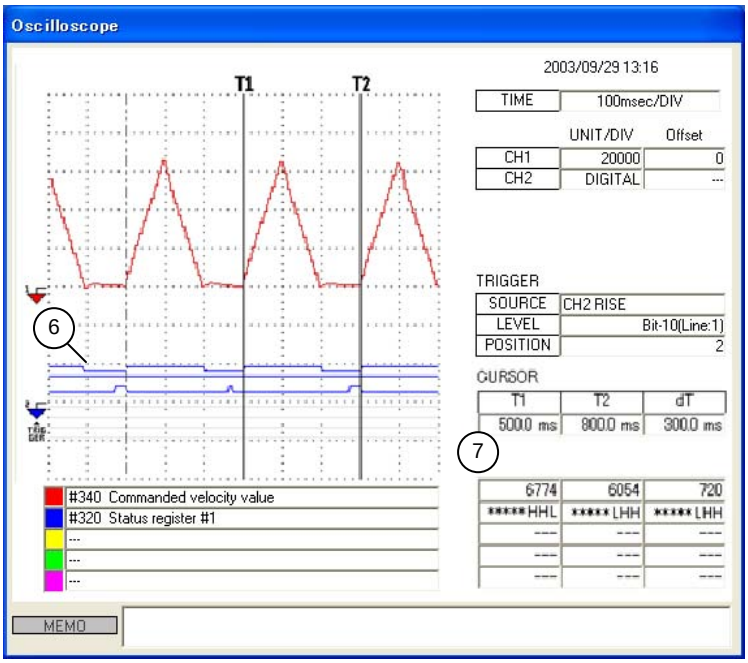
■ Displaying a Waveform in Digital Format

All #parameters/#monitor numbers are managed in units of 32 bits inside the drive. Generally, one #parameter/#monitor number has one definition. However, some #parameters/#monitor numbers are broken into 32 bits, each of which is then assigned with a unique definition (e.g., #320 (Status register 1)).
[Digital waveform display function] can be used to display #parameters/#monitor numbers using an oscilloscope. The following describes the digital display method and the trigger setup method using digital values.





(1) Select [DIGITAL] in the channel you want to display digitally, and set up display bits.
(2) Add a check mark at the left of the numbers of bits you want to display.
(3) Select bit No.'s you want to assign to. In this example, bits 10, 12 and 16 of status register 1 are assigned to No. 0 (top waveform in display), No. 1 and No. 2 waveforms, respectively. The bits that are unchecked are not displayed.
(04) If a digitally set channel is set as a trigger source, a combo box for setting which the bit to be used as the source is displayed. Select a trigger source bit.
(5) Start.



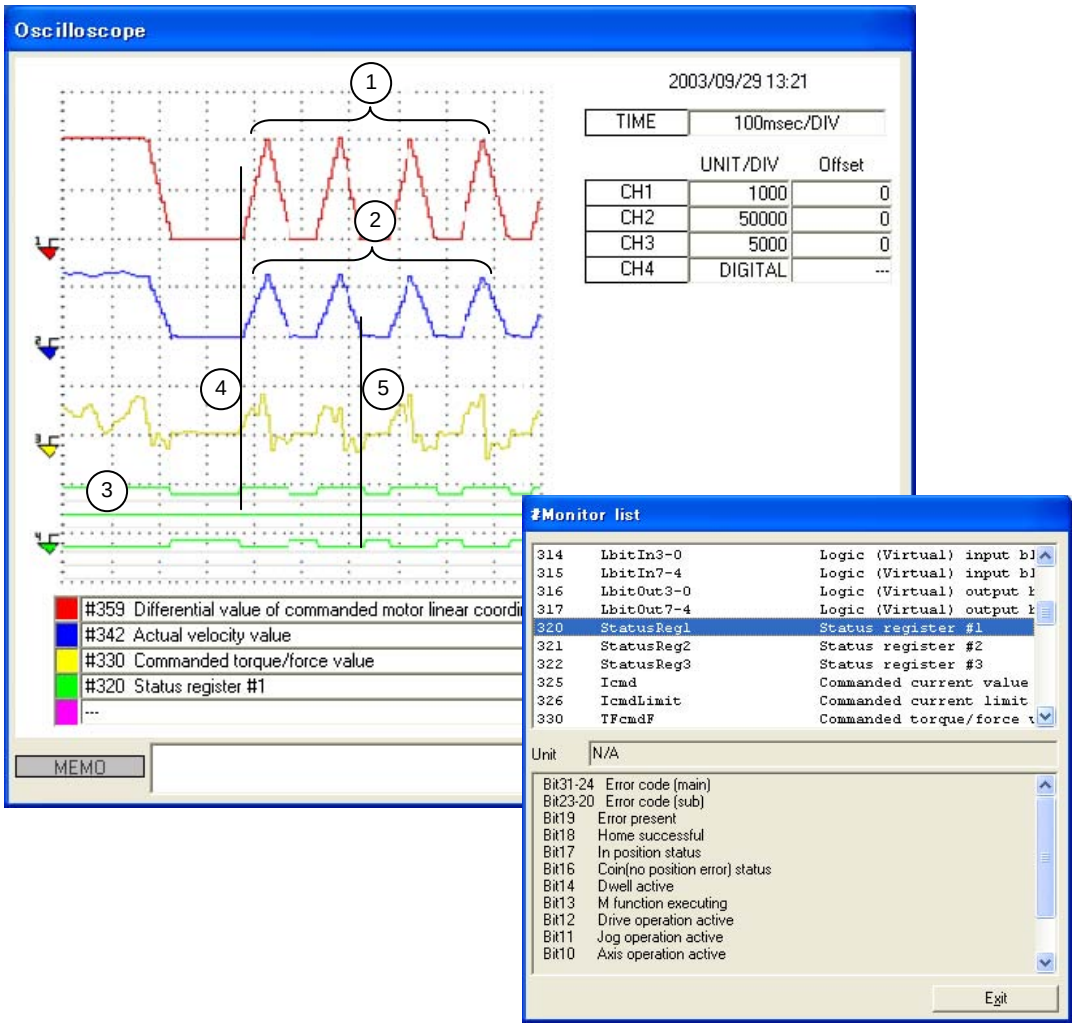
(6) A trigger is applied at the rise of the bit set in No. 0. In this example, a trigger is applied at the rise of the axis-in-operation signal, #320 bit 10.
(7) The status of each bit is expressed by 1: H and 0: L while in digital display.

TIP

A maximum of eight bits can be displayed per channel. To monitor more than eight bits at the same time, a maximum of 32 bits can be displayed by assigning multi-channels to digital display.

■ Understanding an Overview of Motor Operation in AUTO Trigger Mode

It is possible to understand a rough behavior of the motor by setting a long range time axis and monitoring waveforms by AUTO trigger while the motor is operating.



(1) Position command differential value (velocity profile) to be generated by the controller
(2) Actual velocity information. Because there are four peaks within the range indicated by a bracket, it shows that the motor moved triangularly four times.
(3) [Axis operation active], [Drive operation active] and [In position status] are assigned from the top in digital waveform display.
(4) It can be observed that the rise of the axis operation signal and the rise of #359 have the same timing.
(5) It can be observed that the positioning status signal rises at almost the same time as the move completion.

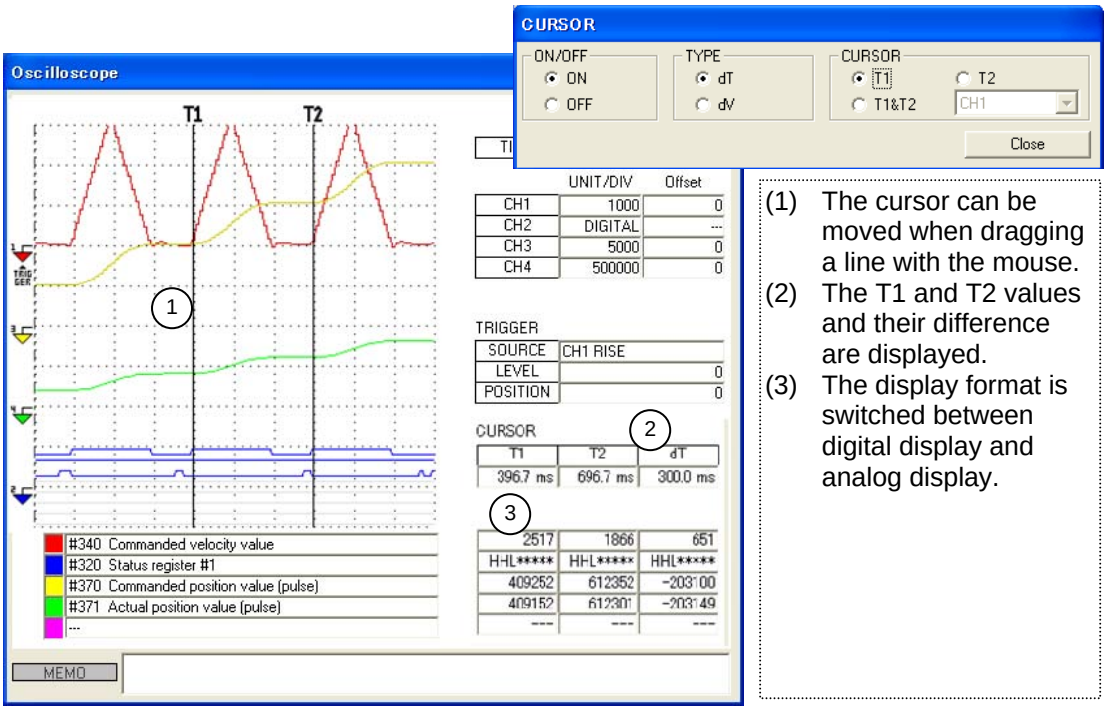
CAUTION

If the time axis is set to display a long range (200 msec/div) as shown in the screen above, due to sampling issues the display may show waveforms that differ from the actual operation waveforms and timing. Always take aliasing problems into account before using the equipment.

■ Using the Cursor Function

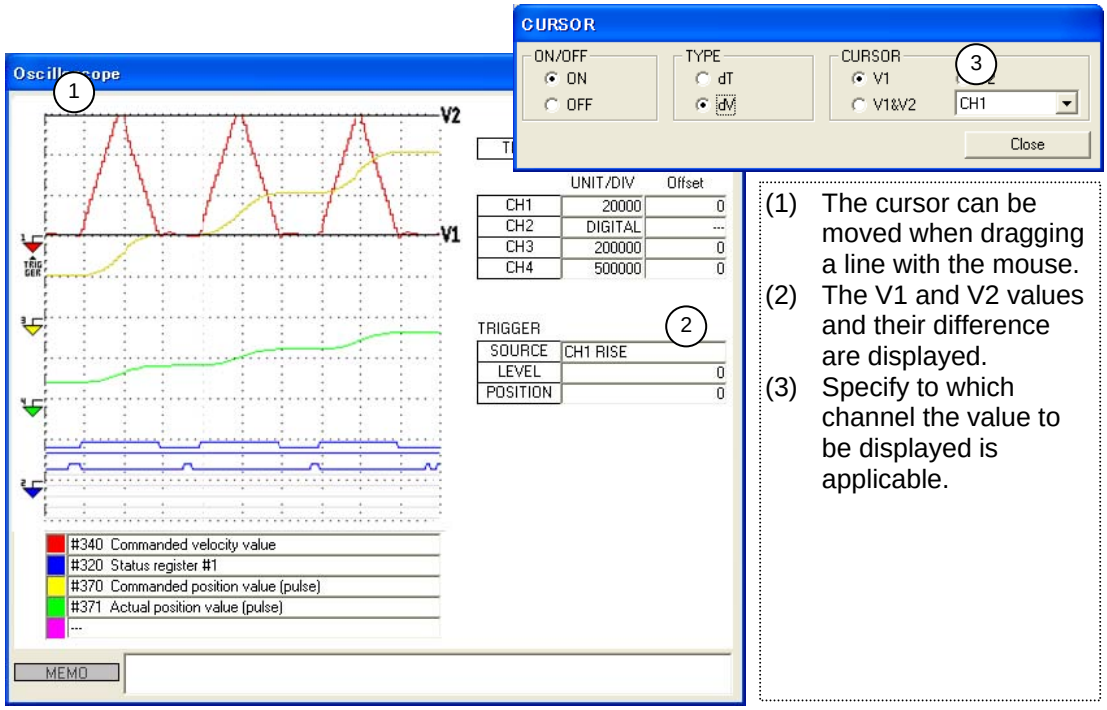
The following describes a method to measure a loaded waveform using the cursor function. Note that the cursor function can be used only while in the [STOP] state. Measure a waveform after it has been loaded.

● Using the Time Axis Cursor



(1) The cursor can be moved when dragging a line with the mouse.
(2) The T1 and T2 values and their difference are displayed.
(3) The display format is switched between digital display and analog display.

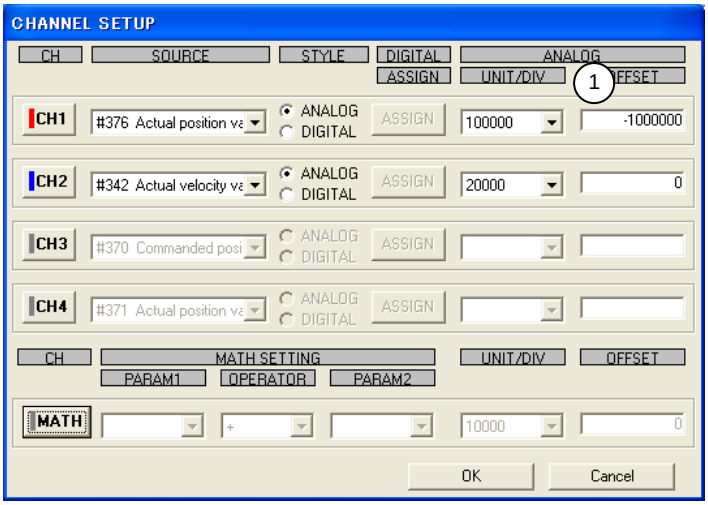
● Using the Vertical Axis Cursor

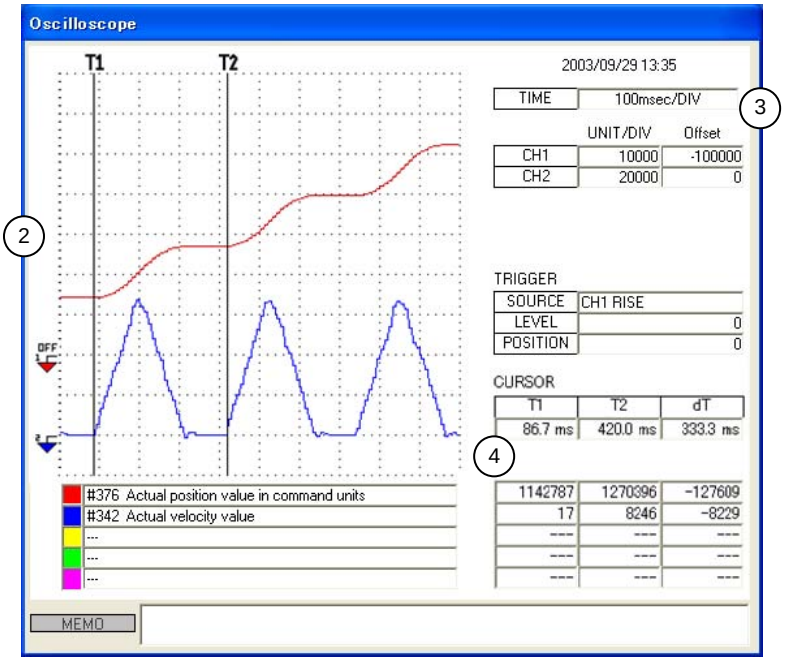


(1) The cursor can be moved when dragging a line with the mouse.
(2) The V1 and V2 values and their difference are displayed.
(3) Specify to which channel the value to be displayed is applicable.

