

General-Purpose AC Servo EZMOTION MR-E Super General-Purpose Interface MODEL MR-E-DA-QW003

MR-E-DAG-QW003

INSTRUCTION MANUAL

Safety Instructions

(Always read these instructions before using the equipment.)

Do not attempt to install, operate, maintain or inspect the servo amplifier and servo motor until you have read through this Instruction Manual, Installation guide, Servo motor Instruction Manual and appended documents carefully and can use the equipment correctly. Do not use the servo amplifier and servo motor until you have a full knowledge of the equipment, safety information and instructions.

In this Instruction Manual, the safety instruction levels are classified into "WARNING" and "CAUTION".



Indicates that incorrect handling may cause hazardous conditions, resulting in death or severe injury.

Indicates that incorrect handling may cause hazardous conditions, resulting in medium or slight injury to personnel or may cause physical damage.

Note that the CAUTION level may lead to a serious consequence according to conditions. Please follow the instructions of both levels because they are important to personnel safety.

What must not be done and what must be done are indicated by the following diagrammatic symbols.

): Indicates what must not be done. For example, "No Fire" is indicated by 🐼 .

Indicates what must be done. For example, grounding is indicated by 🛄

In this Instruction Manual, instructions at a lower level than the above, instructions for other functions, and so on are classified into "POINT".

After reading this installation guide, always keep it accessible to the operator.

1. To prevent electric shock, note the following

- Before wiring or inspection, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Otherwise, an electric shock may occur. In addition, always confirm from the front of the servo amplifier, whether the charge lamp is off or not.
- Connect the servo amplifier and servo motor to ground.
- Any person who is involved in wiring and inspection should be fully competent to do the work.
- Do not attempt to wire the servo amplifier and servo motor until they have been installed. Otherwise, you ^U may get an electric shock.
- Operate the switches with dry hand to prevent an electric shock.
- The cables should not be damaged, stressed, loaded, or pinched. Otherwise, you may get an electric shock.

2. To prevent fire, note the following



- Install the servo amplifier, servo motor and regenerative resistor on incombustible material. Installing them directly or close to combustibles will lead to a fire.
- Always connect a magnetic contactor (MC) between the main circuit power supply and L₁, L₂, and L₃ of the servo amplifier, and configure the wiring to be able to shut down the power supply on the side of the servo amplifier's power supply. If a magnetic contactor (MC) is not connected, continuous flow of a large current may cause a fire when the servo amplifier malfunctions.
- When a regenerative resistor is used, use an alarm signal to switch main power off. Otherwise, a regenerative transistor fault or the like may overheat the regenerative resistor, causing a fire.

3. To prevent injury, note the follow

- Only the voltage specified in the Instruction Manual should be applied to each terminal, Otherwise, a burst, damage, etc. may occur.
- Connect the terminals correctly to prevent a burst, damage, etc.
- Ensure that polarity (+, -) is correct. Otherwise, a burst, damage, etc. may occur.
- Take safety measures, e.g. provide covers, to prevent accidental contact of hands and parts (cables, etc.) with the servo amplifier heat sink, regenerative resistor, servo motor, etc. since they may be hot while power is on or for some time after power-off. Their temperatures may be high and you may get burnt or a parts may damaged.
- During operation, never touch the rotating parts of the servo motor. Doing so can cause injury.

4. Additional instructions

The following instructions should also be fully noted. Incorrect handling may cause a fault, injury, electric shock, etc.

(1) Transportation and installation

CAUTION Transport the products correctly according to their weights. Stacking in excess of the specified number of products is not allowed. Do not carry the servo motor by the cables, shaft or encoder. Do not hold the front cover to transport the servo amplifier. The servo amplifier may drop. Install the servo amplifier in a load-bearing place in accordance with the Instruction Manual. · Do not climb or stand on servo equipment. Do not put heavy objects on equipment. The servo amplifier and servo motor must be installed in the specified direction. Leave specified clearances between the servo amplifier and control enclosure walls or other equipment. Do not install or operate the servo amplifier and servo motor which has been damaged or has any parts missing. Provide adequate protection to prevent screws and other conductive matter, oil and other combustible matter from entering the servo amplifier and servo motor. Do not drop or strike servo amplifier or servo motor. Isolate from all impact loads. • When you keep or use it, please fulfill the following environmental conditions. Conditions Environment Servo amplifier Servo motor 0 to +40 (non-freezing) In [°C] 0 to +55 (non-freezing) operation Ambient [°F] 32 to 131 (non-freezing) 32 to 104 (non-freezing) temperature -20 to +65 (non-freezing) -15 to +70 (non-freezing) [°C] In storage -4 to 149 (non-freezing) 5 to 158 (non-freezing) [°F] Ambient In operation 90%RH or less (non-condensing) 80%RH or less (non-condensing) humidity 90%RH or less (non-condensing) In storage Ambience Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt Altitude Max. 1000m above sea level HF-KE W1-S100 X • Y : 49 HE-SE52.IW1-S100 to (Note) X • Y : 24.5 [m/s²] 5.9 or less HF-SE152JW1-S100 Vibration

Note. Except the servo motor with reduction gear.

- Securely attach the servo motor to the machine. If attach insecurely, the servo motor may come off during
 operation.
- The servo motor with reduction gear must be installed in the specified direction to prevent oil leakage.
- Take safety measures, e.g. provide covers, to prevent accidental access to the rotating parts of the servo motor during operation.
- Never hit the servo motor or shaft, especially when coupling the servo motor to the machine. The encoder may become faulty.
- Do not subject the servo motor shaft to more than the permissible load. Otherwise, the shaft may break.

X:24.5

Y:49

HF-SE202JW1-S100

(2) Wiring



CAUTION

- · Before operation, check the parameter settings. Improper settings may cause some machines to perform unexpected operation.
- The parameter settings must not be changed excessively. Operation will be insatiable.

(4) Usage

- Provide an external emergency stop circuit to ensure that operation can be stopped and power switched off immediately.
- Any person who is involved in disassembly and repair should be fully competent to do the work.
- Before resetting an alarm, make sure that the run signal of the servo amplifier is off to prevent an accident. A sudden restart is made if an alarm is reset with the run signal on.

taShee 40. Do not modify the equipment.

- Use a noise filter, etc. to minimize the influence of electromagnetic interference, which may be caused by electronic equipment used near the servo amplifier.
- Burning or breaking a servo amplifier may cause a toxic gas. Do not burn or break a servo amplifier.
- Use the servo amplifier with the specified servo motor.
- The electromagnetic brake on the servo motor is designed to hold the servo motor shaft and should not be used for ordinary braking.
- For such reasons as service life and mechanical structure (e.g. where a ball screw and the servo motor are coupled via a timing belt), the electromagnetic brake may not hold the servo motor shaft. To ensure safety, install a stopper on the machine side.

(5) Corrective actions



machine may be restarted suddenly (design the machine so that it is secured against hazard if restarted).

(6) Storage for servo motor

Note the following points when storing the servo motor for an extended period of time (guideline: three or more months).

• Always store the servo motor indoors in a clean and dry place.

- If it is stored in a dusty or damp place, make adequate provision, e.g. cover the whole product.
- If the insulation resistance of the winding decreases, reexamine the storage method.
- Though the servo motor is rust-proofed before shipment using paint or rust prevention oil, rust may be produced depending on the storage conditions or storage period.
- If the servo motor is to be stored for longer than six months, apply rust prevention oil again especially to the machined surfaces of the shaft, etc.
- Before using the product after storage for an extended period of time, hand-turn the motor output shaft to confirm that nothing is wrong with the servo motor. (When the servo motor is equipped with a brake, make the above check after releasing the brake with the brake power supply.)

• When the equipment has been stored for an extended period of time, consult Mitsubishi.

(7) Maintenance, inspection and parts replacement

• With age, the electrolytic capacitor of the servo amplifier will deteriorate. To prevent a secondary accident due to a fault, it is recommended to replace the electrolytic capacitor every 10 years when used in general environment.

Please consult our sales representative.

(8) General instruction

• To illustrate details, the equipment in the diagrams of this Instruction Manual may have been drawn without covers and safety guards. When the equipment is operated, the covers and safety guards must be installed as specified. Operation must be performed in accordance with this Instruction Manual.

About processing of waste

When you discard servo amplifier, a battery (primary battery), and other option articles, please follow the law of each country (area).

riangle for maximum safety

- These products have been manufactured as a general-purpose part for general industries, and have not been designed or manufactured to be incorporated in a device or system used in purposes related to human life.
- Before using the products for special purposes such as nuclear power, electric power, aerospace,
- medicine, passenger movement vehicles or under water relays, contact Mitsubishi.
- These products have been manufactured under strict quality control. However, when installing the product where major accidents or losses could occur if the product fails, install appropriate backup or failsafe functions in the system.

\land EEP-ROM life

The number of write times to the EEP-ROM, which stores parameter settings, etc., is limited to 100,000. If the total number of the following operations exceeds 100,000, the servo amplifier and/or converter unit may fail when the EEP-ROM reaches the end of its useful life.

· Write to the EEP-ROM due to parameter setting changes

Precautions for Choosing the Products

Mitsubishi will not be held liable for damage caused by factors found not to be the cause of Mitsubishi; machine damage or lost profits caused by faults in the Mitsubishi products; damage, secondary damage, accident compensation caused by special factors unpredictable by Mitsubishi; damages to products other than Mitsubishi products; and to other duties.

COMPLIANCE WITH EC DIRECTIVES

1. WHAT ARE EC DIRECTIVES?

The EC directives were issued to standardize the regulations of the EU countries and ensure smooth distribution of safety-guaranteed products. In the EU countries, the machinery directive (effective in January, 1995), EMC directive (effective in January, 1996) and low voltage directive (effective in January, 1997) of the EC directives require that products to be sold should meet their fundamental safety requirements and carry the CE marks (CE marking). CE marking applies to machines and equipment into which servo amplifiers have been installed.

(1) EMC directive

The EMC directive applies not to the servo units alone but to servo-incorporated machines and equipment. This requires the EMC filters to be used with the servo-incorporated machines and equipment to comply with the EMC directive. For specific EMC directive conforming methods, refer to the EMC Installation Guidelines (IB(NA)67310).

(2) Low voltage directive

The low voltage directive applies also to servo units alone. Hence, they are designed to comply with the low voltage directive.

(3) Machine directive

Not being machines, the servo amplifiers need not comply with this directive.

2. PRECAUTIONS FOR COMPLIANCE

(1) Servo amplifiers and servo motors used Use the servo amplifiers and servo motors which comply with the standard model.

Servo amplifier	:MR-E-10A-QW003 to MR-E-200A-QW003
	MR-E-10AG-QW003 to MR-E-200AG-QW003
Servo motor	:HF-KE □ W1-S100
	HF-SEDJW1-S100

(2) Configuration



Use the circuit breaker and magnetic contactor which conform to the EN or IEC Standard. Design notice: Where residual-current-operated protective device (RCD) is used for protection case of direct or indirect contact, only RCD of type B is allowed on the supply side of this Electronic Equipment (EE).

(3) Environment

Operate the servo amplifier at or above the contamination level 2 set forth in IEC60664-1. For this purpose, install the servo amplifier in a control box which is protected against water, oil, carbon, dust, dirt, etc. (IP54).

- (4) Power supply
 - (a) Operate the servo amplifier to meet the requirements of the overvoltage category II set forth in IEC60664-1. For this purpose, a reinforced insulating transformer conforming to the IEC or EN Standard should be used in the power input section.
 - (b) As the external power supply for interface, use a 24VDC power supply that has been insulationreinforced in I/O.

(5) Grounding

- (a) To prevent an electric shock, always connect the protective earth (PE) terminals (terminal marked ⊕) of the servo amplifier to the protective earth (PE) of the control box. Connect PE terminal of the control box to the NEUTRAL of a power supply. Be sure to ground the NEUTRAL of a power supply.
- (b) Do not connect two ground cables to the same protective earth (PE) terminal. Always connect the cables to the terminals one-to-one.



(c) If a leakage current breaker is used to prevent an electric shock, the protective earth (PE) terminals of the servo amplifier must be connected to the corresponding earth terminals.

(6) Wiring

(a) The cables to be connected to the terminal block of the servo amplifier must have crimping terminals provided with insulating tubes to prevent contact with adjacent terminals.



(b) Use the servo motor side power connector which complies with the EN Standard. The EN Standardcompliant power connector sets are available from us as options. (Refer to section 13.1.2)

(7) Auxiliary equipment and options

- (a) The circuit breaker and magnetic contactor used should be the EN or IEC standard-compliant products of the models described in section 13.2.2.
- (b) The sizes of the cables described in section 13.2.1 meet the following requirements. To meet the other requirements, follow Table 5 and Appendix C in EN60204-1.
 - Ambient temperature: 40 (104) [°C(°F)]
 - Sheath: PVC (polyvinyl chloride)
 - Installed on wall surface or open table tray
- (c) Use the EMC filter for noise reduction.
- (8) Performing EMC tests

When EMC tests are run on a machine/device into which the servo amplifier has been installed, it must conform to the electromagnetic compatibility (immunity/emission) standards after it has satisfied the operating environment/electrical equipment specifications.

For the other EMC directive guidelines on the servo amplifier, refer to the EMC Installation Guidelines (IB(NA)67310).

CONFORMANCE WITH UL/C-UL STANDARD

(1) Servo amplifiers and servo motors used

Use the servo amplifiers and servo motors which comply with the standard model.

Servo amplifier :MR-E-10A-QW003 to MR-E-200A-QW003 MR-E-10AG-QW003 to MR-E-200AG-QW003 Servo motor :HF-KE□W1-S100 HF-SE□JW1-S100

www.DataShee(2) Installation

Install a cooling fan of 100CFM (2.8 m³/min) air flow 4 in (10.16 cm) above the servo amplifier or provide cooling of at least equivalent capability.

(3) Short circuit rating: SCCR (Short Circuit Current Rating)

This servo amplifier conforms to the circuit whose peak current is limited to 100kA or less. Having been subjected to the short-circuit tests of the UL in the alternating-current circuit, the servo amplifier conforms to the above circuit.

(4) Capacitor discharge time

The capacitor discharge time is as listed below. To ensure safety, do not touch the charging section for 15 minutes after power-off.

Servo amplifier	Discharge time [min]
MR-E-10A-QW003	
MR-E-10AG-QW003	1
MR-E-20A-QW003	I
MR-E-20AG-QW003	
MR-E-40A-QW003	2
MR-E-40AG-QW003	2
MR-E-70A-QW003 to MR-E-200AG-QW003	3
MR-E-70AG-QW003 to MR-E-200AG-QW003	3

(5) Options and auxiliary equipment

Use UL/C-UL standard-compliant products.

(6) About wiring protection

For installation in United States, branch circuit protection must be provided, in accordance with the National Electrical Code and any applicable local codes.

For installation in Canada, branch circuit protection must be provided, in accordance with the Canada Electrical Code and any applicable provincial codes.

<<About the manuals>>

Relevant manuals

Manual name	Manual No.
MR-E Series Instructions and Cautions for Safe Use of AC Servos	IB(NA)0300057
EMC Installation Guidelines	IB(NA)67310

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MEMO

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1. FUNCTIONS AND CONFIGURATION

1.1 Introduction

The Mitsubishi general-purpose AC servo MR-E Super has position control and internal speed control modes. It can perform operation with the control modes changed, e.g. position/internal speed control. Hence, it is applicable to wide range of fields such as precision positioning and smooth speed control of machine tools and general industrial machines.

As this new series has the RS-232C or RS-422 serial communication function, a MR Configurator (servo configuration software)-installed personal computer or the like can be used to perform parameter setting, test operation, status display monitoring, gain adjustment, etc.

With real-time auto tuning, you can automatically adjust the servo gains according to the machine.

The MR-E Super servo motor is equipped with an incremental position encoder that has the resolution of 131072 pulses/rev to ensure high precision positioning.

(1) Position control mode

An up to 1Mpps high-speed pulse train is used to control the speed and direction of a motor and execute precision positioning of 131072 pulses/rev resolution.

The position smoothing function provides a choice of two different modes appropriate for a machine, so a smoother start/stop can be made in response to a sudden position command.

A torque limit is imposed on the servo amplifier by the clamp circuit to protect the power transistor in the main circuit from overcurrent due to sudden acceleration/deceleration or overload. This torque limit value can be changed to any value with the parameter.

(2) Internal speed control mode

The parameter-driven internal speed command (max. 7 speeds) is used to control the speed and direction of a servo motor smoothly.

There are also the acceleration/deceleration time constant setting in response to speed command, the servo lock function at a stop time.

1.2 Function block diagram

The function block diagram of this servo is shown below.



- Note 1. The built-in regenerative resistor is not provided for the MR-E-10A-QW003/MR-E-20A-QW003.
 - 2. The single-phase 230VAC can be used for MR-E-70A-QW003 or smaller servo amplifier.
 - Connect the power supply cables to L_1 and L_2 while leaving L_3 open. Refer to section 1.3 for the power supply specification. 3. The control circuit connectors (CN1, CN2 and CN3) are safely isolated from main circuit terminals
 - (L₁, L₂, L₃, U, V, W, P, C and D).
 - 4. Servo amplifiers MR-E-200A-QW003 have a cooling fan.

1.3 Servo amplifier standard specifications

\sim	_	Servo ar	molifier						
Servo amplifier MR-E-□-QW003				10A	20A	40A	70A	100A	200A
Item	Item			104	204	40/	104	TUUA	2004
Voltage/frequency				3-phase 20)/60Hz or 1-pha 60Hz	se 230VAC,	-) to 230VAC, 60Hz
Power supply	Permissible v	oltage fluctuation	1	1-pha	3-phase 200 170 to 253V) to 230VAC: AC, 50/60Hz 7 to 253VAC, 50)/60Hz	3-phase 170) to 253VAC, 60Hz
Å	Permissible fr	equency fluctuat	ion			Within	±5%		
	Power supply	capacity				Refer to se	ection 12.2		
Inrus	sh current	. ,				Refer to se	ection 12.5		
-	rol system				Sine-wa		I, current control	svstem	
	amic brake						lt-in		
-	ective functions	3		relay), encode	r error protectio	on, regenerative	e shut-off, overlo error protection excessive error	i, undervoltage,	
qe	Max. input pu	lse frequency			1Mpps (for dif	ferential receive	r), 200kpps (for o	open collector)	
ol mo	Command pu	lse multiplying fa	actor		Electronic gea	ar A: 1 to 65535	B: 1 to 65535, 1	/50 < A/B < 50	
contr	In-position range setting 0 to ±10000 pulse (command pulse unit)								
Position control mode	Error excessive ±2.5 revolutions								
Po	Torque limit			Torque limit Set by parameter setting					
speed	Speed control	eed control range Internal speed command 1: 5000							
Internal sp control mo	Speed fluctuation ratio ±0.01% or less (load fluctuation 0 to 100%) 0% (power fluctuation ±10%)								
Intel con	Torque limit					Set by parar	meter setting		
Struc	cture				Self	-cooled, open (I	P00)		Force-cooling, open (IP00)
		Onerstien	[°C]			0 to +55 (n	on-freezing)		
	Ambient		[°F]			32 to +131 (non-freezing)		
	temperature		[°C]			-20 to +65	(non-freezing)		
≌nt	Storade		[°F]	-4 to $+149$ (non-freezing)					
Ambient Operation humidity Storage									
))			
					Free from corr		lirect sunlight)	et duet and dirt	
				Free from corrosive gas, flammable gas, oil mist, dust and dirt Max. 1000m above sea level					
	Altitude Vibration						²] or less		
Mase			[ka]	0.7	0.7	5.9 [11/8	1.7	1.7	2.0
11/1033	Mass [kg]			0.7	0.7	1.1	1.7	1.7	2.0

1.4 Function list

The following table lists the functions of this servo. For details of the functions, refer to the reference field.

Function	Description	(Note) Control mode	Reference
Position control mode	This servo is used as position control servo.	Ρ	Section 3.1.1 Section 3.4.1 Section 4.2.2
Internal speed control mode	This servo is used as internal speed control servo.	S	Section 3.1.2 Section 3.4.2 Section 4.2.3
Position/internal speed control change mode	Using external input signal, control can be switched between position control and internal speed control.	P/S	Section 3.4.4
High-resolution encoder	High-resolution encoder of 131072 pulses/rev is used as a servo motor encoder.	P, S	
Gain changing function	You can switch between gains during rotation and gains during stop or use an external input signal to change gains during operation.	P, S	Section 8.5
Adaptive vibration suppression control	Servo amplifier detects mechanical resonance and sets filter characteristics automatically to suppress mechanical vibration.	P, S	Section 8.3
Low-pass filter	Suppresses high-frequency resonance which occurs as servo system response is increased.	P, S	Section 8.4
Machine analyzer function	Analyzes the frequency characteristic of the mechanical system by simply connecting a MR Configurator (servo configuration software)-installed personal computer and servo amplifier.	Р	
Machine simulation	Can simulate machine motions on a personal computer screen on the basis of the machine analyzer results.	Р	
Gain search function	Personal computer changes gains automatically and searches for overshoot-free gains in a short time.	Р	
Slight vibration suppression control	Suppresses vibration of ± 1 pulse produced at a servo motor stop.	Р	Parameter No.20
Electronic gear	Input pulses can be multiplied by 1/50 to 50.	Р	Parameters No.3, 4, 69 to 71
Auto tuning	Automatically adjusts the gain to optimum value if load applied to the servo motor shaft varies.	P, S	Chapter 7
Position smoothing	Speed can be increased smoothly in response to input pulse.	Р	Parameter No.7
S-pattern acceleration/ deceleration time constant	Speed can be increased and decreased smoothly.	S	Parameter No.13
Regenerative option	Used when the built-in regenerative resistor of the servo		Section 13.1.1

1. FUNCTIONS AND CONFIGURATION

Function	Description	(Note) Control mode	Reference
Alarm history clear	Alarm history is cleared.	P, S	Parameter No.16
Restart after instantaneous power failure	If the input power supply voltage had reduced to cause an alarm but has returned to normal, the servo motor can be restarted by merely switching on the start signal.	S	Parameter No.20
Command pulse selection	Command pulse train form can be selected from among four different types.	Р	Parameter No.21
Input signal selection	Forward rotation start, reverse rotation start, servo-on and other input signals can be assigned to any pins.	P, S	Parameters No.43 to 48
Torque limit	Servo motor torque can be limited to any value.	P, S	Section 3.4.1 (5) Parameter No.28
Status display	Servo status is shown on the 5-digit, 7-segment LED display	P, S	Section 6.2
External I/O signal display	ON/OFF statuses of external I/O signals are shown on the display.	P, S	Section 6.6
Output signal (DO) forced output	Output signal can be forced on/off independently of the servo status. Use this function for output signal wiring check, etc.	P, S	Section 6.7
Test operation mode	Servo motor can be run from the operation section of the servo amplifier without the start signal entered.	P, S	Section 6.8
Analog monitor output	nalog monitor output Servo status is output in terms of voltage in real time.		Parameter No.17
MR Configurator (servo configuration software)			Section 13.1.8
Alarm code output	If an alarm has occurred, the corresponding alarm number is output in 3-bit code.	P, S	Section 10.2.1

Note. P: Position control mode, S: Internal speed control mode

P/S: Position/internal speed control change mode

1.5 Model code definition

(1) Rating plate



1.6 Combination with servo motor

The following table lists combinations of servo amplifiers and servo motors. The same combinations apply to the servo motor models with electromagnetic brakes.

Servo amplifier	Servo motors		
Servo ampliner	HF-KE□W1-S100	HF-SE JW1-S100	
MR-E-10A-QW003	13		
MR-E-20A-QW003	23		
MR-E-40A-QW003	43		
MR-E-70A-QW003	73	52	
MR-E-100A-QW003		102	
MR-E-200A-QW003		152 • 202	

1.7 Parts identification

(1) MR-E-100A-QW003 or less



(2) MR-E-200A-QW003 Reference Name/application Display The 5-digit, seven-segment LED shows the servo status Chapter 6 and alarm number. Operation section Used to perform status display, diagnostic, alarm and parameter setting operations. (\bullet) (\bullet) (\bullet) (\bullet) UP DOWN SET MODE LUsed to set data. Chapter 6 Used to change the display or data in each mode. Used to change the mode. Communication connector (CN3) Section 3.3 Used to connect a command device (RS-232C) and Section 13.1.2 output analog monitor data. I/O signal connector (CN1) Section 3.3 Used to connect digital I/O signals. Rating plate Section 1.5 Encoder connector (CN2) Section 3.3 Used to connect the servo motor encoder. Section 13.1.2 Power supply/regenerative connector (CNP1) Section 3.7 Used to connect the input power supply and regenerative Section 11.1 Cooling fan option. Section 13.1.1 Fixed part Charge lamp Lit to indicate that the main circuit is charged. While this (3 places) lamp is lit, do not reconnect the cables. Protective earth (PE) terminal (+) Section 3.10 Ground terminal. Section 11.1 Servo motor power connector (CNP2) Section 3.7 Used to connect the servo motor. Section 11.1

1. FUNCTIONS AND CONFIGURATION

1.8 Servo system with auxiliary equipment





(1) MR-E-100A-QW003 or less

Note. A 1-phase 230VAC power supply may be used with the servo amplifier of MR-E-70A-QW003 or less. Connect the power supply to L_1 and L_2 terminals and leave L_3 open. Refer to section 1.3 for the power supply specification.

(2) MR-E-200A-QW003



Note. Refer to section 1.3 for the power supply specification.

2. INSTALLATION

	 Stacking in excess of the limited number of products is not allowed.
	 Install the equipment to incombustibles. Installing them directly or close to
	combustibles will led to a fire.
	 Install the equipment on incombustible material. Installing them directly or close to combustibles will lead to a fire.
	 Do not get on or put heavy load on the equipment to prevent injury.
	 Use the equipment within the specified environmental condition range. (For details of the environmental condition, refer to section 2.1.)
el4U.com	 Provide an adequate protection to prevent screws, metallic detritus and other
	conductive matter or oil and other combustible matter from entering the servo amplifier.
	 Do not block the intake/exhaust ports of the servo amplifier. Otherwise, a fault may occur.
	 Do not subject the servo amplifier to drop impact or shock loads as they are precision equipment.
	 Do not install or operate a faulty servo amplifier.
	 When the product has been stored for an extended period of time, consult Mitsubishi.
	 When treating the servo amplifier, be careful about the edged parts such as the corners of the servo amplifier.

2.1 Environmental conditions

Env	vironment		Conditions
	In operation	[°C]	0 to +55 (non-freezing)
Ambient	Inoperation	[°F]	32 to +131 (non-freezing)
temperature	In storage	[°C]	-20 to +65 (non-freezing)
	In storage	[°F]	-4 to +149 (non-freezing)
Ambient			
humidity			90%RH or less (non-condensing)
Ambience	A mala in a s		Indoors (no direct sunlight)
			Free from corrosive gas, flammable gas, oil mist, dust and dirt
Altitude			Max. 1000m above sea level
Vibration [m/s ²]		[m/s ²]	5.9 [m/s ²] or less

2. INSTALLATION

2.2 Installation direction and clearances



(2) Installation of two or more servo amplifiers

Leave a large clearance between the top of the servo amplifier and the internal surface of the control box, and install a cooling fan to prevent the internal temperature of the control box from exceeding the environmental conditions.



(3) Others

When using heat generating equipment such as the regenerative option, install them with full consideration of heat generation so that the servo amplifier is not affected.

Install the servo amplifier on a perpendicular wall in the correct vertical direction.

- 2.3 Keep out foreign materials
- (1) When installing the unit in a control box, prevent drill chips and wire fragments from entering the servo amplifier.
- (2) Prevent oil, water, metallic dust, etc. from entering the servo amplifier through openings in the control box
- (3) When installing the control box in a place where there are much toxic gas, dirt and dust, conduct an air purge (force clean air into the control box from outside to make the internal pressure higher than the external pressure) to prevent such materials from entering the control box.
- 2.4 Cable stress
- (1) The way of clamping the cable must be fully examined so that flexing stress and cable's own weight stress are not applied to the cable connection.
- (2) For use in any application where the servo motor moves, fix the cables (encoder, power supply, brake) supplied with the servo motor, and flex the optional encoder cable or the power supply and brake wiring cables. Use the optional encoder cable within the flexing life range. Use the power supply and brake wiring cables within the flexing life of the cables.
- (3) Avoid any probability that the cable sheath might be cut by sharp chips, rubbed by a machine corner or stamped by workers or vehicles.
- (4) For installation on a machine where the servo motor will move, the flexing radius should be made as large as possible. Refer to section 12.4 for the flexing life.

MEMO

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3. SIGNALS AND WIRING



3. SIGNALS AND WIRING

3.1 Standard connection example



3.1.1 Position control mode

(1) FX-10GM



- Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked) of the servo amplifier to the protective earth (PE) of the control box.
 - 2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
 - 3. The emergency stop switch (normally closed contact) must be installed.
 - 4. When starting operation, always connect the emergency stop (EMG) and forward rotation stroke end (LSN), reverse rotation stroke end (LSP) with VIN. (Normally closed contacts)
 - 5. Trouble (ALM) is connected with VIN in normal alarm-free condition. When this signal is switched off (at occurrence of an alarm), the output of the controller should be stopped by the sequence program.
 - 6. When connecting the personal computer together with monitor outputs 1, 2, use the branch cable (MR-E3CBL15-P). (Refer to section 13.1.3)
 - 7. The pins with the same signal name are connected in the servo amplifier.
 - This length applies to the command pulse train input in the open collector system. It is 10m or less in the differential line driver system.
 - 9. Use MRZJW3-SETUP154E of 154C.
 - 10. Externally supply 24VDC ±10%, 200mA power for the interface. 200mA is a value applicable when all I/O signals are used. Reducing the number of I/O points decreases the current capacity. Refer to the current necessary for the interface described in section 3.6.2. Connect the external 24VDC power supply if the output signals are not used.

3. SIGNALS AND WIRING

(2) AD75PD (A1SD75PD)



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- Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked) of the servo amplifier to the protective earth (PE) of the control box.
 - 2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
 - 3. The emergency stop switch (normally closed contact) must be installed.
 - 4. When starting operation, always connect the emergency stop (EMG) and forward rotation stroke end (LSN), reverse rotation stroke end (LSP) with VIN. (Normally closed contacts)
 - 5. Trouble (ALM) is connected with VIN in normal alarm-free condition. When this signal is switched off (at occurrence of an alarm), the output of the controller should be stopped by the sequence program.
 - 6. When connecting the personal computer together with monitor outputs 1, 2, use the branch cable (MR-E3CBL15-P). (Refer to section 13.1.3)
- 7. The pins with the same signal name are connected in the servo amplifier.
- 8. This length applies to the command pulse train input in the differential line driver system.
 - It is 2m or less in the open collector system.
 - 9. Use MRZJW3-SETUP154E of 154C.
 - 10. To enhance noise immunity, connect LG and pulse output COM.
 - 11. Externally supply 24VDC ±10%, 200mA power for the interface. 200mA is a value applicable when all I/O signals are used. Reducing the number of I/O points decreases the current capacity. Refer to the current necessary for the interface described in section 3.6.2. Connect the external 24VDC power supply if the output signals are not used.
(3) QD75D (differential driver)



- Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked) of the servo amplifier to the protective earth (PE) of the control box.
 - 2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
 - 3. The emergency stop switch (normally closed contact) must be installed.
 - 4. When starting operation, always connect the emergency stop (EMG) and forward rotation stroke end (LSN), reverse rotation stroke end (LSP) with VIN. (Normally closed contacts)
 - 5. Trouble (ALM) is connected with VIN in normal alarm-free condition. When this signal is switched off (at occurrence of an alarm), the output of the controller should be stopped by the sequence program.
 - 6. When connecting the personal computer together with monitor outputs 1, 2, use the branch cable (MR-E3CBL15-P). (Refer to section 13.1.3)
- 7. The pins with the same signal name are connected in the servo amplifier.
- 8. This length applies to the command pulse train input in the differential line driver system.
 - It is 2m or less in the open collector system.
 - 9. Use MRZJW3-SETUP154E of 154C.
 - 10. This connection is not required for the QD75D. Depending on the used positioning module, however, it is recommended to connect the LG and control common terminals of the servo amplifier to enhance noise immunity.
 - 11. Externally supply 24VDC ±10%, 200mA power for the interface. 200mA is a value applicable when all I/O signals are used. Reducing the number of I/O points decreases the current capacity. Refer to the current necessary for the interface described in section 3.6.2. Connect the external 24VDC power supply if the output signals are not used.

3.1.2 Internal speed control mode



- Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked ④) of the servo amplifier to the protective earth (PE) of the control box.
 - 2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
 - 3. The emergency stop switch (normally closed contact) must be installed.
 - 4. When starting operation, always connect the emergency stop (EMG) and forward rotation stroke end (LSN), reverse rotation stroke end (LSP) with VIN. (Normally closed contacts)
 - 5. Trouble (ALM) is connected with VIN in normal alarm-free condition.
 - 6. When connecting the personal computer together with monitor outputs 1, 2, use the branch cable (MR-E3CBL15-P). (Refer to section 13.1.3)
 - 7. The pins with the same signal name are connected in the servo amplifier.
 - 8. Use MRZJW3-SETUP154E of 154C.
 - Externally supply 24VDC ±10%, 200mA power for the interface. 200mA is a value applicable when all I/O signals are used. Reducing the number of I/O points decreases the current capacity. Refer to the current necessary for the interface described in section 3.6.2. Connect the external 24VDC power supply if the output signals are not used.

3.2 Internal connection diagram of servo amplifier

The following is the internal connection diagram where the signal assignment has been made in the initial status in each control mode.



Note. P: Position control mode, S: Internal speed control mode

3.3 I/O signals

3.3.1 Connectors and signal arrangements

- POINT
- The pin configurations of the connectors are as viewed from the cable connector wiring section.
- Refer to the next page for CN1 signal assignment.

(1) Signal arrangement



(2) CN1 signal assignment

The signal assignment of connector changes with the control mode as indicated below;

For the pins which are given parameter No.s in the related parameter column, their signals can be changed using those parameters.

ſ	Connector	Pin No.	(Neto 1) 1/0	(Note 2)	I/O Signals in contr	ol modes	- Related parameter
	Connector	PIT NO.	(Note 1) I/O	Р	P/S	S	
Γ		1		VIN	VIN	VIN	
		2		OPC	OPC		
		3	I	RES	RES/ST1	ST1	No.43 to 48
	. 1	4	I	SON	SON	SON	No.43 to 48
DataSheet	IU.com	5	I	CR	LOP	ST2	No.43 to 48
		6	I	LSP	LSP	LSP	No.43 • 48
		7	I	LSN	LSN	LSN	No.43 • 48
		8	I	EMG	EMG	EMG	
		9	0	ALM	ALM	ALM	No.49
		10	0	INP	INP/SA	SA	No.49
		11	0	RD	RD	RD	No.49
	CNI4	12	0	ZSP	ZSP	ZSP	No.1, 49
		13		SG	SG	SG	
	CN1	14		LG	LG	LG	
		15	0	LA	LA	LA	
		16	0	LAR	LAR	LAR	
		17	0	LB	LB	LB	
		18	0	LBR	LBR	LBR	
		19	0	LZ	LZ	LZ	
		20	0	LZR	LZR	LZR	
		21	0	OP	OP	OP	
		22	I	PG	PG/-		
		23	I	PP	PP/-		
		24	I	NG	NG/—		
		25	I	NP	NP/-		
		26					

Note 1. I: Input signal, O: Output signal

2. P: Position control mode, S: Internal speed control mode, P/S: Position/internal speed control change mode

(3) Symbols and signal names

Symbol	Signal name	Symbol	Signal name
SON	Servo-on	ZSP	Zero speed
LSP	Forward rotation stroke end	INP	In position
LSN	Reverse rotation stroke end	SA	Speed reached
CR	Clear	ALM	Trouble
SP1	Speed selection 1	WNG	Warning
SP2	Speed selection 2	OP	Encoder Z-phase pulse (open collector)
PC	Proportion control	MBR	Electromagnetic brake interlock
ST1	Forward rotation start	LZ	Encoder Z-phase pulse
ST2	Reverse rotation start	LZR	(differential line driver)
TL1	Internal Torque limit selection	LA	Encoder A-phase pulse
RES	Reset	LAR	(differential line driver)
EMG	Emergency stop	LB	Encoder B-phase pulse
LOP	Control change	LBR	(differential line driver)
PP		VIN	Digital I/F power supply input
NP		OPC	Open collector power input
PG	Forward/reverse rotation pulse train	SG	Digital I/F common
NG		LG	Control common
RD	Ready	SD	Shield

3.3.2 Signal explanations

For the I/O interfaces (symbols in I/O column in the table), refer to section 3.6.2.

In the control mode field of the table

- P : Position control mode, S: Internal speed control mode
- O : Denotes that the signal may be used in the initial setting status.
- Δ : Denotes that the signal may be used by setting the corresponding parameter among parameters No.43 to 49.

The pin No.s in the connector pin No. column are those in the initial status.

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POINT	
 The accept 	ance delay time of each input signal is less than 10ms.

Signal	Symbol	Connector pin No.			Functions/a	applications		I/O division	Cor mc P	
Servo-on	SON	CN1-4	amplifier read Disconnect S (servo off) . Set "□□□1	Set "□□□1" in parameter No.41 to switch this signal on (keep terminals connected) automatically in the servo amplifier.					0	0
Reset	RES	CN1-3	Some alarms 10.2.1.) Shorting RES base circuit is	orting RES-VIN in an alarm-free status shuts off the base circuit. The se circuit is not shut off when "□1□□" is set in parameter No.51. is device is not designed to make a stop. Do not turn it ON during				DI-1	0	Δ
Forward rotation stroke end	LSP	CN1-6	To start opera motor to a su Set "□□□1" (Refer to sec (Note) Inp LSP 1 0	dden stop a ' in paramet ion 5.2.3.)	nd make it se er No.22 to r	ervo-locked.	. Open them to bring the stop.	DI-1	0	0
Reverse rotation stroke end	LSN	CN1-7	1 0 0 0 Note. 0: LSP/LSN-VIN off (open) 1: LSP/LSN-VIN on (short) Set parameter No.41 as indicated below to switch on the signals (keep terminals connected) automatically in the servo amplifier. Parameter No.41 Automatic ON □10 LSP □10 LSN							

	Signal	Symbol	Connector pin No.				Functions/applications	I/O division	mo	ntrol ode
	Internal torque limit selection	TL1		When us No.43 to (Refer to	48.	-	nake it usable by making the setting of parameter	DI-1	Р Δ	S ∆
	Forward rotation	ST1	CN1-3		Used to start the servo motor in any of the following directions.					0
	start			(Note ST2) Input s	ignals ST1	Servo motor starting direction			
				0		0	Stop (servo lock)			
eet	Reverse rotation ST2 CN1		CN1-5	0		1	CCW			
	start			1		0	CW			
				1 1 Stop (servo lock)						
			1: If both S [−] motor wil	Note. 0: ST1/ST2-VIN off (open) 1: ST1/ST2-VIN on (short) f both ST1 and ST2 are switched on or off during operation, the servo motor will be decelerated to a stop according to the parameter No.12						
	Speed selection 1	SP1		<internal Used to When u</internal 	etting and servo-locked. Internal speed control mode> Used to select the command speed for operation. When using SP1 to SP3, make it usable by making the setting of parameter No.43 to 48.					Δ
	Speed selection 2	SP2		(Note SP3) Input s SP2	ignals SP1	Servo motor starting direction	DI-1	\backslash	Δ
	Speed selection 3	SP3	Ι	0	0	0	Internal speed command 1 (parameter No.8)	DI-1		Δ
			$\langle \rangle$	0	0	1	Internal speed command 1 (parameter No.8)		\mathbf{N}	
				0	1	0	Internal speed command 2 (parameter No.9)			
				0	1	1	Internal speed command 3 (parameter No.10)			
				1	0	0	Internal speed command 4 (parameter No.72)			
				1	0	1	Internal speed command 5 (parameter No.73)			
				1	1	0	Internal speed command 6 (parameter No.74)			
				1	1	1	Internal speed command 7 (parameter No.75)			
							/IN off (open) /IN on (short)			
	Proportion control	PC	Ν	Connect	PC-VIN	to switc	h the speed amplifier from the proportional integral	DI-1	Δ	Δ
				type to th	e propo	rtional ty	/pe.		1	
							op is rotated even one pulse due to any external			
							e to compensate for a position shift. When the			
							e locked mechanically after positioning completion			
				(stop), switching on the proportion control signal (PC) upon positioning completion will suppress the unnecessary torque generated to compensate						
				for a posi		•••	· · · ·		1	
			When the shaft is to be locked for a long time, set the internal torque limit 1					1		
				and 2 (parameter No.28 and 76) to make the torque less than the rated				1		
				torque at	the sam	ne time d	of turning ON the proportion control signal.			

ſ	Signal	Symbol	Connector pin No.	Functions/applications	I/O division	m	ntrol ode
-	Emergency stop	EMG	CN1-8	Disconnect EMG-VIN to bring the servo motor to emergency stop state, in which the servo is switched off and the dynamic brake is operated. Connect EMG-VIN in the emergency stop state to reset that state.	DI-1	Р 0	S
-	Clear	CR	CN1-5	Connect CR-VIN to clear the position control counter droop pulses on its leading edge. The pulse width should be 10ms or more. When the parameter No.42 setting is "□□1□", the pulses are always cleared while CR-VIN are connected.	DI-1	0	
eek	Electronic gear selection 1	CM1		When using CM1 and CM2, make them usable by the setting of parameters No.43 to 48. The combination of CM1-VIN and CM2-VIN gives you a choice of four different electronic gear numerators set in the parameters. CM1 and CM2 cannot be used in the absolute position detection system.	DI-1	Δ	
-	Electronic gear selection 2	CM2		(Note) Input signalsElectronic gear numeratorCM2CM100Parameter No.3	DI-1	Δ	
				0 1 Parameter No.69 1 0 Parameter No.70 1 1 Parameter No.71 Note. 0: CM1/CM2-VIN off (open) 1: CM1/CM2-VIN on (short)			
	Gain changing	CDP		When using this signal, make it usable by the setting of parameter No.43 to 48. Connect CDP-VIN to change the load inertia moment ratio into the parameter No.61 setting and the gain values into the values multiplied by the parameter No.62 to 64 settings.	DI-1	Δ	Δ
	Control change	LOP		<position change="" control="" internal="" mode="" speed=""> Used to select the control mode in the position/internal speed control change mode. (Note) LOP Control mode 0 Position 1 Internal speed Note. 0: LOP-VIN off (open) 1: LOP-VIN on (short)</position>	DI-1	Refe Fun /app catio	ctions Ili-
	Forward rotation pulse train Reverse rotation pulse train	PP NP PG	CN1-23 CN1-25 CN1-22	 Used to enter a command pulse train. In the open collector system (max. input frequency 200kpps). Forward rotation pulse train across PP-SG Reverse rotation pulse train across NP-SG In the differential receiver system (max. input frequency 500kpps). Forward rotation pulse train across PG-PP 	DI-2	0	
		NG	CN1-24	Reverse rotation pulse train across NG-NP The command pulse train form can be changed using parameter No.21.			$ \rangle$

(2) Output signals

Signal Symbol		Connector pin No.	Functions/applications	I/O division	Cor mc P	
Trouble	ALM	CN1-9	ALM-VIN are disconnected when power is switched off or the protective circuit is activated to shut off the base circuit. Without alarm, ALM-VIN are connected within about 1s after power on.	DO-1	0	0
Ready	RD	CN1-11	RD-VIN are connected when the servo is switched on and the servo amplifier is ready to operate.	DO-1	0	0
In position	INP	CN1-10	NP-VIN are connected when the number of droop pulses is in the preset n-position range. The in-position range can be changed using parameter lo.5. When the in-position range is increased, INP-VIN may be kept connected luring low-speed rotation.		0	
Speed reached SA			SA turns off when servo on (SON) turns off or the servo motor speed has not reached the preset speed with both forward rotation start (ST1) and reverse rotation start (ST2) turned off. SA turns on when the servo motor speed has nearly reached the preset speed. When the preset speed is 20r/min or less, SA always turns on.	DO-1		0
Zero speed	ZSP	CN1-12	ZSP-VIN are connected when the servo motor speed is zero speed (50r/min) or less. Zero speed can be changed using parameter No.24.	DO-1	0	0
Electromagnetic brake interlock	MBR			DO-1	Δ	Δ
Warning	ning WNG To use this signal, assign the connector pin for output using parameter No.49. The old signal before assignment will be unusable. When warning has occurred, WNG-VIN are connected. When there is no warning, WNG-VIN are disconnected within about 1s after power-on.		DO-1	Δ	Δ	

	Signal	Symbol	Connector				Function	s/applications	I/O	Cor mo	
	0.9.10.	0,	pin No.							P	S
	Alarm code	ACD 0 ACD 1 ACD 2		This sign respectiv	al is out e ordina	put wher ry signal	n an alarm Is (RD, IN	parameter No.49. n occurs. When there is no alarm, P, SA, ZSP) are output. listed below.	DO-1	Δ	Δ
		ACD 2		CN1	e) Alarm CN1 11 Pin	CN1	Alarm display	Name			
heet	4U.com						88888	Watchdog			
							AL.12	Memory error 1			
							AL.13	Clock error			
							AL.15	Memory error 2			
				0	0	0	AL.17	Board error			
							AL.19	Memory error 3			
							AL.37	Parameter error			
							AL.8A	Serial communication timeout			
							AL.8E	Serial communication error			
				0	1	0	AL.30	Regenerative error			
				Ű		Ŭ	AL.33	Overvoltage			
				0	0	1	AL.10	Undervoltage			
							AL.45	Main circuit device			
				0	1	1	AL.46	Servo motor overheat			
				Ũ	•		AL.50	Overload 1			
							AL.51	Overload 2			
				1	0	0	AL.24	Main circuit error			
					v	Ŭ	AL.32	Overcurrent			
							AL.31	Overspeed			
				1	1	0	AL.35	Command pulse frequency alarm			
							AL.52	Error excessive			
							AL.16	Encoder error 1			
				1	0	1	AL.1A	Monitor combination error			
							AL.20	Encoder error 2			
				Note. 0: 1:		off (ope on (sho					

	Signal	Symbol Connector Functions/applications		I/O division	mo	ntrol ode	
			-			Ρ	S
	Encoder Z-phase	OP	CN1-21	Outputs the zero-point signal of the encoder. One pulse is output per servo	DO-2	0	0
	pulse			motor revolution. OP and LG are connected when the zero-point position is			
	(Open collector)			reached. (Negative logic)			
				The minimum pulse width is about 400μ s. For home position return using			
				this pulse, set the creep speed to 100r/min. or less.			
	Encoder A-phase	LA	CN1-15	Outputs pulses per servo motor revolution set in parameter No.27 in the	DO-2	0	0
	pulse	LAR	CN1-16	differential line driver system. In CCW rotation of the servo motor, the			
	(Differential line	al line encoder B-phase pulse lags the encoder A-phase pulse by a phase angle					
eet	driver)			of <i>π</i> /2.			
	Encoder B-phase	LB	CN1-17	The relationships between rotation direction and phase difference of the A-			
	pulse	LBR	CN1-18	and B-phase pulses can be changed using parameter No.54.			
	(Differential line						
	driver)						
	Encoder Z-phase	LZ	CN1-19	The same signal as OP is output in the differential line driver system.	DO-2	0	0
	pulse	LZR	CN1-20				
	(Differential line						
	driver)						
	Analog monitor 1	MO1	CN3-4	Used to output the data set in parameter No.17 to across MO1-LG in terms	Analog	0	0
		of voltage. Resolution 10 bits		output			
	Analog monitor 2	alog monitor 2 MO2 CN3-6 Used to output the data set in parameter No.17 to across MO2-LG in terms		Analog	0	0	
				of voltage. Resolution 10 bits	output		

(3) Communication

Signal	Symbol	Connector pin No.	Functions/applications		Functions/applications		Con mo	
	piri No.			division -	Р	S		
RS-232C I/F	RXD	CN3-1	RS-232C communication interface.		0	0		
	TXD	CN3-2						

(4) Power supply

Signal	Symbol Connector pin No.		Functions/applications	I/O division	Cor mo	ode
					Ρ	S
Digital I/F power supply input	VIN	CN1-1	Jsed to input 24VDC for input interface. Connect the positive terminal of the 24VDC external power supply. 24VDC ±10%		0	0
Open collector power input	OPC	CN1-2	When inputting a pulse train in the open collector system, supply this terminal with the positive $(+)$ power of 24VDC.		0	0
Digital I/F common	SG	CN1-13	Common terminal for output signals such as ALM and INP. Separated from LG.		0	0
Control common	LG	CN1-14	Common terminal for OP, MO1, and MO2. Pins are connected internally.		0	0
Shield	SD	Plate	Connect the external conductor of the shield cable.		0	0

3.4 Detailed description of the signals

3.4.1 Position control mode

- (1) Pulse train input
 - (a) Input pulse waveform selection

Encoder pulses may be input in any of three different forms, for which positive or negative logic can be chosen. Set the command pulse train form in parameter No.21.

Arrow \square or \square in the table indicates the timing of importing a pulse train.

A- and B-phase pulse trains are imported after they have been multiplied by 4.

/ww.DataSheet4U.con		Pulse train form	Forward rotation command	Reverse rotation command	Parameter No.21 (Command pulse train)
		Forward rotation pulse train Reverse rotation pulse train	PP J J J J J J		0010
	Negative logic	Pulse train + sign			0011
		A-phase pulse train B-phase pulse train	PP_ff~		0012
		Forward rotation pulse train Reverse rotation pulse train	PP_flflflfl		0000
	Positive logic	Pulse train + sign	_{РР} _ Т _ Т _ Т _ Т _ Т _ Т _		0001
		A-phase pulse train B-phase pulse train			0002

(b) Connections and waveforms

- 1) Open collector system
 - Connect as shown below.



Note. Pulse train input interface is comprised of a photo coupler.

Therefore, it may be any malfunctions since the current is reduced when connect a resistance to a pulse train signal line.

The explanation assumes that the input waveform has been set to the negative logic and forward and reverse rotation pulse trains (parameter No.21 has been set to 0010). The waveforms in the table in (1) (a) of this section are voltage waveforms of PP and NP based on SG. Their relationships with transistor ON/OFF are as follows.



2) Differential line driver system Connect as shown below.



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Note. Pulse train input interface is comprised of a photo coupler.

Therefore, it may be any malfunctions since the current is reduced when connect a resistance to a pulse train signal line.

The explanation assumes that the input waveform has been set to the negative logic and forward and reverse rotation pulse trains (parameter No.21 has been set to 0010). For the differential line driver, the waveforms in the table in (1) (a) of this section are as follows.

The waveforms of PP, PG, NP and NG are based on that of the ground of the differential line driver.



(2) In-position (INP)

PF-VIN are connected when the number of droop pulses in the deviation counter falls within the preset inposition range (parameter No.5). INP-VIN may remain connected when low-speed operation is performed with a large value set as the in-position range.



(4) Electronic gear switching

The combination of CM1-VIN and CM2-VIN gives you a choice of four different electronic gear numerators set in the parameters.

As soon as CM1/CM2 is turned ON or OFF, the numerator of the electronic gear changes. Therefore, if any shock occurs at this change, use position smoothing (parameter No.7) to relieve shock.

(Note) Extern	al input signal	Electropia goor numerator		
CM2 CM1		Electronic gear numerator		
0	0	Parameter No.3		
0	1	Parameter No.69		
1	0	Parameter No.70		
1	1	Parameter No.71		

Note. 0: CM1/CM2-VIN off(open)

1: CM1/CM2-VIN on(short)

(5) Torque limit

CAUTION • Releasing the torque limit during servo lock may cause the servo motor to suddenly rotate according to the position deviation from the instructed position.

(a) Torque limit and torque

By setting parameter No.28 (internal torque limit 1), torque is always limited to the maximum value during operation. A relationship between the limit value and servo motor torque is shown below.



0 100 Torque limit value [%]

(b) Torque limit value selection

When internal torque limit selection (TL1) is made usable by parameter No.43 to 48, internal torque limit 2 (parameter No.76) can be selected. However, if the parameter No.28 value is less than the limit value selected by parameter No.76, the parameter No.28 value is made valid.

(Note) External input signals	- Torque limit value made valid	
TL1		
0	Internal torque limit value 1 (parameter No.28)	
1	Parameter No.76 > Parameter No.28: Parameter No.28	
1	Parameter No.76 < Parameter No.28: Parameter No.76	

Note. 0: TL/TL1-VIN off (open)

1: TL/TL1-VIN on (short)

3.4.2 Internal speed control mode

(1) Speed setting

(a) Speed command and speed

The servo motor is run at the speeds set in the parameters.



The following table indicates the rotation direction according to forward rotation start (ST1) and reverse rotation start (ST2) combination.

(Note 1) External input signals		(Note 2) Rotation direction	
ST2 ST1		Internal speed commands	
0	0	Stop (Servo lock)	
0	1	CCW	
1	0	CW	
1	1	Stop (Servo lock)	

Note 1. 0: ST1/ST2-VIN off (open)

1: ST1/ST2-VIN on (short)

2. Releasing the torque limit during servo lock may cause the servo motor to suddenly rotate according to the position deviation from the instructed position.

The forward rotation start (ST1) and reverse rotation start (ST2) can be assigned to any pins of the connector CN1 using parameters No.43 to 48.

Generally, make connection as shown below.



(b) Speed selection 1 (SP1), speed selection 2 (SP2), speed selection 3 (SP3) and speed command value By making speed selection 1 (SP1), speed selection 2 (SP2) and speed selection 3 (SP3) usable by setting of parameter No.43 to 47, you can choose the speed command values of internal speed commands 1 to 7.

	(Note) External input signals		ut signals	Speed command value	
	SP3	SP2	SP1		
	0	0	0	Internal speed command 1 (parameter No.8)	
	0	0	1	Internal speed command 1 (parameter No.8)	
	0	1	0	Internal speed command 2 (parameter No.9)	
	0	1	1	Internal speed command 3 (parameter No.10) Internal speed command 4 (parameter No.72)	
om	1	0	0		
	1	0	1	Internal speed command 5 (parameter No.73)	
	1	1	0	Internal speed command 6 (parameter No.74)	
	1	1	1	Internal speed command 7 (parameter No.75)	

Note. 0: SP1/SP2/SP3-VIN off (open)

1: SP1/SP2/SP3-VIN on (short)

The speed may be changed during rotation. In this case, the values set in parameters No.11 and 12 are used for acceleration/deceleration.

When the speed has been specified under any internal speed command, it does not vary due to the ambient temperature.

(2) Speed reached (SA)

SA-VIN are connected when the servo motor speed nearly reaches the speed set to the internal speed command.



(3) Torque limit

As in section 3.4.1 (5).

3.4.3 Position/internal speed control change mode

Set "0001" in parameter No.0 to switch to the position/internal speed control change mode. This function is not available in the absolute position detection system.

(1) Control change (LOP)

Use control change (LOP) to switch between the position control mode and the internal speed control mode from an external contact. Relationships between LOP-VIN status and control modes are indicated below.

	(Note) LOP	Servo control mode
	0	Position control mode
et4U.	om 1	Speed control mode

Note. 0: LOP-VIN off (open) 1: LOP-VIN on (short)

The control mode may be changed in the zero-speed status. To ensure safety, change control after the servo motor has stopped. When position control mode is changed to speed control mode, droop pulses are reset. If the LOP has been switched on-off at the speed higher than the zero speed and the speed is then reduced to the zero speed or less, the control mode cannot be changed. A change timing chart is shown below.



Note. When Zero speed (ZSP) is not on, control cannot be changed if Control change (LOP) is switched on-off. If Zero speed (ZSP) switches on after that, control cannot not be changed.

(2) Torque limit in position control mode

As in section 3.4.1 (5).

- (3) Internal speed setting in speed control mode
 - (a) Speed command and speed

The servo motor is run at the speed set in parameter No.8 (internal speed command 1) the forward rotation start (ST1) and reverse rotation start (ST2) are as in section 3.4.2 (1) (a). Generally, make connection as shown below.



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(b) Speed selection 2 (SP2) and speed command value

Use speed selection 2 (SP2) to select between the speed set by the internal speed command 1 and the speed set by the Internal speed command 2 as indicated in the following table.

(Note) External input signals	Speed command value	
SP1		
0	Internal speed command 1 (parameter No.8)	
1	Internal speed command 2 (parameter No.9)	

Note. 0: SP1-VIN off (open)

1: SP1-VIN on (short)

The speed may also be changed during rotation. In this case, it is increased or decreased according to the value set in parameter No.11 or 12.

When the internal speed command 1 is used to command the speed, the speed does not vary with the ambient temperature.

(c) Speed reached (SA)

As in section 3.4.2 (2).

3.5 Alarm occurrence timing chart

	 When an alarm has occurred, remove its cause, make sure that the operation signal is not being input, ensure safety, and reset the alarm before restarting operation.
	 As soon as an alarm occurs, turn off Servo-on (SON) and power off the power supply.

When an alarm occurs in the servo amplifier, the base circuit is shut off and the servo motor is coated to a stop. Switch off the power supply in the external sequence. To reset the alarm, switch the power supply from off to on, press the "SET" button on the current alarm screen, or turn the reset (RES) from off to on. However, the alarm cannot be reset unless its cause is removed.



Note. Shut off the power as soon as an alarm occurs.

(1) Overcurrent, overload 1 or overload 2

If operation is repeated by switching power off, then on to reset the overcurrent (AL.32), overload 1 (AL.50) or overload 2 (AL.51) alarm after its occurrence, without removing its cause, the servo amplifier and servo motor may become faulty due to temperature rise. Securely remove the cause of the alarm and also allow about 30 minutes for cooling before resuming operation.

(2) Regenerative error

If operation is repeated by switching power off, then on to reset the regenerative (AL.30) alarm after its occurrence, the external regenerative resistor will generate heat, resulting in an accident.

(3) Instantaneous power failure

• Undervoltage (AL.10) occurs when the input power is in either of the following statuses.

A power failure of the control circuit power supply continues for 60ms or longer and the control circuit is not completely off.

- The bus voltage dropped to 200VDC.
- (4) In position control mode (incremental)

When an alarm occurs, the home position is lost. When resuming operation after deactivating the alarm, make a home position return.

3.6 Interfaces

3.6.1 Common line

The following diagram shows the power supply and its common line.



Note. For the open collection pulse train input. Make the following connection for the different line driver pulse train input.



3.6.2 Detailed description of the interfaces

This section gives the details of the I/O signal interfaces (refer to I/O Division in the table) indicated in section 3.3.2.

Refer to this section and connect the interfaces with the external equipment.

(1) Digital input interface DI-1

Give a signal with a relay or open collector transistor.



(2) Digital output interface DO-1

A lamp, relay or photocoupler can be driven. Provide a diode (D) for an inductive load, or an inrush current suppressing resistor (R) for a lamp load. (Rated current: 40mA or less, maximum current: 50mA or less, inrush current: 100mA or less)

(a) Inductive load



Note. If the voltage drop (maximum of 2.6V) interferes with the relay operation, apply high voltage (up to 26.4V) from external source.

(b) Lamp load



Note. If the voltage drop (maximum of 2.6V) interferes with the relay operation, apply high voltage (up to 26.4V) from external source.

(3) Pulse train input interface DI-2

Provide a pulse train signal in the open collector or differential line driver system.

(a) Open collector system

1) Interface



Note. Pulse train input interface is comprised of a photo coupler.

Therefore, it may be any malfunctions since the current is reduced when connect a resistance to a pulse train signal line.

2) Conditions of the input pulse



(b) Differential line driver system

1) Interface



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Note. Pulse train input interface is comprised of a photo coupler.

Therefore, it may be any malfunctions since the current is reduced when connect a resistance to a pulse train signal line.

2) Conditions of the input pulse



(4) Encoder pulse output

(a) Open collector system

Interface

Max. output current : 35mA





(b) Differential line driver system

1) Interface

Max. output current: 35mA



2) Output pulse



Time cycle (T) is determined by the settings of parameter No.27 and 54.

(5) Analog output

Output voltage $\pm 10V$ Max. 1mA Max. output current Resolution: 10bit

Servo amplifier



3.7 Input power supply circuit

 Always connect a magnetic contactor (MC) between the main circuit power supply and L₁, L₂, and L₃ of the servo amplifier, and configure the wiring to be able to shut down the power supply on the side of the servo amplifier's power supply. If a magnetic contactor (MC) is not connected, continuous flow of a large current may cause a fire when the servo amplifier malfunctions.
 Use the trouble (ALM) to switch power off. Otherwise, a regenerative transistor fault or the like may overheat the regenerative resistor, causing a fire.

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POINT

• The power supply connector (CNP1) is optional. Purchase it without fail.

3.7.1 Connection example

Wire the power supply and main circuit as shown below so that the servo-on (SON) turns off as soon as alarm occurrence is detected and power is shut off.

A circuit breaker (NFB) must be used with the input cables of the power supply.





Note. To use the built-in regenerative resistor, be sure to connect across P and D of the power supply connector (CNP1).

(2) For 1-phase 230VAC power supply



Note. To use the built-in regenerative resistor, be sure to connect across P and D of the power supply connector (CNP1).

3.7.2 Terminals

Refer to section 11.1 (4) for the signal arrangement.

Connected terminal (Application)	Symbol	Description			
	L ₁	Supply L_1 , L_2 and L_3 with the following power. For 1-phase 230VAC, connect the power supply to L_1 , L_2 and L_3 open.			
		Servo amplifierMR-E-10A-QW003 toMR-E-100A-QW003/Power supplyMR-E-70A-QW003MR-E-200A-QW003			
Power supply	L ₂	3-phase 200 to 230VAC, 50/60Hz			
	L ₃	1-phase 230VAC, 50/60Hz			
	U	Connect to the servo motor power terminals (U, V, W). During power-on, do not open			
Servo motor	V W	or close the motor power line. Otherwise, a malfunction or faulty may occur.			
	P	To use the built-in regenerative resistor of the servo amplifier, connect the wiring across P-D of the power supply connector (CNP1).			
Regenerative option	С	When using the regenerative option, always remove the wiring from across P-D and			
	D	connect the regenerative option across P-C. Refer to section 13.1.1 for details.			
Protective earth (PE)	÷	Connect this terminal to the protective earth (PE) terminals of the servo motor and control box for grounding.			

3.7.3 Power-on sequence

(1) Power-on procedure

- 1) Always wire the power supply as shown in above section 3.7.1 using the magnetic contactor with the power supply (three-phase 200V: L₁, L₂, L₃, single-phase 230V: L₁, L₂). Configure up an external sequence to switch off the magnetic contactor as soon as an alarm occurs.
- 2) The servo amplifier can accept the servo-on (SON) 2s or more after the power supply is switched on. Therefore, when SON is switched on simultaneously with the power supply, the base circuit will switch on in about 1 to 2s, and the ready (RD) will switch on in further about 20ms, making the servo amplifier ready to operate. (Refer to paragraph (2) in this section.)

3) When the reset (RES) is switched on, the base circuit is shut off and the servo motor shaft coasts.

(2) Timing chart



(3) Emergency stop

• Provide an external emergency stop circuit to ensure that operation can be stopped and power switched off immediately.

Make up a circuit which shuts off power as soon as EMG-VIN are opened at an emergency stop. To ensure safety, always install an external emergency stop switch across EMG-VIN. By disconnecting EMG-VIN, the dynamic brake is operated to bring the servo motor to a sudden stop. At this time, the display shows the servo emergency stop warning (AL.E6).

During ordinary operation, do not use the external emergency stop signal to alternate stop and run. The servo amplifier life may be shortened.

Also, if the start signal is on or a pulse train is input during an emergency stop, the servo motor will rotate as soon as the warning is reset. During an emergency stop, always shut off the run command.



3.8 Connection of servo amplifier and servo motor

3.8.1 Connection instructions

 Insulate the connections of the power supply terminals to prevent an electric shock. 		
 Connect the wires to the correct phase terminals (U, V, W) of the servo amplifier and servo motor. Otherwise, the servo motor does not operate properly. Do not connect AC power supply directly to the servo motor. Otherwise, a fault may occur. During power-on, do not open or close the motor power line. Otherwise, a malfunction or faulty may occur. 		
POINT • Refer to section 12.1 for the selection of the encoder cable.		

 The connector (CNP2) for supplying the power to the motor is optional. Be sure to purchase it.

The connection method differs according to the series and capacity of the servo motor and whether or not the servo motor has the electromagnetic brake. Perform wiring in accordance with this section.

(1) For grounding, connect the earth cable of the servo motor to the protective earth (PE) terminal () of the servo amplifier and connect the ground cable of the servo amplifier to the earth via the protective earth (PE) terminal of the control box. Do not connect them directly to the protective earth of the control panel.



(2) Do not share the 24VDC interface power supply between the interface and electromagnetic brake. Always use the power supply designed exclusively for the electromagnetic brake.

3.8.2 Power supply cable wiring diagrams

(1) HF-KE W1-S100 Servo motor

(a) When cable length is 10m or less



Note 1. Connect a surge absorber as close to the servo motor as possible.

- 2. There is no polarity in electromagnetic brake terminals (B1 and B2).
- 3. When using a servo motor with electromagnetic brake, assign the electromagnetic brake interlock (MBR) to external output signal in the parameters No.PA04, PD13 to PD16 and PD18.

When fabricating the motor brake cable MR-BKS1CBL-DM-H, refer to section 13.1.2(5).

(b) Connector and signal allotment

When the cable length exceeds 10m, fabricate an extension cable as shown below. In this case, the motor power supply cable should be within 2m long.

Refer to section 13.1.2 for the wire used for the extension cable.



Note 1. Use of the following connectors is recommended when ingress protection (IP65) is necessary.

Relay Connector	Description	Protective Structure
a) Relay connector for extension cable	Connector: RM15WTPZ-4P(71) Cord clamp: RM15WTP-CP(5)(71) (Hirose Electric) L Numeral changes depending on the cable OD.	IP65
b) Relay connector for motor power supply cable	Connector: RM15WTJA-4S(71) Cord clamp: RM15WTP-CP(8)(71) (Hirose Electric) L Numeral changes depending on the cable OD.	IP65
c) Relay connector for extension cable	CM10-CR2P-* (DDK)	IP65
d) Relay connector for motor brake cable	CM10-SP2S- * (DDK)	IP65

2. Connect a surge absorber as close to the servo motor as possible.

3. There is no polarity in electromagnetic brake terminals (B1 and B2).

4. When using a servo motor with electromagnetic brake, assign the electromagnetic brake interlock (MBR) to external output signal in the parameters No.PA04, PD13 to PD16 and PD18.

(2) HF-SE JW1-S100 servo motor

(a) Wiring diagrams

Refer to section 13.2 for the cables used for wiring.



- Note 1. There is no polarity in electromagnetic brake terminals B1 and B2.
 - 2. When using a servo motor with electromagnetic brake, assign the electromagnetic brake interlock (MBR) to external output signal in the parameters No.1.

(b) Connector and signal allotment

The connector fitting the servo motor is prepared as optional equipment. Refer to section 13.1.2. For types other than those prepared as optional equipment, refer to chapter.



	Servo motor side connectors			
Servo motor	Encoder	Power supply	Electromagnetic brake	
HF-SE52JW1-S100				
HF-SE102JW1-S100		MS3102A18-10P	CN10-R2P	
HF-SE152JW1-S100	MS3102A20-29P		(DDK)	
HF-SE202JW1-S100		MS3102A22-22P		



3.9 Servo motor with electromagnetic brake

3.9.1 Precautions



POINT

- Refer to chapter 14 for specifications such as the power supply capacity and operation delay time of the electromagnetic brake.
- Refer to section 3.8 for wiring diagrams.

Note the following when the servo motor equipped with electromagnetic brake is used.

- 1) Set "□□1□" in parameter No.1 to make the electromagnetic brake interlock (MBR) valid. Note that this will make the zero speed signal (ZSP) unavailable.
- 2) Do not share the 24VDC interface power supply between the interface and electromagnetic brake. Always use the power supply designed exclusively for the electromagnetic brake.
- 3) The brake will operate when the power (24VDC) switches off.
- 4) While the reset (RES) is on, the base circuit is shut off. When using the servo motor with a vertical shaft, use the electromagnetic brake interlock (MBR).
- 5) Switch off the servo-on signal after the servo motor has stopped.

3.9.2 Setting

- 1) Set "DD1D" in parameter No.1 to make the electromagnetic brake interlock (MBR) valid.
- 2) Using parameter No.33 (electromagnetic brake sequence output), set a delay time (Tb) at servo-off from electromagnetic brake operation to base circuit shut-off as in the timing chart shown in section 3.9.3.
3.9.3 Timing charts

(1) Servo-on signal command (from controller) ON/OFF

Tb [ms] after the servo-on (SON) signal is switched off, the servo lock is released and the servo motor coasts. If the electromagnetic brake is made valid in the servo lock status, the brake life may be shorter. Therefore, when using the electromagnetic brake in a vertical lift application or the like, set Delay time (Tb) to about the same as the electromagnetic brake operation delay time to prevent a drop.



3. SIGNALS AND WIRING

(3) Alarm occurrence



Note. Changes with the operating status.

3. SIGNALS AND WIRING

3.10 Grounding

 Ground the servo amplifier and servo motor securely.
 To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked) of the servo amplifier with the protective earth (PE) of the control box.

The servo amplifier switches the power transistor on-off to supply power to the servo motor. Depending on the wiring and ground cable routing, the servo amplifier may be affected by the switching noise (due to di/dt and dv/dt) of the transistor. To prevent such a fault, refer to the following diagram and always ground. To conform to the EMC Directive, refer to the EMC Installation Guidelines (IB(NA)67310).



Note. For 1-phase 230VAC, connect the power supply to L₁, L₂ and leave L₃ open. Refer to section 1.3 for the power supply specification.

3. SIGNALS AND WIRING

3.11 Servo amplifier connectors (CNP1, CNP2) wiring method (When MR-ECPN1-B and MR-ECPN2-B of an option are used.)



(1) Termination of the cables

Solid wire: After the sheath has been stripped, the cable can be used as it is.





Twisted wire: Use the cable after stripping the sheath and twisting the core. At this time, take care to avoid a short caused by the loose wires of the core and the adjacent pole. Do not solder the core as it may cause a contact fault.

(2) Inserting the cable into the connector

(a) Applicable flat-blade screwdriver dimensions

Always use the screwdriver shown here to do the work.



(b) When using the flat-blade screwdriver - part 1



4) Releasing the screwdriver connects the cable.

(c) When using the flat-blade screwdriver - part 2



4) Releasing the screwdriver connects the cable.

3.12 Instructions for the 3M connector

When fabricating an encoder cable or the like, securely connect the shielded external conductor of the cable to the ground plate as shown in this section and fix it to the connector shell.



4. OPERATION

4. OPERATION

4.1 When switching power on for the first time

Before starting operation, check the following.

- (1) Wiring
 - (a) A correct power supply is connected to the power input terminals (L₁, L₂, L₃) of the servo amplifier.
 - (b) The servo motor power supply terminals (U, V, W) of the servo amplifier match in phase with the power input terminals (U, V, W) of the servo motor.

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- (c) The servo motor power supply terminals (U, V, W) of the servo amplifier are not shorted to the power input terminals (L₁, L₂, L₃) of the servo motor.
- (d) The earth terminal of the servo motor is connected to the PE terminal of the servo amplifier.
- (e) When using the regenerative option, the lead has been removed from across D-P of the servo amplifier built-in regenerative resistor, and twisted cables are used for its wiring.
- (f) When stroke end limit switches are used, the signals across LSP-VIN and LSN-VIN are on during operation.
- (g) 24VDC or higher voltages are not applied to the pins of connectors CN1.
- (h) SD and SG of connectors CN1 are not shorted.
- (i) The wiring cables are free from excessive force.
- (2) Environment

Signal cables and power cables are not shorted by wire offcuts, metallic dust or the like.

- (3) Machine
 - (a) The screws in the servo motor installation part and shaft-to-machine connection are tight.
 - (b) The servo motor and the machine connected with the servo motor can be operated.

4.2 Startup

 Do not operate the switches with wet hands. You may get an electric shock.
 Before starting operation, check the parameters. Some machines may perform unexpected operation. Take safety measures, e.g. provide covers, to prevent accidental contact of hands and parts (cables, etc.) with the servo amplifier heat sink, regenerative resistor, servo motor, etc. since they may be hot while power is on or for some time after power-off. Their temperatures may be high and you may get burnt or a parts may damaged. During operation, never touch the rotating parts of the servo motor. Doing so can cause injury.

Connect the servo motor with a machine after confirming that the servo motor operates properly alone.

4.2.1 Selection of control mode

Use parameter No.0 to choose the control mode used. After setting, this parameter is made valid by switching power off, then on.

4.2.2 Position control mode

- (1) Power on
 - 1) Switch off the servo-on (SON).
 - 2) When power is switched on, the display shows "C (Cumulative feedback pulses)", and in two second later, shows data.
- (2) Test operation 1

Confirm servo motor operation by operating JOG of test operation mode at lowest speed possible. (Refer to section 6.8.2)

(3) Parameter setting

Set the parameters according to the structure and specifications of the machine. Refer to chapter 5 for the parameter definitions and to section 6.5 for the setting method.

Parameter No.	Name	Setting	Description
0	Control mode, regenerative option selection		 Position control mode MR-RB12 regenerative option is used.
1	Function selection 1	002	 Input filter 3.555ms (initial value) Electromagnetic brake interlock (MBR) is not used. Used in incremental positioning system.
2	Auto tuning		 Middle response (initial value) is selected. Auto tuning mode 1 is selected.
3	Electronic gear numerator (CMX)	1	Electronic gear numerator
4	Electronic gear denominator (CDV)	1	Electronic gear denominator

Turn the power off after setting parameters No.0 and 1. Then switch power on again to make the set parameter values valid.

4. OPERATION

(4) Servo-on

Switch the servo-on in the following procedure.

- 1) Switch on power supply.
- 2) Switch on the servo-on (SON).

When placed in the servo-on status, the servo amplifier is ready to operate and the servo motor is locked.

(5) Command pulse input

Entry of a pulse train from the positioning device rotates the servo motor. At first, run it at lowest speed possible and check the rotation direction, etc. If it does not run in the intended direction, check the input signal

www.DataSheet4U.**signal.**

On the status display, check the speed, command pulse frequency, load factor, etc. of the servo motor. When machine operation check is over, check automatic operation with the program of the positioning device.

This servo amplifier has a real-time auto tuning function under model adaptive control. Performing operation automatically adjusts gains. The optimum tuning results are provided by setting the response level appropriate for the machine in parameter No.2. (Refer to chapter 7)

(6) Home position return

Make home position return as required.

(7) Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor. Refer to section 3.9 for the servo motor equipped with electromagnetic brake. Note that the stop pattern of forward rotation stroke end (LSP), reverse rotation stroke end (LSN) OFF is as described below.

(a) Servo-on (SON) OFF

The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence

When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Emergency stop (EMG) OFF

The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm AL.E6 (servo emergency stop warning) occurs.

(d) Forward rotation stroke end (LSP), reverse rotation stroke end (LSN) OFF

The droop pulse value is erased and the servo motor is stopped and servo-locked. It can be run in the opposite direction.

4.2.3 Internal speed control mode

- (1) Power on
 - 1) Switch off the servo-on (SON).
 - 2) When circuit power is switched on, the display shows "r (servo motor speed)", and in two second later, shows data.
- (2) Test operation

Using jog operation in the test operation mode, make sure that the servo motor operates. (Refer to section 6.8.2.)

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(3) Parameter setting

Set the parameters according to the structure and specifications of the machine. Refer to chapter 5 for the parameter definitions and to section 6.5 for the setting method.

Parameter No.	Name	Setting	Description
0	Control mode, regenerative option selection		 Internal speed control mode Regenerative option is not used.
1	Function selection 1		 Input filter 3.555ms (initial value) Electromagnetic brake interlock (MBR) is used.
2	Auto tuning		 Middle response (initial value) is selected. Auto tuning mode 1 is selected.
8	Internal speed command 1	1000	Set 1000r/min.
9	Internal speed command 1	1500	Set 1500r/min.
10	Internal speed command 1	2000	Set 2000r/min.
11	Acceleration time constant	1000	Set 1000ms.
12	Deceleration time constant	500	Set 500ms.
13	S-pattern acceleration/deceleration time constant	0	Not used

Turn the power off after setting parameters No.0 and 1. Then switch power on again to make the set parameter values valid.

(4) Servo-on

Switch the servo-on in the following procedure.

- 1) Switch on circuit power supply.
- 2) Switch on the servo-on (SON) signal. (Short between SON and VIN.) When placed in the servo-on status, the servo amplifier is ready to operate and the servo motor is locked.

4. OPERATION

(5) Start

Using speed selection 1 (SP1) and speed selection 2 (SP2), choose the servo motor speed. Turn on forward rotation start (ST1) to run the motor in the forward rotation (CCW) direction or reverse rotation start (ST2) to run it in the reverse rotation (CW) direction. At first, set a low speed and check the rotation direction, etc. If it does not run in the intended direction, check the input signal.

On the status display, check the speed, load factor, etc. of the servo motor.

When machine operation check is over, check automatic operation with the host controller or the like.

This servo amplifier has a real-time auto tuning function under model adaptive control. Performing operation automatically adjusts gains. The optimum tuning results are provided by setting the response level appropriate for the machine in parameter No.2. (Refer to chapter 7)

(6) Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor.

Refer to section 3.9 for the servo motor equipped with electromagnetic brake. Note that simultaneous ON or simultaneous OFF of forward rotation stroke end (LSP), reverse rotation stroke end (LSN) OFF and forward rotation start (ST1) or reverse rotation start (ST2) signal has the same stop pattern as described below.

(a) Servo-on (SON) OFF

The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence

When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Emergency stop (EMG) OFF

The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm AL.E6 (servo emergency stop warning) occurs.

(d) Forward rotation stroke end (LSP), reverse rotation stroke end (LSN) OFF

The servo motor is brought to a sudden stop and servo-locked. The motor may be run in the opposite direction.

(e) Simultaneous ON or simultaneous OFF of forward rotation start (ST1) and reverse rotation start (ST2) signals

The servo motor is decelerated to a stop.

POINT
A sudden stop indicates deceleration to a stop at the deceleration time constant of zero.

MEMO

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5. PARAMETERS

· Never adjust or change the parameter values extremely as it will make operation CAUTION instable.

5.1 Parameter list

5.1.1 Parameter write inhibit

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POINT
 After setting the parameter No.19 value, switch power off, then on to make that setting valid.

This servo amplifier, its parameters are classified into the basic parameters (No.0 to 19), expansion parameters 1 (No.20 to 49) and expansion parameters 2 (No.50 to 84) according to their safety aspects and frequencies of use. In the factory setting condition, the customer can change the basic parameter values but cannot change the expansion parameter values. When fine adjustment, e.g. gain adjustment, is required, change the parameter No.19 setting to make the expansion parameters write-enabled. The following table indicates the parameters which are enabled for reference and write by the setting of parameter No.19. Operation can be performed for the parameters marked **O**.

Parameter No.19 setting	Operation	Basic parameters No.0 to 19	Expansion parameters 1 No.20 to 49	Expansion parameters 2 No.50 to 84
0000	Reference	0		
(initial value)	Write	0		
000A	Reference	No.19 only		
000A	Write	No.19 only		
000B	Reference	0	0	
0008	Write	0		
000C	Reference	0	0	
0000	Write	0	0	
0005	Reference	0	0	0
000E	Write	0	0	0
1000	Reference	0		
100B	Write	No.19 only		
1000	Reference	0	0	
100C	Write	No.19 only		
100E	Reference	0	0	0
IUUE	Write	No.19 only		

5.1.2 Lists

POIN	Т
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 For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

The symbols in the control mode column of the table indicate the following modes. P: Position control mode

S: Internal speed control mode

(1) Item list

	No.	Symbol	Name	Control mode	Initial value	Unit	Customer setting
	0	*STY	Control mode, regenerative option selection	P·S	(Note 1)	/	
	1	*OP1	Function selection 1	P·S	0002	/	
	2	ATU	Auto tuning	P·S	0105	/	
	3	CMX	Electronic gear numerator	Р	1	/	
	4	CDV	Electronic gear denominator	Р	1	/	
	5	INP	In-position range	Р	100	pulse	
	6	PG1	Position loop gain 1	Р	35	rad/s	
	7	DOT	Position command acceleration/deceleration time constant	Р	3		
ers	7	PST	(Position smoothing)	μ	3	ms	
Basic parameters	8	SC1	Internal speed command 1	S	100	r/min	
ara	9	SC2	Internal speed command 2	S	500	r/min	
sicp	10	SC3	Internal speed command 3	S	1000	r/min	
Bas	11	STA	Acceleration time constant	S	0	ms	
	12	STB	Deceleration time constant	S	0	ms	
	13	STC	S-pattern acceleration/deceleration time constant	S	0	ms	
	14	/	For manufacturer setting	/	0	/	
	15	*SNO	Station number setting	P∙S	0	station	
	16	*BPS	Serial communication function selection, alarm history clear	P∙S	0000		
	17	MOD	Analog monitor output	P∙S	0100	/	
	18	*DMD	Status display selection	P∙S	0000	/	
	19	*BLK	Parameter write inhibit	P∙S	0000	/	

		No.	Symbol	Name	Control mode	Initial value	Unit	Customer setting
		20	*OP2	Function selection 2	P∙S	0000	/	
		21	*OP3	Function selection 3 (Command pulse selection)	Р	0000	/	
		22	*OP4	Function selection 4	P∙S	0000	/	
		23	FFC	Feed forward gain	Р	0	%	
		24	ZSP	Zero speed	P∙S	50	r/min	
		25		For manufacturer setting		0	/	
		26	\sim	For manufacturer setting		100	/	
		27	*ENR	Encoder output pulses	P∙S	4000	pulse /rev	
ww.DataSheet4U	com	28	TL1	Internal torque limit 1	P•S	100	%	
		29	/	For manufacturer setting		0		
		30	/	For manufacturer setting		0		
	~	31	MO1	Analog monitor 1 offset	P•S	0	mV	
	ers	32	MO2	Analog monitor 2 offset	P·S	0	mV	
	met	33	MBR	Electromagnetic brake sequence output	P∙S	100	ms	
	Expansion parameters	34	GD2	Ratio of load inertia moment to servo motor inertia moment	P∙S	70	Multiplier (×10 ⁻¹)	
	nsic	35	PG2	Position loop gain 2	Р	35	rad/s	
	xpa	36	VG1	Speed loop gain 1	P∙S	177	rad/s	
	ш	37	VG2	Speed loop gain 2	P∙S	817	rad/s	
		38	VIC	Speed integral compensation	P·S	48	ms	
		39	VDC	Speed differential compensation	P∙S	980	/	
		40		For manufacturer setting		0	/	
		41	*DIA	Input signal automatic ON selection	P·S	0000	/	
		42	*DI1	Input signal selection 1	P·S	0002	/	
		43	*DI2	Input signal selection 2 (CN1-4)	P·S	0111	/	
		44	*DI3	Input signal selection 3 (CN1-3)	P·S	0882	/	
		45	*DI4	Input signal selection 4 (CN1-5)	P·S	0995	/	
		46	*DI5	Input signal selection 5 (CN1-6)	P·S	0000	/	
		47	*DI6	Input signal selection 6 (CN1-7)	P∙S	0000		
		48	*LSPN	LSP/LSN input terminals selection	P∙S	0403	/	
		49	*DO1	Output signal selection 1	P∙S	0000		

		No.	Symbol	Name	Control mode	Initial value	Unit	Customer setting
		50	/	For manufacturer setting	/	0000		\sim
		51	*OP6	Function selection 6	P·S	0000	\backslash	
		52	/	For manufacturer setting		0000	/	
		53	*OP8	Function selection 8	P·S	0000	/	
		54	*OP9	Function selection 9	P∙S	0000	/	
		55	*OPA	Function selection A	Р	0000	/	
		56	SIC	Serial communication time-out selection	P·S	0	s	
		57	/	For manufacturer setting		10		
		58	NH1	Machine resonance suppression filter 1	P·S	0000		
.DataSheet4U	com	59	NH2	Machine resonance suppression filter 2	P·S	0000	/	
		60	LPF	Low-pass filter/adaptive vibration suppression control	P·S	0000	/	
		61	GD2B	Ratio of load inertia moment to Servo motor inertia moment 2	P∙S	70	Multiplier (×10 ⁻¹)	
		62	PG2B	Position control gain 2 changing ratio	Р	100	%	
		63	VG2B	Speed control gain 2 changing ratio	P∙S	100	%	
	rs 2	64	VICB	Speed integral compensation changing ratio	P∙S	100	%	
	Expansion parameters	65	*CDP	Gain changing selection	P·S	0000		
	aran	66	CDS	Gain changing condition	P•S	10	(Note 2)	
	ğ	67	CDT	Gain changing time constant	P∙S	1	ms	
	Jsio	68		For manufacturer setting		0		
	xpai	69	CMX2	Command pulse multiplying factor numerator 2	Р	1	/	
	Ш	70	CMX3	Command pulse multiplying factor numerator 3	Р	1	\geq	
		71	CMX4	Command pulse multiplying factor numerator 4	Р	1		
		72	SC4	Internal speed command 4	S	200	r/min	
		73	SC5	Internal speed command 5	S	300	r/min	
		74	SC6	Internal speed command 6	S	500	r/min	
		75	SC7	Internal speed command 7	S	800	r/min	
		76	TL2	Internal torque limit 2	P·S	100	%	
		77	\backslash	For manufacturer setting	Ν	100	Λ	\setminus
		78	\setminus		\backslash	10000	$ \rangle$	\setminus
		79	\backslash		\setminus	10		\setminus
		80	\setminus			10		\setminus
		81				100		\setminus
		82				100		\setminus
		83				100		\setminus
		84				0000	\	\setminus

Note 1. Depends on the capacity of the servo amplifier.