■ Making the Display Easier to See by Applying an Offset to Waveforms

Waveform data can be observed in a fine range by setting an appropriate offset value in the waveform display in advance.
In this example, the command unit current position is monitored when it is at a position away from the origin. By setting a value from which the away distance (in this example, 1000000) is subtracted as an offset, the actual moving segment can be displayed in enlarged view.



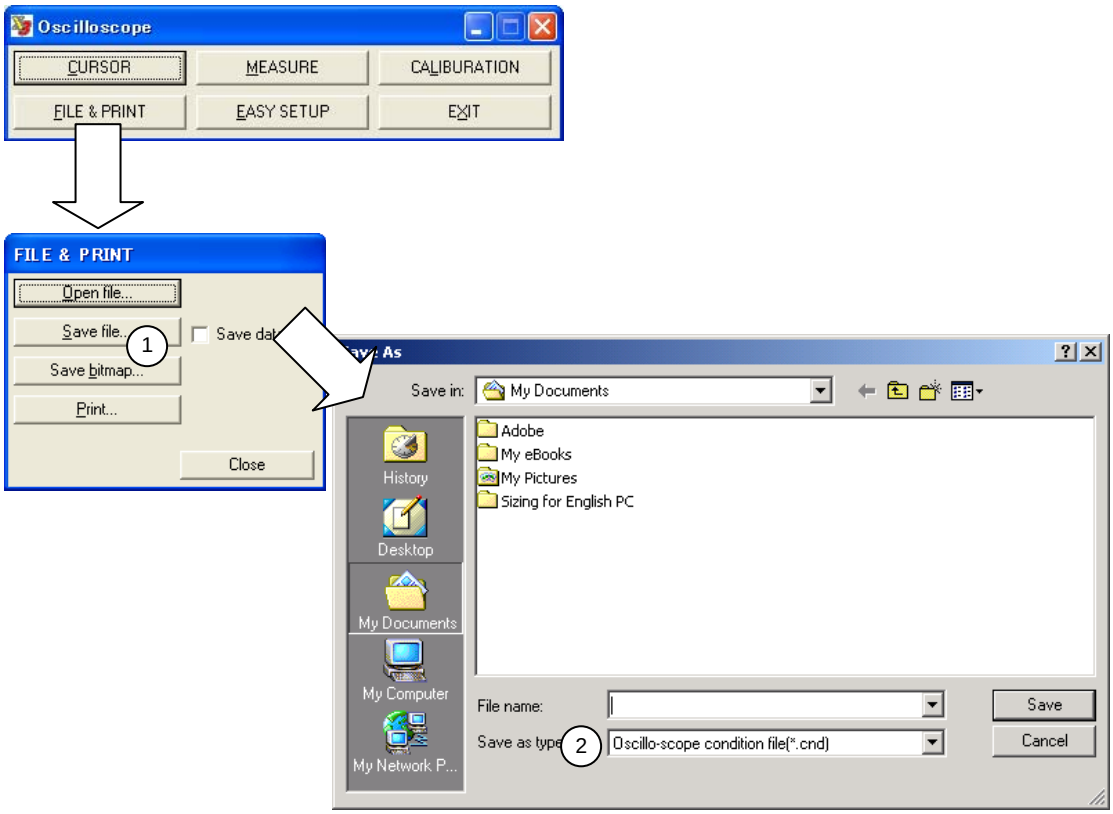


(1) Set an offset.
(2) [OFF] is displayed as the reference icon, indicating that an offset has been set.
(3) The offset value is displayed.
(4) The value to be read by the cursor function is a raw data value (value not added with an offset).

■ Saving Measured Waveform Data

■ Browsing the Waveform Data Measured in the Field Offline

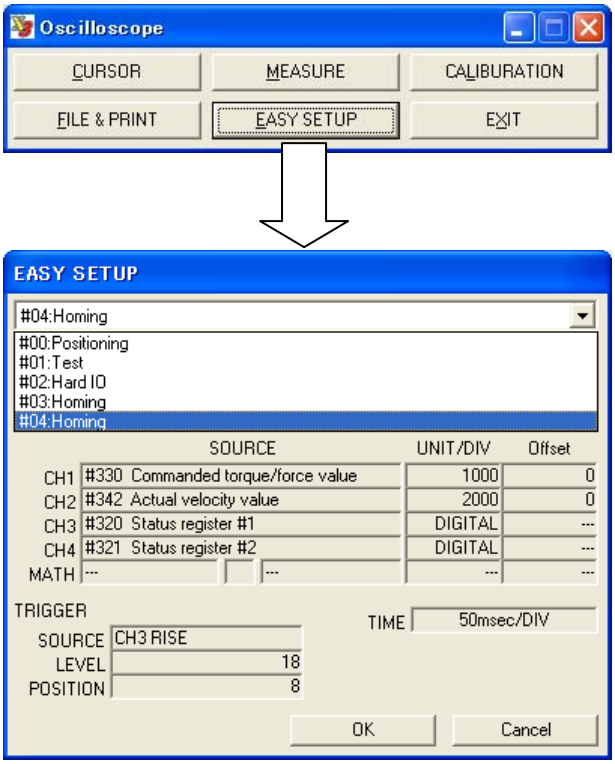
Saving measured waveform data, measurement conditions and so forth as PC files is useful when creating documents or performing troubleshooting. Waveform data can be saved in BMP format or printed directly. Saved data can be browsed offline (not connected to the drive).



(1) To save waveform data, check [Save]. However, this can be skipped to save only measurement conditions.
(2) A waveform data file has an extension of *.cnd, and is saved in text format.

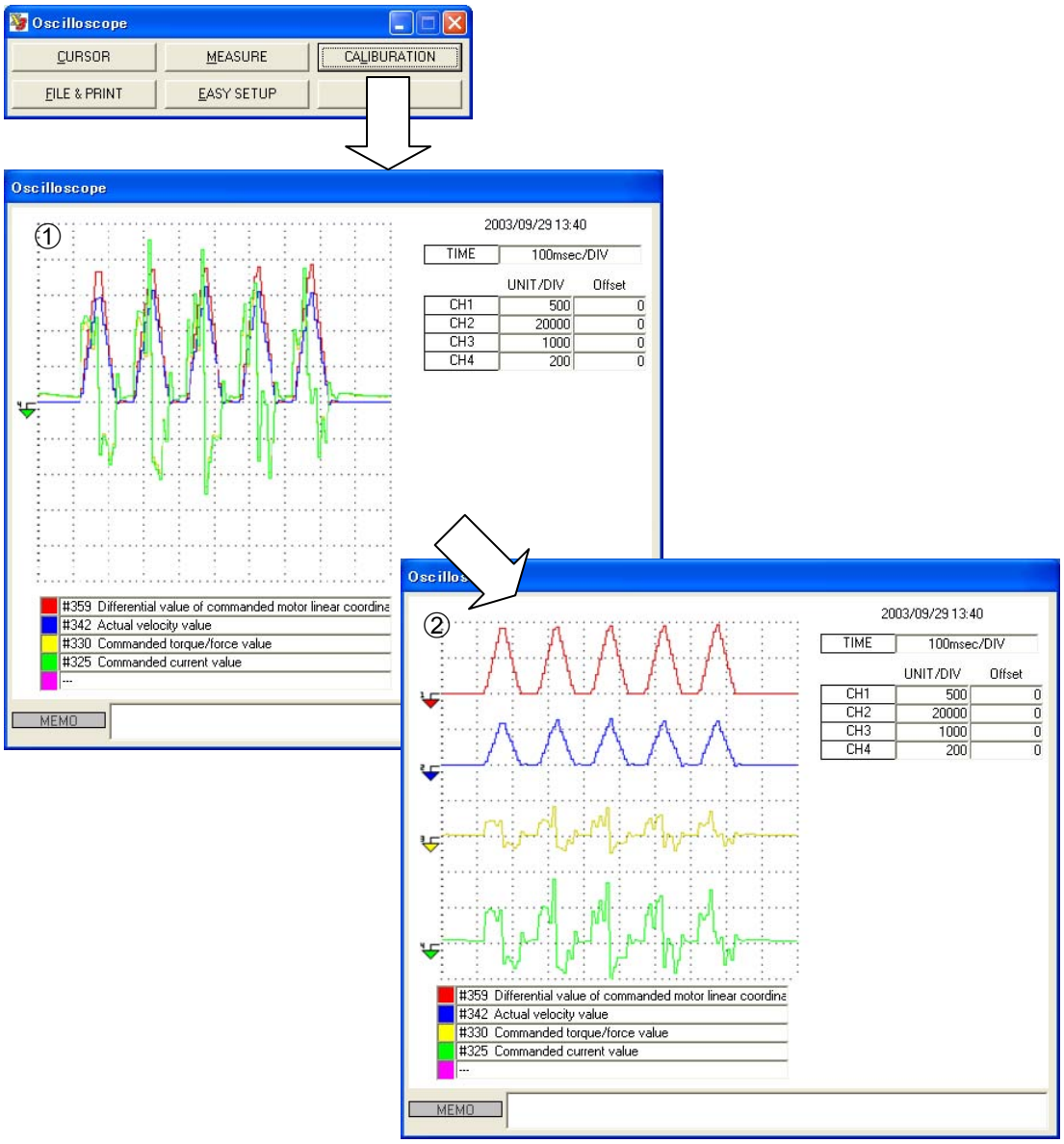
■ Loading Typical Parameters/Monitor Waveforms Using the Easy Setup

The utility software provides typical measurement conditions as [Easy Setup] in advance when observing the operation of a direct drive motor.



■ Obtaining a Rough Waveform Range Using the Calibration Function

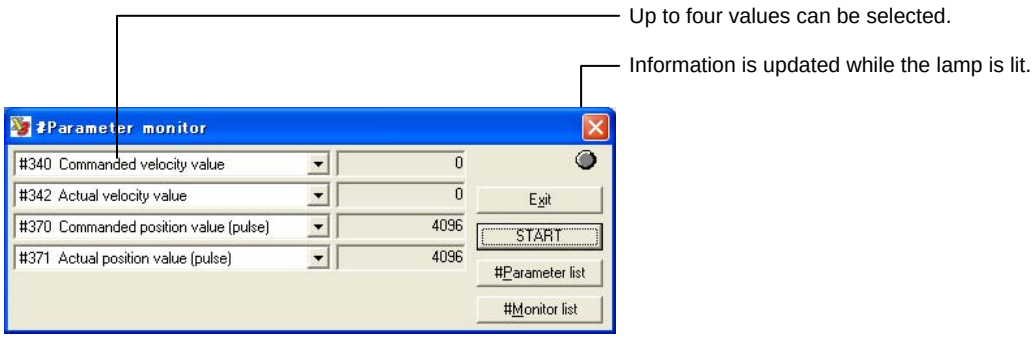
When observing an initial operation pattern or a parameter/monitor number, waveforms may not fit within the Oscilloscope window. In such a case, it is possible to easily observe waveforms by getting a rough display range using [Calibration], and then perform a fine adjustment.



(1) After selecting the parameter/monitor number you want to measure, operate the motor once. Press [START] on the oscilloscope to display waveform data in the window. After stopping the oscilloscope, execute a calibration. The vertical axis of each waveform is displayed in the center of the window after adjusting automatically.
(2) After performing a fine adjustment manually, press [START] on the oscilloscope again.

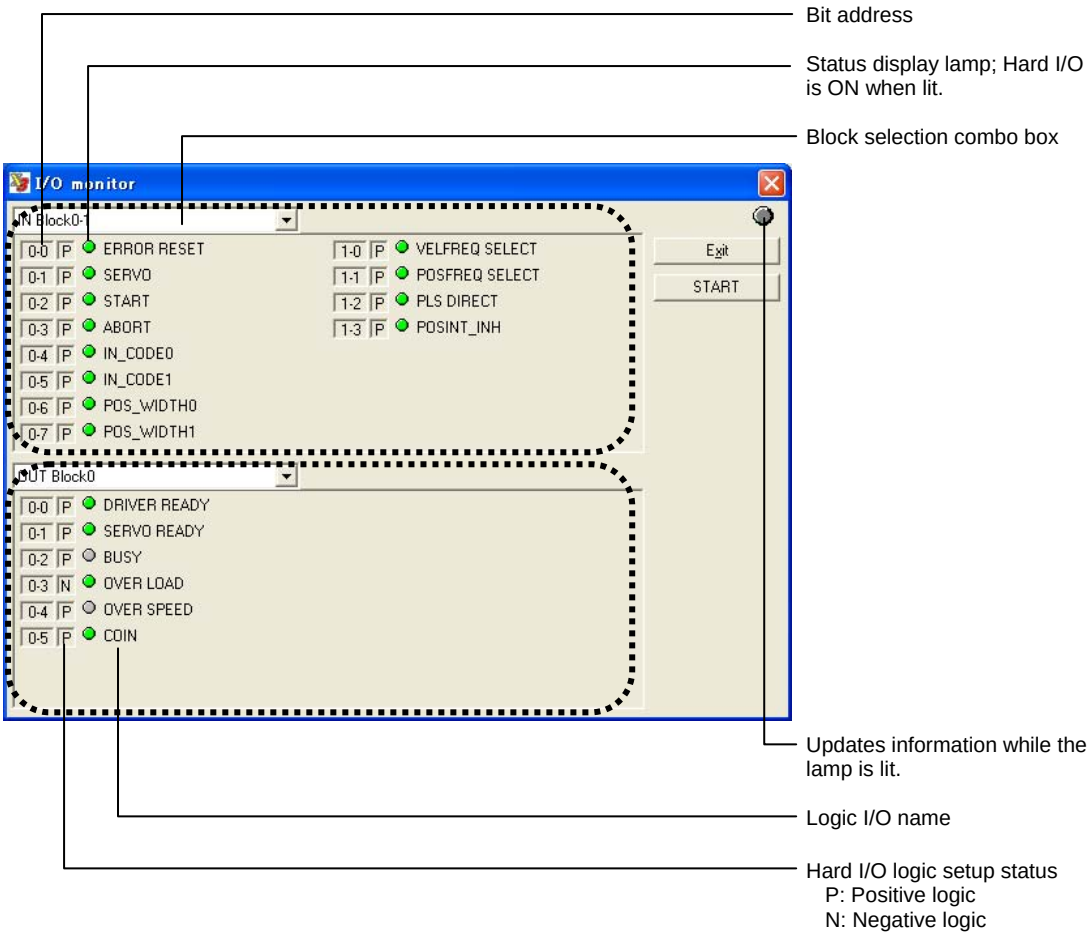
8.5.2 Displaying #parameter/ #monitor

A maximum of four #parameters/#monitor numbers can be updated and displayed continuously. Use this feature if you want to periodically monitor the #monitor values that are likely to change according to the operation of the motor.
However, if other dialog function is used, update may be stopped once. In such a case, resume the operation by pressing the [START] button.