2. Depends on the parameter No.65 setting.

(2) Details list

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Contro mode
Basic parameters	0	*STY	Control mode, regenerative option selection Used to select the control mode and regenerative option. Select the control mode. Select the control mode. Select the control mode. Selection and internal speed Selection Selection of regenerative option Selection of regenerative option Selection of regenerative option Selection of regenerative resistor is not used For the servo amplifier of 400W or New regenerative resistor is not used. Selection of regenerative resistor is used. Selection of regenerative resistor is not used. For the servo amplifier of 400W or New Reganal Selection Selection of regenerative resistor is used. Selection of regenerative resistor is not used. For the servo amplifier of 400W or New Reganal Selection Selection of regenerative resistor is used. Selection of regenerative resistor is not used. For the servo amplifier of 400W or New Reganal Selection Selection of regenerative resistor is used. Selection of the servo amplifier of 400W or Selection of the servo amplifier of 400W or Selection of the servo selection Selection of the servo selection Selection of the servo selection Selection of the servo selected is not for use with the servo amplifier, parameter error (AL.37) occurs.	100W : 0000 200W : 1000 400W : 2000 750W : 4000 1kW : 5010 2kW : 6010		Refer to name and function column.	P - \$
	1	*OP1	Function selection 1 Used to select the input signal filter, the function of pin CN1-12.	0002		Refer to name and function column.	P·S

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Contro mode
Basic parameters	2	ATU	Auto tuning Used to selection the response level, etc. for execution of auto tuning. Refer to chapter 7. O O Auto tuning response level setting Auto tuning response 20Hz 2 response 20Hz 30Hz 5 6 4 5 6 4 5 9 response 8 130Hz 6 4 130Hz 6 4 130Hz 6 130Hz 7 110E 8 130Hz 9 9 9 9 9 9<	value 0105		range Refer to name and function column.	P - S
	3	CMX	Electronic gear numerator Used to set the electronic gear numerator value. For the setting, refer to section 5.2.1. Setting "0" automatically sets the resolution of the servo motor connected.	1		0 1 to 65535	Р
	4	CDV	Electronic gear denominator Used to set the electronic gear denominator value. For the setting, refer to section 5.2.1.	1		1 to 65535	Р

Cla	ss N	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
		5	INP	In-position range Used to set the in-position signal (INP) output range in the command pulse increments prior to electronic gear calculation.	100	pulse	0 to 10000	Р
		6	PG1	Position loop gain 1 Used to set the gain of position loop. Increase the gain to improve track ability in response to the position command. When auto turning mode 1,2 is selected, the result of auto turning is automatically used.	35	red/s	4 to 2000	Ρ
ataSheei4U.d	com	7	PST	Position command acceleration/deceleration time constant (position smoothing) Used to set the time constant of a low-pass filter in response to the position command. You can use parameter No.55 to choose the primary delay or linear acceleration/deceleration control system. When you choose linear acceleration/deceleration, the setting range is 0 to 10ms. Setting of longer than 10ms is recognized as 10ms. POINT • When you have chosen linear acceleration/deceleration, do not select control selection (parameter No.0) and restart after instantaneous power failure (parameter No.20). Doing so will cause the servo motor to make a sudden stop at the time of position control switching or restart. Example: When a command is given from a synchronizing detector, synchronous operation can be started smoothly if started during line operation. Without time constant setting OFF	3	ms	0 to 20000	P
	;	8	SC1	Start —— Internal speed command 1 Used to set speed 1 of internal speed commands.	100	r/min	0 to instan- taneous	S
							permis- sible speed	

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Contro mode
	9	SC2	Internal speed command 2 Used to set speed 2 of internal speed commands.	500	r/min	0 to instan- taneous permis- sible speed	S
	10	SC3	Internal speed command 3 Used to set speed 3 of internal speed commands.	1000	r/min	0 to instan- taneous permis- sible speed	S
Basic parameters	11	STA STB	Acceleration time constant Used to set the acceleration time required to reach the rated speed from Or/min in response to the internal speed commands 1 to 7. If the preset speed command is lower than the rated speed, acceleration/deceleration time Rated speed Zero speed Parameter No.11 setting For example for the servo motor of 3000r/min rated speed, set 3000 (3s) to increase speed from 0r/min to 1000r/min in 1 second. Deceleration time constant Used to set the deceleration time required to reach 0r/min from the rated speed in response to the internal speed commands 1 to 7.	0	ms	0 to 20000	S
Basic po	13	STC	S-pattern acceleration/deceleration time constant Used to smooth start/stop of the servo motor. Set the time of the arc part for S-pattern acceleration/deceleration. Speed command Speed command Speed command	0	ms	0 to 1000	S

Class	No.	Symbol		Name and function	Initial value	Unit	Setting range	Contro mode
	14		For manufacturer sett Do not change this va	-	0			
	15	*SNO	Always set one station	ation number for serial communication. n to one axis of servo amplifier. If one station number	0	station	0 to 31	P·S
Basic parameters	16	*BPS	Serial communication Used to select the ser communication condit 0 Ala 0: I 1: V Wh the Aft is a Serial cc 0: Invalio 1: Valid,	reply sent after delay time of $800 \mu s$ or more	0000		Refer to name and function column.	P-S
	17	MOD	monitor (MO2) output 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	t signal provided to the analog monitor (MO1) - analog . (Refer to section 5.2.2.) halog monitor 2 (MO2) Analog monitor 1 (MO1) ervo motor speed (±8V/max. speed) orque (±8V/max. torque) ervo motor speed (+8V/max. speed) orque (+8V/max. torque) urrent command (±8V/max. current command) pmmand pulse frequency (±10V/500kpulse/s) oop pulses (±10V/128 pulses) oop pulses (±10V/2048 pulses) oop pulses (±10V/32768 pulses) oop pulses (±10V/131072 pulses) Is voltage (+8V/400V)	0100		Refer to name and function column.	P·S

Class	No.	Symbol			Name and	I function			Initial value	Unit	Setting range	Contr mod
	18	*DMD	Status displ	av selection					0000		Refer to	
	10	BIIIB	-	ect the status di	splay showr	n at powe	er-on		0000		name	
					opiay onom	i ui poire					and	
			0 0								function	
			<u> </u>		ation of ata	tua diani	ov ot				column.	
					ection of sta er-on	itus dispi	ay at				oolami.	
					Cumulative	feedback	nulses					
					Servo motor		, pulooo					
					Droop pulse							
				3: 0	Cumulative	comman	d pulses					
4U.com					Command p							
					Regenerativ		itio					
					Effective loa							
					Peak load ra nstantaneo		`					
					Vithin one-r	•		NA/				
					Nithin one-							
					_oad inertia			0				
					Bus voltage							
				Status di	splay at pov	wer-on ir	1					
					nding contr							
					ids on the c		ode.					
				Control	mode	Statu	s display a	t power-on				
				Posit	ion	Cumu	lative feed	back pulses				
ters				Positi				ack pulses/				
me				internal	-		ervo motor					
oara				Internal			ervo motor					
Basic parameters				1: Depen	ids on the fi	irst digit s	setting of th	is parameter.				
Ш	19	*BLK	Parameter v	vrite inhibit					0000		Refer to	P۰
				ect the reference	e and write	ranges o	f the param	eters.			name	
			Operation c	an be performed	d for the par	rameters	marked O.				and function	
			Cat		Basic	E	xpansion	Expansion			column.	
			Set value	Operation	paramete	ers pai	rameters 1	parameters 2				
					No.0 to 1	19 No	0.20 to 49	No.50 to 84				
			0000 (Initial	Reference	0							
			(Initial value)	Write	0							
			,	Reference	No.19 or	nlv —	\sim	\sim				
			000A	Write	No.19 or	/						
			0000	Reference	0	,	0					
			000B	Write	0							
			000C	Reference	0		0					
			0000	Write	0		0					
			000E	Reference	0		0	0				
				Write	0		0	0				
			100B	Reference	0							
				Write	No.19 or	nly						
			100C	Reference	0	. –	0					
				Write	No.19 or	nly						
		1		Reference	0	1	0	0	1	1 1	1	1
			100E	Write	No.19 or	7	/					

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
Expansion parameters 1	20	*OP2	Function selection 2 Used to select restart after instantaneous power failure, servo lock at a stop in internal speed control mode, and slight vibration suppression control. Restart after instantaneous power failure If the power supply voltage has returned to normal after an undervoltage status caused by the reduction of the input power supply voltage in the speed control mode, the servo motor can be restarted by merely turning on the start signal without resetting the alarm. 0: Invalid (Undervoltage alarm (AL.10) occurs.) 1: Valid Stop-time servo lock selection The shaft can be servo-locked to remain still at a stop in the internal speed control mode. 0: Valid 1: Invalid Slight vibration suppression control Made valid when auto tuning selection is set to "0400" in parameter No.2. Used to suppress vibration at a stop. 0: Invalid 1: Valid Encoder cable communication system selection 0: Two-wire type 1: Four-wire type Incorrect setting will result in an encoder alarm 1 (AL.16) or encoder alarm 2 (AL.20).	0000		Refer to name and function column.	
	21	*0P3	Function selection 3 (Command pulse selection) Used to select the input form of the pulse train input signal. (Refer to section 3.4.1.) OOO Command pulse train input form 0: Forward/reverse rotation pulse train 1: Signed pulse train 2: A • B-phase pulse train O: Positive logic 1: Negative logic	0000		Refer to name and function column.	Ρ

	Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
ataShee	i4U.con	22	*OP4	Function selection 4 Used to select stop processing at forward rotation stroke end (LSP) • reverse rotation stroke end (LSN) off and choose TLC/VLC output. • • • • • • • • • • • • • • • • • •	0000		Refer to name and function column.	P•S
		23	FFC	Feed forward gain Set the feed forward gain. When the setting is 100%, the droop pulses during operation at constant speed are nearly zero. However, sudden acceleration/deceleration will increase the overshoot. As a guideline, when the feed forward gain setting is 100%, set 1s or more as the acceleration/deceleration time constant up to the rated speed.	0	%	0 to 100	Р
	-	24	ZSP	Zero speed Used to set the output range of the zero speed (ZSP).	50	r/min	0 to 10000	P·S
	ers	25		For manufacturer setting	0			
	ime	26		Do not change this value by any means.	100			
	Expansion parameters 1	27	*ENR	Encoder output pulses Used to set the encoder pulses (A-phase or B-phase) output by the servo amplifier. Set the value 4 times greater than the A-phase or B-phase pulses. You can use parameter No.54 to choose the output pulse designation or output division ratio setting. The number of A - B-phase pulses actually output is 1/4 times greater than the preset number of pulses. The maximum output frequency is 1.3Mpps (after multiplication by 4). Use this parameter within this range. • For output pulse designation Set "0□□□" (initial value) in parameter No.54. Set the number of pulses per servo motor revolution. Output pulse = set value [pulses/rev] At the setting of 5600, for example, the actually A • B-phase pulses output are as indicated below. A • B-phase output pulses = $\frac{5600}{4}$ = 1400[pulse] • For output division ratio setting Set "1□□□" in parameter No.54. The number of pulses per servo motor revolution is divided by the set value. Output pulse = $\frac{\text{Resolution per servo motor revolution}}{\text{Set value}}$ [pulses/rev] At the setting of 8, for example, the actually A • B-phase pulses output are as indicated below. A • B-phase output pulses = $\frac{10000}{8} \cdot \frac{1}{4} = 313[pulse]$	4000	pulse/ rev	1 to 65535	P·S

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Contro mode
	28	TL1	Internal torque limit 1 Set this parameter to limit servo motor torque on the assumption that the maximum torque is 100[%]. When 0 is set, torque is not produced.	100	%	0 to 100	P • S
			(Note) External input Torque limit value made valid signals TL1				
			0 Internal torque limit value 1 (parameter No.28)				
4U.com			1 Parameter No.76 > Parameter No.28: Parameter No.28 Parameter No.76 < Parameter No.28: Parameter No.76				
			Note. 0: TL1-VIN off (open) 1: TL1-VIN on (short)				
			When torque is output in analog monitor output, this set value is the maximum output voltage $(+8V)$. (Refer to section 3.4.1 (5))				
	29		For manufacturer setting	0			
	30		Do not change this value by any means.				
	31	MO1	Analog monitor 1 offset Used to set the offset voltage of the analog monitor 1 (MO1).	0	mV	—999 to 999	P۰
	32	MO2	Analog monitor 2 offset Used to set the offset voltage of the analog monitor 2 (MO2).	0	mV	—999 to 999	P۰S
	33	MBR	Electromagnetic brake sequence output Used to set the delay time (Tb) between electronic brake interlock (MBR) and the base drive circuit is shut-off.	100	ms	0 to 1000	P۰
Expansion parameters 1	34	GD2	Ratio of load inertia moment to servo motor inertia moment Used to set the ratio of the load inertia moment to the servo motor shaft inertia moment. When auto tuning mode 1 and interpolation mode is selected, the result of auto tuning is automatically used. (Refer to section 7.1.1)	70	Multi- plier (×10 ⁻¹)	0 to 3000	P۰
ion p			In this case, it varies between 0 and 1000.				
Expans	35	PG2	Position loop gain 2 Used to set the gain of the position loop. Set this parameter to increase the position response to level load disturbance. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1 • 2 and interpolation mode is selected, the result of auto tuning is automatically used.	35	rad/s	1 to 1000	Р
	36	VG1	Speed loop gain 1 Normally this parameter setting need not be changed. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1 • 2, manual mode and interpolation mode is selected, the result of auto tuning is automatically used.	177	rad/s	20 to 8000	P•\$
	37	VG2	Speed loop gain 2 Set this parameter when vibration occurs on machines of low rigidity or large backlash. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1 • 2 and interpolation mode is selected, the result of auto tuning is automatically used.	817	rad/s	20 to 20000	P•\$
	38	VIC	Speed integral compensation Used to set the integral time constant of the speed loop. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1 • 2 and interpolation mode is selected, the result of auto tuning is automatically used.	48	ms	1 to 1000	P·S
	39	VDC	Speed differential compensation Used to set the differential compensation.	980		0 to	P۰
			Made valid when the proportion control (PC) is switched on.			1000	

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
	40		For manufacturer setting	0		.cgo	
			Do not change this value by any means.				
ei4U.con	41	*DIA	Input signal automatic ON selection Used to set automatic servo-on (SON) • forward rotation stroke end (LSP) • reverse rotation stroke end (LSN).	0000		Refer to name and function column.	P•S
Expansion parameters 1	42	*DI1	0: Switched on/off by external input. 1: Switched on automatically in servo amplifier. (No need of external wiring) Input signal selection 1 Used to assign the control mode changing signal input pins and to set the clear (CR). 0 0	0002		Refer to name and function column.	P/S
			4 CN1-7 If forward rotation stroke end (LSP) or reverse rotation stroke end (LSN) is assigned to any pin with parameter No.48, this setting is invalid. Clear (CR) selection 0: Droop pulses are cleared on the leading edge. 1: While turning on, droop pulses are always cleared.				P

Class	No.	Symbol		Name ar	nd function		Initial value	Unit	Setting range	Contro mode
	43	*DI2	Input signal selection	on 2 (CN1-4)			0111		Refer to	
	-		Allows any input sig	. ,	d to CN1-pin 4.				name	
						ccording to the control			and	
			mode.		0	0			function	
			0 0]					column.	
				Position	Input signals o	of				
				control mode	CN1-pin 4					
				ternal speed ontrol mode	selected.					
4U.com				-) control mode a	re indicated below by				
10.0011			their symbols.			c malcaled below by				
			Setting of any other	r signal will be inva	alid					
				-		1				
			Set value	(Note) Con		-				
				Р	S					
			0							
ς γ			1	SON	SON					
Expansion parameters 1			2	RES	RES	-				
Iram			3	PC	PC					
n pe			4							
nsio			5	CR	CR	_				
xpa			6		SP1	_				
ш			7		SP2					
			8		ST1					
			9		ST2					
			А		SP3					
			В	CM1						
			С	CM2						
			D	TL1	TL1					
			E	CDP	CDP					
			F							
			Note. P: Position	control mode		-				
			S: Internal	speed control mo	de					
						42 is set to assign the				
			control change (LC			-				
					parameter No.4	48 is set to assign the				
			-			ation stroke end (LSN)				
			to be assigned to (. ,				

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
eei4U.com	44	*DI3	Input signal selection 3 (CN1-3) Allows any input signal to be assigned to CN1-pin 3. The assignable signals and setting method are the same as in input signal selection 2 (parameter No.43). O O Position control mode Input signals of CN1-pin 3 selected. This parameter is unavailable when parameter No.42 is set to assign the control change (LOP) to CN1-pin 3. This parameter is unavailable when parameter No.48 is set to assign the Forward rotation stroke end (LSP) and Reverse rotation stroke end (LSN) to	0882		Refer to name and function column.	P·S
Expansion parameters 1	45	*DI4	Input signal selection 4 (CN1-5) Allows any input signal to be assigned to CN1-pin 5. The assignable signals and setting method are the same as in input signal selection 2 (parameter No.43). 0 9	0995		Refer to name and function column.	P·S
	46	*DI5	Input signal selection 5 (CN1-6) Allows any input signal to be assigned to CN1-pin 6. The assignable signals and setting method are the same as in input signal selection 2 (parameter No.43).	0000		Refer to name and function column.	P·S

Class N	۱o.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
4U.com	47	*DI6	Input signal selection 6 (CN1-7) Allows any input signal to be assigned to CN1-pin 7. The assignable signals and setting method are the same as in input signal selection 2 (parameter No.43).	0000		Refer to name and function column.	P·S
Expansion parameters 1	48	*LSPN	Forward rotation to unartication parameter into the tot to be determined in the forward rotation stroke end (LSP) to be assigned to CN1-pin 7. LSP/LSN input terminal selection Select the pins where the forward rotation stroke end (LSP) and reverse rotation stroke end (LSN) will be assigned. If the signals have already been assigned using parameter No.42 to 47, this parameter setting has preference. However, if the forward rotation stroke end (LSP) is assigned at pin 6 of CN1 (default setting), the setting of parameter No.46 takes priority. Similarly, if the reverse rotation stroke end (LSN) is assigned at pin 7 of CN1 (default setting), the setting of parameter No.47 takes priority. If the forward rotation stroke end (LSP) and reverse rotation stroke end (LSN) are assigned at the same pin, the forward rotation stroke end (LSN) are assigned at the same pin, the forward rotation stroke end (LSN) are assigned at the reverse rotation stroke end (LSN) is disabled. O O Select the pin where the forward rotation stroke end (LSN) will be assigned. O O Select the pin where the forward rotation stroke end (LSN) will be assigned. O O I CN1-5 I CN1-5 I CN1-6 I CN1-7 I CN1-7 I CN1-7 I CN1-7 I CN1-7 I CN1-7 </td <td>0403</td> <td></td> <td>Refer to name and function column.</td> <td>P·S</td>	0403		Refer to name and function column.	P·S

Class	No.	Symbol				Name	e and fun	ction	Initial value	Unit	Setting range	Contr mode
	49	*DO1	Output signa Used to sele (WNG).			or pins	to output	the alarm code and warning	0000		Refer to name and	P∙\$
			00								function column.	
					— Sotti	na of a	alarm cor	de output				
					Ocu			Connector pins				
					Setv	/alue	CN1-10					
						0	INP or S/					
4U.com					_			e is output at alarm occurrence.				
				<u> </u>								
				· ·	e) Alarm		Alarm					
				CN1	CN1	CN1	display	Name				
				pin tu	pin 11	pin 12	88888	Watchdog				
							AL.12	Memory error 1				
							AL.12	Clock error				
							AL.15	Memory error 2				
				0	0	0	AL.17	Board error 2				
						_	AL.19	Memory error 3				
							AL.37	Parameter error				
-							AL.8A	Serial communication time-out error				
ers							AL.8E	Serial communication error				
met				0	1	0	AL.30	Regenerative error				
Expansion parameters 1				0	1	0	AL.33	Overvoltage				
du				1	0	0	AL.10	Undervoltage				
Jsic							AL.45	Main circuit device overheat				
(pai				1	1	0	AL.46	Servo motor overheat				
ш							AL.50	Overload 1				
							AL.51	Overload 2				
				0	0	1	AL.24	Main circuit				
							AL.32	Overcurrent				
					4	4	AL.31 AL.35	Overspeed				
				0	1	1	AL.55 AL.52	Command pulse frequency error Error excessive				
				-			AL.16	Encoder error 1				
				1	0	1		Motor combination error				
					Ű		AL.20	Encoder error 2				
							f (open) n (short)					
							(WNG) o					
							•	o output warning. The old signa				
								navailable.				
				Se	t value	9		or pin No.				
					0	_		output.				
					1	_		1-11				
					2	+		V1-9				
					3	+		1-10				
1					4		CN	1-12		1	1	1

	Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
		50		For manufacturer setting Do not change this value by any means.	0000			
/.DataSheef	4U.com	51	*0P6	Function selection 6 Used to select the operation to be performed when the reset (RES) switches on. O O O Operation to be performed when the reset (RES) switches on 0: Base circuit shut off 1: Base circuit not shut off	0000		Refer to name and function column.	P·S
		52		For manufacturer setting Do not change this value by any means.	0000			
	Expansion parameters 2	53	*0P8	Function selection 8 Used to select the protocol of serial communication. Protocol checksum selection 0: Yes (checksum added) 1: No (checksum not added) Protocol checksum selection 0: With station numbers 1: No station numbers	0000		Refer to name and function column.	P·S
	Expansion	54	*OP9	Function selection 9 Use to select the command pulse rotation direction, encoder output pulse direction and encoder pulse output setting. Servo motor rotation direction changing Changes the servo motor rotation direction for the input pulse train. Set value At forward rotation pulse input 0 CCW 1 CW CW 1 CW CW 1 CW CCW C	0000		Refer to name and function column.	Ρ·S

	Class	No.	Symbol		Name ar	id func	tion			Initial value	Unit	Setting range	Control mode
		55	*OPA	Function selection A Jsed to select the post constant (parameter N			ration/dec	celeratio	on time	0000		Refer to name and function column.	Ρ
DataSheel	4U.com			tin O	osition comman ne constant cor): Primary delay I: Linear accele	ntrol			ation				
		56	SIC	Serial communication Jsed to set the comm	unication protoc	col time		od in [s]		0	s	0 1 to 60	P∙S
		57		When you set "0", time For manufacturer setti Do not change this val	ing		le.			10			
	Expansion parameters 2	58	NH1	Solution Setting value Value 00 Invalid 01 4500 02 2250 03 1500 04 1125 05 900 06 750 07 642.9 Notesting Not	••	selection bu have trol to b D: []1 [Setting value 10 11 12 13 14 15 16 17 17 ction Gai 400 140	on e set adap pe "valid" c r c 2 281.3 264.7 250 236.8 225 214.3 204.5 195.7	otive vil		0000		Refer to name and function column.	P·S
		59	NH2	Sai Ho set be Notc		uppres n parar d not s tion su '.	neter No. set "00" if ppressior	58 you ha i contro		0000		Refer to name and function column.	P•S

	Class	No.	Symbol	Name and function	Initial value	Unit	Setting	Control mode
ŀ							range	
		60	LPF	Low-pass filter/adaptive vibration suppression control	0000		Refer to	P·S
				Used to selection the low-pass filter and adaptive vibration suppression			name	
				control. (Refer to chapter 8.)		Ν	and	
							function	
							column.	
hee	Expansion parameters 2			Low-pass filter selection 0: Valid (Automatic adjustment) 1: Invalid When you choose "valid", VG2 setting ×10 When you choose "valid", 2π(1+GD2 setting ×0.1) Hz] bandwidth filter is set automatically. Adaptive vibration suppression control selection Choosing "valid" or "held" in adaptive vibration suppression control selection makes the machine resonance suppression filter 1 (parameter No.58) invalid. 0: Invalid 1: Valid Machine resonance frequency is always detected and the filter is generated in response to resonance to suppress machine vibration. 2: Held The characteristics of the filter generated so far are held, and detection of machine resonance is stopped. Adaptive vibration suppression control sensitivity selection Used to set the sensitivity of machine resonance detection. 0: Normal				
				1: Large sensitivity				
	-	61	GD2B	Ratio of load inertia moment to servo motor inertia moment 2	70	Multi-	0	P•S
				Used to set the ratio of load inertia moment to servo motor inertia moment		plier	to	
				when gain changing is valid.		(×10 ⁻¹)	3000	
		62	PG2B	Position control gain 2 changing ratio	100	%	10	Р
				Used to set the ratio of changing the position control gain 2 when gain			to	
				changing is valid.			200	
				Made valid when auto tuning is invalid.				
		63	VG2B	Speed control gain 2 changing ratio	100	%	10	P∙S
				Used to set the ratio of changing the speed control gain 2 when gain			to	
				changing is valid.			200	
				Made valid when auto tuning is invalid.				
		64	VICB	Speed integral compensation changing ratio	100	%	50	P·S
				Used to set the ratio of changing the speed integral compensation when			to	
				gain changing is valid. Made valid when auto tuning is invalid.			1000	

Class	No.	Symbol	Name and function	Initial value	Unit	Setting	Control
Class	No. 65	Symbol *CDP	Gain changing selection Used to select the gain changing condition. (Refer to section 8.5.) Gain changing selection Gains are changed in accordance with the settings of parameters No.61 to 64 under any of the following conditions: 0: Invalid 1: Gain changing (CDP) is ON 2: Command frequency is equal to higher than parameter No.66 setting	Initial value 0000	Unit	Setting range Refer to name and function column.	Control mode P • S
arameters 2	66	CDS	3: Droop pulse value is equal to higher than parameter No.66 setting 4: Servo motor speed is equal to higher than parameter No.66 setting Gain changing condition Used to set the value of gain changing condition (command frequency, droop pulses, servo motor speed) selected in parameter No.65.The set value unit changes with the changing condition item. (Refer to section 8.5.)	10	kpps pulse r/min	10 to 9999	P•S
Expansion parameters 2	67	CDT	Gain changing time constant Used to set the time constant at which the gains will change in response to the conditions set in parameters No.65 and 66. (Refer to section 8.5.)	1	ms	0 to 100	P∙S
	68		For manufacturer setting Do not change this value by any means.	0			
	69	CMX2	Command pulse multiplying factor numerator 2 Used to set the multiplier for the command pulse. Setting "0" automatically sets the connected motor resolution.	1		0•1 to 65535	Ρ
	70	CMX3	Command pulse multiplying factor numerator 3 Used to set the multiplier for the command pulse. Setting "0" automatically sets the connected motor resolution.	1	\square	0•1 to 65535	Ρ
	71	CMX4	Command pulse multiplying factor numerator 4 Used to set the multiplier for the command pulse. Setting "0" automatically sets the connected motor resolution.	1		0•1 to 65535	Р
	72	SC4	Internal speed command 4 Used to set speed 4 of internal speed commands.	200	r/min	0 to instan- taneous permis- sible speed	S

С	lass	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
		73	SC5	Internal speed command 5 Used to set speed 5 of internal speed commands.	300	r/min	0 to instan- taneous permis- sible speed	S
heel4U	J.com	74	SC6	Internal speed command 6 Used to set speed 6 of internal speed commands.	500	r/min	0 to instant- aneous permis- sible speed	S
	Expansion parameters 2	75	SC7	Internal speed command 7 Used to set speed 7 of internal speed commands.	800	r/min	0 to instant- aneous permis- sible speed	S
	Expansion	76	TL2	Internal torque limit 2 Set this parameter to limit servo motor torque on the assumption that the maximum torque is 100[%]. When 0 is set, torque is not produced. When torque is output in analog monitor output, this set value is the maximum output voltage (+8V).	100	%	0 to 100	P·S
		777 78 79 80 81 82 83 83 84		For manufacturer setting Do not change this value by any means.	100 10000 10 10 100 100 100 0000			
5.2 Detailed description

5.2.1 Electronic gear







The following setting examples are used to explain how to calculate the electronic gear.

POINT
The following specification symbols are required to calculate the electronic gear
Pb : Ball screw lead [mm]
n : Reduction ratio
Pt : Servo motor resolution [pulses/rev]
$\Delta \ell_0$: Travel per command pulse [mm/pulse]
ΔS : Travel per servo motor revolution [mm/rev]
$\Delta heta^\circ$: Angle per pulse [° /pulse]
$\Delta \theta$: Angle per revolution [° /rev]

(1) For motion in increments of 10μ m per pulse



Hence, set 20 to CMX and 1 to CDV.

(2) Conveyor setting example

For rotation in increments of 0.01° per pulse

Machine specifications

Table : 360° /rev Reduction ratio: n = 1/18 Servo motor resolution: Pt = 10000 [pulses/rev]





www.DataSheet4U.com Hence, set 5 to CMX and 1 to CDV.

5.2.2 Analog monitor

The servo status can be output to two channels in terms of voltage. Using an ammeter enables monitoring the servo status.

(1) Setting

Change the following digits of parameter No.17.



Parameters No.31 and 32 can be used to set the offset voltages to the analog output voltages. The setting range is between -999 and 999mV.

Parameter No.	Setting range [mV]	
31	Used to set the offset voltage for the analog monitor 1 (MO1) output.	-999 to 999
32	Used to set the offset voltage for the analog monitor 2 (MO2) output.	- 999 10 999

(2) Set content

The servo amplifier is factory-set to output the servo motor speed to Analog monitor 1 (MO1) and the torque to Analog monitor 2 (MO2). The setting can be changed as listed below by changing the parameter No.17 value.

Refer to app. 2 for the measurement point.

Setting	Output item	Description	Setting	Output item	Description
0 HU.com	Servo motor speed	Max. speed Max. speed Max. speed Max. speed Max. speed Max. speed	6	Droop pulses (Note 1) (±10V/128pulse)	10[V] CCW direction 128[pulse] 0 128[pulse] 0 128[pulse] CW direction
1	Torque (Note 2)	8[V] Driving in CCW direction	7	Droop pulses (Note 1) (±10V/2048pulse)	2048[pulse] 0 2048[pulse] CW direction
2	Servo motor speed	CW CCW direction 8[V] direction Max. speed 0 Max. speed	8	Droop pulses (Note 1) (±10V/8192pulse)	10[V] ▲ CCW direction 8192[pulse]
3	Torque (Note 2)	Driving in CW direction 8[V] CCW direction Max. torque 0 Max. torque	9	Droop pulses (Note 1) (±10V/32768pulse)	32768[pulse] 0 32768[pulse] CW direction
4	Current command	8[V] ▲ CCW direction Max. command current 0 Max. command current -8[V] CW direction	A	Droop pulses (Note 1) (±10V/131072pulse)	10[V] CCW direction 131072[pulse] 0 131072[pulse] 0 131072[pulse] CW direction
5	Command pulse frequency	-500kpps 0 500kpps -500kpps -500kpps -500kpps -500kpps	В	Bus voltage	8[V] 0 400[V]

Note 1. Encoder pulse unit.

2. 8V is outputted at the maximum torque.

However, when parameter No.28 • 76 are set to limit torque, 8V is outputted at the torque highly limited.

(3) Analog monitor block diagram

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5.2.3 Using forward/reverse rotation stroke end to change the stopping pattern

The stopping pattern is factory-set to make a sudden stop when the forward/reverse rotation stroke end is made valid. A slow stop can be made by changing the parameter No.22 value.

[Parameter No.22 setting	Stopping method				
ſ		Sudden stop				
	(initial value)	Position control mode	: Motor stops with droop pulses cleared.			
		Internal speed control mode	: Motor stops at deceleration time constant of zero.			
		Slow stop				
		Position control mode	: The motor is decelerated to a stop in accordance with the			
et	IU.com □□□1		parameter No.7 value.			
		Internal speed control mode	: The motor is decelerated to a stop in accordance with the			
			parameter No.12 value.			

5.2.4 Alarm history clear

The servo amplifier stores one current alarm and five past alarms from when its power is switched on first. To control alarms which will occur during operation, clear the alarm history using parameter No.16 before starting operation.

Clearing the alarm history automatically returns to "DD0D".

After setting, this parameter is made valid by switch power from OFF to ON.



5.2.5 Position smoothing

By setting the position command acceleration/deceleration time constant (parameter No.7), you can run the servo motor smoothly in response to a sudden position command.

The following diagrams show the operation patterns of the servo motor in response to a position command when you have set the position command acceleration/deceleration time constant.

Choose the primary delay or linear acceleration/deceleration in parameter No.55 according to the machine used.

(1) For step input



MEMO

6. DISPLAY AND OPERATION

6.1 Display flowchart

Use the display (5-digit, 7-segment LED) on the front panel of the servo amplifier for status display, parameter setting, etc. Set the parameters before operation, diagnose an alarm, confirm external sequences, and/or confirm the operation status. Press the "MODE" "UP" or "DOWN" button once to move to the next screen. To refer to or set the expansion parameters, make them valid with parameter No.19 (parameter write disable).



Note. The initial status display at power-on depends on the control mode.

Position control mode: Cumulative feedback pulses(C), Internal speed control mode: Servo motor speed(r) Also, parameter No.18 can be used to change the initial indication of the status display at power-on.

6.2 Status display

The servo status during operation is shown on the 5-digit, 7-segment LED display. Press the "UP" or "DOWN" button to change display data as desired. When the required data is selected, the corresponding symbol appears. Press the "SET" button to display its data. At only power-on, however, data appears after the symbol of the status display selected in parameter No.18 has been shown for 2.

The servo amplifier display shows the lower five digits of 16 data items such as the servo motor speed.

6.2.1 Display examples

The following table lists display examples.

www.DataSheet	4U.com				
	Item	Status	Displayed data		
			Servo amplifier display		
	Servo motor	Forward rotation at 3000r/min			
	speed	Reverse rotation at 3000r/min	Reverse rotation is indicated by "-".		
	Load inertia moment	15.5 times			
		11252pulse	 111 111		
	Multi-revolution counter	—12566pulse	Negative value is indicated by the lit decimal points in the upper four digits.		

6.2.2 Status display list

The following table lists the servo statuses that may be shown.

Name	Symbol	Unit	Description	Display range
Cumulative feedback pulses	С	pulse	Feedback pulses from the servo motor encoder are counted and displayed. The value in excess of \pm 99999 is counted, bus since the servo amplifier display is five digits, it shows the lower five digits of the actual value. Press the "SET" button to reset the display value to zero. Reverse rotation is indicated by the lit decimal points in the upper four digits.	-99999 to 99999
Servo motor speed	r	r/min	The servo motor speed is displayed. The value rounded off is displayed in $\times 0.1r/min$.	-5400 to 5400
Droop pulses	E	pulse	The number of droop pulses in the deviation counter is displayed. When the servo motor is rotating in the reverse direction, the decimal points in the upper four digits are lit. Since the servo amplifier display is five digits, it shows the lower five digits of the actual value. The number of pulses displayed is not yet multiplied by the electronic gear.	-99999 to 99999
Cumulative command pulses	Ρ	pulse	The position command input pulses are counted and displayed. As the value displayed is not yet multiplied by the electronic gear (CMX/CDV), it may not match the indication of the cumulative feedback pulses. The value in excess of \pm 99999 is counted, but since the servo amplifier display is five digits, it shows the lower five digits of the actual value. Press the "SET" button to reset the display value to zero. When the servo motor is rotating in the reverse direction, the decimal points in the upper four digits are lit.	- 9999 to 99999
Command pulse frequency	n	kpps	The frequency of the position command input pulses is displayed. The value displayed is not multiplied by the electronic gear (CMX/CDV).	- 800 to 800
Regenerative load ratio	L	%	The ratio of regenerative power to permissible regenerative power is displayed in %.	0 to 100
Effective load ratio	J	%	The continuous effective load torque is displayed. The effective value in the past 15 seconds is displayed relative to the rated torque of 100%.	0 to 300
Peak load ratio	b	%	The maximum torque generated during acceleration/deceleration, etc. The highest value in the past 15 seconds is displayed relative to the rated torque of 100%.	0 to 400
Instantaneous torque	Т	%	Torque that occurred instantaneously is displayed. The value of the torque that occurred is displayed in real time relative to the rate torque of 100%.	0 to 400
Within one-revolution position low	Cy1	pulse	Position within one revolution is displayed in encoder pulses. The value returns to "0" when it exceeds the maximum number of pulses. The value is incremented in the CCW direction of rotation.	0 to 99999

Name	Symbol	Unit	Description	Display range
Within one-revolution	Cy2	100	The within one-revolution position is displayed in 100 pulse increments of	0
position high		pulse	the encoder.	to
			The value returns to 0 when it exceeds the maximum number of pulses.	1310
			The value is incremented in the CCW direction of rotation.	
Load inertia moment	dC	Multiplier	The estimated ratio of the load inertia moment to the servo motor shaft	0.0
ratio		(×1)	inertia moment is displayed.	to
				300.0
Bus voltage	Pn	V	The voltage (across P-N) of the main circuit converter is displayed.	0
-				to
4U.com				450

6.2.3 Changing the status display screen

The status display item of the servo amplifier display shown at power-on can be changed by changing the parameter No.18 settings.

The item displayed in the initial status changes with the control mode as follows.

Control mode	Status display at power-on			
Position	Cumulative feedback pulses			
Position/				
internal speed	Cumulative feedback pulses/servo motor speed			
Internal speed	Servo motor speed			

6.3 Diagnostic mode

	N	ame		Display	Description
Sea	Sequence				Not ready. Indicates that the servo amplifier is being initialized or an alarm has occurred.
				Ľ –	Ready. Indicates that the servo was switched on after completion of initialization and the servo amplifier is ready to operate.
Sheel4U.c Exte	4U.com External I/O signal display		Refer to	section 6.6.	Indicates the ON-OFF states of the external I/O signals. The upper segments correspond to the input signals and the lower segments to the output signals. Lit: ON Extinguished: OFF The I/O signals can be changed using parameters No.43 to 49.
Out) signal forced			The digital output signal can be forced on/off. For more information, refer to section 6.7.
		Jog feed			Jog operation can be performed when there is no command from the external command device. For details, refer to section 6.8.2.
Tes		Positioning operation			The MR Configurator (servo configuration software) is required for positioning operation. This operation cannot be performed from the operation section of the servo amplifier. Positioning operation can be performed once when there is no command from the external command device.
moo		Motor-less operation			Without connection of the servo motor, the servo amplifier provides output signals and displays the status as if the servo motor is running actually in response to the external input signal. For details, refer to section 6.8.4.
		Machine analyzer operation			Merely connecting the servo amplifier allows the resonance point of the mechanical system to be measured. The MR Configurator (servo configuration software) is required for machine analyzer operation.
Soft	Software version low		-		Indicates the version of the software.
Soft	ftware ve	ersion high			Indicates the system number of the software.
	Manufacturer setting screen			[Screen for manufacturer setting. When this screen is being displayed, do not press any other buttons than "UP" and "DOWN" button.
Mot	Motor series ID				Press the "SET" button to show the motor series ID of the servo motor currently connected.
Mot	Motor type ID				Press the "SET" button to show the motor type ID of the servo motor currently connected.
Enc	coder ID			Ľ	Press the "SET" button to show the encoder ID of the servo motor currently connected.

6.4 Alarm mode

The current alarm, past alarm history and parameter error are displayed. The lower 2 digits on the display indicate the alarm number that has occurred or the parameter number in error. Display examples are shown below.

	Name	Display	Description		
	Current alarm		Indicates no occurrence of an alarm.		
neei	4U.com		Indicates the occurrence of overvoltage (AL.33). Flickers at occurrence of the alarm.		
		80 50	Indicates that the last alarm is overload 1 (AL.50).		
			Indicates that the second alarm in the past is overvoltage (AL.33).		
	Alarm history	82 13	Indicates that the third alarm in the past is undervoltage (AL.10).		
			Indicates that the fourth alarm in the past is overspeed (AL.31).		
		84	Indicates that there is no fifth alarm in the past.		
		85	Indicates that there is no sixth alarm in the past.		
	Parameter error No	E	Indicates no occurrence of parameter error (AL.37).		
	Parameter error No.		Indicates that the data of parameter No.1 is faulty.		

Functions at occurrence of an alarm

- (1) Any mode screen displays the current alarm.
- (2) Even during alarm occurrence, the other screen can be viewed by pressing the button in the operation area. At this time, the decimal point in the fourth digit remains flickering.
- (3) For any alarm, remove its cause and clear it in any of the following methods (for clearable alarms, refer to section 10.2.1).
 - (a) Switch power OFF, then ON.
 - (b) Press the "SET" button on the current alarm screen.
 - (c) Turn on the reset (RES).
- (4) Use parameter No.16 to clear the alarm history.
- (5) Pressing "SET" button on the alarm history display screen for 2s or longer shows the following detailed information display screen. Note that this is provided for maintenance by the manufacturer.



(6) Press the "UP" or "DOWN" button to display the next alarm in the history.

6.5 Parameter mode

The parameters whose abbreviations are marked* are made valid by changing the setting and then switching power off once and switching it on again. Refer to section 5.1.2.

(1) Operation example

The following example shows the operation procedure performed after power-on to change the control mode (parameter No.0) to the Internal speed control mode.

Using the "MODE" button, show the basic parameter screen.





•/•

To shift to the next parameter, press the UP DOWN button.

When changing the parameter No.0 setting, change its set value, then switch power off once and switch it on again to make the new value valid.

(2) Expansion parameters

To use the expansion parameters, change the setting of parameter No.19 (parameter write disable). Refer to section 5.1.1.

6.6 External I/O signal display

The ON/OFF states of the digital I/O signals connected to the servo amplifier can be confirmed.

(1) Operation

Call the display screen shown after power-on. Using the "MODE" button, show the diagnostic screen.



(2) Display definition



The 7-segment LED shown above indicates ON/OFF.

Each segment at top indicates the input signal and each segment at bottom indicates the output signal. The signals corresponding to the pins in the respective control modes are indicated below.

CN1	Input/Output	(Note 2) Signa	al abbreviation	Related parameter No.
Pin No.	(Note 1) I/O	Р	S	Related parameter No.
3	I	RES	ST1	43 to 47
4	I	SON	SON	43 to 47
5	I	CR	ST2	43 to 47
6	I	LSP	LSP	43 to 48
7		LSN	LSN	43 to 48
8	I	EMG	EMG	
9	0	ALM	ALM	49
10	0	INP	SA	49
11	0	RD	RD	49
12	0	ZSP	ZSP	49
21	0	OP	OP	

Note 1. I: Input signal, O: Output signal

2. P: Position control mode, S: Internal speed control mode

3. CN1B-4 and CN1A-18 output signals are the same.

(3) Default signal indications (a) Position control mode EMG (CN 1-8) Emergency stop LSN (CN 1-7) Reverse rotation stroke end LSP (CN 1-6) Forward rotation stroke end CR (CN 1-5) Clear RES (CN 1-3) Reset SON (CN 1-4) Servo-on Input signals Lit: ON Extinguished: OFF Output signals RD (CN 1-11) Ready INP (CN 1-10) In position ZSP (CN 1-12) Zero speed ALM (CN 1-9) Trouble OP (CN 1-21) Encoder Z-phase pulse (b) Internal speed control mode EMG (CN 1-8) Emergency stop - LSN (CN 1-7) Reverse rotation stroke end LSP (CN 1-6) Forward rotation stroke end - ST2 (CN 1-5) Reverse rotation start ST1 (CN 1-3) Forward rotation start SON (CN 1-4) Servo-on Input signals Lit: ON Extinguished: OFF Output signals RD (CN 1-11) Ready SA (CN 1-10) Limiting speed ZSP (CN 1-12) Zero speed ALM (CN 1-9) Trouble



6.7 Output signal (DO) forced output

POINT	
 When the s 	ervo system is used in a vertical lift application, turning on the
electromag	netic brake interlock (MBR) after assigning it to pin CN1-12 will
release the	electromagnetic brake, causing a drop. Take drop preventive
measures of	on the machine side.