8.5.3 I/O monitor

The hard I/O status of the connected drive is updated and displayed periodically. Assigned logic I/O names and the logic setup status of hard I/O are also displayed at the same time. However, if other dialog function is used, update may be stopped once. In such a case, resume the operation by pressing the [START] button.

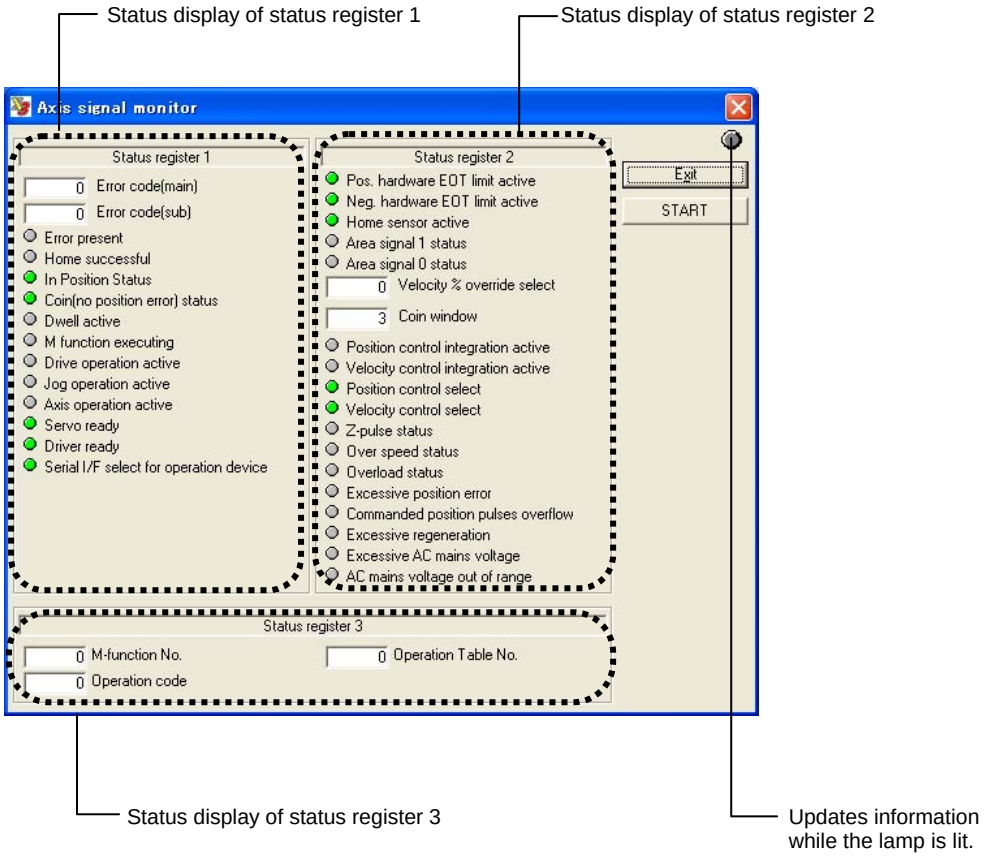


The I/O bits are managed using 8 points as one block in the drive. According to the example above, the input side has hard I/O of 0 blocks 8 bits and 1 block 4 bits, and the output side has hard I/O of 0 blocks 6 bits.
The number of points that can be monitored at a time is a 2-block unit for both input and output. For a drive that has more hard I/O, select the block you want to monitor from [Block selection combo box].

The I/O monitor is used to check whether or not a command signal has actually been entered into the drive when the motor does not operate as expected.

8.5.4 Axis Signal Monitor

The content of the monitor (status registers 1 to 3) that displays the main status of the motor axis is updated and displayed periodically. However, if other dialog function is used, update may be stopped once. In such a case, resume the operation by pressing the [START] button.

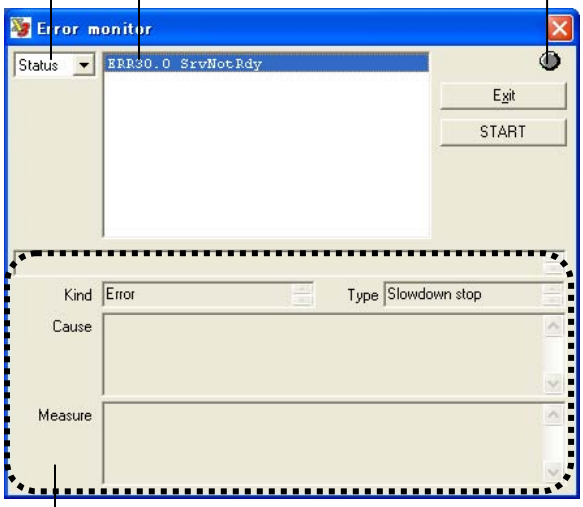


TIP

Information to be output to the status register includes each sensor signal to be input to the drive and the signal status of logic I/O. For more information about a description of each signal, see the chapter on "Operation."

8.5.5 Error Monitor

The drive acquires the record of errors that are currently being generated (hereafter referred to as status) and errors that were generated in the past (hereafter referred to as record). The drive retains record information retains even if its power is off. The drive stores a maximum of 16 statuses and record information. If an error number being displayed is selected, a detailed description pertaining to that error is displayed.
However, if other dialog function is used, update may be stopped once. In such a case, resume the operation by pressing the [START] button.



Switches between status and record information

For status display, a list of generated errors is displayed.
For record display, the past error record stored is displayed.

Updates information while the lamp is lit.

This is an area used to display detailed information about the error selected. It is useful for troubleshooting.

If the drive is in the error state, two or more error numbers may be generated from one error factor. In the status display, errors are displayed in the order they are generated. Therefore, the error displayed at the beginning may represent the main cause. In the status display, if the number of errors that are generated at once exceeds the maximum number of errors that can be stored (16), excessive errors are not displayed.
In record display, the date and time when errors are generated are displayed starting from the oldest date and time. The record information exceeding the maximum number of errors that can be stored (16) is deleted starting from the oldest record.

TIP

A numerical value in one hexadecimal byte length is displayed next to an error code when in record display. This value is a free-run counter value inside the drive at the time of an error occurrence. Although this drive does not have the calendar function, displayed errors can be grouped by error occurrence time by referencing this value.

8.6 Details of the Data Management Group Function

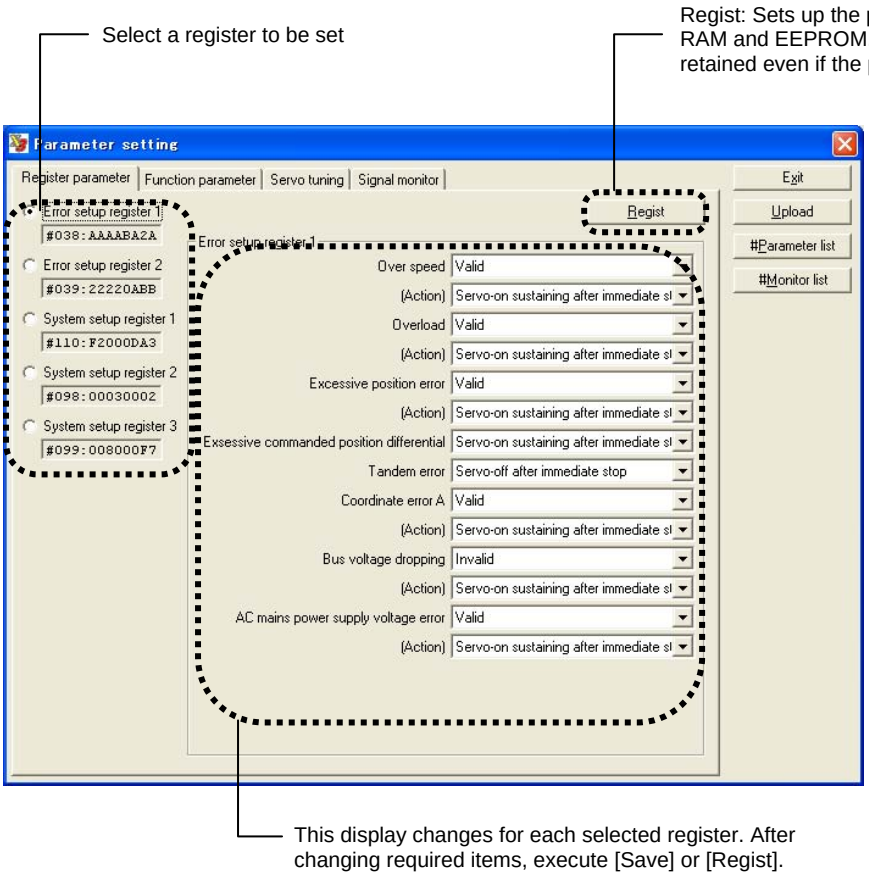
This section mainly describes the Data Management group that has the function of setting and changing internal drive data.

8.6.1 #parameters

A character string command from [Terminal] can also be used to set #parameters in the drive. However, in such a case, it is necessary to identify which #parameter of the function corresponds to which number.
The #parameter function provides #parameter Setting window that is classified by purpose and function. Therefore, #parameters for desired purposes can easily be set up.

■ Registering the Parameter Setting Window

Although each parameter of system setup registers 1 to 3 and error processing setup registers 1 and 2 is managed in 32-bit length, it has assigned a unique definition in units of bits internally. It is possible to perform similar settings from [Terminal]; however, settings can be made easily by using this setting window.

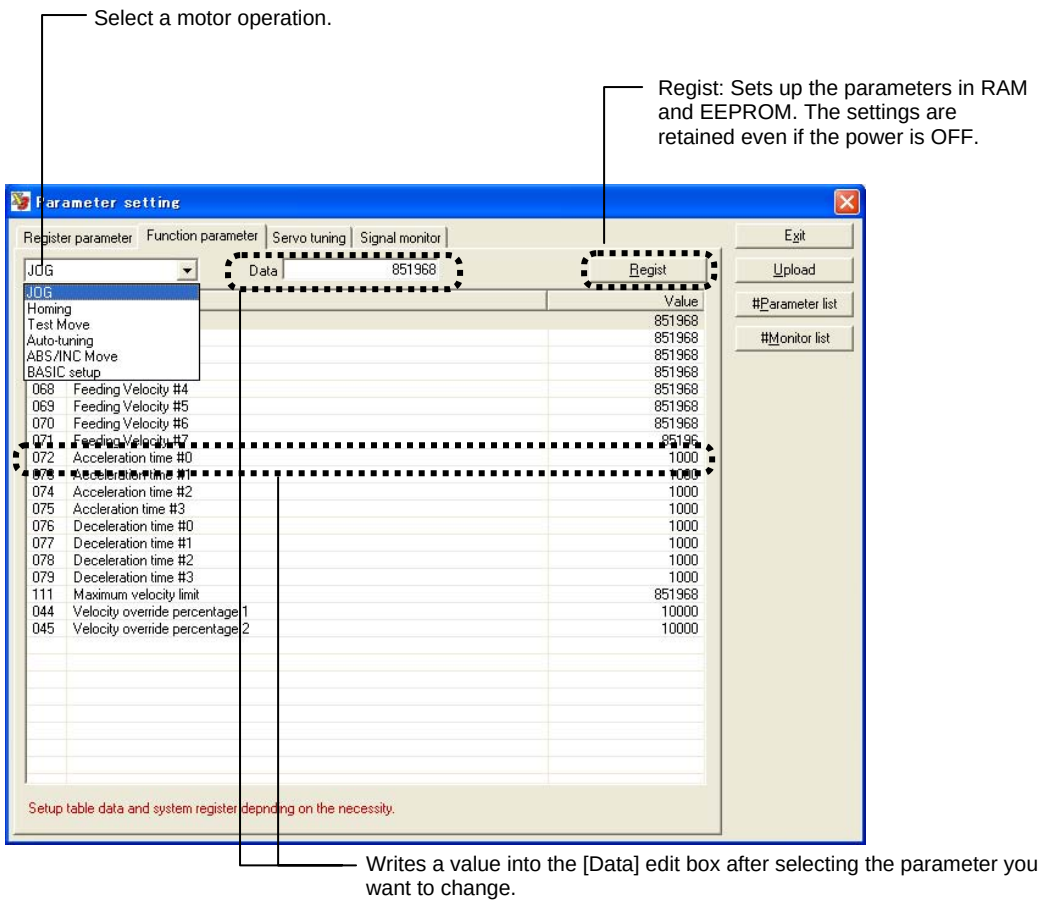


! DANGER

The utility software may issue a software reset to the drive in order to reflect changes when [Regist] is executed. As the servo is set to OFF during a reset operation, be sure to check safety before operating.

■ Function Parameter Setting Window

The Function parameter setting window contains the main #parameters that need to be set up when performing various motor operations. If it is necessary to change #parameters other than those listed in this window, use the terminal function.



TIP

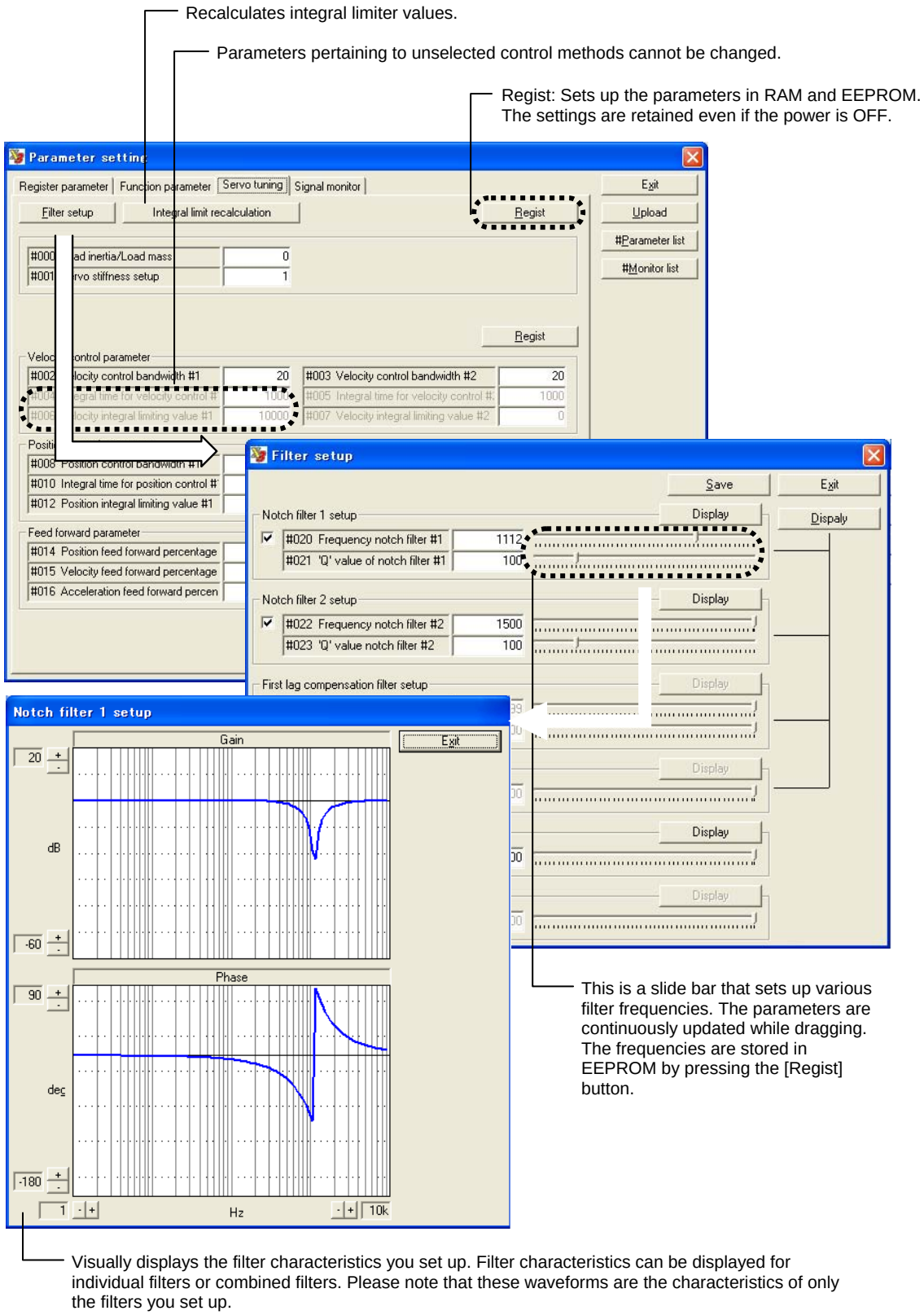
The setup items pertaining to motor operations are found in [Operation table] data and [System register] settings in addition to the items that can be changed in this window. Set up these items as necessary.

CAUTION

Machine setup parameters above #110 require a reset or power cycle before they take effect.

■ Servo Tuning Window

The Servo tuning window contains a #parameter group mainly pertaining to servo characteristics. If it is necessary to change #parameters other than those listed in this window, use the terminal function.

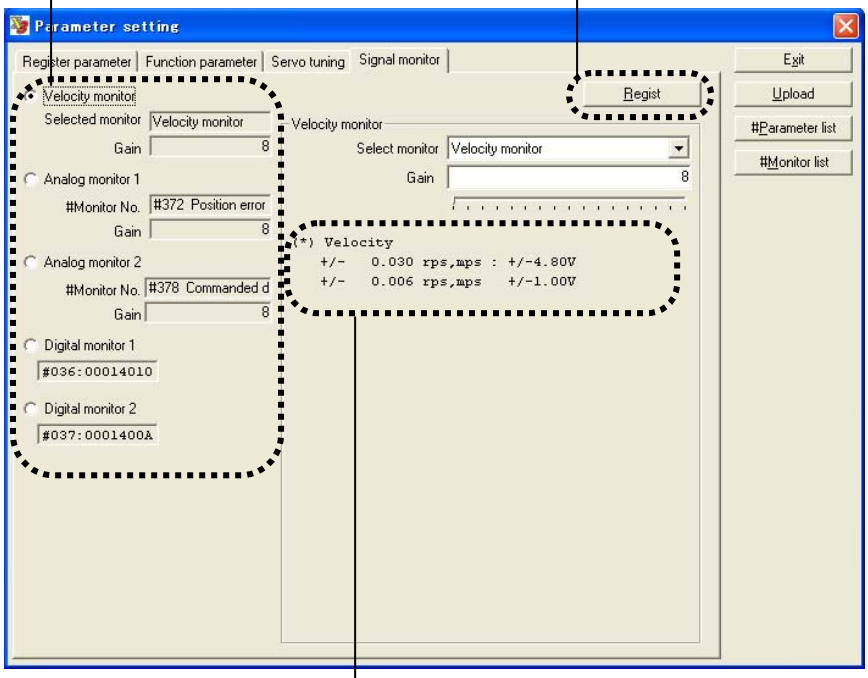


■ Signal Monitor Terminal Setting Window

This drive is equipped with various monitor terminals on the front panel in order to observe the drive status using an actual oscilloscope. The Signal Monitor Terminal Setting window is used to set up #parameter/#monitor numbers to be output as well as the output gain.

Select the monitor terminal to be set up. The status of the right setup area changes according to the selected terminal.

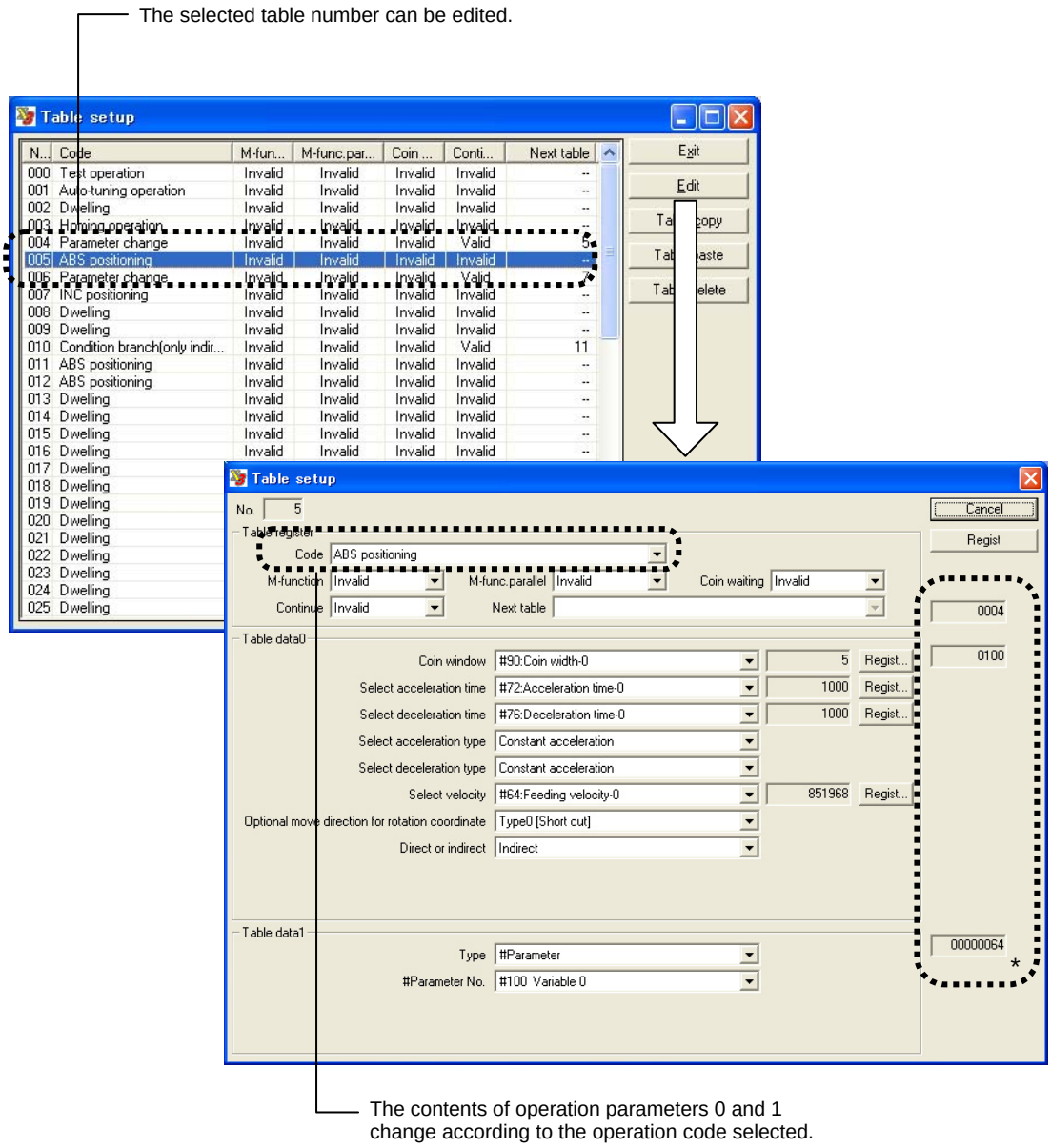
Regist: Sets up the parameters in RAM and EEPROM. The settings are retained even if the power is OFF.



Displays the voltage level output from an actual monitor terminal to the gain you set up. Adjust the gain setting according to the range in which the #parameters/#monitor numbers you want to monitor fluctuate

8.6.2 Table Data Function

The table data function is used to set and correct the operation table data of No.'s 0 to 63 stored in the drive. Each table of the internal table data consists of 8 bytes (16 bits + 16 bits + 32 bits). Table data can be created by a comprehensive wizard by using the table data function. Also, the move, copy and delete functions can easily be executed in units of tables by pressing the [Table copy] & [Table paste] button.



TIP

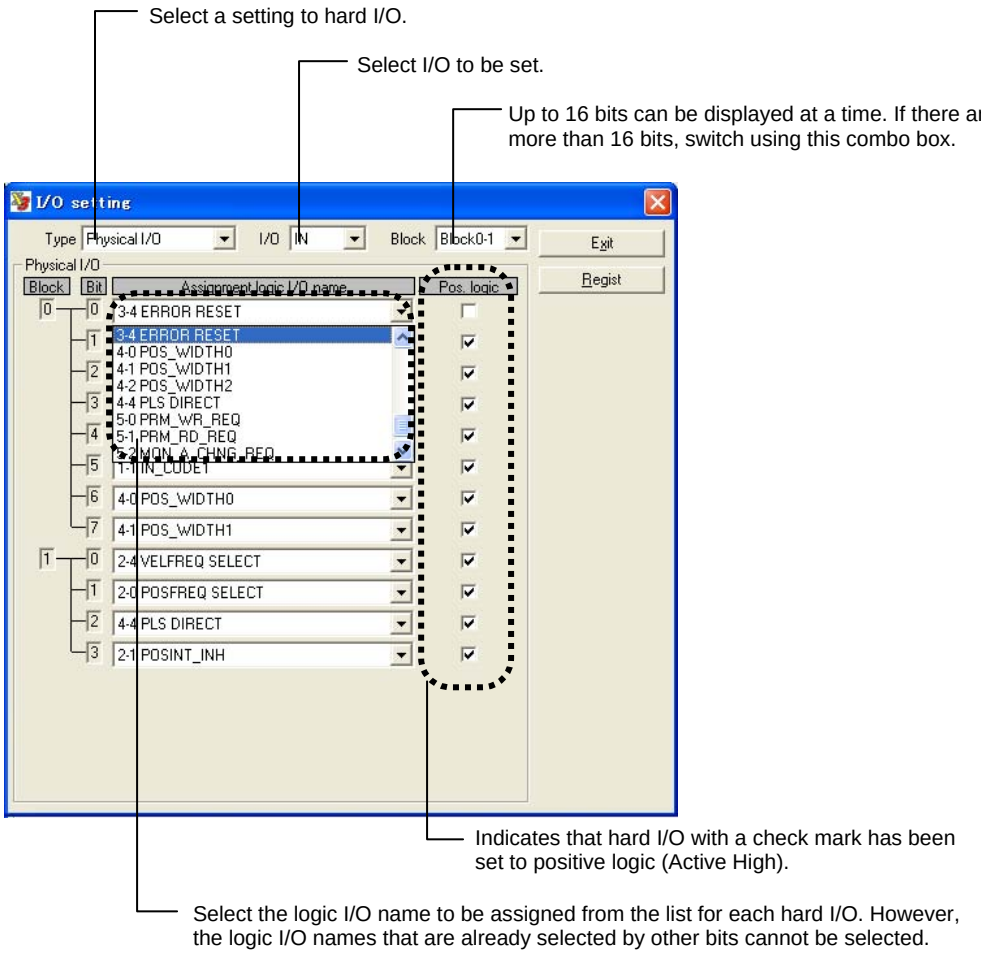
Three data indicated by "*" is raw operation table data. They are called "operation register," "table data 0" and "table data 1" from the top. "Operation register" is common in each operation. The use of "table data 0 and 1" vary depending on the operation code selected. These can be set up from [Terminal], but generally they are set up in this Table Data window.

8.6.3 I/O

This section describes the settings of the following items pertaining to logical I/O inside the drive (hereafter called logic I/O) and physical I/O actually embedded in the drive (hereafter called hard I/O).

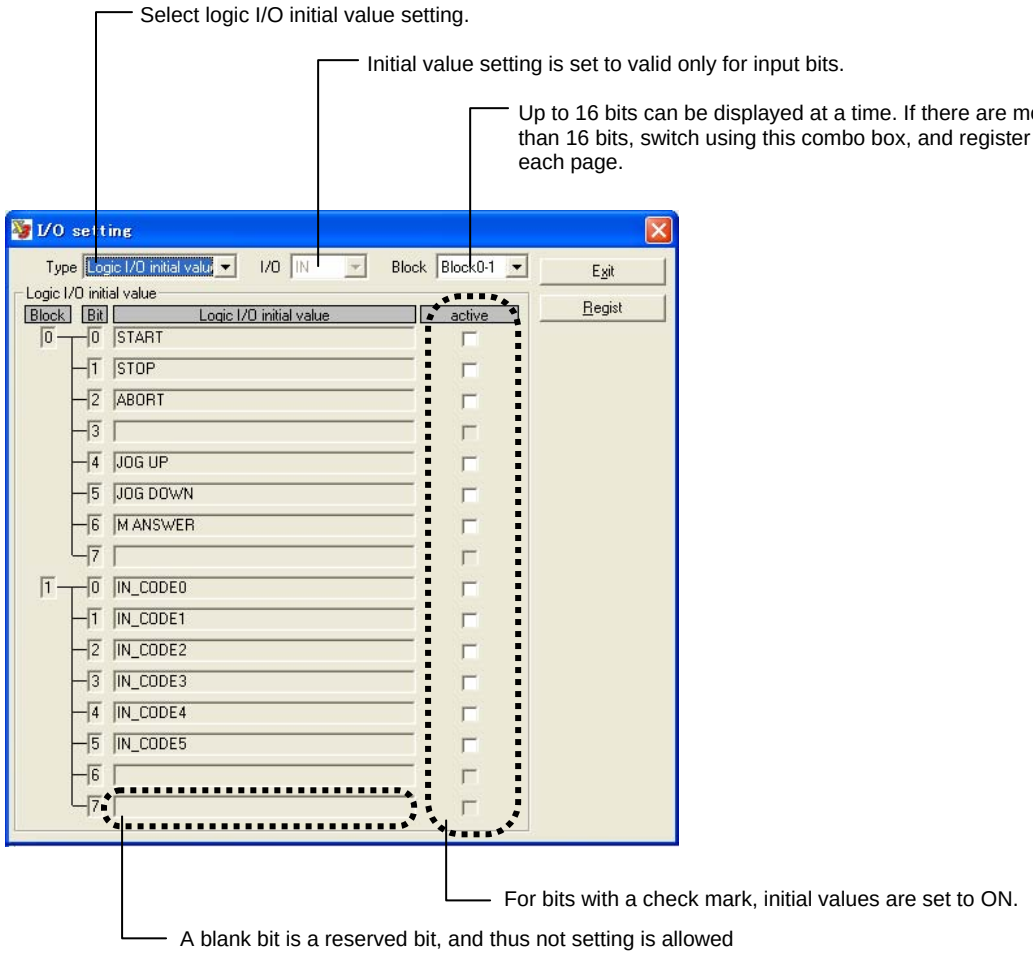
[1] Hard I/O assignment
[2] Hard I/O logical setting
[3] Logic I/O initial value setting

■ **Hard I/O Assignment and Hard I/O Logical Setting Window**



■ Logic I/O Initial Value Setting Window

The initial status of logic I/O at startup can be predetermined for each bit. For example, in the case of an application you want to turn the servo ON unconditionally at power on, you can do so after the power is turned ON by setting the applicable bit to ON when setting up logic I/O initial value, instead of assigning [Servo ON command] to hard I/O. This will save some hard I/O points.