The output signal can be forced on/off independently of the servo status. This function is used for output signal wiring check, etc. This operation must be performed in the servo off state.

Operation

Call the display screen shown after power-on. Using the "MODE" button, show the diagnostic screen.



6.8 Test operation mode

 The test operation mode is designed to confirm servo operation and not to confirm machine operation. In this mode, do not use the servo motor with the machine Always use the servo motor alone. If any operational fault has occurred, stop operation using the emergency stop (EMG) signal. 	
 POINT	

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- The MR Configurator (servo configuration software) is required to perform positioning operation.
 - Test operation cannot be performed if the servo-on (SON) is not turned OFF.

6.8.1 Mode change

Call the display screen shown after power-on. Choose jog operation/motor-less operation in the following procedure. Using the "MODE" button, show the diagnostic screen.



6.8.2 Jog operation

Jog operation can be performed when there is no command from the external command device.

(1) Operation

Connect EMG-VIN to start jog operation to use the internal power supply.

Hold down the "UP" or "DOWN" button to run the servo motor. Release it to stop. When using the MR Configurator (servo configuration software), you can change the operation conditions. The initial conditions and setting ranges for operation are listed below.

	Item	Initial setting	Setting range
ataSheet4U.	Speed [r/min]	200	0 to instantaneous permissible speed
	Acceleration/deceleration time constant [ms]	1000	0 to 50000

How to use the buttons is explained below.

Button	Description	
"UP"	Press to start CCW rotation. Release to stop.	
"DOWN"	Press to start CW rotation. Release to stop.	

If the communication cable is disconnected during jog operation performed by using the MR Configurator (servo configuration software), the servo motor will be decelerated to a stop.

(2) Status display

You can confirm the servo status during jog operation.

Pressing the "MODE" button in the jog operation-ready status calls the status display screen. With this screen being shown, perform jog operation with the "UP" or "DOWN" button. Every time you press the "MODE" button, the next status display screen appears, and on completion of a screen cycle, pressing that button returns to the jog operation-ready status screen. For full information of the status display, refer to section 6.2. In the test operation mode, you cannot use the "UP" and "DOWN" buttons to change the status display screen from one to another.

(3) Termination of jog operation

To end the jog operation, switch power off once or press the "MODE" button to switch to the next screen and then hold down the "SET" button for 2 or more seconds.

6.8.3 Positioning operation

POINT	
 The MR Co 	nfigurator (servo configuration software) is required to perform
positioning	operation.

Positioning operation can be performed once when there is no command from the external command device.

(1) Operation

Connect EMG-VIN to start positioning operation to use the internal power supply.

www.DataSheet4U.Click the "Forward" or "Reverse" button on the MR Configurator (servo configuration software) starts the servo motor, which will then stop after moving the preset travel distance. You can change the operation conditions on the MR Configurator (servo configuration software). The initial conditions and setting ranges for operation are listed below.

Item	Initial setting	Setting range
Travel distance [pulse]	10000	0 to 9999999
Speed [r/min]	200	0 to instantaneous permissible speed
Acceleration/deceleration time constant [ms]	1000	0 to 50000

How to use the buttons is explained below.

Button	Description	
"Forward"	Click to start positioning operation CCW.	
"Reverse"	Click to start positioning operation CW.	
"Pause"	Click during operation to make a temporary stop. Pressing the "Pause" button again erases the remaining distance. To resume operation, click the button that was clicked to start the operation.	

If the communication cable is disconnected during positioning operation, the servo motor will come to a sudden stop.

(2) Status display

You can monitor the status display even during positioning operation.

6.8.4 Motor-less operation

Without connecting the servo motor, you can provide output signals or monitor the status display as if the servo motor is running in response to external input signals. This operation can be used to check the sequence of a host programmable controller or the like.

(1) Operation

After turning off the signal across SON-VIN, choose motor-less operation. After that, perform external operation as in ordinary operation.

(2) Status display

South You can confirm the servo status during motor-less operation.

Pressing the "MODE" button in the motor-less operation-ready status calls the status display screen. With this screen being shown, perform motor-less operation. Every time you press the "MODE" button, the next status display screen appears, and on completion of a screen cycle, pressing that button returns to the motor-less operation-ready status screen. For full information of the status display, refer to section 6.2. In the test operation mode, you cannot use the "UP" and "DOWN" buttons to change the status display screen from one to another.

(3) Termination of motor-less operation

To terminate the motor-less operation, switch power off.

7. GENERAL GAIN ADJUSTMENT

- 7.1 Different adjustment methods
- 7.1.1 Adjustment on a single servo amplifier

The gain adjustment in this section can be made on a single servo amplifier. For gain adjustment, first execute auto tuning mode 1. If you are not satisfied with the results, execute auto tuning mode 2, manual mode 1 and manual mode 2 in this order.

(1) Gain adjustment mode explanation

Gain adjustment mode	Parameter No.2	Estimation of load inertia	Automatically set	Manually set parameters
-	setting	moment ratio	parameters	
Auto tuning mode 1	010□	Always estimated	PG1 (parameter No.6)	Response level setting of
(initial value)			GD2 (parameter No.34)	parameter No.2
			PG2 (parameter No.35)	
			VG1 (parameter No.36)	
			VG2 (parameter No.37)	
			VIC (parameter No.38)	
Auto tuning mode 2	020 🗆	Fixed to parameter No.34	PG1 (parameter No.6)	GD2 (parameter No.34)
		value	PG2 (parameter No.35)	Response level setting of
			VG1 (parameter No.36)	parameter No.2
			VG2 (parameter No.37)	
			VIC (parameter No.38)	
Manual mode 1	030 🗆		PG2 (parameter No.35)	PG1 (parameter No.6)
			VG1 (parameter No.36)	GD2 (parameter No.34)
				VG2 (parameter No.37)
				VIC (parameter No.38)
Manual mode 2	040 🗆			PG1 (parameter No.6)
				GD2 (parameter No.34)
				PG2 (parameter No.35)
				VG1 (parameter No.36)
				VG2 (parameter No.37)
				VIC (parameter No.38)
Interpolation mode	000 🗆	Always estimated	GD2 (parameter No.34)	PG1 (parameter No.6)
			PG2 (parameter No.35)	VG1 (parameter No.36)
			VG2 (parameter No.37)	
			VIC (parameter No.38)	

(2) Adjustment sequence and mode usage



7.1.2 Adjustment using MR Configurator (servo configuration software)

This section gives the functions and adjustment that may be performed by using the servo amplifier with the MR Configurator (servo configuration software) which operates on a personal computer.

Function	Description	Adjustment
Machine analyzer	With the machine and servo motor coupled, the characteristic of the mechanical system can be measured by giving a random vibration command from the personal computer to the servo and measuring the machine response.	 You can grasp the machine resonance frequency and determine the notch frequency of the machine resonance suppression filter. You can automatically set the optimum gains in response to the machine characteristic. This simple adjustment is suitable for a machine which has large machine resonance and does not require much settling time.
Gain search	Executing gain search under to-and-fro positioning command measures settling characteristic while simultaneously changing gains, and automatically searches for gains which make settling time shortest.	 You can automatically set gains which make positioning settling time shortest.
Machine simulation	Response at positioning settling of a machine can be simulated from machine analyzer results on personal computer.	 You can optimize gain adjustment and command pattern on personal computer.

7.2 Auto tuning

7.2.1 Auto tuning mode

The servo amplifier has a real-time auto tuning function which estimates the machine characteristic (load inertia moment ratio) in real time and automatically sets the optimum gains according to that value. This function permits ease of gain adjustment of the servo amplifier.

(1) Auto tuning mode 1

The servo amplifier is factory-set to the auto tuning mode 1.

In this mode, the load inertia moment ratio of a machine is always estimated to set the optimum gains ^{U.} automatically.

Parameter No.	Abbreviation	Name
6	PG1	Position control gain 1
34	GD2	Ratio of load inertia moment to servo motor inertia moment
35	PG2	Position control gain 2
36	VG1	Speed control gain 1
37	VG2	Speed control gain 2
38	VIC	Speed integral compensation

The following parameters are automatically adjusted in the auto tuning mode 1.

POINT

- The auto tuning mode 1 may not be performed properly if the following conditions are not satisfied.
 - Time to reach 2000r/min is the acceleration/deceleration time constant of 5s or less.
 - Speed is 150r/min or higher.
 - The ratio of load inertia moment to servo motor inertia moment is not more than 100 times.
- The acceleration/deceleration torque is 10% or more of the rated torque.
- Under operating conditions which will impose sudden disturbance torque during acceleration/deceleration or on a machine which is extremely loose, auto tuning may not function properly, either. In such cases, use the auto tuning mode 2 or manual mode 1,2 to make gain adjustment.

(2) Auto tuning mode 2

Use the auto tuning mode 2 when proper gain adjustment cannot be made by auto tuning mode 1. Since the load inertia moment ratio is not estimated in this mode, set the value of a correct load inertia moment ratio (parameter No.34).

The following parameters are automatically adjusted in the auto tuning mode 2.

Parameter No.	Abbreviation	Name
6	PG1	Position control gain 1
35	PG2	Position control gain 2
36	VG1	Speed control gain 1
37	VG2	Speed control gain 2
38	VIC	Speed integral compensation

7.2.2 Auto tuning mode operation

The block diagram of real-time auto tuning is shown below.



When a servo motor is accelerated/decelerated, the load inertia moment ratio estimation section always estimates the load inertia moment ratio from the current and speed of the servo motor. The results of estimation are written to parameter No.34 (the ratio of load inertia moment to servo motor). These results can be confirmed on the status display screen of the MR Configurator (servo configuration software) section. If the value of the load inertia moment ratio is already known or if estimation cannot be made properly, chose the "auto tuning mode 2" (parameter No.2: $\Box 2 \Box \Box$) to stop the estimation of the load inertia moment ratio (Switch in above diagram turned off), and set the load inertia moment ratio (parameter No.34) manually. From the preset load inertia moment ratio (parameter No.34) value and response level (The first digit of parameter No.2), the optimum control gains are automatically set on the basis of the internal gain tale. The auto tuning results are saved in the EEP-ROM of the servo amplifier every 60 minutes since power-on. At power-on, auto tuning is performed with the value of each control gain saved in the EEP-ROM being used as an initial value.

POINT

- If sudden disturbance torque is imposed during operation, the estimation of the inertia moment ratio may malfunction temporarily. In such a case, choose the "auto tuning mode 2" (parameter No.2: □2□□) and set the correct load inertia moment ratio in parameter No.34.
- When any of the auto tuning mode 1, auto tuning mode 2 and manual mode 1 settings is changed to the manual mode 2 setting, the current control gains and load inertia moment ratio estimation value are saved in the EEP-ROM.

7.2.3 Adjustment procedure by auto tuning

Since auto tuning is made valid before shipment from the factory, simply running the servo motor automatically sets the optimum gains that match the machine. Merely changing the response level setting value as required completes the adjustment. The adjustment procedure is as follows.



7.2.4 Response level setting in auto tuning mode

Set the response (The first digit of parameter No.2) of the whole servo system. As the response level setting is increased, the track ability and settling time for a command decreases, but a too high response level will generate vibration. Hence, make setting until desired response is obtained within the vibration-free range. If the response level setting cannot be increased up to the desired response because of machine resonance beyond 100Hz, adaptive vibration suppression control (parameter No.60) or machine resonance suppression filter (parameter No.58 • 59) may be used to suppress machine resonance. Suppressing machine resonance may allow the response level setting to increase. Refer to section 8.2, 8.3 for adaptive vibration suppression control and machine resonance suppression filter.

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——Gain adjustment mode selection

	Machine characteristic		
Response level setting	Machine rigidity	Machine resonance frequency guideline	Guideline of corresponding machine
1	Low	15Hz	
2]	20Hz	
3]	25Hz	
4	↑	30Hz	Large conveyor
5]	35Hz	
6]	45Hz	Arm robot
7]	55Hz	
8	Middle	70Hz	General machine tool conveyor
9] [85Hz	Precision
А] [105Hz	working machine
В] [130Hz	
С	↓ ↓	160Hz	Inserter Mounter
D] [200Hz	Bonder
E] [240Hz	
F	High	300Hz	

7.3 Manual mode 1 (simple manual adjustment)

If you are not satisfied with the adjustment of auto tuning, you can make simple manual adjustment with three parameters.

7.3.1 Operation of manual mode 1

In this mode, setting the three gains of position control gain 1 (PG1), speed control gain 2 (VG2) and speed integral compensation (VIC) automatically sets the other gains to the optimum values according to these gains.



Therefore, you can adjust the model adaptive control system in the same image as the general PI control system (position gain, speed gain, speed integral time constant). Here, the position gain corresponds to PG1, the speed gain to VG2 and the speed integral time constant to VIC. When making gain adjustment in this mode, set the load inertia moment ratio (parameter No.34) correctly.

7.3.2 Adjustment by manual mode 1

POINT		
 If machine 	resonance occurs, adaptive vibration suppression control (parameter	
No.60) or machine resonance suppression filter (parameter No.58 • 59) may be		
used to sup	ppress machine resonance. (Refer to section 8.2, 8.3.)	

(1) For speed control

(a) Parameters

The following parameters are used for gain adjustment.

Parameter No.	Abbreviation	Name
34	GD2	Ratio of load inertia moment to servo motor inertia moment
37	VG2	Speed control gain 2
38	VIC	Speed integral compensation

(b) Adjustment procedure

Step	Operation	Description
1	Set an estimated value to the ratio of load inertia moment to servo motor inertia moment (parameter No.34).	
2	Increase the speed control gain 2 (parameter No.37) within the vibration- and unusual noise-free range, and return slightly if vibration takes place.	Increase the speed control gain.
3	Decrease the speed integral compensation (parameter No.38) within the vibration-free range, and return slightly if vibration takes place.	Decrease the time constant of the speed integral compensation.
4	If the gains cannot be increased due to mechanical system resonance or the like and the desired response cannot be achieved, response may be increased by suppressing resonance with adaptive vibration suppression control or machine resonance suppression filter and then executing steps 2 and 3.	Suppression of machine resonance. Refer to section 8.2, 8.3.
5	While checking the settling characteristic and rotational status, fine-adjust each gain.	Fine adjustment

(c)Adjustment description

1) Speed control gain 2 (parameter No.37)

This parameter determines the response level of the speed control loop. Increasing this value enhances response but a too high value will make the mechanical system liable to vibrate. The actual response frequency of the speed loop is as indicated in the following expression.

Speed loop response	Speed control gain 2 setting
frequency(Hz)	$=$ $\frac{1}{(1 + \text{ratio of load inertia moment to servo motor inertia moment}) \times 2\pi$

2) Speed integral compensation (VIC: parameter No.38)

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To eliminate stationary deviation against a command, the speed control loop is under proportional integral control. For the speed integral compensation, set the time constant of this integral control. Increasing the setting lowers the response level. However, if the load inertia moment ratio is large or the mechanical system has any vibratory element, the mechanical system is liable to vibrate unless the setting is increased to some degree. The guideline is as indicated in the following expression.

Speed integral compensation setting(ms) $\geq \frac{2000 \text{ to } 3000}{\text{Speed control gain 2 setting/(1 + ratio of load inertia moment to servo motor inertia moment setting × 0.1)}$

(2) For position control

(a) Parameters

The following parameters are used for gain adjustment.

Parameter No.	Abbreviation	Name	
6	PG1	Position control gain 1	
34	GD2 Ratio of load inertia moment to servo motor inertia moment		
37	37 VG2 Speed control gain 2		
38	VIC	Speed integral compensation	

(b) Adjustment procedure

Step	Operation	Description
1	Set an estimated value to the ratio of load inertia moment to servo motor inertia moment (parameter No.34).	
2	Set a slightly smaller value to the position control gain 1 (parameter No.6).	
3	Increase the speed control gain 2 (parameter No.37) within the vibration- and unusual noise-free range, and return slightly if vibration takes place.	Increase the speed control gain.
4	Decrease the speed integral compensation (parameter No.38) within the vibration-free range, and return slightly if vibration takes place.	Decrease the time constant of the speed integral compensation.
5	Increase the position control gain 1 (parameter No.6).	Increase the position control gain.
6	If the gains cannot be increased due to mechanical system resonance or the like and the desired response cannot be achieved, response may be increased by suppressing resonance with adaptive vibration suppression control or machine resonance suppression filter and then executing steps 3 to 5.	Suppression of machine resonance. Refer to section 8.2, 8.3.
7	While checking the settling characteristic and rotational status, fine-adjust each gain.	Fine adjustment

(c) Adjustment description

1) Position control gain 1 (parameter No.6)

This parameter determines the response level of the position control loop. Increasing position control gain 1 improves track ability to a position command but a too high value will make overshooting liable to occur at the time of settling.

Position control gain 2 setting gain 1 guideline $\leq \frac{\text{Speed control gain 2 setting}}{(1 + \text{ratio of load inertia moment to servo motor inertia moment})} \times \left(\frac{1}{3} \text{ to } \frac{1}{5}\right)$

2) Speed control gain 2 (VG2: parameter No.37)

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This parameter determines the response level of the speed control loop. Increasing this value enhances response but a too high value will make the mechanical system liable to vibrate. The actual response frequency of the speed loop is as indicated in the following expression.

Speed loop response frequency(Hz) = $\frac{\text{Speed control gain 2 setting}}{(1 + \text{ratio of load inertia moment to servo motor inertia moment}) \times 2\pi}$

3) Speed integral compensation (parameter No.38)

To eliminate stationary deviation against a command, the speed control loop is under proportional integral control. For the speed integral compensation, set the time constant of this integral control. Increasing the setting lowers the response level. However, if the load inertia moment ratio is large or the mechanical system has any vibratory element, the mechanical system is liable to vibrate unless the setting is increased to some degree. The guideline is as indicated in the following expression.

Speed integral compensation setting(ms) $\geq \frac{1}{50}$

 $\geq \frac{2000 \text{ to } 3000}{\text{Speed control gain 2 setting}/(1 + \text{ratio of load inertia moment to}}$ servo motor inertia moment 2 setting × 0.1)

7.4 Interpolation mode

The interpolation mode is used to match the position control gains of the axes when performing the interpolation operation of servo motors of two or more axes for an X-Y table or the like. In this mode, the position control gain 2 and speed control gain 2 which determine command track ability are set manually and the other parameter for gain adjustment are set automatically.

(1) Parameter

(a) Automatically adjusted parameters

The following parameters are automatically adjusted by auto tuning.

CCI	Parameter No.	Abbreviation	Name
	34	GD2	Ratio of load inertia moment to servo motor inertia moment
	35	PG2	Position control gain 2
	37	VG2	Speed control gain 2
	38	VIC	Speed integral compensation

(b) Manually adjusted parameters

The following parameters are adjustable manually.

Parameter No.	Abbreviation	Name
6	PG1	Position control gain 1
36	VG1	Speed control gain 1

(2) Adjustment procedure

Step	Operation	Description		
1	Set 15Hz (parameter No.2: 010 ^[]) as the machine resonance frequency of response in the auto tuning mode 1.	Select the auto tuning mode 1.		
2	During operation, increase the response level setting (parameter No.2), and return the setting if vibration occurs.	Adjustment in auto tuning mode 1.		
3	Check the values of position control gain 1 (parameter No.6) and speed Check the upper setting limits.			
4	Set the interpolation mode (parameter No.2: 000□).	Select the interpolation mode.		
5	Using the position control gain 1 value checked in step 3 as the guideline of the upper limit, set in PG1 the value identical to the position loop gain of the axis to be interpolated.	Set position control gain 1.		
6	Using the speed control gain 1 value checked in step 3 as the guideline of the upper limit, look at the rotation status and set in speed control gain 1 the value three or more times greater than the position control gain 1 setting.	Set speed control gain 1.		
7	Looking at the interpolation characteristic and rotation status, fine-adjust the gains and response level setting.	Fine adjustment.		

(3) Adjustment description

(a) Position control gain 1 (parameter No.6)

This parameter determines the response level of the position control loop. Increasing position control gain 1 improves track ability to a position command but a too high value will make overshooting liable to occur at the time of settling. The droop pulse value is determined by the following expression.

 $\frac{\text{Rotation speed (r/min)}}{60} \times 131,072(\text{pulse})$

Droop pulse value (pulse) = Position control gain 1 setting

(b) Speed control gain 1 (parameter No.36)

Set the response level of the speed loop of the model. Make setting using the following expression as a guideline.

Speed control gain 1 setting \geq Position control gain 1 setting \times 3

8. SPECIAL ADJUSTMENT FUNCTIONS

POINT

 The functions given in this chapter need not be used generally. Use them if you are not satisfied with the machine status after making adjustment in the methods in chapter 7.

If a mechanical system has a natural resonance level point, increasing the servo system response may cause the mechanical system to produce resonance (vibration or unusual noise) at that resonance frequency. Using the machine resonance suppression filter and adaptive vibration suppression control functions can suppress the resonance of the mechanical system.

8.1 Function block diagram



- 8.2 Machine resonance suppression filter
- (1) Function

The machine resonance suppression filter is a filter function (notch filter) which decreases the gain of the specific frequency to suppress the resonance of the mechanical system. You can set the gain decreasing frequency (notch frequency) and gain decreasing depth.



You can use the machine resonance suppression filter 1 (parameter No.58) and machine resonance suppression filter 2 (parameter No.59) to suppress the vibration of two resonance frequencies. Note that if adaptive vibration suppression control is made valid, the machine resonance suppression filter 1 (parameter No.58) is made invalid.



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POINT

• The machine resonance suppression filter is a delay factor for the servo system. Hence, vibration may increase if you set a wrong resonance frequency or a too deep notch.

(2) Parameters

(a) Machine resonance suppression filter 1 (parameter No.58)

Set the notch frequency and notch depth of the machine resonance suppression filter 1 (parameter No.58)

When you have made adaptive vibration suppression control selection (parameter No.60) "valid" or "held", make the machine resonance suppression filter 1 invalid (parameter No.58: 0000).



Setting value	Frequency						
00	Invalid	08	562.5	10	281.3	18	187.5
01	4500	09	500	11	264.7	19	180
02	2250	0A	450	12	250	1A	173.1
03	1500	0B	409.1	13	236.8	1B	166.7
04	1125	0C	375	14	225	1C	160.1
05	900	0D	346.2	15	214.3	1D	155.2
06	750	0E	321.4	16	204.5	1E	150
07	642.9	0F	300	17	195.7	1F	145.2

----- Notch depth

Setting value	Depth (Gain)
00	Deep (-40dB)
00	↑ (— 14dB)
00	↓ (-8dB)
00	Shallow(-4dB)

POINT

- If the frequency of machine resonance is unknown, decrease the notch frequency from higher to lower ones in order. The optimum notch frequency is set at the point where vibration is minimal.
- A deeper notch has a higher effect on machine resonance suppression but increases a phase delay and may increase vibration.
- The machine characteristic can be grasped beforehand by the machine analyzer on the MR Configurator (servo configuration software). This allows the required notch frequency and depth to be determined.
- Resonance may occur if parameter No.58 59 is used to select a close notch frequency and set a deep notch.

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(b) Machine resonance suppression filter 2 (parameter No.59)

The setting method of machine resonance suppression filter 2 (parameter No.59) is the same as that of machine resonance suppression filter 1 (parameter No.58). However, the machine resonance suppression filter 2 can be set independently of whether adaptive vibration suppression control is valid or invalid.

8.3 Adaptive vibration suppression control

(1) Function

Adaptive vibration suppression control is a function in which the servo amplifier detects machine resonance and sets the filter characteristics automatically to suppress mechanical system vibration. Since the filter characteristics (frequency, depth) are set automatically, you need not be conscious of the resonance frequency of a mechanical system. Also, while adaptive vibration suppression control is valid, the servo amplifier always detects machine resonance, and if the resonance frequency changes, it changes the filter characteristics in response to that frequency.



When machine resonance is large and frequency is low When machine resonance is small and frequency is high

POINT

- The machine resonance frequency which adaptive vibration suppression control can respond to is about 150 to 500Hz. Adaptive vibration suppression control has no effect on the resonance frequency outside this range. Use the machine resonance suppression filter for the machine resonance of such frequency.
- Adaptive vibration suppression control may provide no effect on a mechanical system which has complex resonance characteristics or which has too large resonance.
- Under operating conditions in which sudden disturbance torque is imposed during operation, the detection of the resonance frequency may malfunction temporarily, causing machine vibration. In such a case, set adaptive vibration suppression control to be "held" (parameter No.60: $\Box 2 \Box \Box$) to fix the characteristics of the adaptive vibration suppression control filter.

(2) Parameters

The operation of adaptive vibration suppression control selection (parameter No.60).



8.4 Low-pass filter

(1) Function

When a ball screw or the like is used, resonance of high frequency may occur as the response level of the servo system is increased. To prevent this, the low-pass filter is factory-set to be valid for a torque command. The filter frequency of this low-pass filter is automatically adjusted to the value in the following expression.

Filter frequency(Hz) = $\frac{\text{Speed control gain 2 setting } \times 10}{2\pi \times (1 + \text{Ratio of load inertia moment to servo motor inertia moment setting } \times 0.1)}$

(2) Parameter

Set the operation of the low-pass filter (parameter No.60.)



8.5 Gain changing function

This function can change the gains. You can change between gains during rotation and gains during stop or can use an external input signal to change gains during operation.

8.5.1 Applications

This function is used when.

- (1) You want to increase the gains during servo lock but decrease the gains to reduce noise during rotation.
- (2) You want to increase the gains during settling to shorten the stop settling time.
- (3) You want to change the gains using an external input signal to ensure stability of the servo system since the load inertia moment ratio varies greatly during a stop (e.g. a large load is mounted on a carrier).

8.5.2 Function block diagram

The valid control gains PG2, VG2, VIC and GD2 of the actual loop are changed according to the conditions selected by gain changing selection CDP (parameter No.65) and gain changing condition CDS (parameter No.66).


8.5.3 Parameters

When using the gain changing function, always set " $\Box \Box 4 \Box$ " in parameter No.2 (auto tuning) to choose the manual mode of the gain adjustment modes. The gain changing function cannot be used in the auto tuning mode.

	Parameter No.	Abbrevi ation	Name	Unit	Description
ſ	6	PG1	Position control gain 1	rad/s	Position and speed gains of a model used to set the response
ſ	36	VG1	Speed control gain 1	rad/s	level to a command. Always valid.
ſ	24	000	Ratio of load inertia moment to	Multiplier	Control parameters before changing.
	34	GD2	servo motor inertia moment	(×10 ⁻¹)	
366	35	PG2	Position control gain 2	rad/s	
	37	VG2	Speed control gain 2	rad/s	
	38	VIC	Speed integral compensation	ms	
	61	GD2B	Ratio of load inertia moment to	Multiplier	Used to set the ratio of load inertia moment to servo motor inertia
	01	GD2B	servo motor inertia moment 2	(×10 ⁻¹)	moment after changing.
	62	PG2B	Position control gain 2 changing	%	Used to set the ratio (%) of the after-changing position control
	02	FG2D	ratio	70	gain 2 to position control gain 2.
	63	VG2B	Speed control gain 2 changing	%	Used to set the ratio (%) of the after-changing speed control gain
	05	VG2D	ratio	70	2 to speed control gain 2.
	64	VICB	Speed integral compensation	%	Used to set the ratio (%) of the after-changing speed integral
	04	VICD	changing ratio	70	compensation to speed integral compensation.
	65	CDP	Gain changing selection		Used to select the changing condition.
				kpps	Used to set the changing condition values.
	66	CDS	Gain changing condition	pulse	
				r/min	
	67	CDT	Gain changing time constant	ms	You can set the filter time constant for a gain change at changing.

(1) Parameters No.6, 34 to 38

These parameters are the same as in ordinary manual adjustment. Gain changing allows the values of ratio of load inertia moment to servo motor inertia moment, position control gain 2, speed control gain 2 and speed integral compensation to be changed.

- (2) Ratio of load inertia moment to servo motor inertia moment 2 (GD2B: parameter No.61) Set the ratio of load inertia moment to servo motor inertia moment after changing. If the load inertia moment ratio does not change, set it to the same value as ratio of load inertia moment to servo motor inertia moment (parameter No.34).
- ^{hee}(3) Position control gain 2 changing ratio (parameter No.62), speed control gain 2 changing ratio (parameter No.63), speed integral compensation changing ratio (parameter No.64)

Set the values of after-changing position control gain 2, speed control gain 2 and speed integral compensation in ratio (%). 100% setting means no gain change.

For example, at the setting of position control gain 2 = 100, speed control gain 2 = 2000, speed integral compensation = 20 and position control gain 2 changing ratio = 180%, speed control gain 2 changing ratio = 150% and speed integral compensation changing ratio = 80%, the after-changing values are as follows. Position control gain 2 = Position control gain $2 \times$ Position control gain 2 changing ratio /100=180rad/s Speed control gain 2 = Speed control gain $2 \times$ Speed control gain 2 changing ratio /100 = 3000rad/s Speed integral compensation = Speed integral compensation \times Speed integral compensation changing ratio /100 = 16ms

(4) Gain changing selection (parameter No.65)

Used to set the gain changing condition. Choose the changing condition in the first digit. If you set "1" here, you can use the gain changing (CDP) external input signal for gain changing. The gain changing (CDP) can be assigned to the pins using parameters No.43 to 48.



(5) Gain changing condition (parameter No.66)

When you selected "command frequency", "droop pulses" or "servo motor speed" in gain changing selection (parameter No.65), set the gain changing level.

The setting unit is as follows.

Gain changing condition	Unit
Command frequency	kpps
Droop pulses	pulse
Servo motor speed	r/min

(6) Gain changing time constant (parameter No.67)

You can set the primary delay filter to each gain at gain changing. This parameter is used to suppress shock given to the machine if the gain difference is large at gain changing, for example.

8.5.4 Gain changing operation

This operation will be described by way of setting examples.

(1) When you choose changing by external input(a) Setting

	Parameter No.	Abbreviation	Name	Setting	Unit
	6	PG1	Position control gain 1	100	rad/s
	36	VG1	Speed control gain 1	1000	rad/s
v.DataShee	4U.com 34	GD2	Ratio of load inertia moment to servo motor inertia moment	4	Multiplier (×10 ⁻¹)
	35	PG2	Position control gain 2	120	rad/s
	37	VG2	Speed control gain 2	3000	rad/s
	38	VIC	Speed integral compensation	20	ms
	61	GD2B	Ratio of load inertia moment to servo motor inertia moment 2	100	Multiplier (×10 ⁻¹)
	62	PG2B	Position control gain 2 changing ratio	70	%
	63	VG2B	Speed control gain 2 changing ratio	133	%
	64	VICB	Speed integral compensation changing ratio	250	%
	65	CDP	Gain changing selection	0001 (Changed by ON/OFF of pin CN1-10)	
	67	CDT	Gain changing time constant	100	ms

(b) Changing operation



Position control gain 1			100					
Speed control gain 1		1000						
Ratio of load inertia moment	4.0	\rightarrow	10.0	\rightarrow	4.0			
to servo motor inertia moment	4.0	,		,	4.0			
Position control gain 2	120	\rightarrow	84	\rightarrow	120			
Speed control gain 2	3000	\rightarrow	4000	\rightarrow	3000			
Speed integral compensation	20	\rightarrow	50	\rightarrow	20			

(2) When you choose changing by droop pulses

(a) Setting

	Parameter No.	Abbreviation	Name	Setting	Unit
Г	6	PG1	Position control gain 1	100	rad/s
Γ	36	VG1	Speed control gain 1	1000	rad/s
	34	GD2	Ratio of load inertia moment to servo motor inertia moment	40	Multiplier (×10 ⁻¹)
_	35	PG2	Position control gain 2	120	(^ 10) rad/s
F	37	VG2	Speed control gain 2	3000	rad/s
-	38	VIC	Speed integral compensation	20	ms
ItaShee	61	GD2B	Ratio of load inertia moment to servo motor inertia moment 2	100	Multiplier (×10 ⁻¹)
	62	PG2B	Position control gain 2 changing ratio	70	%
	63	VG2B	Speed control gain 2 changing ratio	133	%
	64	64 VICB Speed integral compensation changing ratio		250	%
	65 CDP		Gain changing selection	0003 (Changed by droop pulses)	
	66	CDS	Gain changing condition	50	pulse
	67	CDT	Gain changing time constant	100	ms





Position control gain 1			100)			
Speed control gain 1	1000						
Ratio of load inertia moment to servo motor inertia moment	4.0	\rightarrow	10.0	\rightarrow	4.0	\rightarrow	10.0
Position control gain 2	120	\rightarrow	84	\rightarrow	120	\rightarrow	84
Speed control gain 2	3000	\rightarrow	4000	\rightarrow	3000	\rightarrow	4000
Speed integral compensation	20	\rightarrow	50	\rightarrow	20	\rightarrow	50

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9. INSPECTION

	 Before starting maintenance and/or inspection, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Otherwise, an electric shock may occur. In addition, always confirm from the front of the servo amplifier whether the charge lamp is off or not. Any person who is involved in inspection should be fully competent to do the work. Otherwise, you may get an electric shock. For repair and parts replacement, contact your safes representative.
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POINT

- Do not test the servo amplifier with a megger (measure insulation resistance), or it may become faulty.
- Do not disassemble and/or repair the equipment on customer side.

(1) Inspection

It is recommended to make the following checks periodically.

- (a) Check for loose terminal block screws. Retighten any loose screws.
- (b) Check the cables and the like for scratches and cracks. Perform periodic inspection according to operating conditions.
- (c) Check the servo motor bearings, brake section, etc. for unusual noise.
- (d) Check the cables and the like for scratches and cracks. Perform periodic inspection according to operating conditions.
- (e) Check the servo motor shaft and coupling for misalignment.

(2) Life

The following parts must be changed periodically as listed below. If any part is found faulty, it must be changed immediately even when it has not yet reached the end of its life, which depends on the operating method and environmental conditions. For parts replacement, please contact your sales representative.

Part name	Life guideline	
Smoothing capacitor	10 years	
Delay	Number of power-on and number of	
Relay	emergency stop times: 100,000 times	
Bearings	20,000 to 30,000 hours	
Encoder	20,000 to 30,000 hours	
Oil seal	5,000 hours	

(a) Smoothing capacitor

Affected by ripple currents, etc. and deteriorates in characteristic. The life of the capacitor greatly depends on ambient temperature and operating conditions. The capacitor will reach the end of its life in 10 years of continuous operation in normal air-conditioned environment.

(b) Relays

Their contacts will wear due to switching currents and contact faults occur. Relays reach the end of their life when the cumulative number of power-on and emergency stop times is 100,000, which depends on the power supply capacity.

(c) Servo amplifier cooling fan

The cooling fan bearings reach the end of their life in 10,000 to 30,000 hours. Normally, therefore, the cooling fan must be changed in a few years of continuous operation as a guideline. It must also be changed if unusual noise or vibration is found during inspection.

(d) Bearings

When the servo motor is run at rated speed under rated load, change the bearings in 20,000 to 30,000 hours as a guideline. This differs on the operating conditions. The bearings must also be changed if unusual noise or vibration is found during inspection.

www.DataSheet4U.(e) Oil seal, V ring

Must be changed in 5,000 hours of operation at rated speed as a guideline. This differs on the operating conditions. These parts must also be changed if oil leakage, etc. is found during inspection.

10.1 Trouble at start-up

• Excessive adjustment or change of parameter setting must not be made as it will CAUTION make operation instable. POINT

• Using the optional MR Configurator (servo configuration software), you can refer to unrotated servo motor reasons, etc.

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The following faults may occur at start-up. If any of such faults occurs, take the corresponding action.

10.1.1 Position control mode

(1) Troubleshooting

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on (Note)	 LED is not lit. LED flickers. 	Not improved if connectors CN1, CN2 and CN3 are disconnected.	 Power supply voltage fault Servo amplifier is faulty. 	
			Improved when connectors CN1 is disconnected.	Power supply of CNP1 cabling is shorted.	
			Improved when connector CN2 is disconnected.	 Power supply of encoder cabling is shorted. Encoder is faulty. 	
			Improved when connector CN3 is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to section 10.2 and remove	ve cause.	Section 10.2
2	Switch on servo-on	Alarm occurs.	Refer to section 10.2 and remove	ve cause.	Section 10.2
	signal.	Servo motor shaft is not servo-locked (is free).	 Check the display to see if the servo amplifier is ready to operate. Check the external I/O signal indication to see if the servo-on (SON) signal is ON. 	 Servo-on signal is not input. (Wiring mistake) 24VDC power is not supplied to COM. 	Section 6.6
3	Enter input command. (Test operation)	Servo motor does not rotate.	Check cumulative command pulses.	 Wiring mistake (a) For open collector pulse train input, 24VDC power is not supplied to OPC. (b) LSP/LSN-VIN are not connected. No pulses is input. 	Section 6.2
		Servo motor run in reverse direction.		 Mistake in wiring to controller. Mistake in setting of parameter No.54. 	Chapter 5

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
4	Gain adjustment	Rotation ripples	Make gain adjustment in the	Gain adjustment fault	Chapter 7
		(speed fluctuations)	following procedure.		
		are large at low	1. Increase the auto tuning		
		speed.	response level.		
			2. Repeat acceleration and		
			deceleration several times		
			to complete auto tuning.		
		Large load inertia	If the servo motor may be run	Gain adjustment fault	Chapter 7
		moment causes the	with safety, repeat		
		servo motor shaft to	acceleration and deceleration		
4U.cor	m	oscillate side to side.	several times to complete auto		
			tuning.		
5	Cyclic operation	Position shift occurs.	Confirm the cumulative	Pulse counting error, etc.	(2) of this
			command pulses, cumulative	due to noise.	section
			feedback pulses and actual		
			servo motor position.		

Note. Switch power on again after making sure that the charge lamp has turned off completely.

(2) How to find the cause of position shift



When a position shift occurs, check (a) output pulse counter, (b) cumulative command pulse display, (c) cumulative feedback pulse display, and (d) machine stop position in the above diagram.

(A), (B) and (C) indicate position shift causes. For example, (A) indicates that noise entered the wiring between positioning unit and servo amplifier, causing pulses to be miss-counted.

In a normal status without position shift, there are the following relationships.

- 1) Q = P (positioning unit's output counter = servo amplifier's cumulative command pulses)
- 2) P. CMX(parameter No.3)
 - CDV(parameter No.4)
 - = C (cumulative command pulses × electronic gear = cumulative feedback pulses)
- 3) C $\Delta \ell = M$ (cumulative feedback pulses × travel per pulse = machine position)

Check for a position shift in the following sequence.

1) When $Q \neq P$

Noise entered the pulse train signal wiring between positioning unit and servo amplifier, causing pulses to be miss-counted. (Cause A)

Make the following check or take the following measures.

- Check how the shielding is done.
- Change the open collector system to the differential line driver system.
- Run wiring away from the power circuit.
- Install a data line filter.

2) When $P \cdot \frac{CMX}{CDV} \neq C$

During operation, the servo-on signal (SON) or forward rotation stroke end (LSP), reverse rotation stroke end (LSN) signal was switched off or the clear signal (CR) and the reset signal (RES) switched on. (Cause C)

If a malfunction may occur due to much noise, increase the input filter setting (parameter No.1). 3) When C • $\Delta \ell \neq M$

Mechanical slip occurred between the servo motor and machine. (Cause B)

10.1.2 Internal speed control mode

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on (Note)	 LED is not lit. LED flickers. 	Not improved if connectors CN1, CN2 and CN3 are disconnected.	 Power supply voltage fault Servo amplifier is faulty. 	
			Improved when connectors CN1 is disconnected.	Power supply of CN1 cabling is shorted.	
			Improved when connector CN2 is disconnected.	 Power supply of encoder cabling is shorted. Encoder is faulty. 	
4U.com	1		Improved when connector CN3 is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to section 10.2 and remov	/e cause.	Section 10.2
2	Switch on servo-on	Alarm occurs.	Refer to section 10.2 and remov	/e cause.	Section 10.2
	signal.	Servo motor shaft is not servo-locked (is free).	 Check the display to see if the servo amplifier is ready to operate. Check the external I/O signal indication to see if the servo-on (SON) signal is ON. 	 Servo-on signal is not input. (Wiring mistake) 24VDC power is not supplied to COM. 	Section 6.6
3	Switch on forward rotation start (ST1) or reverse rotation start	Servo motor does not rotate.	Call the external I/O signal display and check the ON/OFF status of the input signal.	LSP, LSN, ST1 or ST2 is off.	Section 6.6
	(ST2).		Check the internal speed commands 1 to 7 (parameters No.8 to 10 • 72 to 75).	Set value is 0.	Section 5.1.2 (1)
			Check the internal torque limit 1 (parameter No.28).	Torque limit level is too low as compared to the load torque.	
4	Gain adjustment	Rotation ripples (speed fluctuations) are large at low speed.	 Make gain adjustment in the following procedure. 1. Increase the auto tuning response level. 2. Repeat acceleration and deceleration several times to complete auto tuning. 	Gain adjustment fault	Chapter 7
		Large load inertia moment causes the servo motor shaft to oscillate side to side.	If the servo motor may be run with safety, repeat acceleration and deceleration several times to complete auto tuning.	Gain adjustment fault	Chapter 7

Note. Switch power on again after making sure that the charge lamp has turned off completely.

10.2 When alarm or warning has occurred

POINT	
 As soon as 	an alarm occurs, turn off Servo-on (SON) and power off the power
supply.	

10.2.1 Alarms and warning list

When a fault occurs during operation, the corresponding alarm or warning is displayed. If any alarm or warning has occurred, refer to section 10.2.2 or 10.2.3 and take the appropriate action. When an alarm occurs, the current circuit between ALM and VIN opens.

Set "DDD1" in parameter No.49 to output the alarm code in ON/OFF status across the corresponding pin and VIN. Warnings (AL.96 to AL.E9) have no alarm codes. Any alarm code is output at occurrence of the corresponding alarm. In the normal status, the signals available before alarm code setting (CN1-12: ZSP, CN1-11: RD, CN1-10: INP or SA) are output.

After its cause has been removed, the alarm can be deactivated in any of the methods marked **O** in the alarm deactivation column.

		(No	te 2) Alarm c	ode		Ala	arm deactivat	ion
	Display	CN1-10 pin	CN1-11 pin	CN1-12 pin	Name	Power OFF→ON	Press "SET" on current alarm screen.	Alarm reset (RES) signal
	AL.10	0	1	0	Undervoltage	0	0	0
	AL.12	0	0	0	Memory error 1	0		
	AL.13	0	0	0	Clock error	0		
	AL.15	0	0	0	Memory error 2	0		
	AL.16	1	0	1	Encoder error 1	0		
	AL.17	0	0	0	Board error	0		
	AL.19	0	0	0	Memory error 3	0		
	AL.1A	1	0	1	Motor combination error	0		
	AL.20	1	1	0	Encoder error 2	0		
	AL.24	0	0	1	Main circuit error	0		
	AL.30	0	1	0	Regenerative error	○ (Note 1)	○ (Note 1)	○ (Note 1)
Alams	AL.31	0	1	1	Overspeed	0	0	0
Ala	AL.32	0	0	1	Overcurrent O O		0	0
	AL.33	0	1	0	Overvoltage	· · · · · · · · · · · · · · · · · · ·		
	AL.35	0	1	1	Command pulse frequency error	0	0	0
	AL.37	0	0	0	Parameter error	0		
	AL.45	1	1	0	Main circuit device overheat	○ (Note 1)	○ (Note 1)	○ (Note 1)
	AL.46	1	1	0	Servo motor overheat	○ (Note 1)	○ (Note 1)	○ (Note 1)
	AL.50	1	1	0	Overload 1	○ (Note 1)	○ (Note 1)	○ (Note 1)
	AL.51	1	1	0	Overload 2	○ (Note 1)	○ (Note 1)	○ (Note 1)
	AL.52	0	1	1	Error excessive	0	0	0
	AL.8A	0	0	0	Serial communication time-out error	0	0	0
	AL.8E	0	0	0	Serial communication error	0	0	0
	88888	0	0	0	Watchdog	0		
S	AL.E0				Excessive regenerative warning			
Warnings	AL.E1				Overload warning	Removing the cause of occurrence		
Varr	AL.E6				Servo emergency stop warning	deactivates the alarm automatically.		
>	AL.E9				Undervoltage warning			

Note 1. Deactivate the alarm about 30 minutes of cooling time after removing the cause of occurrence.

2. 0: off

1: on

10.2.2 Remedies for alarms

	 When any alarm has occurred, eliminate its cause, ensure safety, then reset the alarm, and restart operation. Otherwise, injury may occur. As soon as an alarm occurs, turn off Servo-on (SON) and power off the power supply.
4U.com	 POINT When any of the following alarms has occurred, always remove its cause and allow about 30 minutes for cooling before resuming operation. If operation is resumed by switching power off, then on to reset the alarm, the servo amplifier and servo motor may become faulty. Regenerative error (AL.30) Overload 1 (AL.50) Overload 2 (AL.51) The alarm can be deactivated by switching power off, then on press the "SET" button on the current alarm screen or by turning on the reset signal (RES). For details, refer to section 10.2.1.

When an alarm occurs, the trouble signal (ALM) switches off and the dynamic brake is operated to stop the servo motor. At this time, the display indicates the alarm No.

The servo motor comes to a stop. Remove the cause of the alarm in accordance with this section. Use the optional MR Configurator (servo configuration software) to refer to the cause of the alarm.

Display	Name	Definition	Cause	Action
AL.10	Undervoltage	Power supply voltage dropped to 160VAC or less.	 Power supply voltage is low. There was an instantaneous control power failure of 60ms or longer. Shortage of power supply capacity caused the power supply voltage to drop at start, etc. The bus voltage dropped to 200VDC. 	Check the power supply.
			5. Faulty parts in the servo amplifier	Change the servo amplifier.
AL.12 AL.13	Memory error 1 Clock error	RAM, memory fault Printed board fault	Faulty parts in the servo amplifier	Change the servo amplifier.
AL.15	Memory error 2	EEP-ROM fault	 Faulty parts in the servo amplifier The number of write times to EEP- ROM exceeded 100,000. 	Change the servo amplifier.
AL.16	Encoder error 1	Communication error occurred between	1. Encoder connector (CN2) disconnected.	Connect correctly.
		encoder and servo	2. Encoder fault	Change the servo motor.
		amplifier.	3. Encoder cable faulty (Wire breakage or shorted)	Repair or change cable.
AL.17	Board error	CPU/parts fault The output terminals U, V, W of the servo amplifier and the input terminals U, V, W of the servo motor are not connected.	 Faulty parts in the servo amplifier The wiring of U, V, W is disconnected or not connected. 	Change the servo amplifier. Correctly connect the output terminals U, V, W of the servo amplifier and the input terminals U, V, W of the servo motor.
AL.19	Memory error 3	ROM memory fault	Faulty parts in the servo amplifier	Change the servo amplifier.

	Display	Name	Definition	Cause	Action
	AL.1A	Motor combination error	Wrong combination of servo amplifier and servo motor.	Wrong combination of servo amplifier and servo motor connected.	Use correct combination.
	AL.20	Encoder error 2	Communication error occurred between	1. Encoder connector (CN2) disconnected.	Connect correctly.
			encoder and servo	2. Encoder fault	Change the servo motor.
			amplifier.	3. Encoder cable faulty (Wire breakage or shorted)	Repair or change the cable.
	AL.24	Main circuit error	Ground fault occurred at the servo motor powers	1. Power input wires and servo motor power wires are in contact at main circuit terminal block (TE1).	Connect correctly.
`hoo!	411.00m		(U,V and W phases) of the servo amplifier.	 Sheathes of servo motor power cables deteriorated, resulting in ground fault. 	Change the cable.
Sheel	4U.com			3. Main circuit of servo amplifier failed. Checking method Alarm (AL.24) occurs if the servo is switched on after disconnecting the U, V, W power cables from the servo amplifier.	Change the servo amplifier.
	AL.30	Regenerative	Permissible	1. Wrong setting of parameter No.0	Set correctly.
		error	regenerative power of the built-in regenerative resistor	 Built-in regenerative resistor or regenerative option is not connected. 	Connect correctly.
			or regenerative option is exceeded.	 High-duty operation or continuous regenerative operation caused the permissible regenerative power of the regenerative option to be exceeded. 	 Reduce the frequency of positioning. Use the regenerative option of larger capacity. Reduce the load.
				Checking method	
				Call the status display and check	
				the regenerative load ratio.	
				 4. Power supply voltage is abnormal. MR-E-□A-QW003: 260VAC or more 	Check the power supply.
				5. Built-in regenerative resistor or regenerative option faulty.	Change servo amplifier or regenerative option.
			Regenerative transistor fault	 6. Regenerative transistor faulty. Checking method 1) The regenerative option has overheated abnormally. 2) The alarm occurs even after removal of the built-in regenerative resistor or regenerative option. 	Change the servo amplifier.

Display	Name	Definition	Cause	Action
AL.31	Overspeed	Speed has exceeded the instantaneous	1. Input command pulse frequency exceeded the permissible instantaneous speed frequency.	Set command pulses correctly.
		permissible speed.	2. Small acceleration/deceleration time constant caused overshoot to be large.	Increase acceleration/deceleration time constant.
14U.com			 Servo system is instable to cause overshoot. 	 Re-set servo gain to proper value. If servo gain cannot be set to proper value. Reduce load inertia moment ratio; or Reexamine acceleration/ deceleration time constant.
			4. Electronic gear ratio is large (parameters No.3, 4)	Set correctly.
			5. Encoder faulty.	Change the servo motor.
AL.32	Overcurrent	Current that flew is higher than the	 Short occurred in servo amplifier output phases U, V and W. 	Correct the wiring.
		permissible current of the servo amplifier. (When the alarm (AL.32) occurs, switch the power OFF and then ON to reset the alarm. Then, turn on	2. Transistor (IPM) of the servo amplifier faulty. Checking method Alarm (AL.32) occurs if power is switched on after U,V and W are disconnected.	Change the servo amplifier.
		the servo-on. When the alarm (AL.32)	3. Ground fault occurred in servo amplifier output phases U, V and W.	Correct the wiring.
		still occurs at the time, the transistor (IPM • IGBT) of the servo amplifier may be at fault. Do not switch the power OFF/ON repeatedly; check the transistor according to the cause 2 checking method.)	4. External noise caused the overcurrent detection circuit to misoperate.	Take noise suppression measures.
AL.33	Overvoltage	Converter bus voltage exceeded 400VDC.	 Regenerative option is not used. Though the regenerative option is used, the parameter No.0 setting is "□□0□ (not used)". 	Use the regenerative option. Make correct setting.
			 Lead of built-in regenerative resistor or regenerative option is open or disconnected. 	 Change the lead. Connect correctly.
			 Regenerative transistor faulty. Wire breakage of built-in regenerative resistor or regenerative option 	 Change the servo amplifier. 1. For wire breakage of built-in regenerative resistor, change the servo amplifier. 2. For wire breakage of regenerative option, change the regenerative option.
			 Capacity of built-in regenerative resistor or regenerative option is insufficient. 	Add regenerative option or increase capacity.
			7. Power supply voltage high.	Check the power supply.

Display	Name	Definition	Cause	Action
AL.35	Command	Input pulse	1. Pulse frequency of the command	Change the command pulse frequency to a
	pulse frequency	frequency of the	pulse is too high.	proper value.
	error	command pulse is	2. Noise entered command pulses.	Take action against noise.
		too high.	3. Command device failure	Change the command device.
AL.37	Parameter error	Parameter setting is	1. Servo amplifier fault caused the	Change the servo amplifier.
		wrong.	parameter setting to be rewritten.	
			2. Regenerative option or servo motor	Set parameter No.0 correctly.
			not used with servo amplifier was	
			selected in parameter No.0.	
			3. The number of write times to EEP-	Change the servo amplifier.
4U.com			ROM exceeded 100,000 due to	
			parameter write, etc.	
AL.45	Main circuit	Main circuit device	1. Servo amplifier faulty.	Change the servo amplifier.
	device overheat	overheat	2. The power supply was turned on	The drive method is reviewed.
			and off continuously by overloaded	
			status.	
			3. Air cooling fan of servo amplifier	1. Exchange the cooling fan or the servo
			stops.	amplifier.
				2. Reduce ambient temperature.
AL.46	Servo motor	Servo motor	1. Ambient temperature of servo motor	Review environment so that ambient
	overheat	temperature rise	is over 40°C (104°F).	temperature is 0 to 40°C (104°F).
		actuated the thermal	2. Servo motor is overloaded.	1. Reduce load.
		sensor.		2. Review operation pattern.
				3. Use servo motor that provides larger
				output.
41.50			3. Thermal sensor in encoder is faulty.	Change the servo motor.
AL.50	Overload 1	Load exceeded	1. Servo amplifier is used in excess	1. Reduce load.
		overload protection characteristic of	of its continuous output current.	2. Review operation pattern.
		servo amplifier.		 Use servo motor that provides larger output.
		servo ampiner.	2. Servo system is instable and	1. Repeat acceleration/
			hunting.	deceleration to execute auto tuning.
			handing.	2. Change auto tuning response setting.
				3. Set auto tuning to OFF and make gain
				adjustment manually.
			3. Machine struck something.	1. Review operation pattern.
			g.	2. Install limit switches.
			4. Wrong connection of servo motor.	Connect correctly.
			Servo amplifier's output terminals U,	,
			V, W do not match servo motor's	
			input terminals U, V, W.	
			5. Encoder faulty.	Change the servo motor.
			Checking method	
			When the servo motor shaft is	
			rotated with the servo off, the	
			cumulative feedback pulses do	
			not vary in proportion to the rotary angle of the shaft but the	
			indication skips or returns	
			midway.	
1				

Display	Name	Definition	Cause	Action
AL.51	Overload 2	Machine collision or the like caused max.	1. Machine struck something.	 Review operation pattern. Install limit switches.
		output current to flow successively for several seconds. Servo motor locked:	 Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W. 	Connect correctly.
4U.com		1s or more During rotation: 2.5s or more	 Servo system is instable and hunting. 	 Repeat acceleration/deceleration to execute auto tuning. Change auto tuning response setting. Set auto tuning to OFF and make gain adjustment manually.
			4. Encoder faulty. Checking method When the servo motor shaft is rotated with the servo off, the cumulative feedback pulses do not vary in proportion to the rotary angle of the shaft but the indication skips or returns midway.	Change the servo motor.
AL.52	Error excessive	The difference between the model position and the actual servo motor	 Acceleration/deceleration time constant is too small. Torque limit value (parameter No.28) is too small. 	Increase the acceleration/deceleration time constant. Increase the torque limit value.
		position exceeds 2.5 rotations. (Refer to the function block diagram in section 1.2)	 Motor cannot be started due to torque shortage caused by power supply voltage drop. Position control gain 1 (parameter No.6) value is small. 	 Review the power supply capacity. Use servo motor which provides large output. Increase set value and adjust to ensure proper operation.
			5. Servo motor shaft was rotated by external force.	 When torque is limited, increase the limit value. Reduce load. Use servo motor that provides larger output.
			6. Machine struck something.	 Review operation pattern. Install limit switches.
			 7. Encoder faulty 8. Wrong connection of servo motor. Servo amplifier's output terminals U, V, W do not match servo motor's input terminals U, V, W. 	Change the servo motor. Connect correctly.
AL.8A	Serial communication time-out error	RS-232C or RS-422 communication stopped for longer	 Communication cable breakage. Communication cycle longer than parameter No.56 setting. 	Repair or change communication cable. Set correct value in parameter.
		than the time set in parameter No.56.	3. Wrong protocol.	Correct protocol.
AL.8E	Serial communication error	Serial communication error occurred between servo amplifier and communication	 Communication cable fault (Open cable or short circuit) Communication device (e.g. personal computer) faulty 	Repair or change the cable. Change the communication device (e.g.
		device (e.g. personal computer).	· · · · · · · · · · · · · · · · · · ·	
88888	Watchdog	CPU, parts faulty	Fault of parts in servo amplifier	Change the servo amplifier.

10.2.3 Remedies for warnings

POINT	
 When any 	of the following alarms has occurred, do not resume operation by
switching p	ower of the servo amplifier OFF/ON repeatedly. The servo amplifier
and servo	motor may become faulty. If the power of the servo amplifier is
switched C	OFF/ON during the alarms, allow more than 30 minutes for cooling
before resu	iming operation.

- Excessive regenerative warning (AL.E0)
- Overload warning 1 (AL.E1)

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If AL.E6 occurs, the servo off status is established. If any other warning occurs, operation can be continued but an alarm may take place or proper operation may not be performed. Use the optional MR Configurator (servo configuration software) to refer to the cause of the warning.

Display	Name	Definition	Cause	Action
AL.E0	Excessive regenerative warning	There is a possibility that regenerative power may exceed permissible regenerative power of built-in regenerative resistor or regenerative option.	Regenerative power increased to 85% or more of permissible regenerative power of built-in regenerative resistor or regenerative option. Checking method Call the status display and check regenerative load ratio.	 Reduce frequency of positioning. Change regenerative option for the one with larger capacity. Reduce load.
AL.E1	Overload warning	There is a possibility that overload alarm 1 or 2 may occur.	Load increased to 85% or more of overload alarm 1 or 2 occurrence level. Cause, checking method Refer to AL.50, 51.	Refer to AL.50, AL.51.
AL.E6	Servo emergency stop warning	EMG-VIN are open.	External emergency stop was made valid. (EMG-VIN opened.)	Ensure safety and deactivate emergency stop.
AL.E9	Undervoltage warning	This alarm occurs when the servo motor speed decreases to or below 50r/min with the bus voltage dropping.		Check the power supply.

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11. OUTLINE DIMENSION DRAWINGS

11.1 Servo amplifiers

(1) MR-E-10A-QW003 • MR-E-20A-QW003



Mass: 0.7 [kg] (1.54 [lb])



11. OUTLINE DIMENSION DRAWINGS

(2) MR-E-40A-QW003



[Unit: mm]

(3) MR-E-70A-QW003 • MR-E-100A-QW003

[Unit: mm]



L₂ 0

L3 0

(4) MR-E-200A-QW003



11.2 Connectors

(1) Miniature delta ribbon (MDR) system (3M)(a) One-touch lock type

[Unit: mm]



Connector	Shell kit	Each type of dimension				
Connector		А	В	С	D	E
10126-3000PE	10326-52F0-008	25.8	37.2	14.0	10.0	12.0

(b) Jack screw M2.6 type

This is not available as option.

[Unit: mm]



Connector	Shell kit		E	ach type o	f dimensio	n	
	Shell Kit	А	В	С	D	Ш	F
10126-3000PE	10326-52A0-008	25.8	37.2	14.0	10.0	12.0	27.4

(2) CN2 Connector (Molex)

Connector set

: 54599-1019



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(3) CN3 Connector (Marushin electric mfg) Connector: MP371/6



[Unit: mm]



(4) CNP1 • CNP2 Connector (Molex)(a) Crimping type



8.5	2	25	
			٦
	15.3		
	8.5		

				[Unit: mm]	
Connector	Variable dimensions [mm] ([in])		Number of	Application	
	А	В	poles		
51240-0300			2	CNP2	
51240-0300	17.8	10	3	(1kW or less)	
E1040 0600	1240-0600 32.8 25		6	CNP1	
51240-0600			6	(1kW or less)	

Crimping tool: 57349-5300 (Molex)

[Unit: mm]

Connector	Variable dimensions [mm] ([in])		Number of poles	Application	
	А	В	poles		
51241-0300	22.8	15	3	CNP2 (2kW)	
51241-0600	45.3	37.5	6	CNP1 (2kW)	

Crimping tool: 57349-5300 (Molex)

Circuit number indicatio	n

•		A B)	
	<mark>∢7.5</mark> Pitch	<mark>∢</mark> 3.75	



(b) Insertion type



				[Unit: mm]	
Connector	Variable dimensions [mm]		Number of	Application	
	А	В	poles		
54927-0310	310 16.5	10	2	CNP2	
54927-0310			3	(1kW or less)	
54927-0610	1007.0010 04.5		6	CNP1	
54927-0610	31.5	25	0	(1kW or less)	



				[Unit: mm]	
Connector	Variable d [m	imensions m]	Number of	Application	
	А	В	poles		
54928-0310	21.5	22.5	3	CNP2	
54920-0310	21.5	22.5	3	(2kW)	
54928-0610	44	27.5	6	CNP1	
54926-0010	44	44 37.5		(2kW)	

	E]			E		[
Housing						Housing cover				





12. CHARACTERISTICS

12.1 Overload protection characteristics

An electronic thermal relay is built in the servo amplifier to protect the servo motor and servo amplifier from overloads. Overload 1 (AL.50) occurs if overload operation performed is above the electronic thermal relay protection curve shown in any of Figs 12.1, Overload 2 (AL.51) occurs if the maximum current flew continuously for several seconds due to machine collision, etc. Use the equipment on the left-hand side area of the continuous or broken line in the graph.

In a machine like the one for vertical lift application where unbalanced torque will be produced, it is recommended to use the machine so that the unbalanced torque is 70% or less of the rated torque.



Note. If operation that generates torque more than 100% of the rating is performed with an abnormally high frequency in a servo motor stop status (servo lock status) or in a 30r/min or less low-speed operation status, the servo amplifier may fail even when the electronic thermal relay protection is not activated.

Fig 12.1 Electronic thermal relay protection characteristics

12.2 Power supply equipment capacity and generated loss

(1) Amount of heat generated by the servo amplifier

Table 12.1 indicates servo amplifiers' power supply capacities and losses generated under rated load. For thermal design of an enclosure, use the values in Table 12.1 in consideration for the worst operating conditions. The actual amount of generated heat will be intermediate between values at rated torque and zero torque according to the duty used during operation. When the servo motor is run at less than the maximum speed, the power supply capacity will be smaller than the value in the table, but the servo amplifier's generated heat will not change.

Servo amplifier	Servo motor	(Note 1) Power supply	(Note 2) Servo amplifier-generated heat [W]		Area required for heat dissipation
		capacity [kVA]	At rated torque	With servo off	[m²]
MR-E-10A-QW003	HF-KE13W1-S100	0.3	25	15	0.5
MR-E-20A-QW003	HF-KE23W1-S100	0.5	25	15	0.5
MR-E-40A-QW003	HF-KE43W1-S100	0.9	35	15	0.7
	HF-SE52JW1-S100	1.0	40	15	0.8
MR-E-70A-QW003	HF-KE73W1-S100	1.3	50	15	1.0
MR-E-100A-QW003	HF-SE102JW1-S100	1.7	50	15	1.0
	HF-SE152JW1-S100	2.5	90	20	1.8
MR-E-200A-QW003	HF-SE202JW1-S100	3.5	90	20	1.8

Table 12.1 Power sur	poly capacity and	generated heat pe	er servo amplifier at rated outpu	Jt
	pry oupdoity and	gonoratoa noat po	er eer re ampiner at ratea eap	~

Note 1. Note that the power supply capacity will vary according to the power supply impedance. This value assumes that the power factor improving reactor is not used.

2. Heat generated during regeneration is not included in the servo amplifier-generated heat. To calculate heat generated by the regenerative option, refer to section 13.1.1.

(2) Heat dissipation area for enclosed servo amplifier

The enclosed control box (hereafter called the control box) which will contain the servo amplifier should be designed to ensure that its temperature rise is within $+10^{\circ}$ C at the ambient temperature of 40° C (104° F). (With a 5°C (41° F) safety margin, the system should operate within a maximum 55°C (131° F) limit.) The necessary enclosure heat dissipation area can be calculated by Equation 12.1.

 $A = \frac{P}{K \cdot \Delta T}$ where, A : Heat dissipation area [m²]
P : Loss generated in the control box [W] $\Delta T : \text{Difference between internal and ambient temperatures [°C]}$ corr K : Heat dissipation coefficient [5 to 6]

When calculating the heat dissipation area with Equation 12.1, assume that P is the sum of all losses generated in the enclosure. Refer to Table 12.1 for heat generated by the servo amplifier. "A" indicates the effective area for heat dissipation, but if the enclosure is directly installed on an insulated wall, that extra amount must be added to the enclosure's surface area.

The required heat dissipation area will vary wit the conditions in the enclosure. If convection in the enclosure is poor and heat builds up, effective heat dissipation will not be possible. Therefore, arrangement of the equipment in the enclosure and the use of a cooling fan should be considered.

Table 12.1 lists the enclosure dissipation area for each servo amplifier when the servo amplifier is operated at the ambient temperature of 40° C (104° F) under rated load.





When air flows along the outer wall of the enclosure, effective heat exchange will be possible, because the temperature slope inside and outside the enclosure will be steeper.

12. CHARACTERISTICS

12.3 Dynamic brake characteristics

Fig. 12.3 shows the pattern in which the servo motor comes to a stop when the dynamic brake is operated. Use Equation 12.2 to calculate an approximate coasting distance to a stop. The dynamic brake time constant τ varies with the servo motor and machine operation speeds. (Refer to Fig. 12.4)





L _{max} =	$= \frac{V_0}{60} \cdot \left\{ te + \tau \left[1 + \frac{J_L}{J_M} \right] \right\}.$	(12.2)
Lmax	: Maximum coasting distance	[mm]
Vo	: Machine rapid feed rate	[mm/min]
Jм	: Servo motor inertial moment	[kg • cm ²][oz • in ²]
J_L	: Load inertia moment converted into equivalent value on servo motor shaft	
τ	: Brake time constant	
te	: Delay time of control section	[s]
	(There is internal relay delay time of about 30ms.)	





Use the dynamic brake under the load inertia moment ratio indicated in the following table. If the load inertia moment is higher than this value, the built-in dynamic brake may burn. If there is a possibility that the load inertia moment may exceed the value, contact Mitsubishi.

Servo amplifier	Load inertia moment ratio [times]
MR-E-10A-QW003 to MR-E-200A-QW003	30

12.4 Encoder cable flexing life

The flexing life of the cables is shown below. This graph calculated values. Since they are not guaranteed values, provide a little allowance for these values.



12.5 Inrush currents at power-on of main circuit and control circuit

The following table indicates the inrush currents (reference value) that will flow when the maximum permissible voltage (253VAC) is applied at the power supply capacity of 2500kVA and the wiring length of 1m.

Servo amplifier	Inrush currents (A _{0-p})	
	Main circuit power supply (L_1, L_2, L_3)	
MR-E-10A-QW003	50A (Attenuated to approx. 10A in 10ms)	
MR-E-20A-QW003		
MR-E-40A-QW003		
MR-E-70A-QW003	70A (Attenuated to approx. 20A in 10ms)	
MR-E-100A-QW003	TOA (Attenuated to approx. 20A IIT TOTIS)	
MR-E-200A-QW003	110A (Attenuated to approx. 20A in 10ms)	

Since large inrush currents flow in the power supplies, always use circuit breakers and magnetic contactors. (Refer to section 13.2.2.)

When circuit protectors are used, it is recommended to use the inertia delay type that will not be tripped by an inrush current.

13. OPTIONS AND AUXILIARY EQUIPMENT

WARNING may occur. In addition, always confirm from the front of the servo amplifier whether the charge lamp is off or not.		 Before connecting any option or peripheral equipment, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Otherwise, an electric shock may occur. In addition, always confirm from the front of the servo amplifier whether the charge lamp is off or not.
---	--	--

 Use the specified auxiliary equipment and options. Unspecified ones may lead to a
fault or fire.

13.1 Options

13.1.1 Regenerative options

```
    The specified combinations of regenerative options and servo amplifiers may only

be used. Otherwise, a fire may occur.
```

(1) Combination and regenerative power

The power values in the table are resistor-generated regenerative powers and not rated powers.

		Permissible regenerative power [W]				
Servo amplifier	Built-in regenerative resistor	MR-RB032 [40Ω]	MR-RB12 [40Ω]	MR-RB32 [40Ω]	MR-RB30 [13Ω]	(Note) MR-RB50 [13Ω]
MR-E-10A-QW003		30			/	
MR-E-20A-QW003		30	100	/	/	
MR-E-40A-QW003	10	30	100			
MR-E-70A-QW003	20	30	100	300	/	
MR-E-100A-QW003	20	30	100	300		
MR-E-200A-QW003	100	/	/		300	500

Note. Always install a cooling fan.

(2) Selection of the regenerative option

(a) Simple selection method

In horizontal motion applications, select the regenerative option as described below. When the servo motor is run without load in the regenerative mode from the running speed to a stop, the permissible duty is as indicated in section 5.1 of the separately available Servo Motor Instruction Manual.

For the servo motor with a load, the permissible duty changes according to the inertia moment of the load and can be calculated by the following formula.

Permissible _ Permissible duty for servo motor with no load (value indication section 5.1 in Servo Motor Instruction Manual) duty (m+1)



where m = load inertia moment/servo motor inertia moment

From the permissible duty, find whether the regenerative option is required or not. Permissible duty < number of positioning times [times/min]

Select the regenerative option out of the combinations in (1) of this section.

(b) To make selection according to regenerative energy

Use the following method when regeneration occurs continuously in vertical motion applications or when it is desired to make an in-depth selection of the regenerative option.

a. Regenerative energy calculation

Use the following table to calculate the regenerative energy.

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Formulas for calculating torque and energy in operation

	r official of oaloalacing torque and energy in	
Regenerative power	Torque applied to servo motor [N • m]	Energy [J]
1)	$T_{1} = \frac{(J_{L}+J_{M}) \cdot N_{0}}{9.55 \times 10^{4}} \cdot \frac{1}{T_{psa1}} + T_{U} + T_{F}$	$E_{1} = \frac{0.1047}{2} \cdot N_{0} \cdot T_{1} \cdot T_{psa1}$
2)	$T_2 = T_U + T_F$	$E_2 = 0.1047 \cdot N_0 \cdot T_2 \cdot t_1$
3)	$T_{3} = \frac{-(J_{L}+J_{M}) \cdot N_{0}}{9.55 \times 10^{4}} \cdot \frac{1}{T_{psd1}} + T_{U} + T_{F}$	$E_3 = \frac{0.1047}{2} \cdot N_0 \cdot T_3 \cdot T_{psd1}$
4), 8)	$T_4 = T_U$	$E_4 \ge 0$ (No regeneration)
5)	$T_{5} = \frac{(JL+JM) \cdot N_{0}}{9.55 \times 10^{4}} \cdot \frac{1}{T_{psa2}} - TU + T_{F}$	$E_5 = \frac{0.1047}{2} \cdot N_0 \cdot T_5 \cdot T_{psa2}$
6)	$T_6 = -T_U + T_F$	$E_6 = 0.1047 \cdot N_0 \cdot T_6 \cdot t_3$
7)	$T_7 = \frac{-(JL+JM) \cdot N_0}{9.55 \times 10^4} \cdot \frac{1}{T_{psd2}} - T_U + T_F$	$E_7 = \frac{0.1047}{2} \cdot N_0 \cdot T_7 \cdot T_{psd_2}$

From the calculation results in 1) to 8), find the absolute value (Es) of the sum total of negative energies.

b. Losses of servo motor and servo amplifier in regenerative mode

The following table lists the efficiencies and other data of the servo motor and servo amplifier in the regenerative mode.

Servo amplifier	Inverse efficiency [%]	Capacitor charging [J]
MR-E-10A-QW003	55	9
MR-E-20A-QW003	70	9
MR-E-40A-QW003	85	11
MR-E-70A-QW003	80	18
MR-E-100A-QW003	80	18
MR-E-200A-QW003	85	40

Inverse efficiency (η)

:Efficiency including some efficiencies of the servo motor and servo amplifier when rated (regenerative) torque is generated at rated speed. Since the efficiency varies with the speed and torque, allow for about 10%.

Capacitor charging (Ec)

:Energy charged into the electrolytic capacitor in the servo amplifier.

Subtract the capacitor charging from the result of multiplying the sum total of regenerative energies by the inverse efficiency to calculate the energy consumed by the regenerative option.

$$ER[J] = \eta \cdot Es - Ec$$

Calculate the power consumption of the regenerative option on the basis of single-cycle operation period tf [s] to select the necessary regenerative option.

PR [W] = ER/tf

(3) Connection of the regenerative option

Set parameter No.2 according to the option to be used.



(4) Connection of the regenerative option



The regenerative option will cause a temperature rise of $+100^{\circ}$ C relative to the ambient temperature. Fully examine heat dissipation, installation position, used cables, etc. before installing the option. For wiring, use flame-resistant cables and keep them clear of the regenerative option body. Always use twisted cables of max. 5m length for connection with the servo amplifier.

Always remove the wiring from across P-D and fit the regenerative option across P-C.

The G3 and G4 terminals act as a thermal sensor. G3-G4 are disconnected when the regenerative option overheats abnormally.

Servo amplifier Always remove the lead from across P-D.



Note 1. When using the MR-RB50, forcibly cool it with a cooling fan (92×92, minimum air flow: 1.0m³).

2. Make up a sequence which will switch off the magnetic contactor (MC) when abnormal heating occurs.

G3-G4 contact specifications Maximum voltage: 120V AC/DC Maximum current: 0.5A/4.8VDC

Maximum capacity: 2.4VA

(5) Outline drawing

(a) MR-RB032 • MR-RB12







[Unit: mm]

Terminal block



Terminal screw: M4 G3 Tightening torque: 1.2 [N m] (10.6 [lb in])

Mounting screw

Screw : M6

Tightening torque: 5.4 [N-m](47.79 [lb-in])

Regenerative option	Mass [kg] (lb)
MR-RB30	2.0.(0.4)
MR-RB32	2.9 (6.4)

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13. OPTIONS AND AUXILIARY EQUIPMENT



(c) MR-RB50



[Unit: mm (in)]

P C Terminal screw: M4 G3 Tightening torque: 1.2 [N-m](10.6 [lb-in]) G4

Mounting screw
 Screw : M6
 Tightening torque: 5.4 [N-m](47.79 [lb-in])

Regenerative option	Mass [kg(lb)]
MR-RB50	5.6 (12.3)
13.1.2 Cables and connectors

POINT
 Protective structure indicated for cables and connecters is for a cable or connector alone. When the cables and connectors are used to connect the servo amplifier and servo motor, and if protective structures of the servo amplifier and servo motor are lower than that of the cable and connector, specifications of the servo amplifier and servo motor apply.

(1) Cable make-up

^{t4U}. The following cables are used for connection with the servo motor and other models. Those indicated by broken lines in the figure are not options.



No.	Product	Model	[Description	Applicatio
1)	Standard encoder cable	MR-EKCBL⊡M-L Refer to (2) (a) in this section.	Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M) or Connector set: 54599-1019 (Molex)	Housing: 1-172161-9 Connector pin: 170359-1 (Tyco Electronics or equivalent) Cable clamp: MTI-0002 (Toa Denki kogyo)	Standard flexing life IP20
2)	Long flex life encoder cable	MR-EKCBL□M-H Refer to (2) (a) in this section.			Long flex li IP20
3) 4U.cc	Standard encoder cable	MR-ESCBL□M-L Refer to (2) (d) in this section.	Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M) or Connector set: 54599-1019 (Molex)	Plug: D/MS3106B20-29S Cable clamp: D/MS3057-12A (DDK)	Standard flexing life IP20
4)	Long flex life encoder cable	MR-ESCBL□M-H Refer to (2) (e) in this section.			Long flex li IP20
5)	IP65/IP67- compliant encoder cable	MR-ENECBL⊡M-H Refer to (2) (e) in this section.	Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M) or Connector set: 54599-1019 (Molex)	Plug: D/MS3106A20-29S (D190) Cable clamp : CE3057-12A-3-D Back shell: CE02-20BS-S-D (DDK)	Long flex li IP65 IP67 Not oil- resistant.
6)	Encoder	MR-ECNM	Receptacle: 36210-0100PL	Housing: 1-172161-9	IP20
	connector set		Shell kit: 36310-3200-008 (3M) or Connector set: 54599-1019 (Molex)	Connector pin: 170359-1 (Tyco Electronics or equivalent) Cable clamp: MTI-0002 (Toa Denki kogyo)	
7)	Encoder connector set	MR-ECNS	Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M) or Connector set: 54599-1019 (Molex)	Plug: D/MS3106B20-29S Cable clamp: D/MS3057-12A (DDK)	IP20
8)	Encoder connector set	MR-ENECNS	Receptacle: 36210-0100PL Shell kit: 36310-3200-008 (3M) or Connector set: 54599-1019 (Molex)	Plug: D/MS3106A20-29S (D190) Cable clamp : CE3057-12A-3-D Back shell: CE02-20BS-S-D (DDK)	IP65 IP67
9)	Control signal connector set	MR-ECN1 (In units of 20 pcs.	Connector: 10126-3000PE Shell kit: 10326-52F0-008		

No.	Product	Model	[Description	Application
10)	Amplifier power supply connector set (Insulation displacement type) MR-E-10A-QW003 to MR-E-100A- QW003	MR-ECNP1-A (In units of 20 pcs. /box)	Connector: 51240-0600 (Molex or equivalent)	Terminal: 56125-0128 (Molex or equivalent)	Insulation displacement type
11) 4U.co	Amplifier power supply connector set (Insertion type) MR-E-10A-QW003 to MR-E-100A- QW003	MR-ECNP1-B (In units of 20 pcs. /box)	Connector: 54927-0610 (Molex or equivalent)		Insertion type
12)	Analog monitor RS-232C branch cable	MR-E3CBL15-P	Connector: MP371/6	Connector: MJ372/6 (Marushin Musen Denki or equivalent)	Analog monitor RS- 232C branch cable
13)	Analog monitor RS-232C connector	MR-ECN3 (In units of 20 pcs. /box)		Connector: MP371/6 (Marushin Musen Denki or equivalent)	Analog monitor for RS-232C
14)	Communication cable	Refer to (3) in this section. QC30R2	Connector: MP371/6 (Mini-DIN 6-pin male) (Marushin Musen Denki or equivalent)	For connection with PC-AT compatible personal computer	
15)	Motor power supply connector set	MR-PWCNS4 (For HF-SP52 • 102 • 152 motor)	Plug: CE05-6A18-10SD-D-BSS Cable clamp: CE3057-10A-1-D (DDK) Example of applicable cable Wire size: $2mm^2$ (AWG14) to 3. Cable finish ϕ D: ϕ 10.5 to 14.1n	IP67	
16)	Motor power supply connector set	MR-PWCNS5 (For HF-SP202 - 352 motor)	Plug: CE05-6A22-22SD-D-BSS Cable clamp: CE3057-12A-1-D (DDK) Example of applicable cable Wire size: $5.5mm^2$ (AWG10) to Cable finish ϕ D: ϕ 12.5 to 16mm	IP65 IP67	
17)	Brake connector set	MR-BKCNS1	Straight plug: CM10-SP2S-L Socket contact: CM10-#22SC(S (DDK)	S2)-100	IP65 IP67
18)	Motor power supply connector (Insulation displacement type) MR-E-10A-QW003 to MR-E-100A- QW003	MR-ECNP2-A (In units of 20 pcs. /box)	Connector: 51240-0300 (Molex or equivalent)	Terminal: 56125-0128 (Molex or equivalent)	Insulation displacement type
19)	Motor power supply connector (Insertion type) MR-E-10A-QW003 to MR-E-100A- QW003	MR-ECNP2-B (In units of 20 pcs. /box)	Connector: 54927-0310 (Molex or equivalent)		Insertion type

No.	Product	Model		Description	Application
20)	Amplifier power supply connector set (Insulation displacement type) MR-E-200A- QW003	MR-ECNP1-A1 (In units of 20 pcs. /box)	Connector: 54241-0600 (Molex or equivalent)	Terminal: 56125-0128 (Molex or equivalent)	Insulation displacemen type
21) U.co	Amplifier power supply connector set (Insertion type) MR-E-200A- QW003	MR-ECNP1-B1 (In units of 20 pcs. /box)	Connector: 54928-0610 (Molex or equivalent)		Insertion type
22)	Motor power supply connector (Insulation displacement type) MR-E-200A- QW003	MR-ECNP2-A1 (In units of 20 pcs. /box)	Connector: 54241-0300 (Molex or equivalent)	Terminal: 56125-0118 (Molex or equivalent)	Insulation displacemen type
23)	Motor power supply connector (Insertion type) MR-E-200A- QW003	MR-ECNP2-B1 (In units of 20 pcs. /box)	Connector: 54928-0310 (Molex or equivalent)		Insertion type
24)	Motor power supply cable	MR-PWS1CBL□M- A1-L Cable length: 2 • 5 • 10m		Power supply connector	IP65 Load side lead
25)	Motor power supply cable	MR-PWS1CBL□M- A1-H Cable length: 2 • 5 • 10m	Refer to section 13.1.2 (4) fo		IP65 Load side lead Long flex life
26)	Motor power supply cable	MR-PWS1CBL□M- A2-L Cable length: 2 • 5 • 10m) ∋	Power supply connector	IP65 Opposite-to- load side lea
27)	Motor power supply cable	MR-PWS1CBL□M- A2-H Cable length: 2 • 5 • 10m	Refer to section 13.1.2 (4) fo		IP65 Opposite-to- load side lea Long flex life
28)	Motor power supply cable	MR-PWS2CBL03M- A1-L Cable length: 0.3m		Power supply connector	IP55 Load side lead
29)	Motor power supply cable	MR- PWS2CBL03M-A2- L Cable length: 0.3m	Refer to section 13.1.2 (4) fo	Power supply connector	IP55 Opposite-to- load side lea
			Refer to section 13.1.2 (4) for	or details	

Γ	No.	Product	Model	Description	Application
Ī	30)	Motor brake cable	MR-BKS1CBL□M-		IP65
			A1-L	Brake connector	Load side
			Cable length:		lead
			2 • 5 • 10m	☐ HF-KE□W1-S100	
-	31)	Motor brake cable	MR-BKS1CBLDM-		IP65
	-		A1-H		Load side
			Cable length:	Refer to section 13.1.2 (5) for details.	lead
			2 • 5 • 10m		Long flex life
	32)	Motor brake cable	MR-BKS1CBL□M-		IP65
			A2-L	Brake connector	Opposite-to-
Sheet	4U.co		Cable length:		load side lead
onool	10.00		2 • 5 • 10m	— HF-KE□W1-S100	
	33)	Motor brake cable	MR-BKS1CBLDM-		IP65
			A2-H		Opposite-to-
			Cable length:	Refer to section 13.1.2 (5) for details.	load side lead
			2 • 5 • 10m		Long flex life
F	34)	Motor brake cable	MR-BKS2CBL03M-		IP55
	,		A1-L	Brake connector	Load side
			Cable length: 0.3m		lead
			cable length elem	HF-KE□W1-S100	
				Refer to section 13.1.2 (5) for details.	
	35)	Motor brake cable	MR-BKS2CBL03M-	Brake connector	IP55
			A2-L		Opposite-to-
			Cable length: 0.3m		load side lead
				HF-KE□W1-S100	
-	20)			Refer to section 13.1.2 (5) for details.	
	36)	Encoder cable	MR-J3ENCBLDM-		IP65
			A1-L		Load side
			Cable length:	HF-KE⊡W1-S100	lead
	27)		2 5 10m		
	37)	Encoder cable	MR-J3ENCBLDM-		IP65
			A1-H	Refer to section 13.1.2 (2) (a) for details.	Opposite-to-
			Cable length:		load side lead
ŀ	38)	Freedor			Long flex life
	50)	Encoder cable	MR-J3ENCBLDM-		IP65 Opposito to
			A2-L Cable length:		Opposite-to- load side lead
			2 5 10m	HF-KE□W1-S100	וטמע שועב ובמע
ŀ	39)	Encoder cable	MR-J3ENCBLDM-		IP65
	20)		A2-H		Opposite-to-
			Cable length:	Refer to section 13.1.2 (2) (a) for details.	load side lead
			2 - 5 - 10m		Long flex life
ŀ	40)	Encoder cable	MR-J3JCBL03M-		IP20
	,		A1-L	Encoder connector	Load side
			Cable length: 0.3m		lead
			Cable length. 0.011		1000
				HF-KEDW1-S100	
				Refer to section 13.1.2 (2) (c) for details.	

No.	Product	Model	Description	Application
41)	Encoder cable	MR-J3JCBL03M- A2-L Cable length: 0.3m	Encoder connector HF-KEDW1-S100 Refer to section 13.1.2 (2) (c) for details.	IP20 Opposite-to- load side lead

(2) Encoder cable - connector sets

· · · · · · · · · · · · · · · · · · ·							
	 If you have fabricated the encoder cable, connect it correctly. Otherwise, not doing so may cause unexpected operation. 						
	 POINT The encoder cable is not oil resistant. Refer to section 12.4 for the flexing life of the encoder cable. When the encoder cable is used, the sum of the resistance values of the cable used for P5 and the cable used for LG should be within 2.4Ω. When soldering the wire to the connector pin, insulate and protect the connection portion using heat-shrinkable tubing. When using the encoder cable of four-wire type communication system, set "1□□□" in parameter No.20 to select the four-wire type. 						

Generally use the encoder cable available as our options. If the required length is not found in the options, fabricate the cable on the customer side.

When fabricating an encoder cable, use the selection example of wires given in section 13.2.1 and the MR-ECNM connector set for encoder cable fabrication, and fabricate an encoder cable as shown in the wiring diagram.

Refer to section 14.5 and choose the encode side connector according to the servo motor installation environment.

(a) MR-J3ENCBL M-A1-L/H • MR-J3ENCBL M-A2-L/H

These cables are encoder cables for the HF-KE \square W1-S100 series servo motors. The numerals in the Cable Length field of the table are the symbols entered in the \square part of the cable model. The cables of the lengths with the symbols are available.