DANGER

The utility software issues a software reset to the drive in order to reflect settings after executing [Regist]. The drive is set to the servo OFF state during a reset operation. Therefore, be sure to check safety before operating.

8.7 Details of the Maintenance Group Function

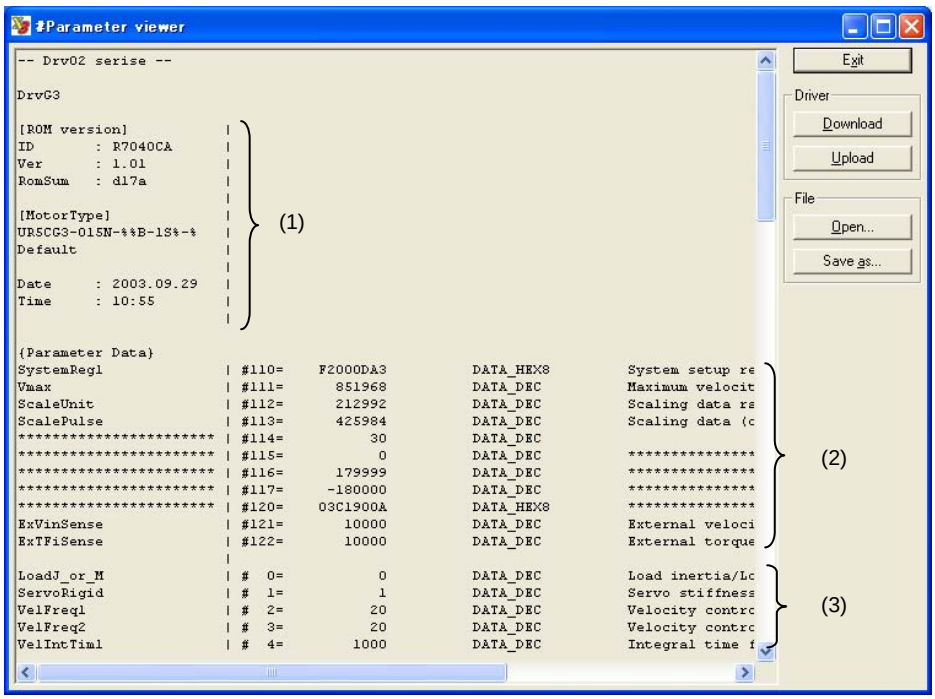
This section mainly describes the Maintenance group that has the function to browse, download and upload (*) the internal data of the drive.

TIP

Download: Processing to send data from a PC to the drive (restore work)
Upload: Processing to store the drive information to a PC (backup work)

8.7.1 #parameter Maintenance

The #parameter maintenance function is used to save and browse the #parameters set up by users and the user #parameters that are saved as files in the drive.
Downloading/uploading of only #parameters can be performed with the drive connected.



A #parameter file is saved as a text file. Although it is not necessary to be aware of the file format, a brief description of the file format is given below:

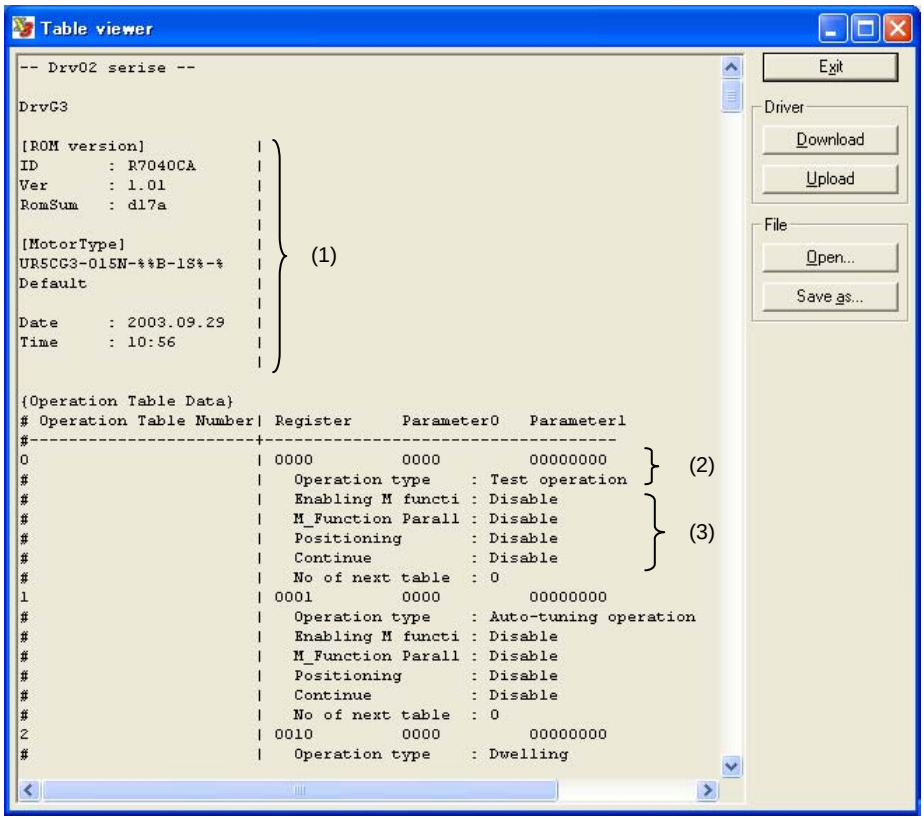
(1) It contains drive information, and is processed as comments.
(2) It is a group of machine setup parameters that requires cycling of the power to reflect it.
(3) It is followed by a group of regular parameters.

DANGER

The utility software issues a software reset to the drive after downloading of a group of machine setup parameters listed in (2) above as a download sequence to the drive. The drive is set to the servo OFF state during a reset operation. Therefore, be sure to check safety before operating.

8.7.2 Table Data Maintenance

The table data maintenance function is used to save and browse the setup data that is saved as table data or files in the drive. Downloading/uploading of only table data can be performed with the drive connected.



A table data file is saved as a text file. Although it is not necessary to be aware of the file format, a brief description of the file format is given below:

(1) It contains drive information, and is processed as comments.

(2) Data is saved in the order of the table No., operation register, table data 0 and table data 1 from the left.

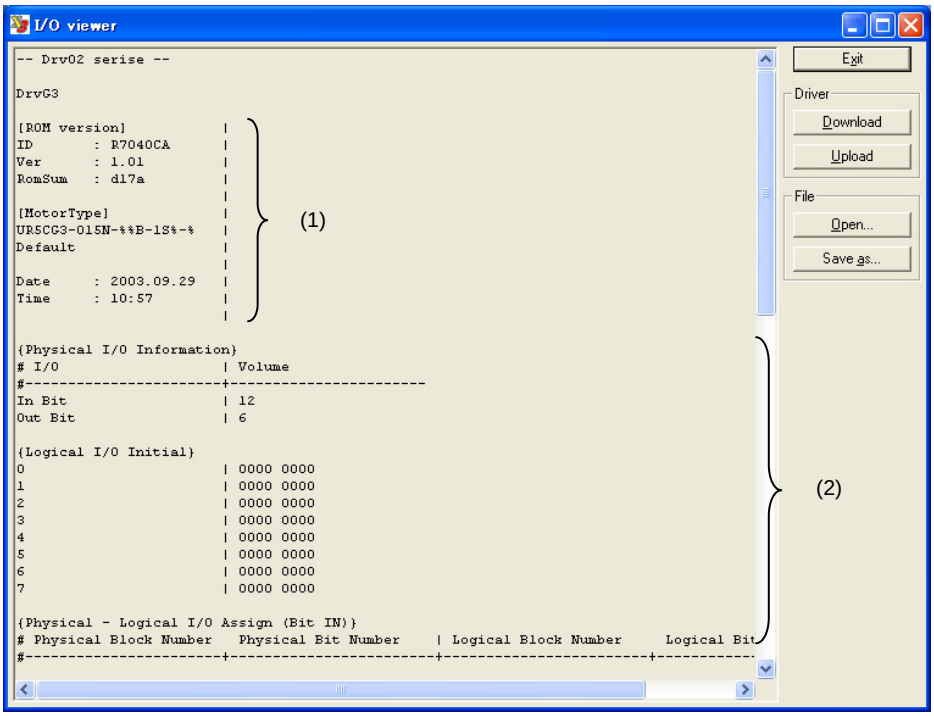
(3) It contains comments, which are the translations of the contents of the operation registers.

CAUTION

This function translates data obtained as post-processing of upload from the drive. This processing may take some time depending on the PC used.

8.7.3 I/O Maintenance

The I/O maintenance function is used to save and browse the I/O related settings defined in the drive or a definition file saved in the drive. Download/uploading of only I/O definition data can be performed with the drive connected.



An I/O data file is saved as a text file. Although it is not necessary to be aware of the file format, a brief description of the file format is given below:

(1) It contains drive information, and is processed as comments.

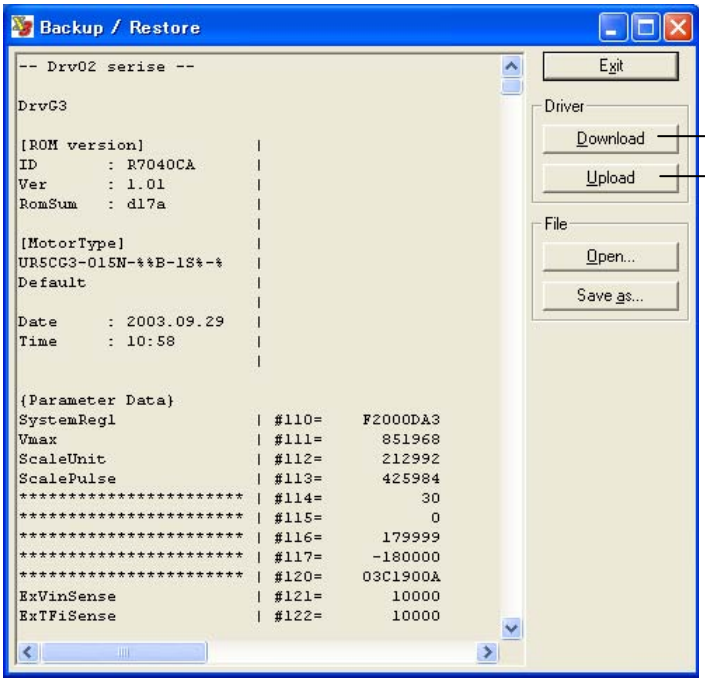
(2) It consists of hard I/O assignments, hard I/O logical settings, logic I/O initial value setup information and translated comments.

DANGER

The utility software issues a software reset to the drive after downloading all I/O settings in order to reflect the settings as a download sequence. The drive is set to the servo OFF state during a reset operation. Therefore, be sure to check safety before operating.

8.7.4 Backup

The backup function is used to perform the batch backup/batch restore operation of all user setup data set up in the drive. Backed up data is saved as one file.
This function is useful for backup work for maintenance and when creating a copy of drive data with the same settings.



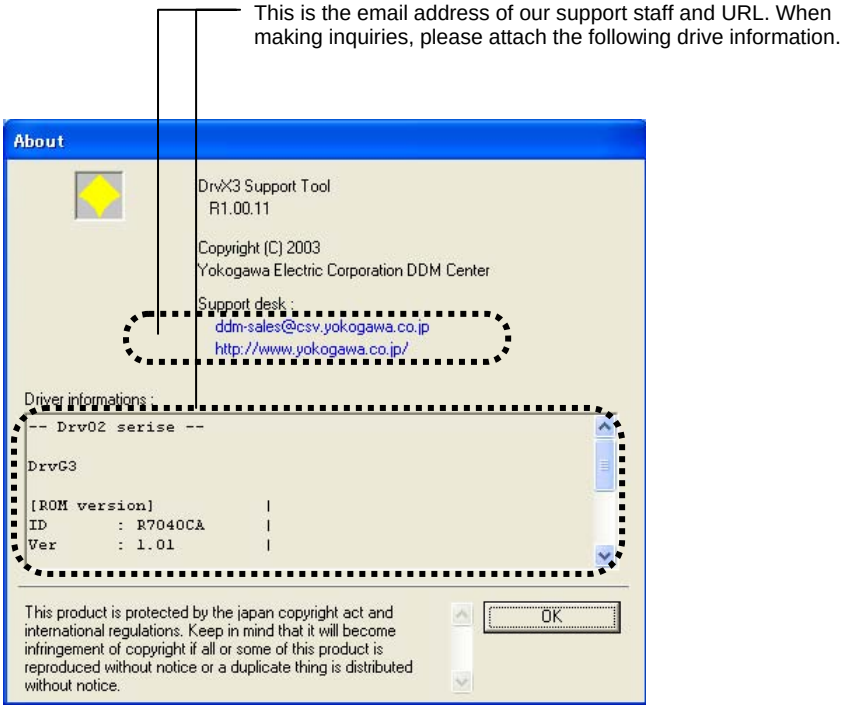
A backup file is saved as a text file. Its format is equivalent when the parameter file, operation table file and I/O setup file explained in the previous sections are connected.

! DANGER

The utility software issues a software reset to the drive as a download sequence. At this time, the servo is set to OFF, causing unexpected movements. When a reset confirmation message is displayed, be sure to check safety before operating.

8.7.5 Version Information

The currently connected drive's version information, motor type and other information are obtained and displayed. If you have any questions or inquiries about the product, contact our support desk shown in Version Information.



8.8 FAQ Pertaining to the Utility Software

This section describes the frequently asked questions (FAQ) pertaining to the utility software.

■ Updated Parameters are not Stored.

Writing data to a parameter (e.g., #1=2) changes only that value in RAM of the drive. Therefore, that data is erased when the power is turned OFF. If you want to store updated data, rewrite the parameter in EEPROM (e.g., ##1=2), or write all parameters using the @16 command.

■ The Utility Software Stops during Waveform Display due to a Communication Error.

Insufficient performance of your PC may be the cause. Check if the operating conditions are met. Close all other applications if possible. Especially, if you are using the oscilloscope function, it uses up more CPU power than any other functions.
If a communication error still occurs, change the communication cycle to a slower cycle. However, in such a case, the oscilloscope function cannot be used.

■ A Communication Error Occurs while Using the Oscilloscope Function for an Extended Period in Windows 98.

Particularly in Windows 98, it seems there is a time contention problem between the power supply monitor interrupt and the communication port interrupt. When using the oscilloscope function, disable all power supply monitor related functions.

■ Waveforms Different from Expected Waveforms were Obtained when the Time Axis was set to a Long Range.

Especially when the time axis is set to a long range, waveforms different from actual waveforms may be obtained especially relating to sampling. Always take account of an aliasing problem before using.

■ Communication Errors Occur Frequently on a USB-RS232C Converter.