	Cable model	Cable length							Protective	Flex life	Application
		2m	5m	10m	20m	30m	40m	50m	structure	I lex lile	Application
	MR-J3ENCBL 🗆 M-A1-L	2	5	10	/				IP65	Standard	For HF-KE W1-S100
	MR-J3ENCBL 🗆 M-A1-H	2	5	10					IP65	Long flex	servo motor
		_	Ŭ							life	Load side lead
	MR-J3ENCBL 🗆 M-A2-L	2	5	10	/	\backslash	/		IP65	Standard	For HF-KE W1-S100
eet	4U.com MR-J3ENCBL □ M-A2-H	2	5	10					IP65	Long flex	servo motor
		2	5	10					1600	life	Opposite-to-load side lead

1) Connection of servo amplifier and servo motor



Cable model	1) For CN2 c	connector	2) For encoder connector
MR-J3ENCBL□M-A1-L	Receptacle: 36210-0100PL Shell kit: 536310-3200-008 (3M)	Connector set: 54599-1019 (Molex)	Connector: 1674320-1 Crimping tool for ground clip: 1596970-1 Crimping tool for receptacle
MR-J3ENCBL□M-A1-H	(Note) Signal layout $\begin{array}{c} 2 & 6 & 10 \\ $	(Note) Signal layout	contact: 1596847-1 (Tyco Electronics) (Note) Signal layout 98H0 7 8 5MR 6P56 3 P5 4MRR 1 2
MR-J3ENCBL⊡M-A2-H	Note. Keep open the pins shown with manufacturer adjustment. If it is co amplifier cannot operate normally.	View seen from wiring side. Note. Keep open the pin shown with an .	

2) Cable internal wiring diagram



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Note. When an encoder cable is fabricated, this wire is not required.

(b) MR-EKCBL I M-L/H

POINT									
 The following 	• The following encoder cables are of four-wire type. When using any of these								
encoder cabl	es, set parameter No.20 to "1 $\Box\Box\Box$ " to select the four-wire type.								
MR-EKCBL3	0M-L								
MR-EKCBL3	0M-H								
MR-EKCBL4	0M-H								
MR-EKCBL5	0M-H								

The servo amplifier and servo motor cannot be connected with these cables only. The servo motor side encoder cable (MR-J3JCBL03M-A1-L or MR-J3JCBL03M-A2-L) is required.

The numerals in the Cable Length field of the table are the symbols entered in the \Box part of the cable model. The cables of the lengths with the symbols are available.

Cable model	Cable length						Protective	Flex life	Application	
	2m	5m	10m	20m	30m	40m	50m	structure	I lex lile	Application
MR-EKCBL 🗆 M-L	\searrow			20	(Note) 30			IP20	Standard	For HF-KE⊟W1-S100 servo motor
MR-EKCBL 🗆 M-H				20	(Note) 30	(Note) 40	(Note) 50	IP20	Long flex life	Use in combination with MR-J3JCBL03M-A1-L or MR-J3JCBL03M-A2-L.

Note. Four-wire type cable.



1) Connection of servo amplifier and servo motor



2) Internal wiring diagram

Note. When an encoder cable is fabricated, this wire is not required.

All a second a least a set of a second secon	the second second states and the second second	corresponding to the length indicated below.
When tabricating the cable	Lisa tha Wiring diadram	Corresponding to the length indicated helow

Cable flex life	Applicable wiring diagram					
Cable liex life	Less than 10m	30m to 50m				
Standard	MR-EKCBL20M-L					
Long flex life	MR-EKCBL20M-H	MR-EKCBL30M-H				
		MR-EKCBL40M-H				
		MR-EKCBL50M-H				

P5E

P5G

MR

MD

MRR

MDR

CONT

SHD

P5E

P5G

MR

MD

MRR

MDR

CONT SHD

7

8

1

2

4

5

3

6

9

7

8

1

2

4

5

3 6

9

3) When fabricating the encoder cable

When fabricating the cable, prepare the following parts and tool, and fabricate it according to the wiring diagram in 2). Refer to section 13.2.1 for the specifications of the used cable.

Parts/tool	Description						
Connector set	MR-ECNM						
		•					
	Servo amplifier side connector	Encoder side connector					
	Receptacle: 36210-0100PL	Housing: 1-172161-9					
	Shell kit: 536310-3200-008	Connector pin: 170359-1					
	(3M)	(Tyco Electronics or equivalent)					
	Or	Cable clamp: MTI-0002					
	Connector set: 54599-1019	(Toa Electric Industries)					
	(Molex)						

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(c) MR-J3JCBL03M-A1-L • MR-J3JCBL03M-A2-L The servo amplifier and servo motor cannot be connected with these cables only. The servo motor side encoder cable (MR-EKCBLDM-L/H) is required.

Cable model	Cable length	Protective structure	Flex life	Application
MR-J3JCBL03M-A1-L	0.3m	IP20 Standard	For HF-KE W1-S100 servo motor Load side lead Use in combination with MR-EKCBL M-L/H.	
MR-J3JCBL03M-A2-L				For HF-KE□W1-S100 servo motor Opposite-to-load side lead Use in combination with MR-EKCBL □M-L/H.

(d) MR-ESCBL M-L (standard flex life model)

- These encoder cables are used with the HF-SE JW1-S100 servo motors.
- 1) Model explanation

Model: MR-ESC	BL <u>D</u> M-L		
			—— Standard flex life
	Symbol	Cable length	Communication system
	2	2	
	5	5	Two wins trues
	10	10	Two-wire type
	20	20	
	30	30	(Note) Four-wire type

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Note. Set "1 $\Box \Box \Box$ " in parameter No.20.

2) Connection diagram

For the pin assignment on the servo amplifier side, refer to section 3.3.1.



a) Encoder cable of less than 30m

When fabricating an encoder cable, use the MR-ECNS connector set. Referring to the following wiring diagram, you can fabricate an encoder cable of up to less than 30m.



MR-ESCBL20M-L



Note. When an encoder cable is fabricated, this wire is not required.

b) Encoder cable of 30m or more

POINT					
 The commu 	unication system of the encoder cable in this wiring diagram is the				
four-wire type. Set "1					

When fabricating an encoder cable, use the MR-ECNS connector set. Referring to the following wiring diagram, you can fabricate an encoder cable of up to 50m.



Note. When an encoder cable is fabricated, this wire is not required.

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- (e) MR-ESCBL M-H (long flex life model) MR-ENECBL M-H (IP65/IP67-compatible, long flex life model)
 - These encoder cables are used with the HC-SFE series servo motors.

1) Model explanation

Model: MR-ESCBL

	Long flex life							
Symbol	Cable length	Communication system						
2	2							
5	5	- · ·						
10	10	Two-wire type						
20	20							
30	30							
40	40	(Note) Four-wire type						
50	50							

Model: MR-ENECBL IM-H ΤТ

 Long fl	ex life

		-
Symbol	Cable length	Communication system
2	2	
5	5	- · ·
10	10	Two-wire type
20	20	
30	30	
40	40	(Note) Four-wire type
50	50	

2) Connection diagram

For the pin assignment on the servo amplifier side, refer to section 3.3.1.



a) Encoder cable of less than 30m

When fabricating an encoder cable, use the MR-ECNS (IP20-compatible model) or MR-ENECNS (IP65/IP67-compatible model) connector set. Referring to the following wiring diagram, you can fabricate an encoder cable of up to less than 30m.



Note. When an encoder cable is fabricated, this wire is not required.

b) Encoder cable of 30m or more

POINT ■ The communication system of the encoder cable in this wiring diagram is the four-wire type. Set "1□□□" in parameter No.20.

When fabricating an encoder cable, use the MR-ECNS (IP20-compatible model) or MR-ENECNS (IP65/IP67-compatible model) connector set. Referring to the following wiring diagram, you can fabricate an encoder cable of up to 50m.

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Note. When an encoder cable is fabricated, this wire is not required.

(3) Communication cable

POINT
 This cable may not be used with some personal computers. After fully examining the signals of the RS-232C connector, refer to this section and fabricate the cable.

(a) Model definition

Model: QC30R2 (Cable length 3[m])

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(b) Connection diagram for fabrication - MR-CPCATCBL3M Personal computer side Servo amplifier side Plate SD TXD RXD 3 1 3 LG RXD TXD 2 2 5 GND 7 RTS CTS 8 DSR 6 DTR 4 D-SUB9 pins Mini DIN 6 pins

When fabricating the cable, refer to the connection diagram in this section. Though this connection diagram is not the connection diagram of the QC30R2, it is identical in functions. The following must be observed in fabrication.

- 1) Always use a shielded, multi-core cable and connect the shield with SD securely.
- 2) The optional communication cable is 3m long. When the cable is fabricated, its maximum length is 15m in offices of good environment with minimal noise.

(4) Motor power supply cables

These cables are motor power supply cables for the HF-KE \square W1-S100 servo motors. The numerals in the Cable Length field of the table are the symbols entered in the \square part of the cable model. The cables of the lengths with the symbols are available.

Refer to section 3.8 when wiring.

Cable model			Protective	Flex life	Application		
	0.3m	2m	5m	10m	structure		F 1
MR-PWS1CBL□M-A1-L	\searrow	2	5	10	IP65	Standard	For HF-KE⊟W1-S100 servo motor Load side lead
MR-PWS1CBL□M-A2-L	\backslash	2	5	10	IP65	Standard	For HF-KE W1-S100 servo motor
		2	5	10	IP05	Standard	Opposite-to-load side lead
MR-PWS1CBL□M-A1-H	\searrow	2	5	10	IP65	Long flex	For HF-KE W1-S100 servo motor
		2	5	10	IF05	life	Load side lead
MR-PWS1CBL□M-A2-H	\backslash	2	5	10	IP65	Long flex	For HF-KEDW1-S100 servo motor
		2	5	10	IF05	life	Opposite-to-load side lead
MR-PWS2CBL□M-A1-L	03	\searrow	\searrow	\mathbf{N}	IP55	Standard	For HF-KEDW1-S100 servo motor
	03				IPbb	Standard	Load side lead
MR-PWS2CBL□M-A2-L	03	$\overline{\ }$	$\overline{\ }$		IP55	Standard	For HF-KEDW1-S100 servo motor
	03				1222	Standard	Opposite-to-load side lead

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(a) Connection of servo amplifier and servo motor



Cable model	1) For motor power suppl	y connector
MR-PWS1CBL 🗆 M-A1-L	Connector: JN4FT04SJ1-R	Signal layout
MR-PWS1CBL M-A2-L	Hod, socket insulator Bushing, ground nut	
MR-PWS1CBL 🗆 M-A1-H	Contact: ST-TMH-S-C1B-100-(A534G) Crimping tool: CT160-3-TMH5B	
MR-PWS1CBL 🗆 M-A2-H	(Japan Aviation Electronics Industry)	
MR-PWS2CBL03M-A1-L	Connector: JN4FT04SJ2-R Hod, socket insulator Bushing, ground nut	View seen from wiring side.
MR-PWS2CBL03M-A2-L	Contact: ST-TMH-S-C1B-100-(A534G) Crimping tool: CT160-3-TMH5B (Japan Aviation Electronics Industry)	

(b) Internal wiring diagram

MR-PWS1CBL□M-A1-H MR-PWS1CBL□M-A2-H MR-PWS2CBL03M-A1-L MR-PWS2CBL03M-A2-L

AWG 19 (Red) (Note)	
AWG 19 (White)	
AWG 19 (Black)	N.
AWG 19 (Green/yellow)	W

Note. These are not shielded cables.

(5) Motor brake cables

These cables are motor brake cables for the HF-KE \square W1-S100 servo motors. The numerals in the Cable Length field of the table are the symbols entered in the \square part of the cable model. The cables of the lengths with the symbols are available.

Refer to section 3.8 when wiring.

Cable model	Cable length			Protective	Flex life	Application	
Cable model	0.3m	2m	5m	10m	structure		Application
MR-PWS1CBL□M-A1-L		2	5	10	IP65	Standard	For HF-KE□W1-S100 servo motor Load side lead
MR-PWS1CBL□M-A2-L		2	5	10	IP65	Standard	For HF-KE⊒W1-S100 servo motor Opposite-to-load side lead
MR-PWS1CBL□M-A1-H		2	5	10	IP65	Long flex life	For HF-KE⊒W1-S100 servo motor Load side lead
MR-PWS1CBL□M-A2-H		2	5	10	IP65	Long flex life	For HF-KE□W1-S100 servo motor Opposite-to-load side lead
MR-PWS2CBL□M-A1-L	03				IP55	Standard	For HF-KE□W1-S100 servo motor Load side lead
MR-PWS2CBL□M-A2-L	03				IP55	Standard	For HF-KE□W1-S100 servo motor Opposite-to-load side lead

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(a) Connection of servo amplifier and servo motor



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Cable model	1) For motor brake connector				
MR-BKS1CBL□M-A1-L	Connector: JN4FT02SJ1-R	Signal layout			
MR-BKS1CBL□M-A2-L	Hod, socket insulator Bushing, ground nut				
MR-BKS1CBL□M-A1-H	Contact: ST-TMH-S-C1B-100-(A534G) Crimping tool: CT160-3-TMH5B				
MR-BKS1CBL□M-A2-H	(Japan Aviation Electronics Industry)				
MR-BKS2CBL03M-A1-L	Connector: JN4FT02SJ2-R Hod, socket insulator Bushing, ground nut	View seen from wiring side.			
MR-BKS2CBL03M-A2-L	Contact: ST-TMH-S-C1B-100-(A534G) Crimping tool: CT160-3-TMH5B (Japan Aviation Electronics Industry)				

(b) Internal wiring diagram





Note. These are not shielded cables.

13.1.3 Analog monitor, RS-232C branch cable (MR-E3CBL15-P)

(1) Usage

The analog monitor, RS-232C branch cable (MR-E3CBL15-P) is designed for use when a personal computer and analog monitor outputs are used at the same time.



(2) Connection diagram



13.1.4 MR Configurator (servo configurations software)

The MR Configurator (servo configurations software MRZJW3-SETUP154E, 154C) uses the communication function of the servo amplifier to perform parameter setting changes, graph display, test operation, etc. on a personal computer.

(1) Specifications

	Item	Description				
ſ	Model	154E: English, 154C: Chinese				
Ē	Communication signal	Conforms to RS-232C.				
	Baud rate [bps]	57600, 38400, 19200, 9600				
	System	Station selection, Automatic demo				
t4U.com Monitor Display, high speed monitor, trend graph Minimum resolution changes with the processing speed of the personal computer.						
	Alarm	Display, history, amplifier data				
	Diagnostic	Digital I/O, no motor rotation, total power-on time, amplifier version info, motor information, tuning data, Automatic VC offset display, Axis name setting.				
	Parameters	Parameter list, turning, change list, detailed information				
	Test operation	Jog operation, positioning operation, Operation w/o motor, Forced output, Demo mode.				
	Advanced function	Machine analyzer, gain search, machine simulation.				
Ē	File operation	Data read, save, print				
	Others	Automatic demo, help display				

(2) System configuration

(a) Components

To use this MR Configurator (servo configurations software), the following components are required in addition to the servo amplifier and servo motor.

Model	(Note 1) Description
(Note 2) Personal computer	 IBM PC-AT compatible where the English version and Chinese version of Windows[®] 95, Windows[®] 98, Windows[®] Me, Windows NT[®] Workstation 4.0, Windows[®] 2000 Professional, Windows[®] XP Professional and Windows[®] XP Home Edition operates Processor: Pentium[®] 133MHz or more (Windows[®] 95, Windows[®] 98, Windows NT[®] Workstation 4.0, Windows[®] 2000 Professional) Pentium[®] 150MHz or more (Windows[®] Me) Pentium[®] 300MHz or more (Windows[®] XP Professional, Windows[®] XP Home Edition) Memory: 16MB or more (Windows[®] 95), 24MB or more (Windows[®] 98) 32MB or more (Windows[®] Me, Windows NT[®] Workstation 4.0, Windows[®] 2000 Professional) 128MB or more (Windows[®] XP Professional, Windows[®] XP Home Edition) Free hard disk space: 60MB or more Serial port used
OS	Windows [®] 95, Windows [®] 98, Windows [®] Me, Windows NT [®] Workstation 4.0, Windows [®] 2000 Professional, Windows [®] XP Home Edition (English version, Chinese version)
Display	One whose resolution is 800×600 or more and that can provide a high color (16 bit) display. Connectable with the above personal computer.
Keyboard	Connectable with the above personal computer.
Mouse	Connectable with the above personal computer. Note that a serial mouse is not used.
Printer	Connectable with the above personal computer.
Communication cable	QC30R2 When this cannot be used, refer to section 13.1.2 (3) and fabricate.

Note 1. Windows and Windows NT are the registered trademarks of Microsoft Corporation in the United States and other countries. Pentium is the registered trademarks of Intel Corporation.

2. On some personal computers, this MR Configurator (servo configurations software) may not run properly.

(b) Configuration diagram



13.2 Auxiliary equipment

Always use the devices indicated in this section or equivalent. To comply with the EN Standard or UL/C-UL (CSA) Standard, use the products which conform to the corresponding standard.

13.2.1 Selection example of wires

(1) Wires for power supply wiring

The following diagram shows the wires used for wiring. Use the wires given in this section or equivalent.



Note. When using the regenerative option, always remove the wiring across D-P.

The following table lists wire sizes. The wires used assume that they are 600V vinyl wires and the wiring distance is 30m max. If the wiring distance is over 30m, choose the wire size in consideration of voltage drop.

Refer to section 3.11 for connection with the connector (CNP1, CNP2).

The servo motor side connection method depends on the type and capacity of the servo motor. Refer to section 3.8.

To enable the built-in regenerative brake, connect the wiring across D-P. (Refer to section 3.7.2 for the connection method.)

To comply with the UL/C-UL (CSA) Standard, use UL-recognized copper wires rated at 60°C (140°F) or more for wiring.

Servo amplifier	(Note) Wires [mm ²]							
Servo ampliner	1) L ₁ • L ₂ • L ₃	3) U · V · W · 🕀	4) P • C • D	5) B1 • B2				
MR-E-10A-QW003								
MR-E-20A-QW003	2 (AWG14)							
MR-E-40A-QW003		1.25 (AWG16)	2 (AWG14)					
MR-E-70A-QW003			2 (AWG14)	1.25 (AWG16)				
MR-E-100A-QW003		2 (AWG14)						
MR-E-200A-QW003	(Note) 2.5 (AWG14)	(Note) 2.5 (AWG14)						

Table 13.1 Selection example of wires

Note. Use the heat-resistant PVC cable (rated 105°C (221°F) or more), if AWG14 cable is used in ambient temperature 40°C (104°F) or more.

(2) Wires for cables

When fabricating a cable, use the wire models given in the following table or equivalent.

			Length	Core size	Number	С	haracteristics of	one core	(Note 2)	
	Туре	Model	[mm]	[mm ²]	of cores	Structure [Wires/mm]	Conductor resistance [Ω/mm]	Insulation coating ODd [mm] (Note 1)	Finishing OD [mm]	Wire model
			2 to 10	0.3	4 (2 pairs)	12/0.18	65.7	1.3	7.3	(Note 3) 20276 composite
	Encoder cable	MR-EKCBL□M-L MR-ESCBL□M-L	21010	0.08	4 (2 pairs)	7/0.127	234	0.67	7.5	4-pair shielded cable (A-TYPE)
			20 • 30	0.3	12 (6 pairs)	7/0.18	63.6	1.2	8.2	UL20276AWG#23 6 pair (BLACK)
aShee		er cable MR-EKCBL⊡M-H MR-ESCBL⊡M-H	2 to 10	0.2	8 (4 pairs)	40/0.08	105	0.88	7.2	(Note 3) A14B2339 4P
			20	0.2	12 (6 pairs)	40/0.08	105	0.88	7.2	(Note 3) A14B2343 6P
		MR-ENECBL⊡M-H	30 to 50	0.2	14 (7 pairs)	40/0.08	105	0.88	8.0	(Note 3) J14B0238 (0.2 * 7P)
	Communication cable	QC30R2	3	0.08	6 (3 pairs)	7/0.127	222	0.38	4.6	UL20276 AWG#28 3pair (BLACK)

Table 13.2 Wires for option cables

Note 1. d is as shown below.

d

Conductor Insulation sheath

2. Standard OD. Max. OD is about 10% greater.

3. Purchased from Toa Electric Industry

13.2.2 Circuit breakers, fuses, magnetic contactors

Always use one circuit breaker and one magnetic contactor with one servo amplifier. When using a fuse instead of the circuit breaker, use the one having the specifications given in this section.

Servo amplifier		Circuit breaker		Fus	Magnetic contactor	
Serve			Class	Current [A]	Voltage AC [V]	
MR-E-1	0A-QW003	30A frame 5A		10		
MR-E-2	0A-QW003	30A frame 5A		10		
MR-E-4	0A-QW003	30A frame 10A	K5	15	250	S-N10
MR-E-7	0A-QW003	30A frame 15A	11.5	15	250	
MR-E-1	00A-QW003	30A frame 15A		15		
MR-E-2	00A-QW003	30A frame 20A		15		S-N18

13.2.3 Power factor improving reactors

The input power factor is improved to be about 90%. For use with a 1-phase power supply, it may be slightly lower than 90%.



Note. Connect a 1-phase 200 to 230VAC power supply to L_1 , L_2 and keep L_3 open.

Servo amplifier	Model	Dimensions [mm]							Terminal	Mass
Servo ampliller	woder	W	W1	Н	D	D1	С	screw size	screw size	[kg (lb)]
MR-E-10A-QW003 MR-E-20A-QW003	FR-BAL-0.4K	135	120	115	59	45 _{-2.5}	7.5	M4	M3.5	2.0 (4.4)
MR-E-40A-QW003	FR-BAL-0.75K	135	120	115	69	57 _{-2.5}	7.5	M4	M3.5	2.8 (6.17)
MR-E-70A-QW003	FR-BAL-1.5K	160	145	140	71	$55_{-2.5}^{0}$	7.5	M4	M3.5	3.7 (8.16)
MR-E-100A-QW003	FR-BAL-2.2K	160	145	140	91	$75_{-2.5}^{0}$	7.5	M4	M3.5	5.6 (12.35)
MR-E-200A-QW003	FR-BAL-3.7K	220	200	192	90	70_2.5	10	M5	M4	8.5 (18.74)

13.2.4 Relays

The following relays should be used with the interfaces.

Interface	Selection example
Input signals (interface DI-1) signals	To prevent defective contacts, use a relay for small signal (twin contacts).
	(Ex.) Omron: type G2A, MY
Relay used for digital output signals (interface DO-1)	Small relay with 12VDC or 24VDC of rating 40mA or less
	(Ex.) Omron: type MY

13.2.5 Surge absorbers

A surge absorber is required for the electromagnetic brake. Use the following surge absorber or equivalent. Insulate the wiring as shown in the diagram.

	ľ	Maximum ratin	g			Static		
Permissible circuit voltage		Surge immunity	Energy immunity	Rated power	Maxi limit v	mum oltage	capacity (reference value)	Varistor voltage rating (range) V1mA
AC[Vma]	DC[V]	[A]	[J]	[W]	[A]	[V]	[pF]	[V]
140	180	(Note) 500/time	5	0.4	25	360	300	220 (198 to 242)

Note. 1 time = $8 \times 20 \mu s$

(Example) ERZV10D221 (Matsushita Electric Industry) TNR-10V221K (Nippon chemi-con) Outline drawing [mm] (ERZ-C10DK221)



13.2.6 Noise reduction techniques

Noises are classified into external noises which enter the servo amplifier to cause it to malfunction and those radiated by the servo amplifier to cause peripheral devices to malfunction. Since the servo amplifier is an electronic device which handles small signals, the following general noise reduction techniques are required. Also, the servo amplifier can be a source of noise as its outputs are chopped by high carrier frequencies. If peripheral devices malfunction due to noises produced by the servo amplifier, noise suppression measures must be taken. The measures will vary slightly with the routes of noise transmission.

(1) Noise reduction techniques

- (a) General reduction techniques
- Avoid laying power lines (input and output cables) and signal cables side by side or do not bundle them together. Separate power lines from signal cables.
 - Use shielded, twisted pair cables for connection with the encoder and for control signal transmission, and connect the shield to the SD terminal.
 - Ground the servo amplifier, servo motor, etc. together at one point (refer to section 3.10).
- (b) Reduction techniques for external noises that cause the servo amplifier to malfunction If there are noise sources (such as a magnetic contactor, an electromagnetic brake, and many relays which make a large amount of noise) near the servo amplifier and the servo amplifier may malfunction, the following countermeasures are required.
 - Provide surge absorbers on the noise sources to suppress noises.
 - Attach data line filters to the signal cables.
 - Ground the shields of the encoder connecting cable and the control signal cables with cable clamp fittings.
 - Although a surge absorber is built into the servo amplifier, to protect the servo amplifier and other equipment against large exogenous noise and lightning surge, attaching a varistor to the power input section of the equipment is recommended.
- (c) Techniques for noises radiated by the servo amplifier that cause peripheral devices to malfunction Noises produced by the servo amplifier are classified into those radiated from the cables connected to the servo amplifier and its main circuits (input and output circuits), those induced electromagnetically or statically by the signal cables of the peripheral devices located near the main circuit cables, and those transmitted through the power supply cables.



Noise transmission route	Suppression techniques
	When measuring instruments, receivers, sensors, etc. which handle weak signals and may malfunction
	due to noise and/or their signal cables are contained in a control box together with the servo amplifier or
	run near the servo amplifier, such devices may malfunction due to noises transmitted through the air. The
	following techniques are required.
	(1) Provide maximum clearance between easily affected devices and the servo amplifier.
1) 2) 3)	(2) Provide maximum clearance between easily affected signal cables and the I/O cables of the servo
	amplifier.
	(3) Avoid laying the power lines (Input cables of the servo amplifier) and signal cables side by side or
	bundling them together.
	(4) Insert a line noise filter to the I/O cables or a radio noise filter on the input line.
aSheei4U.com	(5) Use shielded wires for signal and power cables or put cables in separate metal conduits.
	When the power lines and the signal cables are laid side by side or bundled together, magnetic induction
	noise and static induction noise will be transmitted through the signal cables and malfunction may occur.
	The following techniques are required.
	(1) Provide maximum clearance between easily affected devices and the servo amplifier.
4) 5) 6)	(2) Provide maximum clearance between easily affected signal cables and the I/O cables of the servo
	amplifier.
	(3) Avoid laying the power lines (Input cables of the servo amplifier) and signal cables side by side or
	bundling them together.
	(4) Use shielded wires for signal and power cables or put the cables in separate metal conduits.
	When the power supply of peripheral devices is connected to the power supply of the servo amplifier
	system, noises produced by the servo amplifier may be transmitted back through the power supply cable
7)	and the devices may malfunction. The following techniques are required.
	(1) Insert the radio noise filter (FR-BIF) on the power cables (Input cables) of the servo amplifier.
	(2) Insert the line noise filter (FR-BSF01) on the power cables of the servo amplifier.
	When the cables of peripheral devices are connected to the servo amplifier to make a closed loop circuit,
8)	leakage current may flow to malfunction the peripheral devices. If so, malfunction may be prevented by
	disconnecting the grounding cable of the peripheral device.

(2) Noise reduction products

(a) Data line filter

Noise can be prevented by installing a data line filter onto the encoder cable, etc.

For example, the ZCAT3035-1330 of TDK and the ESD-SR-25 of NEC Tokin make are available as data line filters.

As a reference example, the impedance specifications of the ZCAT3035-1330 (TDK) are indicated below.

This impedances are reference values and not guaranteed values.



Outline drawing (ZCAT3035-1330)

(b) Surge suppressor

The recommended surge suppressor for installation to an AC relay, AC valve or the like near the servo amplifier is shown below. Use this product or equivalent.



Maximum current: Not less than twice the drive current of the relay or the like

(c) Cable clamp fitting (AERSBAN□-SET)

Generally, the earth of the shielded cable may only be connected to the connector's SD terminal. However, the effect can be increased by directly connecting the cable to an earth plate as shown below. Install the earth plate near the servo amplifier for the encoder cable. Peel part of the cable sheath to expose the external conductor, and press that part against the earth plate with the cable clamp. If the cable is thin, clamp several cables in a bunch.

The clamp comes as a set with the earth plate.



Diode

Outline drawing

Earth plate 2-**¢**5 hole installation hole 17.5 B±0.3 1 $24_{-0.2}^{0}$ 35 φ 22 6 (Note)M4 screw 35 Ξ

[Unit: mm]

Clamp section diagram





Note. Screw hole for grounding. Connect it to the earth plate of the control box.

Туре	А	В	С	Accessory fittings
AERSBAN-DSET	100	86	30	clamp A: 2pcs.
AERSBAN-ESET	70	56	/	clamp B: 1pc.

Clamp fitting	L
А	70
В	45

(d) Line noise filter (FR-BSF01)

This filter is effective in suppressing noises radiated from the power supply side and output side of the servo amplifier and also in suppressing high-frequency leakage current (zero-phase current) especially within 0.5MHz to 5MHz band.



(e) Radio noise filter (FR-BIF)...for the input side only

This filter is effective in suppressing noises radiated from the power supply side of the servo amplifier especially in 10MHz and lower radio frequency bands. The FR-BIF is designed for the input side only.



(f) Varistors for input power supply (Recommended)

Varistors are effective to prevent exogenous noise and lightning surge from entering the servo amplifier. When using a varistor, connect it between each phase of the input power supply of the equipment. For varistors, the TND20V-431K and TND20V-471K, manufactured by NIPPON CHEMI-CON, are recommended. For detailed specification and usage of the varistors, refer to the manufacturer catalog.

	Power supply voltage	/ Varistor		Maximum rating						Static	Varistor voltage	
			Permissible circuit voltage		Surge current immunity	Energy immunity	Rated pulse power	Maximum limit voltage		capacity (reference value)	rating (range)	
			AC [V _{rms}]	DC [V]	8/20µs [A]	2ms [J]	[W]	[A]	[V]	[pF]	[V]	
DataSheet	100V class	TND20V-431K	275	350	10000/1 time	195	1.0	1.0 100	100 710		1300	430(387 to 473)
	200V class	TND20V-471K	300	385	7000/2 time	215	1.0	100	775	1200	470(423 to 517)	

[Unit: mm]



Model	D	Н	Т	Е	(Note) L	Φd	W
	Max.	Max.	Max.	±1.0	min.	±0.05	±1.0
TND20V-431K	21.5	24.5	6.4	3.3	20	0.8	10.0
TND20V-471K			6.6	3.5			

Note. For special purpose items for lead length (L), contact the manufacturer.

13.2.7 Leakage current breaker

(1) Selection method

High-frequency chopper currents controlled by pulse width modulation flow in the AC servo circuits. Leakage currents containing harmonic contents are larger than those of the motor which is run with a commercial power supply.

Select a leakage current breaker according to the following formula, and ground the servo amplifier, servo motor, etc. securely.

Make the input and output cables as short as possible, and also make the grounding cable as long as possible (about 30cm) to minimize leakage currents.

Rated sensitivity current $\geq 10 \cdot \{ lg1 + lgn + lga + K \cdot (lg2 + lgm) \} [mA] \dots (13.1)$



- lg1: Leakage current on the electric channel from the leakage current breaker to the input terminals of the servo amplifier (Found from Fig. 13.1.)
- lg2: Leakage current on the electric channel from the output terminals of the servo amplifier to the servo motor (Found from Fig. 13.1.)
- Leakage current when a filter is connected to the input side (4.4mA per one FR-BIF) Ign:
- lga: Leakage current of the servo amplifier (Found from Table 13.4.)
- Igm: Leakage current of the servo motor (Found from Table 13.3.)



Table 13.4 Servo amplifier's					
leakage curren					
example (Iga)					
Servo amplifier	Leakage				
capacity [kW]	current [mA]				
0.1 to 0.6	0.1				
0.7 to 2.0	0.15				

Table 13.5 Leakage circuit breaker selection example

	Rated sensitivity		
Servo amplifier	current of leakage		
	circuit breaker [mA]		
MR-E-10A-QW003 to	15		
MR-E-200A-QW003			

(2) Selection example

Indicated below is an example of selecting a leakage current breaker under the following conditions.



Use a leakage current breaker generally available. Find the terms of Equation (13.1) from the diagram.

 $Ig1 = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$

$$lg2 = 20 \cdot \frac{5}{1000} = 0.1 \text{ [mA]}$$

Ign = 0 (not used)

Iga = 0.1 [mA]

Igm = 0.1 [mA]

Insert these values in Equation (13.1).

$$lg \ge 10 \cdot \{0.1 + 0 + 0.1 + 1 \cdot (0.1 + 0.1)\}$$

≥ 4.0 [mA]

According to the result of calculation, use a leakage current breaker having the rated sensitivity current (Ig) of 4.0 [mA] or more. A leakage current breaker having Ig of 15 [mA] is used with the NV-SP/SW/CP/CW/HW series.
13.2.8 EMC filter

For compliance with the EMC Directive of the EN Standard, it is recommended to use the following filter. Some EMC filters are large in leakage current.

(1) Combination with the servo amplifier

Servo amplifier	Recomme	Mass [kg]([lb])	
Serve ampinier	Model	Leakage current [mA]	Mass [kg]([b])
MR-E-10A-QW003 to MR-E-100A-QW003	SF1252	38	0.75 (1.65)
MR-E-200A-QW003	SF1253	57	1.37 (1.65)

(2) Connection example



Note 1. For 1-phase 230VAC power supply, connect the power supply to L₁,L₂ and leave L₃ open. 2. Connect when the power supply has earth.

(3) Outline drawing



14. SERVO MOTOR

14.1 Compliance with the overseas standards

14.1.1 Compliance with EC directives

Use the servo motor compatible with the EN Standard.

Unless otherwise specified, the handling, performance, specifications and others of the EN Standardcompatible models are the same as those of the standard models.

To comply with the EN Standard, also observe the following items strictly.

14.1.2 Conformance with UL/C-UL standard

Use the UL/C-UL Standard-compliant model of servo motor.

Unless otherwise specified, the handling, performance, specifications, etc. of the UL/C-UL Standard-compliant models are the same as those of the standard models.

Strictly observe the following items to conform to the UL/C-UL Standard.

The flange sizes in this table assume that the flanges are made of aluminum.

The rated torque of the servo motor indicates the continuous permissible torque value that can be generated when it is mounted on the flange specified in the following table and used in the environment of 40° C (104° F) ambient temperature.

Flange size	Servo motor		
T lange size	HF-KE□W1-S100	HF-SEDJW1-S100	
250 × 250 × 6	13 • 23		
250 × 250 × 12	43	52 to 152	
300 × 300 × 12	73		
300 × 300 × 20		202	

14.2 Introduction

14.2.1 Features of servo motor

The following table indicates the main features of the servo motor. The items marked **O** are supported as standard. For detailed specifications, refer to the chapter of the servo motor series.

Item -		Servo motor series		
		HF-KE□W1-S100	HF-SE□JW1-S100	
Feature		Low inertia - Small capacity	Medium inertia/medium capacity	
2000r/min			0	
Rated speed	3000r/min	0		
Encoder resolution [pulse/rev]		131072	131072	
Rated output [kW]		0.1 to 0.75	0.5 to 2.0	
Power supply voltage of compatible servo amplifierOne-phase 230VAC(Note 1)Three-phase 200VAC		0	○ (Note 4)	
		0	0	
Electromagnetic brake		○ (Note 2)	O (Note 2)	
Special shaft	Special shaft		○ (Note 3)	
Compliance with overseas EN Standard		0	0	
standards	UL/C-UL Standard	0	0	
Protection type	Protection type		IP65	

Note 1. Some power supply voltages may not be usable depending on the servo amplifier capacity.

For the power supply voltage range, refer to section 1.3.

2. Compatible products are available. For details, refer to section 14.6.3 and 14.7.3.

3. Compatible products are available. For details, refer to section 14.6.4 and 14.7.4.

4. Except for the shaft-through portion.

5. Only HF-SE52JW1-S100 corresponds.

14.2.2 Rating plate



14.2.3 Parts identification

(1) HF-KE W1-S100

For full information of the cable connector, refer to section 13.1.2.



Note. The servo motor with electromagnetic brake has the electromagnetic brake connector separately.

(2) HF-SE JW1-S100



Note. The servo motor with electromagnetic brake has the electromagnetic brake connector separately.

14.2.4 Electromagnetic brake characteristics

	• The electromagnetic brake is provided to prevent a drop at a power failure or
	servo alarm occurrence during vertical drive or to hold a shaft at a stop. Do not
	use it for normal braking (including braking at servo lock).
	 The brake has a time lag. Use the brake so that servo motor control is started
	after the brake has completely opened.
	 Configure the electromagnetic brake operating circuit as a double circuit so that it
	will also be operated by an external emergency stop (EMG).
neel4U.com	 For details of the circuit configuration and timing chart, refer to section 3.5 and
	3.7.

The servo motor with electromagnetic brake can be used to prevent a drop in vertical lift applications or to ensure double safety at an emergency stop, for example. When performing servo motor operation, supply power to the electromagnetic brake to release the brake. Switching power off makes the brake effective.

(1) Electromagnetic brake power supply

Prepare the following power supply for use with the electromagnetic brake only. The electromagnetic brake terminals (B1, B2) have no polarity.



The surge absorber (VAR) must be installed across B1-B2. For the selection of the surge absorber, refer to section 13.2.5.

(2) Sound generation

Though the brake lining may rattle during operation, it poses no functional problem. If braking sound occurs, it may be improved by setting the machine resonance suppression filter or adaptive vibration suppression control in the servo amplifier parameters. For details, refer to section 8.2 and 8.3.

(3) Others

A leakage magnetic flux will occur at the shaft end of the servo motor equipped with electromagnetic brake. Note that chips, screws and other magnetic substances are attracted.

14.2.5 Servo motor shaft shapes

In addition to the straight shaft, the keyway shaft and D cut shaft are available as the servo motor shafts.

The keyway shaft and D cut shaft cannot be used in frequent start/stop applications. Since we cannot warrant the servo motor against fracture and similar accidents attributable to a loose key, use a friction coupling, etc. when coupling the shaft with a machine.

The shaft shape of the standard servo motor changes depending on the series and capacity. Refer to section 14.6.4 and 14.7.4.



D cut shaft

Straight shaft

14.3 Installation

	 Stacking in excess of the limited number of products is not allowed.
	Install the equipment to incombustibles. Installing them directly or close to
	combustibles will led to a fire.
	Install the equipment in a load-bearing place in accordance with this Instruction
	Manual.
	Do not get on or put heavy load on the equipment to prevent injury.
	• Use the equipment within the specified environmental condition range.
	Refer to the specifications of the servo motor series.
aSheei4U.com	 Do not subject the servo motor to drop impact or shock loads as they are precision equipment.
	 Do not install or operate a faulty servo amplifier.
	 Do not hold the cable, shaft or encoder to carry the servo motor. Otherwise, a fault or injury may occur.
	The lifting eyebolts of the servo motor may only be used to transport the servo
	motor. They must not be used to transport the servo motor when it is mounted on a machine.
	 The servo motor with reduction gear must be installed in the specified direction. Otherwise, it can leak oil, leading to a fire or fault.
	 Securely fix the servo motor to the machine. If fixed insecurely, the servo motor will come off during operation, leading to injury.
	• When coupling the shaft end of the servo motor, do not subject the shaft end to
	impact, such as hammering. The encoder may become faulty.
	 When coupling a load to the servo motor, do not use a rigid coupling. Doing so can cause the shaft to break.
	 Balance the load to the extent possible. Failure to do so can cause vibration during servo motor operation or damage the bearings and encoder.
	 Take safety measures, e.g. provide covers, to prevent accidental access to the rotating parts of the servo motor during operation.
	• Do not subject the servo motor shaft to more than the permissible load. Otherwise,
	the shaft may break, leading to injury.
	• When the product has been stored for an extended period of time, consult
	Mitsubishi.

14.3.1 Installation orientation

(1) Standard servo motor

The following table indicates the installation orientation of the standard servo motor.

Servo Motor Series	Direction of Installation	Remarks
HF-KE□W1-S100	May be installed in any	For installation in the horizontal direction, it is recommended to set the
HF-SE□JW1-S100	EDJW1-S100 direction. connector section downward.	

When installing the servo motor horizontally, face the power cable and encoder cable down ward. When installing the servo motor vertically or obliquely, provide a connection and trap for the cable.

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(2) Servo motor with electromagnetic brake

The servo motor with electromagnetic brake can also be installed in the same orientation as the standard servo motor.

When the servo motor with electromagnetic brake is installed with the shaft end at top, the brake plate may generate sliding sound but it is not a fault.

14.3.2 Load remove precautions



(1) When mounting a pulley to the servo motor shaft provided with a keyway, use the screw hole in the shaft end. To fit the pulley, first insert a double-end stud into the screw hole of the shaft, put a washer against the end face of the coupling, and insert and tighten a nut to force the pulley in.



- (2) For the servo motor shaft with a keyway, use the screw hole in the shaft end. For the shaft without a keyway, use a friction coupling or the like.
- (3) When removing the pulley, use a pulley remover to protect the shaft from hard load and or impact.
- (4) To ensure safety, fit a protective cover or the like on the rotary area, such as the pulley, mounted to the shaft.
- (5) When a threaded shaft end part is needed to mount a pulley on the shaft, please contact us.
- (6) The orientation of the encoder on the servo motor cannot be changed.
- (7) For installation of the servo motor, use spring washers, etc. and fully tighten the bolts so that they do not become loose due to vibration.

www.DataSheel14.3.3 Permissible load for the shaft

POINT	
 Do not use 	a rigid coupling as it may apply excessive bending load to the shaft,
leading to s	haft breakage.

For the permissible shaft load specific to the servo motor, refer to the chapter of the servo motor series.

- (1) Use a flexible coupling and make sure that the misalignment of the shaft is less than the permissible radial load.
- (2) When using a pulley, sprocket or timing belt, select a diameter that will fit into the permissible radial load.
- (3) Excess of the permissible load can cause the bearing life to reduce and the shaft to break.
- (4) The load indicated in this section is static load in a single direction and does not include eccentric load. Make eccentric load as small as possible. Not doing so can cause the servo motor to be damaged.

14.3.4 Protection from oil and water

Avoid foreign matter, such as oil, from being inside the axis on the servo motor. When installing the servo motor, consider the items in this section.

(1) Do not use the servo motor with its cable soaked in oil or water. (Figure on the right)



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(2) When the servo motor is to be installed with the shaft end at top, provide measures so that it is not exposed to oil and water entering from the machine side, gear box, etc.



- (3) If the servo motor is exposed to oil such as coolant, the sealant, packing, cable and others may be affected depending on the oil type.
- (4) In the environment where the servo motor is exposed to oil mist, oil, water, grease and/or like, the servo motor of the standard specifications may not be usable. Contact us.

14.3.5 Cable

The power supply cable, brake cable and encoder cables connected to the servo motor should be fixed to the servo motor to keep them from moving. Otherwise, cable breaks may occur. In addition, do not modify the connectors, terminals and others at the ends of the cables.

14.3.6 Inspection

	 Before starting maintenance and/or inspection, turn off the power and wait for 15 minutes or more until the charge lamp turns off. Otherwise, an electric shock may occur. In addition, always confirm from the front of the servo amplifier whether the charge lamp is off or not. Any person who is involved in inspection should be fully competent to do the work. Otherwise, you may get an electric shock. For repair and parts replacement, contact your safes representative.
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POINT

Do not disassemble and/or repair the equipment on customer side.

It is recommended to make the following checks periodically.

- (a) Check the servo motor bearings, brake section, etc. for unusual noise.
- (b) Check the cables and the like for scratches and cracks. Especially when the junction cable is movable, perform periodic inspection according to operating conditions.
- (c) Check the servo motor shaft and coupling for misalignment.
- (d) Check the power supply connector and encoder connector tightening screws for looseness.

14.3.7 Life

The following parts must be changed periodically as listed below. If any part is found faulty, it must be changed immediately even when it has not yet reached the end of its life, which depends on the operating method and environmental conditions. For parts replacement, please contact your sales representative.

Part name	Guideline of life	Remarks
Bearings	20,000 to 30,000 hours	The Guideline of Life field gives the reference time. If any fault is
Encoder	20,000 to 30,000 hours	found before this time is reached, the part must be changed.

When the servo motor is run at rated speed under rated load, change the bearings in 20,000 to 30,000 hours as a guideline. This differs on the operating conditions. The bearings must also be changed if unusual noise or vibration is found during inspection.

14.3.8 Machine accuracies

The following table indicates the machine accuracies of the servo motor around the output shaft and mounting. (except the optional products)

	Measuring	Flange size		
Accuracy [mm]	position	Less than □100	□130	□176
Runout of flange surface to output shaft	a)	0.05	0.06	0.08
Runout of fitting OD of flange surface	b)	0.04	0.04	0.06
Runout of output shaft end	C)	0.02	0.02	0.03

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a)

14.4 Connectors used for servo motor wiring

14.4.1 Selection of connectors

Use the connector configuration products given in the table as the connectors for connection with the servo motor. Refer to section 14.4.2 for the compatible connector configuration products.

(1) HF-KE**D**W1-S100

Servo motor		Wiring connector			
		For encoder	For power supply	For brake	
www.DataSheet	HF-KE(B)W1-S100	Connector configuration A	Connector configuration B	Connector configuration C	

(2) HF-SE JW1-S100

Servo motor Cable side connector			
Serve motor	For encoder For power supply For brake		
HF-SE52(B)JW1-S100 to	Connector configuration D		
HF-SE152(B)JW1-S100	or	Connector configuration F	Connector configuration G
HF-SE202(B)JW1-S100	Connector configuration E	Connector configuration H	

14.4.2 Wiring connectors (Connector configurations A • B • C)



These connectors can be used for the EN Standard and UL/C-UL Standard.



Connector configuration	Configurat	ion product	Servo motor encoder connector	
Connector configuration	Connector (IP65)	Crimping tool		
A	Connector: 1674320-1 (Tyco Electronics)	For Ground clip: 1596970-1 For REC. contact: 1596847 (Tyco Electronics)	1674339-1 (Tyco Electronics)	

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Connector configuration	Configurat	Servo motor power supply	
Connector configuration	Connector (IP55)	Crimping tool	connector
В	Connector: JN4FT04SJ1-R HOOD • SOCKET INSULATOR • BUSHING • GROUND NUT Contact: ST-TMH-S-C1B-100 (A534G) (JAE)	СТ160-3-ТМН5В (JAE)	JN4AT04NJ1 (JAE)



Connector configuration	Configurat	Servo motor brake connector	
Connector conliguration	Connector (IP55)	Crimping tool	Serve motor brake connector
с	Connector: JN4FT02SJ1-R HOOD • SOCKET INSULATOR • BUSHING • GROUND NUT Contact: ST-TMH-S-C1B-100 (A534G) (JAE)	CT160-3-TMH5B (JAE)	JN4AT02PJ1 (JAE)

14.4.3 Wiring connectors (Connector configurations D, E, F, G, H)



1) Plug 2) Cable clamp Cable



1) Plug 2) Cable clamp Cable



Connector				2) Cable	clamp(DDK)	Servo motor encoder	
configuration	Application		1) Plug (DDK)		Model name	connector	
Е	General Straight		D/MS3106B20-29S	<i>ф</i> 15.9	D/MS3057-12A	D/MS2102A20 20D	
E	environment (Note) Angle	Angle	D/MS3108B20-29S	(Bushing ID)	DINI33037-12A	D/MS3102A20-29P	

Note. Not compliant with the EN Standard.

1) Plug 2) Cable clamp Cable







				1) Plug (DDK)	2) Cable C	Clamp (DDK)	
	Connector configuration	Application	Туре	Model name	Cable OD [mm] (Reference)	Model name	Servo motor power supply connector
		IP65/IP67	Straight	CE05-6A18-10SD-D-BSS Applicable wire size: AWG14 to 12	<i>Φ</i> 8.5 to <i>Φ</i> 11 <i>Φ</i> 10.5 to <i>Φ</i> 14.1	CE3057-10A-2-D CE3057-10A-1-D	
/w.DataSheet4	F General	EN Standard compliant	Angle	CE05-8A18-10SD-D-BAS Applicable wire size: AWG14 to 12	<i>φ</i> 8.5 to <i>φ</i> 11 <i>φ</i> 10.5 to <i>φ</i> 14.1	CE3057-10A-2-D CE3057-10A-1-D	
			Straight	D/MS3106B18-10S Applicable wire size: AWG14 to 12	φ14.3 (Bushing ID)	D/MS3057-10A	D/MS3102A18-10P
		environment (Note)	Angle	D/MS3108B18-10S Applicable wire size: AWG14 to 12	φ14.3 (Bushing ID)	D/MS3057-10A	

Note. Not compliant with the EN Standard.



				Plug (DDK)			Servo motor
Connector configuration		Туре	Straight plug	Socket contact	Contact shape	Cable OD [mm] (Reference)	brake connector
			CM10-SP2S-S	CM10-#22SC(S2)-100	Soldering type	<i>ϕ</i> 4.0 to <i>ϕ</i> 6.0	
		CM	CM10-SP2S-M	CM10-#22SC(S2)-100	Applicable wire size:	<i>Φ</i> 6.0 to <i>Φ</i> 9.0	
			CM10-SP2S-L	CM10-#22SC(S2)-100	AWG16 or less	Ø9.0 to Ø11.6	
	IP65		CM10-SP2S-S	CM10-#22SC(C3)-100	Crimping type	<i>Φ</i> 4.0 to <i>Φ</i> 6.0	
G	G IP67		CM10-SP2S-M	CM10-#22SC(C3)-100	Applicable wire size:	<i>Φ</i> 6.0 to <i>Φ</i> 9.0	CM10-R2P
		CM10-SP2S-L	CM10-#22SC(C3)-100	AWG20 to 16 Connection tool (357J-50448) is necessary.	<i>∲</i> 9.0 to <i>∲</i> 11.6		



1) Plug 2) Cable clamp Cable



	Connector			1) Plug (DDK)	2) Cable	clamp (DDK)	Servo motor power	
	configuration	Application	Туре	Model name	Cable OD [mm] (Reference)	Model name	supply connector	
			Straight	CE05-6A22-22SD-D-BSS	Φ9.5 to Φ13	CD3057-12A-2-D		
		IP65/IP67 EN Standard	Straight	Applicable wire size: AWG12 to 8	¢12.5 to ¢16	CD3057-12A-1-D		
		compliant	Angle	CE05-8A22-22SD-D-BAS	<i>Ф</i> 9.5 to <i>Ф</i> 13	CD3057-12A-2-D	D/MS3102A22-22P	
Sheet4	U.com H	compliant	Angle	Applicable wire size: AWG12 to 8	Ф12.5 to Ф16	CD3057-12A-1-D		
		Canaral	Straight	D/MS3106B22-22S	<i>ф</i> 15.9	D/M020E7 124		
		General environment	Straight	Applicable wire size: AWG12 to 8	(Bushing ID)	D/MS3057-12A		
		(Note)	Anglo	D/MS3108B22-22S	<i>Ф</i> 15.9	D/MS3057-12A		
		(11010)	Angle	Applicable wire size: AWG12 to 8	(Bushing ID)	D/10103007-12A		

Note. Not compliant with the EN Standard.

14.5 Connector outline drawings

The connector outline drawings for wiring the servo motor are shown below.

(1) Tyco Electronics

Model

Housing

Connector pin

: 170359-1 • 170363-1 (loose piece)

: 1-172161-9



(2) Molex



			[Unit: mm]
Model	Number of poles	А	В
5509-04P-210	4	4.2	9.6
5559-06P-210	6	8.4	13.8
Terminal: FFF0DD	TOI		

Terminal: 5558PBT3L Hand tool: 57022-5300

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(3) DDK

<Plug>



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Model name	А	В	С	D	W
CE05-6A18-10SD-D-BSS	1 1/8-18UNEF-2B	34.13	32.1	57	1-20UNEF-2A
CE05-6A22-22SD-D-BSS	1 3/8-18UNEF-2B	40.48	38.3	61	1 3/16-18UNEF-2A

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[Unit: mm]

[Unit: mm]

Model name	А	В	D	W	R	U	(S)	Y
CE05-8A18-10SD-D-BAS	1 1/8-18UNEF-2B	34.13	69.5	1-20UNEF-2A	13.2	30.2	43.4	7.5
CE05-8A22-22SD-D-BAS	1 3/8-18UNEF-2B	40.48	75.5	1 3/16-18UNEF-2A	16.3	33.3	49.6	7.5

 $\phi 35$

7.85

or more

Effective thread length (Spanner fitting)

[Unit: mm]



Model	А	В	С	D	E	G	J
D/M22106420 208/D100	1 1/4-18UNEF-2B	37.28	34.11	1 1/8-18UNEF-2A	12.16	26.8	18.26
D/MS3106A20-29S(D190)	1 1/4-10UNEF-2B	(1.47)	(1.34)	1 1/0-10UNEF-2A	(0.48)	(1.06)	(0.72)

Γ		Contact size								
	#16 #12 #8 #4					#0				
	Н	8 or less	8 or less	10 or less	13 or less	13 or less				

CM10-SP2S-S/M/L [Unit: mm] ø_ φ 18.9 or less 9 For CM10-SP2S-S/M/L 51.4 <Back shell> [Unit: mm] [Unit: mm] CE02-20BS-S-D CE-20BA-S 50.5 or less 1 3/16-18UNEF-2A ±35 10.9 39.6 or less CL 1 1/8-18UNEF-2B 1 1/8-18UNEF-2B φ17.8 O ring CL ŝ

31.6

O ring $\phi 36$

48.3

1 3/16-18UNEF-2A

33.3

5 or more

<Cable clamp>

[Unit: mm] Effective thread length C 1.6 $f \oplus f$ (Bushing ID) $f \oplus f$ (Cable clamp ID) $f \oplus f$ (Movable range)

	Model name	Shell size	А	В	С	D	Е	F	G	V	Bushing
ww.DataSheet4U.co	D/MS3057-10A	18	23.8	30.1	10.3	15.9	14.3	3.2	31.7	1-20UNEF	AN3420-10
	D/MS3057-12A	20.22	23.8	35.0	10.3	19.0	15.9	4.0	37.3	1 3/16-18UNEF-2A	AN3420-12

[Unit: mm]



Model name	Shell size	А	В	С	D	E	F	G	Н	V	Bushing	Cable range								
CE3057- 10A-1-D	10	40						20.1	10.2	44.0	15.0	14.1	04 7		1-20UNEF-	CE3420- 10-1	¢10.5 to ¢14.1			
CE3057- 10A-2-D	18	18 23.8	30.1	10.3	41.3	15.9	11.0	31.7	3.2	2B	CE3420- 10-2	Ф8.5 to Ф11								
CE3057- 12A-1-D	- 22	- 22	22				00.0	00.0	00.0	00.0		10.0		10	16.0	07.0	4.0	1 3/16-	CE3420- 12-1	φ12.5 to φ16
CE3057- 12A-2-D				22 23.8 35	10.3	41.3	19	13.0	37.3	4.0	18UNEF-2B	CE3420- 12-2	Ф9.5 to Ф13							
CE3057- 12A-3-D	20	23.8	35	10.3	41.3	19	10.0	37.3	4.0	1 3/16- 18UNEF-2B	CE3420- 12-3	Φ6.8 to Φ10								

14.6 HF-KE W1-S100

This chapter provides information on the servo motor specifications and characteristics. When using the HF-KE W1-S100 servo motor, always read the Safety Instructions in the beginning of this manual and section 14.1 to 14.4, in addition to this section.

14.6.1 Model name make up



200

400

750

2 3

4

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14.6.2 Standard specifications

(1) Standard specifications

			Servo mo	tor	Н	F-KE□W1-S100 (low	inertia small capac	ity)		
Item					13	23	43	73		
Applicable servo amplifier/drive ur	Applicable servo MR-E-□A-QW003 amplifier/drive unit MR-E-□AG-QW003				10	20	40	70		
Continuous	Rated output	t	[k'	W]	0.1	0.2	0.4	0.75		
running duty	Rated torque	<u> </u>	[N •	m]	0.32	0.64	1.3	2.4		
(Note 1)		5	[oz •	in]	45.32	90.63	184.10	339.87		
Rated speed (No	ote 1)		[r/m	in]		300	00			
Maximum speed [r/min]						450	00			
4nstantaneous permissible speed [r/min]						51	75			
Maximum torque				m]	0.95	1.9	3.8	7.2		
[oz · in]				134.53	269.06	538.13	1019.61			
Power rate at continuous rated torque [kW/s]					11.5	16.9	38.6	39.9		
Inertia moment (Note 3) $\frac{J [\times 10^{4} \text{kg} \cdot \text{m}^{2}]}{\text{WK}^{2} [\text{oz} \cdot \text{in}^{2}]}$					0.088	0.24	0.42	1.43		
					0.48	1.31	2.30	7.82		
Recommended r motor shaft inerti			ment to ser	vo		15 times	or less			
Degenerative b	regene	amplifier's rative res			(Note 4)	(Note 4)	249	140		
Regenerative bi duty [times/min]	MR-RB	MR-RB032 (30W)			(Note 4)	(Note 4)	747	210		
outy [times/min]	MR-RB	312 (100V	V)			(Note 4)	2490	700		
	MR-RB	332 (300V	V)					2100		
Power supply ca	pacity				Refer to section 12.2.					
Rated current [A]					0.8	1.4	2.7	5.2		
Maximum current [A]				[A]	2.4	4.2	8.1	15.6		
Speed/position d	etector				Incremental encoder (Resolution per servo motor 1 rotation: 131072 pulse/rev)					
Accessory										
Insulation class						Clas	-			
Structure					Totally - enclosed, self-cooled (protection type: IP55 (Note 5) 0 to +40 (non-freezing)					
		Duri		C]						
	Ambient	ope		۴]	32 to 104 (non-freezing)					
	temperature	rature		°C]	-15 to 70 (non-freezing)					
		III SI	In storage [°F]		5 to 158 (non-freezing)					
Environmental	Ambient	Duri	ng operatio	-	80%RH or less (non-condensing)					
conditions	humidity		torage		90%RH or less (non-condensing)					
(Note 6)			<u> </u>		Indoors (no direct sunlight)					
	Ambience				Free from corrosive gas, flammable gas, oil mist, dust and dirt.					
	Altitude				Max. 1000m above sea level					
	Vibration		[res.]	o ² 1		V V	• 40			
(Note 7) [m/s ²]					X, Y: 49					
Vibration rank (Note 8)					V-10					
	L		[m	m]	25 30 40					
Permissible load for the shaft	Radial		[N]		88	88 245 392				
	Nauldi			lb]	20	55 88				
(Note 9)	Thrust			[N]	59	98	8	147		
	must			lb]	13	22	2	33		
Maga (Nata 2)				<g]< td=""><td>0.56</td><td>0.94</td><td>1.5</td><td>2.9</td></g]<>	0.56	0.94	1.5	2.9		
Mass (Note 3)				[b]	1.24	2.07	3.31	6.39		

Note 1. The rated output and rated speed of the servo motor assume that the rated power supply voltage and frequency are as indicated in section 1.3.

2. If the load inertia moment ratio exceeds the indicated value, please consult us.

3. Refer to the outline dimension drawing for the servo motors with electromagnetic brake.

4. When the effective torque is within the rated torque range, there are no restrictions on the regenerative brake duty. Note that the recommended load inertia moment ratio is 15 times or less.

5. Except for the shaft-through portion.

- 6. In the environment where the servo motor is exposed to oil mist, oil and/or water, the servo motor of the standard specifications may not be usable. Contact us.
- 7. The vibration direction is as shown in the figure. The value is the one at the part that indicates the maximum value (normally the opposite-to-load side bracket). When the servo motor stops, fretting is likely to occur at the bearing. Therefore, suppress the vibration to about half of the permissible value.



8. V-10 indicates that the amplitude of a single servo motor is 10µm or less. The following figure shows the servo motor installation position for measurement and the measuring position.



9. For the symbols in the table, refer to the following diagram: Do not subject the shaft to load greater than this value. The values in the table assume that the loads work singly.



L: Distance from flange mounting surface to load center

(2) Torgue characteristics





[HF-KE23W1-S100]





14.6.3 Electromagnetic brake characteristics

•	 The electromagnetic brake is provided to prevent a drop at a power failure or
	servo alarm occurrence during vertical drive or to hold a shaft at a stop. Do not
	use it for normal braking (including braking at servo lock).

The characteristics of the electromagnetic brake provided for the servo motor with electromagnetic brake are indicated below.

		Servo motor	HF-KE□BW1-S100						
eel4 ltém om			13	23	43	73			
Type (Note 1)			Spring-loaded safety brake						
Rated voltage (Note 4)				24V _10% DC					
Capacity	[W]] at 20°C (68°F)	6.3	7.9)	10			
Statio friction torque		[N • m]	0.32	1.3	}	2.4			
Static friction torque		[oz • in]	45.3	184	184.2				
Release delay time (Note 2	2)	[s]	0.03	0.0	0.03				
Braking delay time (Note 2) [s]	DC off		0.01	0.0	2	0.02			
Dormiosible broking work	Per braking	[J]	5.6	22		64			
Permissible braking work	Per hour [J]		56	220	220				
Brake looseness at servo n	notor shaft (Note	5) [degrees]	2.5	1.2	1.2				
Number of brail Brake life (Note 3) [times]		ing cycles	20000	2000	00	20000			
	Work per brakir	ng [J]	5.6	22		64			

Note 1. There is no manual release mechanism. When it is necessary to hand-turn the servo motor shaft for machine centering, etc., use a separate 24VDC power supply to release the brake electrically.

2. The value for initial ON gap at 20° C (68° F).

3. The brake gap will increase as the brake lining wears, but the gap is not adjustable. The brake life indicated is the number of braking cycles after which adjustment will be required.

4. Always prepare a power supply exclusively used for the electromagnetic brake.

5. The above values are typical initial values and not guaranteed values.

14.6.4 Servo motors with special shafts

The servo motors with special shafts indicated by the symbols $(K \cdot D)$ in the table are available. K and D are the symbols attached to the servo motor model names.

Servo motor	Shaft shape				
Servo motor	Keyway shaft (with key)	D cut shaft			
HF-KE13W1-S100		D			
HF-KE23W1-S100 to	K				
HF-KE73W1-S100	n.				

(1) Keyway shaft (with key)



(2) D cut shaft



14.6.5 Outline dimension drawings

The dimensions without tolerances are reference dimensions.

(1) Standard (Without electromagnetic brake, without reduction gear)

Model	Output	Inertia moment	Mass
	[W]	J[×10 ⁻⁴ kg • m²] (WK²[oz • in²])	[kg]([lb])
HF-KE13W1-S100	100	0.088 (0.48)	0.56 (1.24)







(2) With electromagnetic brake









14.7 HF-SE JW1-S100

This chapter provides information on the servo motor specifications and characteristics. When using the HF-SEDJW1-S100 servo motor, always read the Safety Instructions in the beginning of this manual and section 14.1 to 14.4, in addition to this section.

14.7.1 Model name make up



Rated output [W]						
500						
1000						
1500						
2000						

14.7.2 Standard specifications

(1) Standard specifications

			Servo r	notor	HF-SE	□JW1-S100 (mediur	n inertia medium ca	apacity)		
Item					52	102	152	202		
Applicable servo amplifier/drive ur		R-E-□A- R-E-□A0	QW003 G-QW003		70	100	200	200		
Continuous	Rated outpu	ut		[kW]	0.5	1.0	1.5	2.0		
running duty	Rated torqu	0	[N	• m]	2.39	4.77	7.16	9.55		
(Note 1)	Raleu loigu	C	[oz	r in]	338.5	675.5	1014	1352		
Rated speed (No	ote 1)		[r	/min]		20	00			
Maximum speed			[r	/min]		30	00			
Ihstantaneous p	ermissible sp	eed	[r	/min]		34	50			
Maximum torgue				• m]	7.16	14.3	21.5	28.6		
[oz · in]				r in]	1014	2025	3045	4050		
Power rate at co	ntinuous rate	ed torque		-	9.34	19.2	28.8	23.8		
Inertia moment (Note 3)	J	[×10 ⁻⁴ kg		6.1	11.9	17.8	38.3		
Inertia moment (Note 3) $\frac{5 [\times 10 \text{ kg} \cdot \text{III}]}{\text{WK}^2 [\text{oz} \cdot \text{in}^2]}$				• in ²]	33.4	65.1	97.3	209		
Recommended ratio of load inertia moment to servo motor shaft inertia moment (Note 2)						15 time	s or less			
		amplifier erative re	's built-in sistor		120	62	152	71		
Dogonorativa	MR-RE	3032 (30	W)		180	93				
Regenerative b duty [times/min]	MR-RE	312 (100	W)		600	310				
duty [times/min]	MR-RE	MR-RB30 (300W)					456	213		
	MR-RE	332 (300	W)		1800	930				
MR-RB50 (500W)							760	355		
Power supply ca	pacity					Refer to se	ection 12.2.			
Rated current				[A]	2.9	5.3	8.0	10		
Maximum currer	nt			[A]	8.7	15.9	24	30		
Speed/position c	letector				Incremental encoder (resolution: 131072pulse/rev)					
Accessory						Oil	seal			
Insulation class					Class F					
Structure	-	•			Totally - enclosed, self-cooled(protection type: IP65 (Note 4))					
			iring	[°C]	0 to +40 (non-freezing)					
	Ambient			[°F]	32 to 104 (non-freezing)					
	temperatur			[°C]		—15 to 70 (r	non-freezing)			
				[°F]	5 to 158 (non-freezing)					
Environmental	Ambient	Du	iring opera		80%RH or less (non-condensing)					
conditions	humidity		storage		90%RH or less (non-condensing)					
(Note 4)	Ambience		0		Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt.					
	Altitude				Max. 1000m above sea level					
	Vibration (Note 5)		[m/s²]	X, Y: 24.5 X: 24.					
Vibration rank (Note 6)					V-10					
L [mm]			[mm]	55 79						
Permissible	Dedial			[N]		980		2058		
load for the F shaft	Radial			[lb]		220		463		
	Thrust			[N]		490		980		
(Note 7)	Thrust	rust				110		220		
Maga (Nata 2)				[kg]	4.8	6.5	8.3	12		
				[lb]	10.6	14.3	18.3	26.5		

Note 1. The rated output and rated speed of the servo motor assume that the rated power supply voltage and frequency are as indicated in section 1.3.

2. If the load inertia moment ratio exceeds the indicated value, please consult us.

3. Refer to the outline dimension drawing for the servo motor with electromagnetic brake.
- 4. In the environment where the servo motor is exposed to oil mist, oil and/or water, the servo motor of the standard specifications may not be usable. Contact us.
- 5. The vibration direction is as shown in the figure. The value is the one at the part that indicates the maximum value (normally the opposite-to-load side bracket). When the servo motor stops, fretting is likely to occur at the bearing. Therefore, suppress the vibration to about half of the permissible value.



6. V-10 indicates that the amplitude of a single servo motor is 10^µm or less. The following figure shows the servo motor installation position for measurement and the measuring position.



7. For the symbols in the table, refer to the following diagram: Do not subject the shaft to load greater than this value. The values in the table assume that the loads work singly.



L: Distance from flange mounting surface to load center

(2) Torque characteristics

[HF-SE52JW1-S100]

【HF-SE102JW1-S100】

【HF-SE152JW1-S100】

[HF-SE202JW1-S100]



14.7.3 Electromagnetic brake characteristics

 The electromagnetic brake is provided to prevent a drop at a power failure or servo alarm occurrence during vertical drive or to hold a shaft at a stop. Do not use it for normal braking (including braking at servo lock).

The characteristics of the electromagnetic brake provided for the servo motor with electromagnetic brake are indicated below.

		Servo motor	HF-SED	BJW1-S100
Item			52 to 152	202
Type (Note 1)				ed safety brake
Rated voltage (Note 4)			24	′ ⁰ –10% DC
Capacity	[W] at 20°C (6	68°F)	19	34
Static friction torque		[N • m]	8.3	44
Static inclion torque		[oz • in]	1175	6231
Release delay time (Note 2	2)	[s]	0.04	0.1
Braking delay time (Note 2) [s]	DC off		0.03	0.03
Dormiosible broking work	Per braking	[J]	400	4500
Permissible braking work	Per hour	[J]	4000	45000
Brake looseness at servo n	notor shaft (Note s	5) [degrees]	0.2 to 0.6	0.2 to 0.6
Brake life (Note 3)	Number of brakin cycles[times]	ng	20000	20000
	Work per braking	g [J]	200	1000

Note 1. There is no manual release mechanism. When it is necessary to hand-turn the servo motor shaft for machine centering, etc., use a separate 24VDC power supply to release the brake electrically.

2. The value for initial ON gap at 20°C (68°F).

3. The brake gap will increase as the brake lining wears, but the gap is not adjustable. The brake life indicated is the number of braking cycles after which adjustment will be required.

4. Always prepare a power supply exclusively used for the electromagnetic brake.

5. The above values are typical initial values and not guaranteed values.

14.7.4 Servo motors with special shafts

The servo motors with special shafts indicated by the symbol (K) in the table is available. K is the symbols attached to the servo motor model names.

Servo motor	Shaft shape
Servo motor	Keyway shaft (without key)
HF-SE52JW1-S100 to	K
HF-SE202JW1-S100	ĸ



Variable dimension table											
Servo motor			v								
36100 110101	S	R	Q	W	QK	QL	υ	r	I		
HF-SE52KJW1-S100 to HF-SE152KJW1-S100	24h6	55	50	8_0_0_0_0_0_0_0_0_0_0_0_0_0_0_0_0_0_0_0	36	5	4 ^{+0.2} ₀	4	M8 Depth 20		
HC-SE202KJW1-S100	35 ^{+0.010}	79	75	10 _0.036	55	5	5 ^{+0.2}	5	M8 Depth 20		

Keyway shaft (without key)

14. SERVO MOTOR

14.7.5 Outline dimension drawings

The values in yards/pounds are reference values.

(1) Standard (Without electromagnetic brake, without reduction gear)





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14. SERVO MOTOR

(2) With electromagnetic brake



14. SERVO MOTOR

Model	Output	Static friction torque	Inertia moment	Mass
	[W]	[N m] ([oz in])	J[×10⁻⁴kg • m²] (WK²[oz • in²])	[kg] ([lb])
HF-SE152BJW1-S100	1.5	8.5 (1203.7)	20.0 (109.3)	10.3 (23.8)

[Unit: mm]



POINT

 In this chapter, difference of the operation of MR-E-□AG-QW003 from that of MR-E-□A-QW003 is described. For description not given in this chapter, refer to chapters 1 through 14.

15.1. Functions and configuration

15.1.1 Introduction

The analog input MR-E-DAG-QW003 Servo Amplifier is based on the MR-E-DA-QW003 Servo Amplifier with capability of speed control and torque control.

(1) Speed control mode

An external analog speed command (0 to \pm 10VDC) or parameter-driven internal speed command (max. 7 speeds) is used to control the speed and direction of a servo motor smoothly.

There are also the acceleration/deceleration time constant setting in response to speed command, the servo lock function at a stop time, and automatic offset adjustment function in response to external analog speed command.

(2) Torque control mode

An external analog torque command (0 to \pm 8VDC) or parameter-driven internal torque command is used to control the torque output by the servo motor.

To prevent unexpected operation under no load, the speed limit function (external or internal setting) is also available for application to tension control and the like.

15.1.2 Function block diagram

The function block diagram of this servo is shown below.



Note 1. The built-in regenerative resistor is not provided for the MR-E-10AG-QW003/MR-E-20AG-QW003.

- 2. Single-phase 230VAC power supply can be used for MR-E-70AG-QW003 or servo amplifiers with smaller capacities. Connect the power cables to L_1 and L_2 while leaving L_3 open. Refer to section 15.1.3 for the power supply specification.
- 3. The control circuit connectors (CN1, CN2 and CN3) are safely isolated from main circuit terminals (L₁, L₂, L₃, U, V, W, P, C and D). 4. Servo amplifiers MR-E-200AG-QW003 have a cooling fan.

15.1.3 Servo amplifier standard specifications

Servo amplifier IDAG 20AG 40AG TOAG 100AG 200AG Item 3-phase 200 to 230VAC, 50/60Hz or 1-phase 230VAC, 50/60Hz 3-phase 200 to 230VAC, 50/60Hz 3-phase 200 to 230VAC, 50/60Hz 3-phase 170 to 253VAC, 50/60Hz 50/60Hz </th <th><hr/></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th> <th></th>	<hr/>													
Item Original System Original System Original System Original System Premissible requency 3-phase 200 to 230VAC; 50/60Hz or 1-phase 230VAC; 50/60Hz 3-phase 200 to 230VAC; 170 to 253VAC; 50/60Hz 3-phase 170 to 253VAC; 50/60Hz Permissible frequency fluctuation 3-phase 200 to 230VAC; 170 to 253VAC; 50/60Hz 3-phase 170 to 253VAC; 50/60Hz 50/60Hz Permissible frequency fluctuation Within ±596														
Voltage/frequency 3-phase 200 to 230VAC, 50/60Hz or 1-phase 230VAC, 50/60Hz 3-phase 200 to 250VC/77F ± 50°F)), when u	14 a mag		MIK-E-U-C	20003	10AG	20AG	40AG	70AG	100AG	200AG				
Votage/requency 50/60Hz 50/60Hz 50/60Hz Permissible voltage fluctuation 3-phase 200 to 230VAC: 170 to 253VAC, 50/60Hz 3-phase 200VAC: 120 to 253VAC, 50/60Hz 3-phase 170 to 253VAC, 50/60Hz 3-phase 200VAC: 120 to 253VAC, 50/60Hz </td <td>Item</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td>	Item													
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Protective functions relay), encoder error protection, regenerative error protection, undervoltage, instantaneous power failure protection, overspeed protection, excessive error protection					Overcurrent sh	ut-off, regenera	tive overvoltage	shut-off, overlo	ad shut-off (ele	ctronic thermal				
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$ \begin{array}{ c c c } \hline \label{eq:control} \hline \mbox{mode} \hline \mbox{mode} \hline \mbox{spectrum} \mbox{mode} \hline \mbox{spectrum} \mbox{mode} \mbox{mode} \mbox{spectrum} \mbox{mode} \mbox{mode} \mbox{spectrum} \mbox{mode} \mbox{mode} \mbox{spectrum} \mbox{mode} \mbox{spectrum} \mbox{mode} \mbox{spectrum} \mbox{mode} \mbox{mode} \mbox{spectrum} \mbox{mode} \mbox{spectrum} \mbox{mode} \mbox{spectrum} \mbox{mode} \mbox{mod} \m$	0,	Torque limit			Set by parameter setting or external analog input (0 to +10VDC/maximum torque)									
modeSpeed limitSet by parameter setting or external analog input (0 to $\pm 10VDC/Rated speed$)Force- cooling, open (IP00)StructureForce- cooling, open (IP00)Ambient temperatureOperation (°C)Operation (°C)Operation (°C)Operation (°C)Ambient temperatureOperation (°C)Operation (°C)Operation (°C)Operation (°C)Operation (°C)Operation (°C)Operation (°C)Operation (°C)Operation (°C)Operation humidityStorageOperation (°C)Operation (°C)Operation (°C)Operation (°C)Operation (°C)Motions (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirtAmbient AltitudeAmbient (VibrationAution (VibrationStructureMass(kg)0.70.70.7StructureMass	Torc	que Analog	torque command	input	0 to ± 8 VDC/Maximum torque (input impedance 10 to 12k Ω)									
Nide Force-cooling, open (IP00) Force-cooling, open (IP00) Self-cooled, open (IP00) Ambient temperature Operation [°C] $0 to +55 (non-freezing)$ Ambient temperature Operation [°C] $-20 to +65 (non-freezing)$ $-20 to +65 (non-freezing)$ Ambient humidity Operation [°C] $-20 to +65 (non-freezing)$ $-4 to +149 (non-freezing)$ Ambient humidity Operation g0%RH or less (non-condensing) $-4 to +149 (non-freezing)$ Ambient humidity Operation g0%RH or less (non-condensing) $-4 to +149 (non-freezing)$ Ambient Operation g0%RH or less (non-condensing) $-4 to +149 (non-freezing)$ Ambient Operation g0%RH or less (non-condensing) $-4 to +149 (non-freezing)$ Ambient Operation g0%RH or less (non-condensing) $-4 to +149 (non-freezing)$ Ambient Operation g0%RH or less (non-condensing) $-59 [m/s^2]$ or less Mass [kg] 0.7 0.7 1.1 1.7 1.7 2.0		Sneed	limit		Set by	parameter settir	g or external an	alog input (0 to :	±10VDC/Rated	l speed)				
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Ambient temperature Operation [°F] 32 to + 131 (non-freezing) Ambient humidity [°C] -20 to + 65 (non-freezing) Ambient humidity Operation [°F] -4 to + 149 (non-freezing) Ambient humidity Operation 90%RH or less (non-condensing) Ambient Operation 90%RH or less (non-condensing) Ambient Storage Indoors (no direct sunlight) Free from corrosive gas, flammable gas, oil mist, dust and dirt Altitude Max. 1000m above sea level 5.9 [m/s ²] or less Mass [kg] 0.7 0.7 1.1 1.7 2.0				1º01						(1F00)				
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Indoors (no direct sunlight) Ambient Indoors (no direct sunlight) Altitude Max. 1000m above sea level Vibration 5.9 [m/s ²] or less	uuo				4	ç	0%RH or less (non-condensing	1)					
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Altitude Max. 1000m above sea level Vibration 5.9 [m/s ²] or less	ш	Ambient												
Vibration 5.9 [m/s ²] or less Mass [kg] 0.7 0.7 1.1 1.7 1.7 2.0						Free from corre			st, dust and dirt					
[kg] 0.7 0.7 1.1 1.7 1.7 2.0		Altitude												
Mass		Vibration					5.9 [m/s	²] or less						
[b] 1.54 1.54 2.43 3.75 3.75 4.41	Mag	e		[kg]	0.7	0.7	1.1	1.7	1.7	2.0				
	ivias			[lb]	1.54	1.54	2.43	3.75	3.75	4.41				



15.1.4 Model code definition

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15.1.5 Parts identification

(1) MR-E-100AG-QW003 or less



(2) MR-E-200AG-QW003 Reference Name/application Display The 5-digit, seven-segment LED shows the servo status Section 15.5 and alarm number. Operation section Used to perform status display, diagnostic, alarm and parameter setting operations. (\bullet) (\bullet) (\bullet) (\bullet) UP DOWN MODE SET LUsed to set data. Section 15.5 Used to change the display or data in each mode. Used to change the mode. Communication connector (CN3) Section 3.3 Used to connect a command device (RS-232C) and Section 13.1.2 output analog monitor data. Chapter 14 I/O signal connector (CN1) Section 15.2 Used to connect digital I/O signals. Rating plate Section 1.5 Encoder connector (CN2) Connector for connection of the servo motor encoder. Section 3.3 Section 13.1.2 Power supply/regenerative connector (CNP1) Section 3.7 Used to connect the input power supply and regenerative Section 11.1 Cooling fan option. Section 13.1.1 Fixed part Charge lamp Lit to indicate that the main circuit is charged. While this (4 places) lamp is lit, do not reconnect the cables. Protective earth (PE) terminal (+) Section 3.10 Ground terminal. Section 11.1 Servo motor power connector (CNP2) Section 3.7 Used to connect the servo motor. Section 11.1

15.1.6 Servo system with auxiliary equipment





(1) MR-E-100AG-QW003 or less

Note. A 1-phase 230VAC power supply may be used with the servo amplifier of MR-E-70AG-QW003 or less. Connect the power supply to L_1 and L_2 terminals and leave L_3 open. Refer to section 15.1.3 for the power supply specification.

(2) MR-E-200AG-QW003



15.2. Signals and wiring

15.2.1 Standard connection example

(1) Speed control mode



- Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked) of the servo amplifier to the protective earth (PE) of the control box.
 - 2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
 - 3. The emergency stop switch (normally closed contact) must be installed.
 - 4. When starting operation, always connect the emergency stop (EMG) and forward rotation stroke end (LSP), reverse rotation stroke end (LSN) with VIN. (Normally closed contacts)
 - 5. Trouble (ALM) is connected with VIN in normal alarm-free condition.
 - 6. When connecting the personal computer together with monitor outputs 1, 2, use the branch cable (MR-E3CBL15-P). (Refer to section 13.1.3)
 - 7. The pins with the same signal name are connected in the servo amplifier.
- 8. Use MRZJW3-SETUP 154E or 154C.
 - 9. Externally supply 24VDC ±10%, 200mA power for the interface. 200mA is a value applicable when all I/O signals are used. Reducing the number of I/O points decreases the current capacity. Refer to the current necessary for the interface described in section 3.6.2. Connect the external 24VDC power supply if the output signals are not used.

(2) Torque control mode



- Note 1. To prevent an electric shock, always connect the protective earth (PE) terminal (terminal marked
) of the servo amplifier to the protective earth (PE) of the control box.
 - 2. Connect the diode in the correct direction. If it is connected reversely, the servo amplifier will be faulty and will not output signals, disabling the emergency stop and other protective circuits.
 - 3. The emergency stop switch (normally closed contact) must be installed.
 - 4. When starting operation, always connect the emergency stop (EMG) with VIN. (Normally closed contacts)
 - 5. Trouble (ALM) is connected with VIN in normal alarm-free condition.
 - 6. When connecting the personal computer together with monitor outputs 1, 2, use the branch cable (MR-E3CBL15-P). (Refer to section 13.1.3)
 - 7. The pins with the same signal name are connected in the servo amplifier.
 - 8. Use MRZJW3-SETUP 154E or 154C.
 - Externally supply 24VDC ±10%, 200mA power for the interface. 200mA is a value applicable when all I/O signals are used. Reducing the number of I/O points decreases the current capacity. Refer to the current necessary for the interface described in section 3.6.2. Connect the external 24VDC power supply if the output signals are not used.

15.2.2 Internal connection diagram of servo amplifier

The following is the internal connection diagram where the signal assignment has been made in the initial status in each control mode.



Note. S: Speed control mode, T: Torque control mode

15.2.3 Connectors and signal arrangements

POINT

 The pin configurations of the connectors are as viewed from the cable connector wiring section.

Refer to the next page for CN1 signal assignment.

(1) Signal arrangement



(2) CN1 signal assignment

The signal assignment of connector changes with the control mode as indicated below. For the pins which are given parameter No.s in the related parameter column, their signals can be changed using those parameters.

Connector	Pin No.	(Note 1) I/O	(Note 2)	I/O Signals in contr	ol modes	Related
Connector	FILLINO.		S	S/T	Т	parameter
	1		VIN	VIN	VIN	
	2	1	TLA	TLA/TC	TC	
	3	1	ST1	ST1/RS2	RS2	No.43 to 48
	4	I	SON	SON	SON	No.43 to 48
taSheel4U.com	5	1	ST2	LOP	RS1	No.43 to 48
	6	1	LSP	LSP/-		No.43 48
	7	1	LSN	LSN/-		No.43 48
	8	1	EMG	EMG	EMG	
	9	0	ALM	ALM	ALM	No.49
	10	0	SA	SA/-		No.49
	11	0	RD	RD	RD	No.49
	12	0	ZSP	ZSP	ZSP	No.1, 49
CN1	13		SG	SG	SG	
CINT	14		LG	LG	LG	
	15	0	LA	LA	LA	
	16	0	LAR	LAR	LAR	
	17	0	LB	LB	LB	
	18	0	LBR	LBR	LBR	
	19	0	LZ	LZ	LZ	
	20	0	LZR	LZR	LZR	
	21	0	OP	OP	OP	
	22					
	23					
	24					
	25					
	26	I	VC	VC/VLA	VLA	

Note 1. I: Input signal, O: Output signal

2. S: Speed control mode, T: Torque control mode, S/T: Speed/torque control switching mode

15.2.4 Signal explanations

For the I/O interfaces (symbols in I/O column in the table), refer to section 3.6.2.

In the control mode field of the table

- S: speed control mode, T: Torque control mode
- O: Denotes that the signal may be used in the initial setting status.
- Δ : Denotes that the signal may be used by setting the corresponding parameter among parameters 43 to 49. The pin No.s in the connector pin No. column are those in the initial status.

(1) Input signals

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POINT

 The acceptance delay time of each input signal is less than 10ms.