Some converters may not operate correctly in this system. In particular, failure to receive data occurs with the frequently communicated oscilloscope function. Also, an error may occur during communication with the drive connected to the COM port of a PC due to the effect of the drive software's in the converter.

■ How can I Control the Drive from a PC Using an RS232C/485 Port?

We have control DLL for this purpose. You can create an application that controls multiple drives in Visual Basic from your PC by installing this control DLL. For more information, contact our Support Desk.

■ Installation Failed in Windows 98.

The utility software is supported in Windows 98 Second Edition or higher.

■ How can I Update Various Resource Files?

We periodically update the PDF and CSV files referenced from the utility software. To update these files on your system, download the latest versions from our Web site and overwrite them into the install folder.

9. Maintenance and Inspection

Do not disassemble the motor and the drive.
Make sure to conduct an overall inspection at least every 20,000 hours of operation or every 5 years. Depending on the operating environment and operating conditions, it is appropriate to carry out inspections at shorter intervals.
Depending on the result of inspection, the motor or the drive may require servicing or replacing.
If there are any problems with the external wiring or usage environment/operating conditions, solve such problems first and then repair or replace the motor or the drive.
Accumulated dust and dirt may cause failure; clean the motor and drive regularly to maintain good usage conditions.

9.1 Daily Inspection

Inspect the motor and the drive before the start of operation to check that there are no problems.
If you find any abnormalities, remove the causes and solve the problems before the start of operation. The daily inspection check list covers the minimum items that should be checked to ensure that there are no problems at the start of operation. Make sure the motor and the drive are in good conditions when using them, so that the operation will be stable and problem free.

Check item	Inspection	Judgment criteria
Power supply	Is the input voltage within the standard range?	200 ~ 230V + 10 to15% (200VAC system) 100 ~ 115V + 10 to15% (100VAC system)
Interface power supply	Is the input voltage within the standard range?	Depends on the interface specification
Peripheral environment	Is the ambient temperature appropriate?	0 ~ 40°C (motor) 0 ~ 50°C (drive)
	Is the humidity appropriate?	20 ~ 85% RH (motor) 20 ~ 90% RH (drive)
	Is there dust?	There must be no dust.
	Is there any condensation?	There must be no condensation.
Wiring condition	Are all connectors fixed securely?	The connectors must not be loosened.
	Are all screws of external wiring fixed?	The screws must not be loosened.
	Are there any cables that are close to getting cut?	There must be no abnormality in appearance and current conduction.
	Is there any interference between a cable and moving part?	There must be no contacts.
Installation condition	Is the main body fixed securely?	The main body must not be loosened.
	Is the load fixed securely?	The load must not be loosened.
	Are the driving sound and vibration normal?	There must not be any worse sounds or vibrations than during usual operation.
Conditions of internal mechanical parts	Are all bearings normal?	Bearings must rotate smoothly without play.
	Are the driving sound and vibration normal?	There must not be any worse sounds than usual operation.
Appearance	Are there any scratches, damages, dirt, deformation or discoloration?	There must be no scratches, damages, dirt, deformation and discoloration.

9.2 Backup and Restore Operations of User Data

It is recommended to back up user data to avoid data loss in case of accidents.
Backed up data is useful when startup new devices. For example, it is possible to restore particular backed up data on several drives to use the same settings for each of them.
Backup and restore operations can be performed using the following methods.

■ Backup and Restore Operations Using the Utility Software

By backing up user data using the utility software, the data can be saved as electronic files.
See Section 8.7.4, "Backup" for more information.

■ Backup and Restore Operations Using the Operation Display Pendant (Optional)

By backing up user data using the operation display pendant, the data can be saved in the embedded EEPROM of the operation display pendant. User data for multiple drives can be stored without using other external devices. See the technical document of the operation display pendant for more information.

9.3 Initialization of User Data (Reset All)

[Reset All] refers to returning all user data to the settings at the time of shipment from the factory. Perform [Reset All] when you want to redo the drive settings from the scratch.

●Operating Procedure

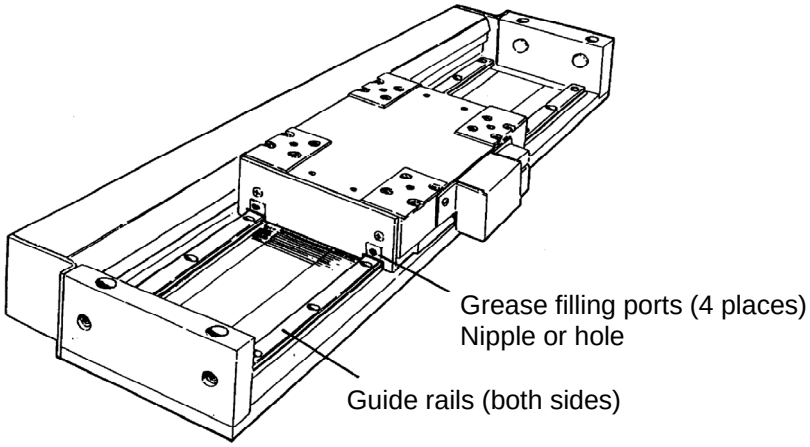
The reset all operation can be performed only by entering the designated command in [Terminal Function] of the utility software or [Terminal Function] of the operation display panel in order to prevent an erroneous operation. Erroneous operation can also be prevented by requiring a password with command. The command format is as follows.

@90 : 2003
└── Password

9.4 Lubrication of the Motor Unit

To protect the linear guide unit of the motor unit against wear and damage, and assure a sufficiently long product life, it is important to keep the guide unit constantly lubricated.
For the linear guide unit of the motor unit, apply sufficient grease for lubrication from the grease filling ports shown in the figure below using a grease gun whenever the motor has operated for 100 km of driving distance or three months, whichever is sooner. After application, wipe away the excess grease from the linear guide unit using lint-free cloth or similar material. The rails of the linear guide unit require lubrication. Do not wipe the motor with organic solvent or similar substance. Using such solvent may damage the guide and motor units.
Different types of grease should be used depending on the model used. Be sure to refill with the appropriate grease. If in doubt, consult Yokogawa regarding the type of grease and grease gun to be used.

Model	Grease to be used
LM105/LM110/ LM505/LM510	Multemp PS No. 2 (made by Kyodo Yushi)
LM130/ LM205/LM210/LM230/LM240 LM305/LM310/LM330 LM530	AFB grease (THK) for THK guide Albania EP2 (Showa Shell) for IKO guide



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◆ Details of Main Error Codes

Name	Error code	Recovery	Cause and condition detected	Action taken at occurrence	Countermeasure
Memory error					
ROM error	1.1	Not possible	An error was detected during memory check	Initial processing not completed	○ Cycle the power. ○ If all uploading has been complete, initialize the drive. ○ It is necessary to repair the drive board.
RAM error	1.2				
EEPROM error	3.0	Not possible	An error was detected in EEPROM that stores data	Initial processing not completed or deceleration stopped	
Watchdog error	4.0	Not possible	The drive CPU is not operating properly	Reset the CPU (communication operation set to valid)	
Data checksum error					
Parameter checksum error	10.1	Not possible	It was detected that the stored data was destroyed during processing when the power was turned ON.	Initial processing not completed	
Operation table checksum error	10.3				
I/O setup data checksum error	10.5				
Data error					
Motor/drive data error	11.1	Not possible	It was detected that the setup data could not be processed during processing when the power was turned ON.	Initial processing not completed	
System data error	11.3				
Power module mismatch	11.4				
Old coordinate system setup data error	11.5				
Error record data error	11.6				
Encoder error					
SIG0 edge disengaged	15.1	Not possible	An error was detected in an encoder/resolver signal. ○ Contact failure or breakdown of a connector ○ Cable disconnection ○Noise is generated in an encoder/resolver cable. ○ A problem inside the motor ○ A problem in the drive * Check the conductivity of the cable by using a tester. The contact area must not be deformed or damaged.	Servo OFF	○ Check the connector section, repair or replace if necessary. ○ Replace the cable. ○ Eliminate the noise generating source, and review the wiring route. ○ Replace the motor unit. ○ Replace the drive.
SIG1 edge disengaged	15.2				
SIG0 cycle error	15.3				
SIG1 cycle error	15.4				
Coordinate system error A					
Eccentric compensation error	16.1	Not possible	It was detected that the slit plate deviated from the center and exceeded the allowable eccentric volume in a DM series motor unit (except DM1B-004/006, DM1C-004). ○ A moment load was applied to the rotation section. ○ A support and cable made contact with the hollow hole and therefore force was applied. ○ A substantial impact was applied to the motor. ○ An abnormal encoder signal was generated. * A low velocity (0.05rps or less) was used for detection.	Error setup register 1 dependent, bits 11 to 8	○ Remove the load, and also remove the one that is giving force. ○ Adjust the support and cable so that they are not in contact with the hollow hole. ○ Repair the motor unit if an error occurs while in the no-load state. ○ Check the items pertaining to the encoder errors.
Coordinate system error B					
Outside of command coordinate area	17.2	Possible	The setup value to be used for coordinate system operation (coordinate value setting) was less than 0 or more than the scaling command unit value when the rotation coordinate system was used.	None in particular	
Monitor pulse error	18.0	Not possible	Attempted to generate a pulse of 3MHz or more, which exceeded an allowable monitor pulse output. ○ The motor overran. ○ Resonating and hunting.	Error setup register 2 dependent, bits 11 to 8	○ Check the wiring of the motor cable and encoder cable. ○ Take an action against resonance, and set an appropriate adjustment value. ○ Set the scaling data to an appropriate value.

Name	Error code	Recovery	Cause and condition detected	Action taken at occurrence	Countermeasure
Power module error					
Over-voltage	20.1	Possible	Over-voltage level ≤ main line voltage value	Servo OFF Regeneration error output	○ Check the main power supply voltage level. ○ Verify that the motor is not rotated by an external force.
IPM fault	20.2		Temperature: 150°C or more Control current: 12.5V or less Over-current: 27A or more at 500W, 5μs 54A or more at 2kW, 5μs Output short-circuited With 1msec chattering process	Servo OFF	○ High ambient temperature and high current duty ○ The GND of the motor cable is wrongly wired to one of phase A, B or C. ○ Verify that the motor is not rotated at a high velocity by an external force.
Current transformer detection			Detection level: 15A at 500 W, 1μs 45A at 2kW, 1μs With 1msec chattering process		○ The GND of the motor cable is wrongly wired to one of phase A, B or C. ○ Verify that the motor is not rotated at a high velocity by an external force.
Low voltage	20.3		Low voltage (servo OFF) level ≤ main line voltage value < low voltage level	Error setup register 1 dependent, bits 7 to 4	Check the main power supply voltage level.
Low voltage (servo OFF level)	20.4		Main line voltage value < low voltage (servo OFF) level	Servo OFF	
Phases A and B actual current monitoring	20.5		Phases A and B actual current vector lengths (after bandwidth 10 Hz filter processing) exceeded 110% of the maximum motor current.		
Main power supply error	21.0	Possible	XMPSIG output threshold: 70VAC XMPSIG from the power module maintained the OFF state exceeding the value set up in system setup register 1.	Error setup register 1 dependent, bits 3 to 0	Check the main power supply voltage level. ○ The main power supply is momentary shut down. ○ Fluctuations of the main power supply are substantial.
Overload					
Motor coil line overload	22.1	Possible	The power-squared duty is calculated from the current command value, but it exceeded the designated value. Perform current control without monitoring setting. Limited current when the value became lower than the cancellation current-squared duty value.	Error setup register 1 dependent, bits 27 to 24 Current control was executed regardless of its setting.	○ Review the operation cycle. ○ Set a longer acceleration/deceleration time. ○ Eliminate an external force that is constantly being applied. The current-squared duty can be checked by #386.
Heat sink over-heat	22.2		Detected a heat generation of 85°C or more inside the drive. Limited current while detecting, and cancelled it when not detecting.		Check the ambient temperature and installation environment of the drive.
Excessive position deviation	23.0	Possible	The position deviation exceeded the user setup value when position control was executed. ○ Acceleration/deceleration time is too short. ○ Servo tuning failure	Error setup register 1 dependent, bits 23 to 20	○ Set a longer acceleration/deceleration time. ○ Perform a servo tuning again, and set an appropriate value. ○ Eliminate an external force that interferes with the motor's rotation.
Over-speed	24.0	Possible	The absolute value of the current velocity value detected from SIG0 was more than the maximum velocity of the motor. The velocity exceeding the monitor #305 value was detected.	Error setup register 1 dependent, bits 31 to 28	○ Set a longer acceleration/deceleration time. ○ Perform a servo tuning again, and set an appropriate value.
Regeneration error					
Regeneration resistor over-load	25.1	Not possible	Excessive electric power was applied to a regeneration resistor, and thus the allowable electric power of the regeneration resistor was exceeded.	Servo Off Regeneration error output	○ If a regeneration resistor is not installed, install one. ○ If this error occurs when a regeneration resistor is already installed, review the acceleration/deceleration time and the operation cycle. ○ The motor unit is rotated by an external force.
Regeneration FET over-load	25.2		Excessive electric power was applied to a regeneration FET, and thus the allowable electric power of the regeneration FET was exceeded.		
Regeneration circuit error	25.3		The RGN_FET status and RGN_ANS status sampled at every msec were verified at every 32msec. This error occurred when a difference exceeding 2 digits was detected in each on-duty.		

Name	Error code	Recovery	Cause and condition detected	Action taken at occurrence	Countermeasure
Servo not ready	30.0	Possible	The Servo OFF state occurred during an axis operation by internal control, or during an axis operation by an external position command.	Servo OFF	○ Check the wiring, power supply and PLC software so that the IN_SERVO signal does not change during an operation. ○ Execute an axis operation command after turning the servo on.
Excessive position command differential value	31.0	Possible	Attempted to execute an axis operation at a velocity exceeding the maximum motor velocity set by the user during an axis operation by internal control, or during an axis operation by an external position command.	Error setup register 1 dependent, bits 18 to 16	The maximum rate of pulse input exceeded the maximum velocity (#305) of the motor.
+ direction hardware EOT	42.0	Possible	A + direction EOT signal was detected during an axis operation by internal control, during an axis operation by an external position command, or while moving in the + direction.	Error setup register 2 dependent, bits 31 to 28	○ Reduce the amount of movement so that it does not exceed the hardware EOT sensor. ○ Change the conversion of pulse units. Is the sensor operating normally? Is any noise generated on the sensor power supply? ○ Check the wiring connection of the sensor.
- direction hardware EOT	43.0	Possible	A - direction EOT signal was detected during an axis operation by internal control, during an axis operation by an external position command, or while moving in the - direction.	Error setup register 2 dependent, bits 27 to 24	
+ direction software EOT (only for linear coordinates)	44.0	Possible	The target axis operation position by internal control is within the + direction software limit area. The command unit instruction value is within the - direction software limit area during an axis operation by internal control, during an axis operation by an external position command, or while moving in the + direction.	Error setup register 2 dependent, bits 23 to 20	Check the motor's instructed movement amount against the current position. Is the position exceeded the set software over-limit area?
- direction software EOT (only for linear coordinates)	45.0	Possible	The target axis operation position by internal control is within the - direction software limit area. The command unit instruction value is within the - direction software limit area during an axis operation by internal control, during an axis operation by an external position command, or while moving in the - direction.	Error setup register 2 dependent, bits 19 to 10	
Immediate stop	46.2	Possible	An immediate stop input signal from the user was set ON.	Error setup register 2 dependent, bits 7 to 4	○ Set the immediate stop signal to OFF, and reset the error. ○ If the error status still remains even if the error is reset: 1. Check the wiring. 2. Check the internal parameters.
Homing error					
Origin dog position error	49.1	Possible	The distance between the origin proximity signal edge and Z-pulse edge is out of the designated range.	Stop the operation	Adjust the dog position.

Name	Error code	Recovery	Cause and condition detected	Action taken at occurrence	Countermeasure
Not executable					
Executing	50.2	Possible	A command that could not be executed during an operation was issued.	Deny the command	Execute the next operation command after the current operation is complete.
An error is being generated	50.3		A command that could not be executed when an error occurred was issued.		Clear the error and then operate.
Invalid data	50.5		Data that could not be processed was included.		
Access timing	50.6		A command was issued while in the invalid state, such as issuing a parameter registration command while parameter registration was being processed.		
Drive mode	50.7		A command that could not be executed in the drive mode during an operation was issued.		
Data not ready	51.2	Possible	Data was requested while data to be sent to the built-in logger was not ready.	Deny the command	
Time out	52.0	Possible	Timeout was generated during internal processing. Waveform capture during an auto-tuning operation failed.	Stop operation	
Not calculable					
Auto-tuning	53.1	Possible	A condition in which computations could not be performed occurred in internal processing The range of the waveform capture time during an auto-tuning operation was exceeded.	Stop operation	
Command translation Invalid	60.0	Possible	A command that could not be translated was issued.	Deny the command	
Command format error	61.0	Possible	A command that did not match the command format was issued.		
Out of range data	62.0	Possible	A command using data that exceeds the allowable range was issued.		
Invalid parameter/monitor number	65.0	Possible	A command that specified a parameter/monitor having a non-existent number was issued.		
Invalid device	66.0	Possible	A command was issued by an interface that did not have an operation privilege.		

Error process setup register 1

	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Initial value	Over-speed				Over-road				Excesive position deviation				Invalid setting disable	Position command differential			Invalid setting disable	Tandem error			Coordinates error				Main line power supply voltage lowered				Main power suppl yerror			
Initial value	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	1	1	0	1	0	1	0	1	0	1	0	1	0

Error process setup register 2

	+direction hardware EOT	-directionh hardware EOT	+direction soft OT	-direction soft OT	(reserve)		Interface emergency stop	(reserve)
						PⅢ CC-Link communication error GⅢ monitor pulse error		
	Valid/Invalid	Processing at error occurrence(0 to						

0:Maintains servo ON after deceleration and stop
1:Servo OFF after deceleration and stop
2:Maintains servo ON after sudden stop
3:Servo OFF after sudden and stop
4:Servo OFF immediately

Initial value	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0

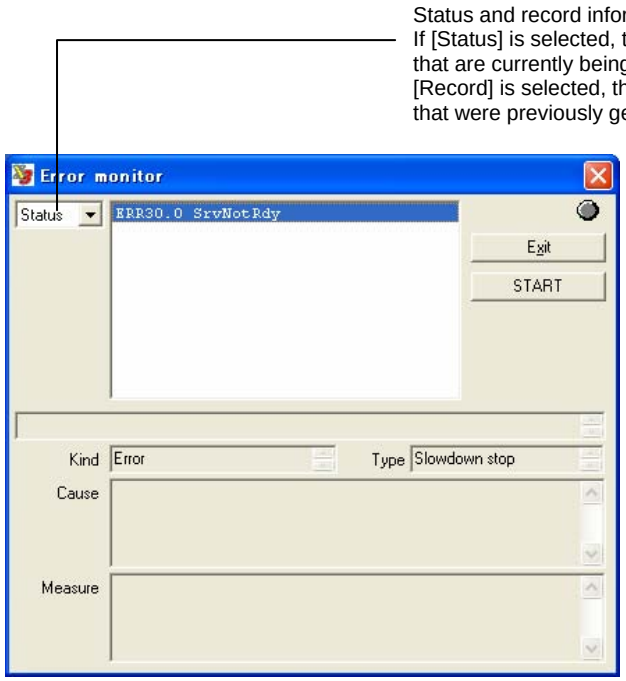
DrvGⅢ	1	0	1	0	1	0	1	1
DrvPⅢcontact	0	0	1	0				

How to Check Error Codes

When an error occurs, the [RDY/ERR] LED on the drive's front panel is illuminated red. In the event of an error, check the error code using the utility software and following the steps below. For more information about the error windows, see Section 8.5.5, “Error Display.”

How to check an error

STEP1 Select [Error display] in the utility software.
STEP2 Select [Status] from the [Status/Record] switch field.
STEP3 Select [START] to display an error list.
STEP4 Select [STOP], and click the error you want to display in detail. An error detail is displayed.



If the drive is placed in the error state, two or more error numbers may be generated from one error factor. The errors are displayed in the order generated in status display. The error that is displayed first may likely be the main cause. If the number of errors that is generated at a time exceeds the maximum number of errors (16) that can be stored, excessive errors are not displayed in status display.
Conversely, in record display, the date and time of errors generated are displayed in the order beginning from the oldest date/time. If the past errors exceed the maximum number of errors (16) that can be stored, they are deleted in the order beginning from the oldest one.

◆ Glossary

This glossary lists the terms used in this document.

■ Symbols

#
Indicates the number of a parameter stored on RAM. Example: #100

##
Indicates the number of a parameter stored on EEPROM. Example: ##100

@
Indicates a command number. Example: @3:10

@Command
A general term for operation commands issued from a PC to the drive. Example: @3:10

■ A

ABS
Absolute position, or a motor built in with an absolute position detector called the ABS motor

Absolute Accuracy
The difference between the angle at which the motor should be rotated (instructed value) and the angle at which the motor actually rotates. This value is displayed after adding a sign to a half of the maximum value for the entire circumference of one rotation.

Absolute Positioning
Operation to position at an absolute coordinate position

Alarm
A warning whose level is lower than an error

Aliasing
A phenomenon in which waveforms cannot be displayed accurately when the sampling velocity becomes half (Nyquist frequency) or below the input signal. Generally, in order to display accurate waveforms on a digital oscilloscope, a sampling velocity about 4 to 10 times the frequency of the input signal as well as a frequency band at least three times the frequency of the input signal are required.

All Reset
An operation to return all user data to the factory preset values.

Analog Monitor Card
A board that is inserted into a connector of the front panel section of the drive and used to monitor the velocity and other information using an oscilloscope (optional).

Analog Monitor Terminal
General-purpose monitor terminals AM1 and AM2 on the analog monitor card

Argument
An option to be added to an operation command. Some commands have no argument or have multiple arguments.

Auto Start Table
Set [Auto Start Function] to [Valid] to perform automatic operation after the power is turned ON. By this setting, the table having the number that has been set up starts.

Auto Tuning
: A series of operations to rotate the motor, measure the load inertia/load mass, and set up the parameters of the control section on its own.

Axial load (Forward, Reverse)
: The motor is fastened to the base and a uniform dead load is applied to the rotor's load mounting area in the axial direction. The "axial load" is the maximum load when all component parts of the motor are within the elastic deformation zone. When the load is removed, all the component parts must be restored to their original states. Note that the forward axial load refers to contracting the motor in its axial direction, and the reverse axial load refers to adding a load to the motor in its expansion direction.

Axial stiffness (Forward, Reverse)
: This refers to the axial displacement per unit axial load when the motor is fastened to the base and a uniform dead load is added to the rotor's load mounting area in the axial direction within the axial load. "Axial displacement/axial load" must be linear. Forward Axial stiffness refers to contracting the motor in its axial direction, and the reverse Axial stiffness refers to adding a load to the motor in its expansion direction.

AXIS
: Motor axis

Axis Command Unit
: The common unit set up by the #112 parameter

■ B

Backup
: Storing data from the drive to an upper device (PC, operation display pendant). Same as upload.

Basic Data
: Maker information of the drive/motor, which cannot be manipulated by users. This data cannot be erased by all reset operations.

BCD
: Binary coded decimal

BIN
: Binary

Binary Code
: A numerical code in binary notation

Bit AND
: AND for each bit. This is used to extract several bits.

Bit EXOR
: Exclusive OR for each bit

Bit OR
: OR for each bit. This is used to turn ON several bits.

Block
: Logic I/O and physical (hard) I/O are internally managed in 8-bit units, each of which is called a block. I/O settings are also performed in block units.

Branching
: To branch. Table operation - condition branching

Bus Voltage
: Main power supply voltage after rectification

■ C

CC-Link
: Open network standard - fieldbus

CCW
: Counterclockwise - Counterclockwise direction when the motor is viewed from the load mounting plane

Chattering Processing
: In this document, it refers to the processing to give hysteresis for eliminating unnecessary ON/OFF when generating a position settling signal. The number of processing to be performed can be set up using a parameter.

COIN
: Coincidence signal (position settling signal) - A signal that is output when the motor is within the coin window that has been set up

Coin Waiting
: In motor operation, this refers to a wait until the motor is positioned within the coin window before moving to the next operation upon completion of a position command.

Control Power Supply
: A power supply for the control board

Current Transformer
: A transformer built in the power module for detecting current. It monitors the current of the bus.

CW
: Clockwise - Clockwise direction when the motor is viewed from the load mounting plane

■ D

DEC
: Decimal

Decimal Code
: A numerical code in decimal notation

Digit
: Unit of calculations used by firmware inside the drive

Digital Monitor Terminal
: Dedicated digital monitor terminals DM1 and DM2 on the analog monitor card

DM series
: Motors built in with an optical encoder

Download
: Writing data from an upper device (PC, operation display pendant) to the drive

DR series
: Motors built in with a magnetic encoder (resolver)

■ E

EEPROM
: Nonvolatile memory built in the drive that stores mechanical data and user data. There is a limit on the number of times it can be rewritten.

Encoder Resolution
: Number of pulses output from the encoder when the motor makes one rotation.

EOT
: EOT signal - there are hardware EOT and software EOT.

Error
: An abnormality whose level is higher that an alarm. Errors are classified by error number. For some errors, the behavior of the motor after an error occurrence can be defined using the error setup register.

■ F

Filter
: A function to remove unwanted signal components from signals

Firmware
: A program code of the CPU in the drive

Function Key
: General-purpose keys on the operation display pendant. The functions of these keys change depending on the screen displayed.

■ G

■ H

Heat Sink
: Radiating fins on the side of the drive. Equipped only on 2kW drives.

HEX
: Hexadecimal

Hexadecimal Code
: A numerical code in hexadecimal notation

Hollow Hole Structure
: A motor structure in which a hollow hole is provided in the center of the motor axis so that piping, a wiring, shaft and ball screws can be fed through in the DYNASERV.

Host
: An upper device that sends instructions to the drive

■ I

ID
: Drive station number set up by the rotary switches on the front panel

Idle State
: A state in which no operation is being performed

INC
: Increment (relative position notation)

Increment Positioning
A relative move command from the current position

Interlock
The velocity override value is set to 0% internally.

Invalid
Invalid state. To not use a specific function in parameter settings, etc., set to invalid (0).

IPM fault signal
An error signal output by the IPM unit built in the power module

IPM fault signal
An error signal output by the IPM unit built in the power module

■ J

■ K

kpulse
Unit of pulses obtained by raising 10 to the third power

■ L

Linear Coordinate System
A coordinate system that manages coordinates within a range of -999999999 to 999999999 linearly. If this range is exceeded, a software EOT error occurs.

LM series
Linear motors

Load Inertia
The moment of inertia of load attached to the motor

Load Scale Factor
Load scale factor [K] = load inertia/rotor inertia

Logic I/O
A virtual I/O of firmware in the drive. Some of logic I/O are assigned to actual I/O (hard I/O).

Logic I/O Initial Value
Initial values (ON or OFF) at power-on start can be set up for logic I/O (inputs only). Setting initial values to logic I/O actually assigned to hard I/O has no significance as they are initialized to external commands at startup.

■ M

Machine Resonance
Since the DD motor directly drives load, the characteristics of the load may affect the control system, causing oscillations. These oscillations include hunting and windup phenomenon at a relatively low frequency (several Hz), an oscillation around a high frequency phase, and a mechanical oscillation. To take appropriate countermeasures, it is necessary to know the accurate resonance frequency.

Machine Setting Parameter
If these parameters are changed, the changes made take effect when the power is turned ON next time (parameters starting from #110).

Main Power
A power supply for operating the motor

Maker Data
Internal data set up by Yokogawa. This data cannot be set up by users. It cannot be erased by all reset operation. (Basic data, adjustment data)

Manual Tuning
An operation for adjusting each control parameter by operating the motor via a test operation and then using an oscilloscope and the utility software functions.

Master
Indicates the master motor/drive in a master and slave relation in tandem operation.

Maximum Output Torque
The motor's output torque when driving at the drive's maximum output current. The maximum output torque is generated at startup (the velocity is zero) in the case of DD motors.

Maximum overhung load
The motor is fastened to the base and a moment dead load is applied to the rotor's load mounting area in the direction where the rotor's rotation axis core is tilted. The "maximum overhung load" is the maximum load when all component parts of the motor are within the elastic deformation zone. When the load is removed, all the component parts must be restored to their original states. In addition, the gap between the rotor and the stator core must not be zero (the core makes contact) in the worst condition.

Maximum Velocity
The maximum velocity a motor can rotate.

Moment displacement stiffness
The motor is fastened to the base and a moment dead load is applied to the rotor's load mounting area in the direction where the rotor's rotation axis core is tilted within the maximum overhung load. Moment displacement stiffness is the axis core tilt displacement angle per unit moment load at this time. "Displacement angle/moment load" must be linear.

Monitor Pulse
Current position value pulse output from the drive

Motorless Operation (Emulation Mode)
A mode for simulating the operations of the motor using only the drive without connecting the actual motor. This feature is convenient to check general operations of the motor before starting the system. The utility software is used for simulation.

Mpulse
Unit of pulses obtained by raising 10 to the sixth power

Multichannel Connection
A connection to connect multiple drives to a party line using RS485 communication. A dedicated DLL is required for control from a PC.

■ N

■ O

Operation Display Panel
A separately sold device that is connected to the drive, which displays/edits parameters and issues commands.

Operation Display Pendant
: A separately sold device that is connected to the drive, which displays/edits parameters and issues commands. It has the backup/restore function.

Operation Privilege
: A right to issue major commands. Available on the PLC interface side or RS232C interface side.

ORG
: Origin proximity signal

Outer Rotor Mechanism
: A mechanism that rotates the outer part of the motor. A load can be installed directly.

■ P

Parameter Reflected at Power On
: See Machine Setting Parameter.

Parameter Setting Value
: Generally, parameter values set up on the drive's internal RAM (example: #100). The operation of the drive is determined based on these parameter values.

Physical (Hard) I/O
: I/O actually mounted to the drive (physical I/O)

Physical (Hard) I/O Logical Setting
: Setting regarding whether I/O input/output is positive logic (internally ON when a I/O is ON) or negative logic (internally OFF when a I/O is OFF)

PLC
: Programmable logic controller, generally called the sequencer. Yokogawa offers the FA-M3 range free controller.

Position Command Differential Value
: Difference among position command values per sampling cycle (1msec)

Product Dependency
: The initial value of a parameter takes a different value according to the type of the motor/drive.

Prompt
: A character string, parameter name, error name and so forth included in a response from the drive when a communication is made with the drive using the utility software, display panel, etc.

Pulse Direct
: A weighted signal of an external pulse. If this signal is ON, the motor operates one pulse of motor resolution by an external one pulse command, ignoring the scale setting.

■ R

Reboot
: Restarting the drive by cycling the power or using a software reset command.

Registered Parameter Value
: Parameter values stored on the drive's internal EEPROM (example: ##100). The drive loads these values as parameter setup values at startup. If these parameter values are changed, the parameter setup values are also changed at the same time.

Repeatability Accuracy
: Positioning is repeated seven times from the same rotation direction. This value is displayed after adding a sign to a half of the maximum width value of variations of the seven positions.

Restore
: Writing backed up data from an upper device (PC, operation display pendant) to the drive. Same as download.

Rotation Coordinate System
: A coordinate system in which the coordinate values after one motor rotation becomes equal to the coordinate values before movement. The coordinate system does not overflow even if the motor is continuously rotated in the same direction.

Rotor Core
: A magnetic circuit provided in the motor's rotating part

Rotor Inertia
: Inertial moment around the rotor's rotation axis of the motor. Self-inertia.

RxD
: Receive signal during host communication

■ S

Scaling
: Scale factors specified by the #112 and 113 parameters, which are used for conversion between pulse units and command units.

Settling Time
: A delay occurs in the actual motion of the motor in response to a position command. Upon executing a position command, the difference in time until a settling signal is output is specifically called the settling time.

Setup Dependency
: The allowable setup range of the maximum and minimum values of a parameter changes according to the setup values of other parameters

SIG0 and SIG1 signals
: Analog velocity signals generated by an encoder signal

Skew
: Variations in the phases among signals

Slave
: It refers to the driven motor/drive in a master and slave relation in tandem operation.

Software Drive Reset
: Restarting the drive by a command issued by the utility software, operation display panel/pendant, etc. This function is equivalent to cycling of the power.

Start Option
: Command arguments

Startup Operation
: Table operation executed automatically when the power is turned ON according to settings.

Station Number
A drive number set up by the rotary switches on the front panel section when connecting multichannels.

Stator Core
A magnetic circuit provided in the motor fastening section

Status Register
#320, 321 and 322 monitors. They constantly display the status of the motor/drive. Just like the system registers, each bit is assigned with a unique definition.

Sum Value
Firmware and data embedded in the drive are managed using sum values.

System Register
#98, 99 and 110 parameters. These parameters set up the drive's main operations. The system register parameters are 32-bit wide data, and each bit is assigned with a unique definition.

■ T

Table Data
Operation command data contained within the drive, total of 64

Tandem Operation
An operation method for obtaining large torque and thrust by connecting multiple motors and drives using a multi-drop connection

Tuning
An operation for adjusting each servo parameter to an appropriate value. This drive is installed with the auto tuning function by which tuning is performed automatically.

TxD
Transmit signal during host communication

■ U

Unit
Unit refers to a command unit in this document.

Upload
Moving data from the drive to an upper device (PC, operation display pendant)

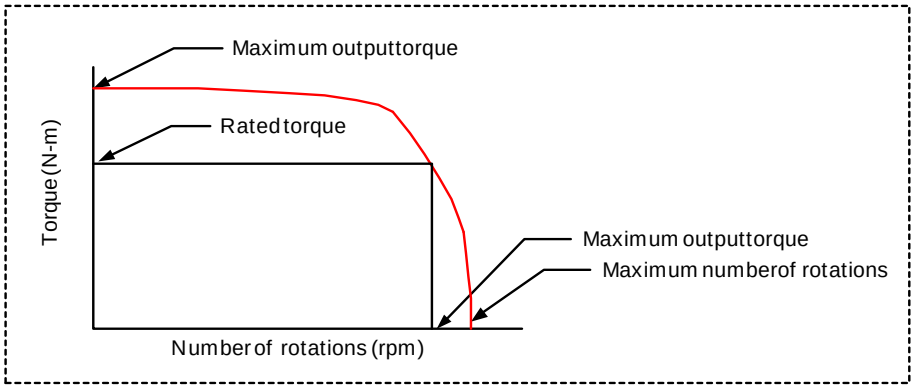
User Data
Internal data, such as parameters, table data and I/O setup values, which can be rewritten using the utility software/operation display pendant, etc.

■ V

Valid
Permitted state. To use a function by setting its parameters and other items, set to valid (1).

Velocity - Torque Characteristic Curve (T-N Curve)

A graph representing the relationship between the velocity and torque when a DD motor is driven. The horizontal axis shows the velocity (rpm) and the vertical axis shows torque (N-m).



Velocity Override

A velocity scale in which the feed velocity set up by a parameter is 100%, which can be set in a range from 0% and 200%.

Velocity Profile

A time differential waveform of the position command. The ideal operation path generated in the drive.

■ W

Watchdog Timer

A mechanism for preparing for a situation where programs cannot be executed normally due to uncontrollable running and other reasons. This timer functions just like a watchdog. A minimum communication can be performed even if a watchdog timer error occurs in this drive.

■ X

■ Y

■ Z

ZERO

Motor origin signal. Software and hardware Z-pulses are available depending on the generation method. There are several of them in one rotation or one stroke.

◆ Descriptions of Operation Tables and Sample Programs

Sample programs are included in a part of the operation tables at shipment from the factory. These sample programs can be useful as a reference when creating operation tables. You can delete or overwrite sample programs that are not used.
Sample programs for the DYNASERV are different from those for the LINEARSERV.
Be sure to check peripheral safety before starting the system.

(1) Sample Programs for the Rotary Motor

■ No. 4 ~ No. 5 ABS Positioning to 90° Position

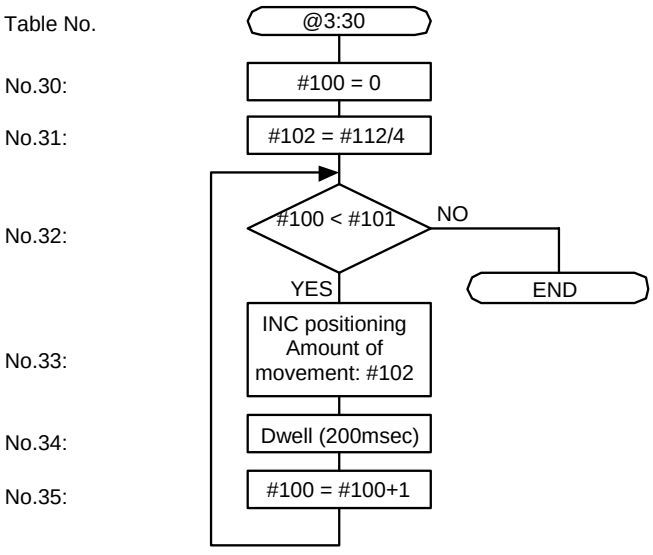
This program substitutes 1/4 of the #112 scaling data ratio numerator (on the command) for #100 (user variable) at table No. 4. ABS positioning is performed by referencing the #100 parameter at next table No. 5. To start from Terminal in the utility software, use @3:4.

■ No. 6 ~ No. 7 INC Positioning to 180° Position

This program substitutes 1/2 of the #112 scaling data (command unit side) for #100 (user variable) at table No. 6. INC positioning in the + direction is performed by referencing #100 at next table No. 7. To start from Terminal in the utility software, use @3:6.

■ No. 30 ~ No. 35 90° N times INC Positioning

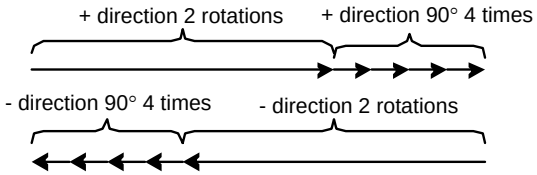
This program performs 90° INC positioning in the + direction by the count preset in #101. This sequence is as shown in the flowchart below. To start from Terminal in the utility software, use @3:30.

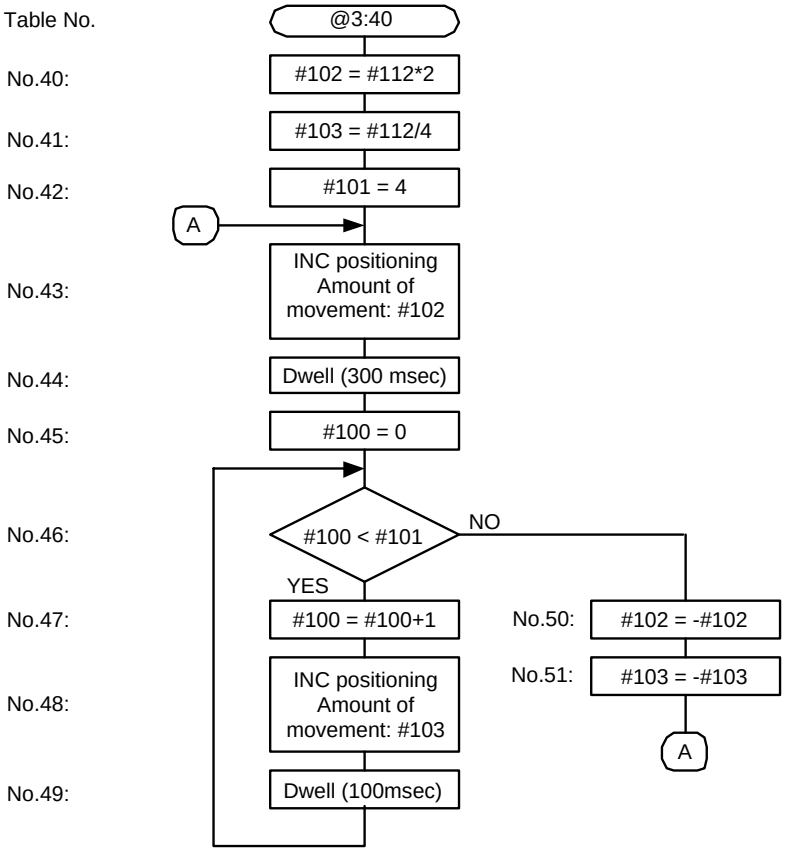


■ No. 40 ~ No. 51 Example of a Slightly Complicated Operation Pattern

This example shows a slightly complicated operation pattern of the motor. This operation pattern may not be used as is; use it as a sample when utilizing an operation table.

Operation pattern





(2) Sample Programs for the Linear Motor

■ No. 4 ABS Positioning

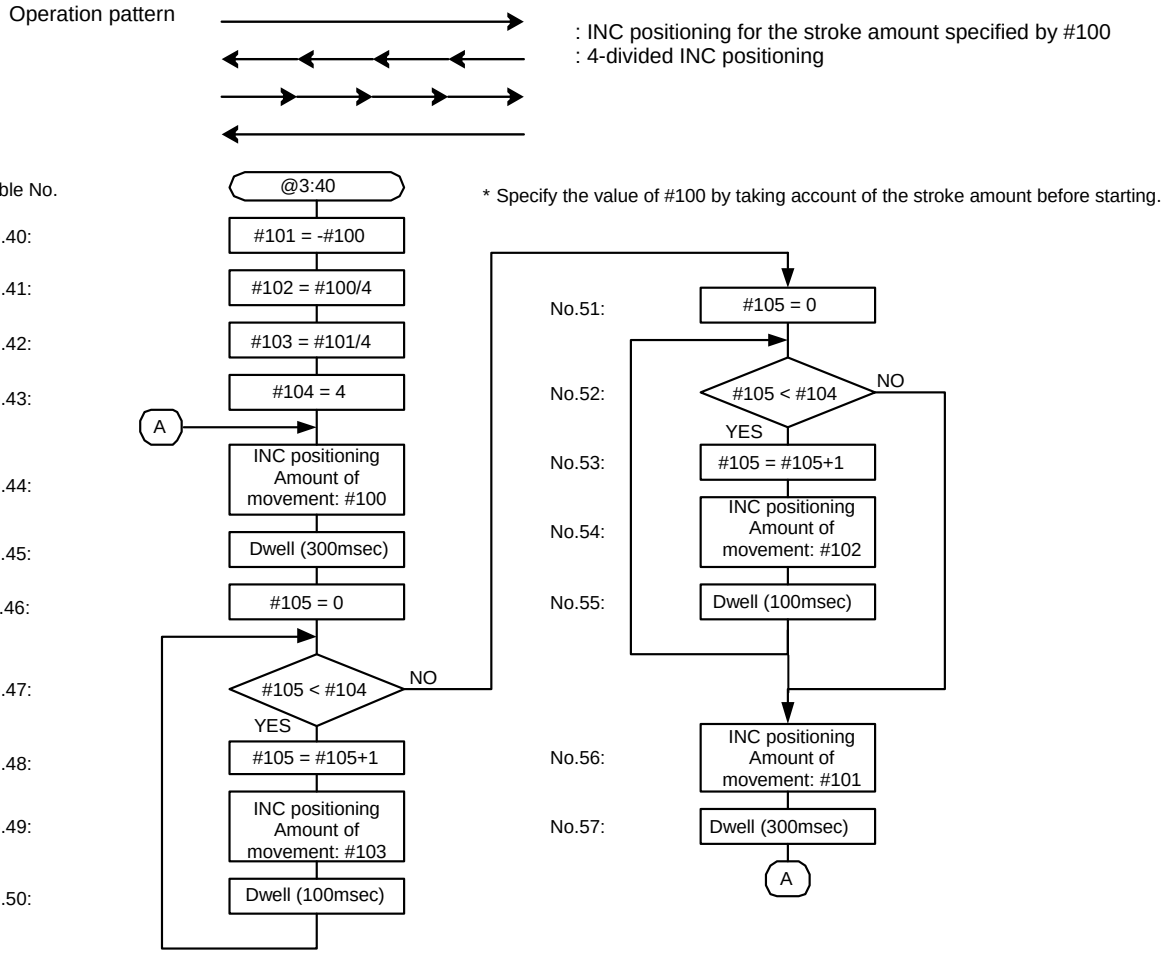
This sample program performs ABS positioning to the command unit position specified by #100 (user variable) at table No. 4. Specify the value of #100 by taking account of the stroke amount. To start from Terminal in the utility software, use @3:4.

■ No. 6 INC Positioning

This sample program performs INC positioning in the + direction by the command unit value specified by #100 (user variable) at table No. 6. Specify the value of #100 by taking account of the stroke amount. To start from Terminal in the utility software, use @3:6.

■ No. 40 ~ No. 57 Example of a Slightly Complicated Operation Pattern

This example shows a slightly complicated operation pattern of the motor. This operation pattern may not be used as is; use it as a sample when utilizing an operation table. Specify the value of #100 by taking account of the stroke amount.



CAUTION

A pattern may collide with the stroke end depending on the operation starting position. Check the starting position before executing.

◆ Revision Record

Document name: Direct Drive Motor <LINEARSERV> Intelligent Drive <DrvGIII> Technical Information

Document number: TI 71M02D03-01E

March, 2004 1st Edition
New issuance: Drive's main unit version: R7040CA:1.07
Support tool version: R1.02.00

Publisher Yokogawa Electric Corporation
2-9-32, Nakacho, Musashino-shi, Tokyo, 180-8750