Signal	Symbol	Connector pin No.			Functions/A	Applications		I/O division		ntrol ode T
Forward rotation stroke end	LSP	CN1-6	To start oper motor to a su Set "□□□1 (Refer to sec	udden stop a " in paramet		DI-1	0			
			(Note) Inp	out signals	Oper	ation				
			LSP	LSN	CCW direction	CW direction				
			1	1	0	0				
			0	1		0				
Reverse rotation	LSN	CN1-7	1	0	0					
stroke end			0	0						
			1: SP/		(short) indicated b		tch on the signals (keep nplifier.			
			Parame	ter No.41	Automa	atic ON				
				10	LS	8P				
			□1		LS	SN .	J			
Outside torque limit selection	TL		on to make A	Analog torque this signal, r	e limit (TLA) v nake it usabl	valid. e by making	eter No.28) valid, or turn it g the setting of parameter	DI-1	Δ	
Internal torque limit selection	TL1			this signal, r	nake it usabl		g the setting of parameter	DI-1	Δ	Δ

	Signal	Symbol	Connector pin No.		Functions/applications				
	Forward rotation start	ST1	CN1-3	Used to start	the servo m	notor in any of the following directions.	DI-1		0
	Start			(Note) Inp ST2	out signals ST1	Servo motor starting direction			
				0	0	Stop (servo lock)			
	Reverse rotation start	ST2	CN1-5	0	1 0	CCW			
	Start			1	1	Stop (servo lock)			
eei4	Forward rotation selection	RS1	CN1-5	If both ST1 a motor will be setting and s	n (short) switched on or off during operation, the servo to a stop according to the parameter No.12	DI-1		0	
				(Note) Inp ST2	out signals ST1	Torque generation direction			
				0	0	Torque is not generated.			
	Reverse rotation selection	RS2	CN1-3	0	1	Forward rotation in driving mode/reverse rotation in regenerative mode			
				1	0	Reverse rotation in driving mode/forward rotation in regenerative mode			
				1	1	Torque is not generated.			
				Note. 0: ST 1: ST	1/ST2-VIN of 1/ST2-VIN of				

Signal	Symbol	Connector			Functions/applications	I/O		ntrol ode
olgridi	Cymbol	pin No.				division	Р	S
Speed selection	1 SP1			the comr P1 to SP3	nand speed for operation. 3, make it usable by making the setting of	DI-1	Δ	Δ
Speed selection 2	2 SP2		(Note) Input s SP3 SP2	ignals SP1	Speed command	DI-1	Δ	
Speed selection	3 SP3		0 0	0	Analog speed command (VC)	DI-1	Δ	Δ
4U.com			0 0	1	Internal speed command 1 (parameter No.8)			
			0 1	0	Internal speed command 2 (parameter No.9)			
			0 1	1	Internal speed command 3 (parameter No.10)			
			1 0	0	Internal speed command 4 (parameter No.72)			
			1 0	1	Internal speed command 5 (parameter No.73)			
			1 1	0	Internal speed command 6 (parameter No.74)			
			1 1	1	Internal speed command 7 (parameter No.75)			
			<speed control="" n<br="">Used to select When using SF</speed>	1: SP1/SP2/SP3-VIN on (short) Speed control mode> Used to select the command speed for operation. When using SP1 to SP3, make it usable by making the setting of parameter No.43 to 48.				
			(Note) Input s	ignals				
			SP3 SP2	SP1	Speed limit			
			0 0	0	Analog speed limit (VLA)			
			0 0	1	Internal speed limit 1 (parameter No.8)			
			0 1	0	Internal speed limit 2 (parameter No.9)			
			0 1	1	Internal speed limit 3 (parameter No.10)			
			1 0	0	Internal speed limit 4 (parameter No.72)			
			1 0	1	Internal speed limit 5 (parameter No.73)			
			1 1	0	Internal speed limit 6 (parameter No.74)			
			1 1	1	Internal speed limit 7 (parameter No.75)			
			Note. 0: SP1/SF 1: SP1/SF		/IN off (open) /IN on (short)			
Control change	LOP		<position speed<br="">Used to select mode.</position>		change mode> ntrol mode in the position/speed control change	DI-1	Ref fund tion	c- is/
			(Note) LC	P	Control mode		tion	
			0		Position			
			1		Speed			
			Note. 0: LOP-V 1: LOP-V	• • •				
Servo-on	SON	CN1-4	Same as MR-E-	□A-QW	003. (Refer to section 3.3.2 (1).)	DI-1	0	Z
Reset	RES					DI-1	Δ	2
Proportion control	PC					DI-1	Δ	4
Emergency stop	EMG	CN1-8				DI-1	0	(
Gain changing	CDP	/				DI-1	Δ	

	Signal	Signal Symbol Connector r pin No.		Functions/applications	I/O division	Cor mo	
	Analog torque limit	TLA	CN1-2	To use this signal in the speed control mode, set any of parameters No.43 to 48 to make TL available. When the analog torque limit (TLA) is valid, torque is limited in the full servo motor output torque range. Apply 0 to $+10$ VDC across TLA-LG. Connect the positive terminal of the power supply to TLA. Maximum torque is generated at $+10$ V. (Refer to section 15.2.5 (1)(a).) Resolution:10bit	Analog input	Δ	
eet	Analog torque command 4U.com	TC		Used to control torque in the full servo motor output torque range. Apply 0 to ± 8 VDC across TC-LG. Maximum torque is generated at ± 8 V. (Refer to section 15.2.5 (2)(a).) The torque at ± 8 V input can be changed using parameter No.26.	Analog input		0
	Analog speed command	VC	CN1-26	Apply 0 to \pm 10VDC across VC-LG. Speed set in parameter No.25 is provided at \pm 10V. (Refer to section 15.2.5 (1)(a).) Resolution:14bit or equivalent	Analog input	0	
	Analog speed limit	VLA		Apply 0 to \pm 10VDC across VLA-LG. Speed set in parameter No.25 is provided at \pm 10V. (Refer to section 15.2.5 (2)(c).)	Analog input		0

(2) Output signals

	Signal	Symbol	Connector pin No.	Functions/Applications	I/O division		ntrol ode T
	Speed reached	SA		SA turns off when servo on (SON) turns off or the servo motor speed has not reached the preset speed with both forward rotation start (ST1) and reverse rotation start (ST2) turned off. SA turns on when the servo motor speed has nearly reached the preset speed. When the preset speed is 30r/min or less, SA always turns on.	DO-1		0
heel	Limiting speed 4U.com	VLC		VLC turns on when speed reaches the value limited using any of the internal speed limits 1 to 7 (parameter No.8 to 10, 72 to 75) or the analog speed limit (VLA) in the torque control mode. VLC turns off when servo on (SON) turns off.	DO-1		C
	Limiting torque	TLC		TLC turns on when the torque generated reaches the value set to the internal torque limit 1 (parameter No.28) or analog torque limit (TLA). TLC turns off when servo on (SON) turns off.	DO-1	0	
	Trouble	ALM	CN1-9	Same as MR-E-DA-QW003. (Refer to section 3.3.2 (2).)	DO-1	0	C
	Ready	RD	CN1-11		DO-1	0	C
	Zero speed	ZSP	CN1-12		DO-1	0	0
	Electromagnetic brake interlock	MBR	[CN1-12]		DO-1	Δ	4
	Warning	WNG			DO-1	Δ	2
	Alarm code	ACD0 ACD1 ACD2			DO-1	Δ	2
	Encoder Z-phase pulse (Open collector)	OP	CN1-21		DO-2	0	C
4 (()	Encoder A-phase pulse (Differential line driver)	LA LAR	CN1-15 CN1-16				
	Encoder B-phase pulse (Differential line driver)	LB LBR	CN1-17 CN1-18				
	Encoder Z-phase pulse (Differential line driver)	LZ LZR	CN1-19 CN1-20				
	Analog monitor 1	MO1	CN3-4		Analog output	0	(
	Analog monitor 2	MO2	CN3-6		Analog output	0	(

(3) Power

Signal	Symbol Connector	Functions/Applications	I/O division	Cor mc			
ů	2	pin No.			S	Т	
Digital I/F power supply input	VIN	CN1-1	Same as MR-E-DA-QW003. (Refer to section 3.3.2 (4).)	\searrow	0	0	
Open collector power input	OPC	CN1-2				0	0
Digital I/F common	SG	CN1-13			0	0	
Control common	LG	CN1-14		\backslash	0	0	
Shield	SD	Plate		\backslash	0	0	

15.2.5 Detailed description of the signals

(1) Speed control mode

- (a) Speed setting
 - 1) Speed command and speed

The servo motor is run at the speeds set in the parameters or at the speed set in the applied voltage of the analog speed command (VC). A relationship between the analog speed command (VC) applied voltage and the servo motor speed is shown below.

In the initial setting, rated speed is $\pm 10V$. The speed at $\pm 10V$ can be changed using parameter No.25.

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The following table indicates the rotation direction according to forward rotation start (ST1) and reverse rotation start (ST2) combination.

(Note 1) Extern	nal input signals	(Note 2) Rotation direction					
CT2	OT1	An	Internal speed				
ST2	ST1	+Polarity	0V	-Polarity	commands		
0	0	Stop	Stop	Stop	Stop		
0		(Servo lock)	(Servo lock)	(Servo lock)	(Servo lock)		
0	1	CCW	Stop	CW	CCW		
1	0	CW	(No servo lock)	CCW	CW		
1		Stop	Stop	Stop	Stop		
1	1	(Servo lock)	(Servo lock)	(Servo lock)	(Servo lock)		

Note 1. 0: off

1: on

2. Releasing the torque limit during servo lock may cause the servo motor to suddenly rotate according to the position deviation from the instructed position.

The forward rotation start (ST1) and reverse rotation start (ST2) can be assigned to any pins of the connector CN1 using parameters No.43 to 48. Generally, make connection as shown below.



2) Speed selection 1 (SP1), speed selection 2 (SP2), speed selection 3 (SP3) and speed command value by making speed selection 1 (SP1), speed selection 2 (SP2) and speed selection 3 (SP3) usable by setting of parameter No.43 to 47, you can choose the speed command values of internal speed commands 1 to 7.

(Note) E	(Note) External input signals		Speed command value	
SP3	SP2	SP1	Speed command value	
0	0	0	Analog speed command (VC)	
0	0	1	Internal speed command 1 (parameter No.8)	
0	1	0	Internal speed command 2 (parameter No.9)	
0	1	1	Internal speed command 3 (parameter No.10)	
1	0	0	Internal speed command 4 (parameter No.72)	
1	0	1	Internal speed command 5 (parameter No.73)	
1	1	0	Internal speed command 6 (parameter No.74)	
1	1	1	Internal speed command 7 (parameter No.75)	

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Note. 0: SP1/SP2/SP3-VIN off (open)

1: SP1/SP2/SP3-VIN on (short)

The speed may be changed during rotation. In this case, the values set in parameters No.11 and 12 are used for acceleration/deceleration.

When the speed has been specified under any internal speed command, it does not vary due to the ambient temperature.

(b) Speed reached (SA)

SA-VIN are connected when the servo motor speed nearly reaches the speed set to the internal speed command.



(c) Torque limit

 Releasing the torque limit during servo lock may cause the servo motor to CAUTION suddenly rotate according to the position deviation from the instructed position.

1) Torque limit and torque

By setting parameter No.28 (internal torque limit 1), torque is always limited to the maximum value during operation. A relationship between the limit value and servo motor torque is shown below.





A relationship between the applied voltage of the analog torque limit (TLA) and the torque limit value of the servo motor is shown below. Torque limit values will vary about 5% relative to the voltage depending on products.

At the voltage of less than 0.05V, torque may vary as it may not be limited sufficiently. Therefore, use this function at the voltage of 0.05V or more.



2) Torque limit value selection

Use parameters No.43 through 48 to enable external torque limit (TL) and internal torque limit (TL1). Torque limit values can be selected as shown in the following table. However, if the parameter No.28 value is less than the limit value selected by TL/TL1, the parameter No.28 value is made valid.

(Note) External input signals		Torque limit value made valid	
TL1	TL		
0	0	Internal torque limit 1 (parameter No.28)	
0	1	TLA > Parameter No.28: Parameter No.28	
0		I	TLA < Parameter No.28: TLA
1	0	Parameter No.76 > Parameter No.28: Parameter No.28	
I	0	Parameter No.76 < Parameter No.28: Parameter No.76	
1	1	TLA > Parameter No.76: Parameter No.76	
I	I	I	TLA < Parameter No.76: TLA

Note.0: off

1: on

(2) Torque control mode

(a) Torque command

1) Torque command and torque

A relationship between the applied voltage of the analog torque command (TC) and the torque by the servo motor is shown below.

The maximum torque is generated at $\pm 8V$. Note that the torque at $\pm 8V$ input can be changed with parameter No.26.



Generated torque limit values will vary about 5% relative to the voltage depending on products. Also the torque may vary if the voltage is low (-0.05 to +0.05V) and the actual speed is close to the limit value. In such a case, increase the speed limit value.

The following table indicates the torque generation directions determined by the forward rotation selection (RS1) and reverse rotation selection (RS2) when the analog torque command (TC) is used.

(Note) Externa	al input signals	Rotation direction			
RS2	RS1	Torque control command (TC)			
R52	ROT	+ Polarity	0V	 Polarity 	
0	0	Torque is not generated.		Torque is not generated.	
0	1	CCW (reverse rotation in driving mode/forward rotation in regenerative mode)	Torque is not	CW (forward rotation in driving mode/reverse rotation in regenerative mode)	
1	0	CW (forward rotation in driving mode/reverse rotation in regenerative mode)	generated.	CCW (reverse rotation in driving mode/forward rotation in regenerative mode)	
1	1	Torque is not generated.		Torque is not generated.	

Note. 0: off 1: on

Generally, make connection as shown below.



2) Analog torque command offset

Using parameter No.30, the offset voltage of -999 to +999mV can be added to the TC applied voltage as shown below.



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(b) Torque limit

By setting parameter No.28 (internal torque limit 1), torque is always limited to the maximum value during operation. A relationship between limit value and servo motor torque is as in (1)(c) of this section. Note that the analog torque limit (TLA) is unavailable.

- (c) Speed limit
 - 1) Speed limit value and speed

The speed is limited to the values set in parameters No.8 to 10, 72 to 75 (internal speed limits 1 to 7) or the value set in the applied voltage of the analog speed limit (VLA).

A relationship between the analog speed limit (VLA) applied voltage and the servo motor speed is shown below.

When the servo motor speed reaches the speed limit value, torque control may become unstable. Make the set value more than 100r/min greater than the desired speed limit value.



The following table indicates the limit direction according to forward rotation selection (RS1) and reverse rotation selection (RS2) combination.

(Note) External input signals		Speed limit direction				
RS1	RS2	Analog speed limit (VLA)		Internal speed		
		+ Polarity	 Polarity 	commands		
1	0	CCW	CW	CCW		
0	1	CW	CCW	CW		

Note.0: off 1: on

Generally, make connection as shown below.



2) Speed selection 1(SP1)/speed selection 2(SP2)/speed selection 3(SP3) and speed limit values
 Choose any of the speed settings made by the internal speed limits 1 to 7 using speed selection 1(SP1), speed selection 2(SP2) and speed selection 3(SP3) or the speed setting made by the analog speed limit (VLA), as indicated below.

(Note) External input signals			Speed limit value	
SP3	SP2	SP1	Speed limit value	
0	0	0	Analog speed limit (VLA)	
0	0	1	Internal speed limit 1 (parameter No.8)	
0	1	0	Internal speed limit 2 (parameter No.9)	
0	1	1	Internal speed limit 3 (parameter No.10)	
1	0	0	Internal speed limit 4 (parameter No.72)	
1	0	1	Internal speed limit 5 (parameter No.73)	
1	1	0	Internal speed limit 6 (parameter No.74)	
1	1	1	Internal speed limit 7 (parameter No.75)	

Note.0: off

1: on

When the internal speed limits 1 to 7 are used to command the speed, the speed does not vary with the ambient temperature.

3) Limiting speed (VLC)

VLC turns on when the servo motor speed reaches the speed limited using any of the internal speed limits 1 to 7 or the analog speed limit (VLA).

(3) Speed/torque control change mode

Set "0003" in parameter No.0 to switch to the speed/torque control change mode.

(a) Control change (LOP)

Use control change (LOP) to switch between the speed control mode and the torque control mode from an external contact. Relationships between LOP and control modes are indicated below.

Servo control mode
Speed control mode
Torque control mode

w.DataSheet4U.com Note.0: off 1: on

The control mode may be changed at any time. A change timing chart is shown below.



Note. When the start (ST1 • ST2) is switched off as soon as the mode is changed to speed control, the servo motor comes to a stop according to the deceleration time constant.

- (b) Speed setting in speed control mode Same as (1)(a).
- (c) Torque limit in speed control mode Same as (1)(c).
- (d) Speed limit in torque control mode Same as (2)(c).
- (e) Torque control in torque control mode Same as (2)(a).
- (f) Torque limit in torque control mode Same as (2)(b).

15.3 Startup

 Do not operate the switches with wet hands. You may get an electric shock.
 Before starting operation, check the parameters. Some machines may perform unexpected operation. Take safety measures, e.g. provide covers, to prevent accidental contact of hands and parts (cables, etc.) with the servo amplifier heat sink, regenerative resistor, servo motor, etc. since they may be hot while power is on or for some time after power-off. Their temperatures may be high and you may get burnt or a parts may damaged. During operation, never touch the rotating parts of the servo motor. Doing so can cause injury.

Perform pre-operation checks while referring to section 4.1. Connect the servo motor with a machine after confirming that the servo motor operates properly alone.

Use parameter No.0 to choose the control mode used. After setting, this parameter is made valid by switching power off, then on.

15.3.1 Speed control mode

- (1) Power on
 - 1) Switch off the servo-on (SON).
 - 2) When power is switched on, the display shows "r (servo motor speed)", and in two second later, shows data.
- (2) Test operation

Confirm servo motor operation by operating JOG of test operation mode at lowest speed possible. (Refer to section 6.8.2.)

(3) Parameter setting

Set the parameters according to the structure and specifications of the machine. Refer to chapter 5 for the parameter definitions and to section 6.5 for the setting method.

	Parameter No.	Parameter No. Name		Description
	0	Control mode, regenerative option selection		 Speed control mode Regenerative option is not used.
	1	Function selection 1		 Input filter 3.555ms (initial value) Electromagnetic brake interlock (MBR) is used.
U.	iom 2	Auto tuning		 Middle response (initial value) is selected. Auto tuning mode 1 is selected.
	8	Internal speed command 1	1000	Set 1000r/min.
	9	Internal speed command 1	1500	Set 1500r/min.
	10	Internal speed command 1	2000	Set 2000r/min.
	11	Acceleration time constant	1000	Set 1000ms.
	12	Deceleration time constant	500	Set 500ms.
	13	S-pattern acceleration/deceleration time constant	0	Not used

Turn the power off to validate changes in parameters No.0 and 1. Then switch power on again to make the set parameter values valid.

(4) Servo-on

Switch the servo-on in the following procedure.

- 1) Switch on power supply.
- 2) Switch on the servo-on (SON).

When placed in the servo-on status, the servo amplifier is ready to operate and the servo motor is locked.

(5) Start

Using speed selection 1 (SP1) and speed selection 2 (SP2), choose the servo motor speed. Turn on forward rotation start (ST1) to run the motor in the forward rotation (CCW) direction or reverse rotation start (ST2) to run it in the reverse rotation (CW) direction. At first, set a speed as low as possible and check the rotation direction, etc. If it does not run in the intended direction, check the input signal.

On the status display, check the speed, load factor, etc. of the servo motor.

When machine operation check is over, check automatic operation with the host controller or the like. This servo amplifier has a real-time auto tuning function under model adaptive control. Performing operation automatically adjusts gains. The optimum tuning results are provided by setting the response level appropriate for the machine in parameter No.2. (Refer to chapter 7.)

(6) Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor. Refer to section 3.9 for the servo motor equipped with electromagnetic brake. Note that simultaneous ON or simultaneous OFF of forward rotation stroke end (LSP), reverse rotation stroke end (LSN) OFF and forward rotation start (ST1) or reverse rotation start (ST2) has the same stop pattern as described below. (a) Servo-on (SON) OFF

The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence

When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Emergency stop (EMG) OFF

POINT

- The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm AL.E6 (servo emergency stop warning) occurs.
- (d) Forward rotation stroke end (LSP), reverse rotation stroke end (LSN) OFF The servo motor is brought to a sudden stop and servo-locked. The motor may be run in the opposite direction.
- (e) Simultaneous ON or simultaneous OFF of forward rotation start (ST1) and reverse rotation start (ST2) The servo motor is decelerated to a stop.

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 A sudden stop indicates deceleration to a stop at the deceleration time constant of zero.
15.3.2 Torque control mode

(1) Power on

1) Switch off the servo-on (SON).

- 2) When power is switched on, the display shows "U (torque command voltage)", and in two second later, shows data.
- (2) Test operation

Using jog operation in the test operation mode, make sure that the servo motor operates. (Refer to section 6.8.2.)

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(3) Parameter setting

Set the parameters according to the structure and specifications of the machine. Refer to chapter 5 for the parameter definitions and to section 6.5 for the setting method.

Parameter No.	Name	Setting	Description
0	Control mode, regenerative option selection		 Torque control mode Regenerative option is not used.
1	Function selection 1		 Input filter 3.555ms (initial value) Electromagnetic brake interlock (MBR) is used.
8	Internal speed command 1	1000	Set 1000r/min.
9	Internal speed command 1	1500	Set 1500r/min.
10	Internal speed command 1	2000	Set 2000r/min.
11	Acceleration time constant	1000	Set 1000ms.
12	Deceleration time constant	500	Set 500ms.
13	S-pattern acceleration/deceleration time constant	0	Not used
14	Torque command time constant	2000	Set 2000r/min.
28	Internal torque limit 1	50	Controlled to 50% output

Turn the power off after setting parameters No.0 and 1. Then switch power on again to make the set parameter values valid.

(4) Servo-on

Switch the servo-on in the following procedure.

- 1) Switch on power supply.
- 2) Switch on the servo-on (SON).

When placed in the servo-on status, the servo amplifier is ready to operate and the servo motor is locked.

(5) Start

Using speed selection 1 (SP1) and speed selection 2 (SP2), choose the servo motor speed. Turn on forward rotation select (DI4) to run the motor in the forward rotation (CCW) direction or reverse rotation select (DI3) to run it in the reverse rotation (CW) direction, generating torque. At first, set a low speed and check the rotation direction, etc. If it does not run in the intended direction, check the input signal. On the status display, check the speed, load factor, etc. of the servo motor.

When machine operation check is over, check automatic operation with the host controller or the like.

(6) Stop

In any of the following statuses, the servo amplifier interrupts and stops the operation of the servo motor. Refer to section 3.9 for the servo motor equipped with electromagnetic brake.

(a) Servo-on (SON) OFF

The base circuit is shut off and the servo motor coasts.

(b) Alarm occurrence

When an alarm occurs, the base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop.

(c) Emergency stop (EMG) OFF

^{com}The base circuit is shut off and the dynamic brake is operated to bring the servo motor to a sudden stop. Alarm AL.E6 (servo emergency stop warning) occurs.

(d) Simultaneous ON or simultaneous OFF of forward rotation selection (RS1) and reverse rotation selection (RS2)

The servo motor coasts.

POINT

 A sudden stop indicates deceleration to a stop at the deceleration time constant of zero.

15.4 Parameters

POINT

- Before changing the settings of parameters No.20 through 84, cancel write protection while referring to section 5.1.1.
- For any parameter whose symbol is preceded by *, set the parameter value and switch power off once, then switch it on again to make that parameter setting valid.

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The symbols in the control mode column of the table indicate the following modes: S: Speed control mode

T: Torque control mode

15.4.1 Item list

Class	No.	Symbol	Name	Control mode	Initial value	Unit	Customer setting
	0	*STY	Control mode, regenerative option selection	S•T	(Note 1)	/	
	1	*OP1	Function selection 1	S•T	0002		
	2	ATU	Auto tuning	S	0105		
	3	\backslash	For manufacturer setting		1	\backslash	
	4				1	\backslash	
	5				100		
	6	PG1	Position loop gain 1	S	35	rad/s	
	7		For manufacture setting		3		
	8	SC1	Internal speed command 1	S	100	r/min	
ters	0	001	Internal speed limit 1	Т	100	r/min	
Basic parameters	9	SC2	Internal speed command 2	S	500	r/min	
para	Ŭ	002	Internal speed limit 2	Т	500	r/min	
sic	10	SC3	Internal speed command 3	S	1000	r/min	
Ba	10	000	Internal speed limit 3	Т	1000	r/min	
	11	STA	Acceleration time constant	S•T	0	ms	
	12	STB	Deceleration time constant	S•T	0	ms	
	13	STC	S-pattern acceleration/deceleration time constant	S•T	0	ms	
	14	TQC	Torque command time constant	Т	0	ms	
	15	*SNO	Station number setting	S•T	0	station	
	16	*BPS	Serial communication function selection, alarm history clear	S•T	0000		
	17	MOD	Analog monitor output	S•T	0100	\square	
	18	*DMD	Status display selection	S•T	0000		
	19	*BLK	Parameter block	S•T	0000		

Clas	s N	lo.	Symbol	Name	Control mode	Initial value	Unit	Custome setting
	2	20	*OP2	Function selection 2	S•T	0000	/	
	2	21		For manufacturer setting	/	0000	\sim	/
	2	22	*OP4	Function selection 4	S·T	0000	\sim	
	2	23		For manufacturer setting	/	0	\sim	/
	2	24	ZSP	Zero speed	S·T	50	r/min	
				Analog speed command maximum speed	S	(Note 3)0	(r/min)	
	2	25	VCM	Analog speed limit maximum speed	Т	(Note 3)0	(r/min)	
	2	26	TLC	Analog torque command maximum output	Т	100	%	
t4U.com	n 2	27	*ENR	Encoder output pulses	S • T	4000	pulse /rev	
	2	28	TL1	Internal torque limit 1	S • T	100	%	
				Analog speed command offset	S	(Note 2)	mV	
	2	29	VCO	Analog speed limit offset	Т	(Note 2)	mV	
	-			Analog torque command offset	Т	0	mV	
~	3	30	TLO	Analog torque limit offset	S	0	mV	
ters	3	31	MO1	Analog monitor 1 offset	S•T	0	mV	
imei	3	32	MO2	Analog monitor 2 offset	S•T	0	mV	1
bara		33	MBR	Electromagnetic brake sequence output	S•T	100	ms	
Expansion parameters 1	3	34	GD2	Ratio of load inertia moment to servo motor inertia moment	S · T	70	Multiplier (×10 ⁻¹)	
xpa	. 7	35	PG2	Position loop gain 2	S	35	rad/s	
ш		36	VG1	Speed loop gain 1	S	177	rad/s	
	_	37	VG1 VG2	Speed loop gain 1	S	817	rad/s	
	_	38	VIC	Speed hop gain 2 Speed integral compensation	S	48	ms	
	_	39	VDC	Speed integral compensation Speed differential compensation	S	980		
		10		For manufacturer setting	\sim	0		
		+0 +1	*DIA	Input signal automatic ON selection	S•T	0000		
	_	12	*DI1	Input signal selection 1	S/T	0002	\sim	
	_	+2 13	*DI2	Input signal selection 2 (CN1-4)	S•T	0111		
					S•T	0882		
		14 15	*DI3 *DI4	Input signal selection 3 (CN1-3) Input signal selection 4 (CN1-5)	SIT	0882		
		+5 16	*DI5		SIT	0995		
		+0 17	*DI6	Input signal selection 5 (CN1-6) Input signal selection 6 (CN1-7)	SIT	0000		
		18 19	*LSPN *DO1	LSP/LSN input terminals selection Output signal selection 1	S S•T	0403 0000		
	_	50	<u> </u>		· · ·	0000		
		51	*OP6	For manufacturer setting Function selection 6	S·T	0000		/
					~ /			
		52	*0.00	For manufacturer setting		0000		/
		53	*OP8	Function selection 8	S•T	0000		
s 2	0	54	*OP9	Function selection 9	S·T	0000		
eter	0	55		For manufacturer setting		0000		/
ame	5	56	SIC	Serial communication time-out selection	S·T	0	s	
Expansion parameters 2	. 5	57		For manufacturer setting		10		/
sion	5	8	NH1	Machine resonance suppression filter 1	S•T	0000		
Jans	5	59	NH2	Machine resonance suppression filter 2	S•T	0000		
Exp		50 51	LPF GD2B	Low-pass filter/adaptive vibration suppression control Ratio of load inertia moment to Servo motor inertia moment 2	S•T S	0000 70	Multiplier	
		_					(×10 ⁻¹)	
		62		For manufacturer setting		100	\vdash	
	6	63	VG2B	Speed control gain 2 changing ratio	S	100	%	ļ
	6	64	VICB	Speed integral compensation changing ratio	S	100	%	

Class	No.	Symbol	Name	Control mode	Initial value	Unit	Customer setting
	65	*CDP	Gain changing selection	S	0000	/	
	66	CDS	Gain changing condition	S	10	(Note 2)	
	67	CDT	Gain changing time constant	S	1	ms	
	68	\backslash	For manufacturer setting		0	\backslash	\backslash
	69	\backslash		\backslash	1	\backslash	
	70				1		
	71				1		
	72	SC4	Internal speed command 4	S	200	r/min	
	12	304	Internal speed limit 4	Т	200	1/11111	
U.con	70	0.05	Internal speed command 5	S	300	r/min	
lete	73	SC5	Internal speed limit 5	Т	300	r/min	
Expansion parameters	74	0.00	Internal speed command 6	S	500	n/maina	
n pa	74	SC6	Internal speed limit 6	Т	500	r/min	
Isio	75	SC7	Internal speed command 7	S	800	r/min	
kpar	75	307	Internal speed limit 7	Т	000	1/11111	
Ĥ	76	TL2	Internal torque limit 2	S•T	100	%	
	77	\setminus	For manufacturer setting	\setminus	100	Ν	\setminus
	78	\setminus		\setminus	10000	\setminus	\backslash
	79	\setminus		\setminus	10	\setminus	\backslash
	80	\setminus		\setminus	10	\setminus	\setminus
	81				100		
	82			\setminus	100		
	83	\setminus		\setminus	100		
	84				0000		

Note 1. Depends on the capacity of the servo amplifier.

2. Depends on the parameter No.65 setting.

3. The setting of "0" provides the rated servo motor speed.

15.4.2 Details list

	Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
DataShee	4U.com	No. 0	Symbol *STY	Name and function Control mode, regenerative option selection Used to select the control mode and regenerative option. Select the control mode. 0: Speed 1: Speed and torque 2: Torque Motor series selection 0: HF-KE □W1-S100 1: HF-SE □JW1-S100 Selection of regenerative option 0: Regenerative resistor is not used • For the servo amplifier of 200W or lower, regenerative resistor is not used. • For the servo amplifier of 400W or higher, built-in regenerative resistor is used. 2: MR-RB032 3: MR-RB12 4: MR-RB30 6: MR-RB50 (Cooling fan is required) Motor capacity selection 0: 100W 1: 200W		Unit	Refer to name and function column.	
	Basic parameters	1	*OP1	3: 500W 4: 750W 5: 1kW 6: 1.5kW 7: 2kW POINT Wrong setting may cause the regenerative option to burn. If the regenerative option selected is not for use with the servo amplifier, parameter error (AL.37) occurs. Function selection 1 Used to select the input signal filter, the function of pin CN1-12. 000	0002		Refer to name and function	S•T
				Input signal filter If external input signal causes chattering due to noise, etc., input filter is used to suppress it. 0: None 1: 1.777[ms] 2: 3.555[ms] 3: 5.333[ms] CN1-12 function selection 0: Zero Speed detection signal 1: Electromagnetic brake interlock (MBR)			column.	

Class	No.	Symbol			Name and fur	nction	Initial value	Unit	Setting range	Contro mode
	2	ATU	Auto tunir Used to Refer to	selectio		. for execution of auto tuning.	0105		Refer to name and function	S
					 L Auto tuning respo	unse level setting			column.	
						-				
					Set Response value level	Machine resonance frequency guideline				
					1 Low	15Hz				
4U.com					2 response	20Hz				
10.0011					3	25Hz				
					4	30Hz				
					5	35Hz				
					6 7	45Hz 55Hz				
					8 Middle	70Hz				
					9 response	85Hz				
					A	105Hz				
					В	130Hz				
					С	160Hz				
					D ↓ E High	200Hz				
					F response	240Hz 300Hz				
					If the machine hunts					
					large gear sound, deo					
S					set value.					
nete					To improve performant	-				
aran					shorten the settling tir the set value.	me, increase				
ic p;					Gain adjustment mode	selection				
Basic parameters					(For more information, I					
				Set value	Gain adjustment mode	Description				
				0	Interpolation mode	Fixes position control gain 1 (parameter No.6).				
				1	Auto tuning mode 1	Ordinary auto tuning.				
				2	Auto tuning mode 2	Fixes the load inertia moment				
					Ŭ	ratio set in parameter No.34. Response level setting can be changed.				
				3	Manual mode 1	Simple manual adjustment.				
				4	Manual mode 2	Manual adjustment of all gains.				
	3		For manu	facturer	setting		1			
	4	\backslash			this value by any means.		1			
	5			-			100	$1 \setminus$		
	6	PG1	Position le	oop dair	n 1		35	l		S
	-	-			gain of position loop.			$\left \right\rangle$	\backslash	
						pility in response to the position		$ \rangle$	\backslash	
			commai	nd.					\setminus	
					-	ted, the result of auto turning is				
			automat							
					ameter, set " $\Box\Box$ 1 \Box " to	parameter No.20 to validate servo		\		
			lock at s	stop.				\		
	7		For manu				3			

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Contro mode
	8	SC1	Internal speed command 1 Used to set speed 1 of internal speed commands.	100	r/min	0 to instan- taneous	S
			Internal speed limit 1 Used to set speed 1 of internal speed limits.			permi- ssible speed	Т
	9	SC2	Internal speed command 2 Used to set speed 2 of internal speed commands.	500	r/min	0 to instan- taneous	S
			Internal speed limit 2 Used to set speed 2 of internal speed limits.			permi- ssible speed	Т
el4U.com	10	SC3	Internal speed command 3 Used to set speed 3 of internal speed commands.	1000	r/min	0 to instan- taneous	S
			Internal speed limit 3 Used to set speed 3 of internal speed limits.			permi- ssible speed	Т
Basic parameters	11	STA	Acceleration time constant Used to set the acceleration time required to reach the rated speed from Or/min in response to the analog speed command and internal speed commands 1 to 7. If the preset speed command is lower than the rated speed, acceleration/deceleration time Rated Speed Zero Parameter No.11 setting For example for the servo motor of 3000r/min rated speed, set 3000 (3s) to increase speed from 0r/min to 1000r/min in 1 second. Deceleration time constant Used to set the deceleration time required to reach 0r/min from the rated speed in response to the analog speed command and internal speed commands 1 to 7.	0	ms	0 to 20000	S•T
Ba	13	STC	S-pattern acceleration/deceleration time constant Used to smooth start/stop of the servo motor. Set the time of the arc part for S-pattern acceleration/deceleration. Speed command Image: Speed command STA: Acceleration time constant (parameter No.11) STB: Deceleration time constant (parameter No.12) STC: S-pattern acceleration time constant) or STB (deceleration time constant (parameter No.13) Long setting of STA (acceleration time constant) or STB (deceleration time constant) The upper limit value of the a	0	ms	0 to 1000	S·T

	Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
DataSheei	4U.com	14	TQC	Torque command time constant Used to set the constant of a low-pass filter in response to the torque command. Torque Torque command After filtered TQC TQC TIME TQC: Torque command time constant	0	ms	0 to 20000	Т
	~	15	*SNO	Station number setting Used to specify the station number for serial communication. Always set one station to one axis of servo amplifier. If one station number	0	station	0 to 31	S•T
	Basic parameters	16	*BPS	is set to two or more stations, normal communication cannot be made. Serial communication function selection, alarm history clear Used to select the serial communication baud rate, select various communication conditions, and clear the alarm history.	0000		Refer to name and function column.	S•T
				Serial baud rate selection 0: 9600 [bps] 1: 19200[bps] 2: 38400[bps] 3: 57600[bps] Alarm history clear 0: Invalid (not cleared) 1: Valid (cleared) When alarm history clear is made valid, the alarm history is cleared at next power-on. After the alarm history is cleared, the setting is automatically made invalid (reset to 0). Serial communication response delay time 0: Invalid 1: Valid, reply sent after delay time of 800µs or more				

Class N	o. Symbol	Name and function	Initial value	Unit	Setting range	Contro mode
4U.com	7 MOD	Analog monitor output Used to selection the signal provided to the analog monitor (MO1) - analog monitor (MO2) output. (Refer to section 5.2.2) OOO OO Setting Analog monitor 2 (MO2) Analog monitor 1 (MO1) O Servo motor speed (±8V/max. speed) 1 Torque (±8V/max. torque) 2 Servo motor speed (+8V/max. speed) 3 Torque (+8V/max. torque) 4 Current command (±8 V/max. current command) 5 Cannot be used. 6 7 8 9 A B Bus voltage (+8V/400V)	0100		Refer to name and function column.	S • 1
Basic parameters	8 *DMD	Status display selection Used to select the status display shown at power-on. O O Selection of status display at power-on O: Cumulative feedback pulses 1: Servo motor speed 2: Cannot be used 3: Cannot be used 4: Cannot be used 7: Regenerative load ratio 8: Effective load ratio 9: Peak load ratio 9: Peak load ratio 9: Peak load ratio 9: Peak load ratio 1: Instantaneous torque B: Within one-revolution position low C: Within one-revolution position high D: Load inertia moment ratio E: Bus voltage Status display at power-on in corresponding control mode 0: Depends on the control mode. Control Mode Status display at power-on Speed Servo motor speed Speed Servo motor speed/ analog torque command voltage Torque Analog torque command voltage 1: Depends on the first digit setting of this parameter.	0000		Refer to name and function column.	S·T

Class	No.	Symbol			Name and fun	ction		Initial value	Unit	Setting range	Contro mode
	19	*BLK	Parameter I	olock				0000		Refer to	S•T
			Used to se	elect the referen	ice and write rar	nges of the para	neters.			name	
						neters marked (1	and	
					-	-			1	function	
			Set		Basic parameters	Expansion parameters 1	Expansion parameters 2		1	column.	
			value	Operation	No.0	No.20	No.50			oolanni.	
			Value		to No.19	to No.49	to No.84				
			0000	Reference	0						
			(Initial value)	Write	0						
4U <mark>S</mark> on			000A	Reference	No.19 only						
Basic parameters			000A	Write	No.19 only						
ara			000B	Reference	0	0					
ic p			0000	Write	0						
3asi			000C	Reference	0	0					
ш			0000	Write	0	0					
			000E	Reference	0	0	0				
			UUUL	Write	0	0	0				
			100B	Reference	0						
			TOOD	Write	No.19 only						
			100C	Reference	0	0					
			1000	Write	No.19 only						
			100E	Reference	0	0	0				
			TOOL	Write	No.19 only						

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Contro mode
Expansion parameters 1	20	*OP2	Function selection 2 Used to select restart after instantaneous power failure, servo lock at a stop in speed control mode, and slight vibration suppression control.	value 0000		range Refer to name and function column.	
			 Slight vibration suppression control Made valid when auto tuning selection is set to "0400" in parameter No.2. Used to suppress vibration at a stop. 0: Invalid 1: Valid 				S
			Encoder cable communication system selection 0: Two-wire type 1: Four-wire type Incorrect setting will result in an encoder alarm 1 (AL.16) or encoder alarm 2 (AL.20).				S-T
	21		For manufacturer setting Do not change this value by any means.	0000			

Class	No.	Symbol	Name and function		Initial value	Unit	Setting range	Contro mode
	22	*OP4	Function selection 4		0000		Refer to	
			Used to select stop processing at forward r	rotation stroke end (LSP) •			name	$\left \right\rangle$
			reverse rotation stroke end (LSN) off, choose	TLC/VLC output and choose			and	$ \rangle$
			VC/VLA voltage averaging.				function	
			0				column.	
			How to make a stop wh	on forward				$ \rangle$
			rotation stroke end (LS					
			reverse rotation stroke	,				
4U.com			is valid. (Refer to section	on 5.2.3.)				s
FU.COIII			0: Sudden stop					Ŭ
			1: Slow stop					
			TLC/VLC output selection	a at which				
			Select the connector pir Torque Limit (TLC) or S					
			(VLC) is output.					
			Set value Conne	ctor pin No.				
				t output				
			1 C	N1-11				S · T
			2 (CN1-9				
			3 C	N1-10				
			4 C	N1-12				
on pa			or analog speed limit (VLA Set 0 to vary the speed to in real time. Increase the s	voltage fluctuation				
pansion pa			Set 0 to vary the speed to) is imported. voltage fluctuation et value to vary the				
Expansion parameters 1			Set 0 to vary the speed to in real time. Increase the s) is imported. voltage fluctuation et value to vary the ictuation.				
Expansion pa			Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flu) is imported. voltage fluctuation et value to vary the ictuation. ime [ms]				
Expansion pa			Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flu Set value Filtering t) is imported. voltage fluctuation et value to vary the ictuation. ime [ms]				
Expansion pa			Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flu Set value Filtering t 0 0) is imported. voltage fluctuation et value to vary the ictuation. ime [ms] 44				
Expansion pa			Set 0 to vary the speed to in real time. Increase the s speed slower to voltage fluSet valueFiltering t0010.4) is imported. voltage fluctuation et value to vary the ictuation. ime [ms] 44 88				
Expansion pa			Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flu Set value Filtering t 0 0 1 0.4 2 0.8) is imported. voltage fluctuation et value to vary the actuation. ime [ms] 44 88 77				
Expansion pa	23		Set 0 to vary the speed to in real time. Increase the s speed slower to voltage fluxSet valueFiltering t0010.420.831.7) is imported. voltage fluctuation et value to vary the actuation. ime [ms] 44 88 77	0			
Expansion pa	23		Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flu Set value Filtering t 0 0 0 1 0.4 2 0.8 3 1.7 4 3.5 For manufacturer setting Do not change this value by any means.) is imported. voltage fluctuation et value to vary the actuation. ime [ms] 44 88 77				
Expansion pa	23	ZSP	Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flu Set value Filtering t 0 0 1 0.4 2 0.8 3 1.7 4 3.5 For manufacturer setting Do not change this value by any means. Zero speed) is imported. voltage fluctuation et value to vary the ictuation. ime [ms] 44 88 77 55	0 50	r/min		s•1
Expansion pa		ZSP	Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flu Set value Filtering t 0 0 0 1 0.4 2 0.8 3 1.7 4 3.5 For manufacturer setting Do not change this value by any means.) is imported. voltage fluctuation et value to vary the ictuation. ime [ms] 44 88 77 55		r/min	0 to 10000	s·1
Expansion pa		ZSP	Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flu Set value Filtering t 0 0 0 1 0.4 2 0.8 3 1.7 4 3.5 For manufacturer setting Do not change this value by any means. Zero speed Used to set the output range of the zero speed Analog speed command maximum speed) is imported. voltage fluctuation et value to vary the ictuation. ime [ms] 44 88 77 55		r/min	to	s.T
Expansion pa	24		Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flu Set value Filtering t 0 0 0 1 0.4 2 0.8 3 1.7 4 3.5 For manufacturer setting Do not change this value by any means. Zero speed Used to set the output range of the zero speed Used to set the speed at the maximum input) is imported. voltage fluctuation et value to vary the ictuation. ime [ms] 44 88 77 55	50	r/min r/min	to 10000	
Expansion pa	24		Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flu Set value Filtering t 0 0 0 1 0.4 2 0.8 3 1.7 4 3.5 For manufacturer setting Do not change this value by any means. Zero speed Used to set the output range of the zero speed Used to set the speed at the maximum input speed command (VC).) is imported. voltage fluctuation et value to vary the ictuation. ime [ms] 44 88 77 55 4 (ZSP). voltage (10V) of the analog	50		to 10000 0 1 to	
Expansion pa	24		Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flux Set value Filtering t 0 0 1 0.4 2 0.8 3 1.7 4 3.5 For manufacturer setting Do not change this value by any means. Zero speed Used to set the output range of the zero speed Used to set the speed at the maximum input speed command (VC). Set "0" to select the rated speed of the servo n) is imported. voltage fluctuation et value to vary the ictuation. ime [ms] 44 88 77 55 4 (ZSP). voltage (10V) of the analog	50		to 10000 0 1 to 50000	S
Expansion pa	24		Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flu Set value Filtering t 0 0 0 1 0.4 2 0.8 3 1.7 4 3.5 For manufacturer setting Do not change this value by any means. Zero speed Used to set the output range of the zero speed Used to set the speed at the maximum input speed command (VC).) is imported. voltage fluctuation et value to vary the ictuation. ime [ms] 44 88 77 55 4 (ZSP). voltage (10V) of the analog notor connected.	50	r/min	to 10000 0 1 to 50000 0	
Expansion pa	24		Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flux Set value Filtering t 0 0 1 0.4/td> 2 0.8/td> 3 1.7/td> 4 3.5/td> For manufacturer setting Do not change this value by any means. Zero speed Used to set the output range of the zero speed Used to set the speed at the maximum input speed command (VC). Set "0" to select the rated speed of the servo means Analog speed limit maximum speed Used to set the speed at the maximum input speed limit (VLA).) is imported. voltage fluctuation et value to vary the inctuation. ime [ms] 44 88 77 55 4 (ZSP). voltage (10V) of the analog notor connected. voltage (10V) of the analog	50		to 10000 0 1 to 50000 0 1	S
Expansion pa	24		Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flux Set value Filtering t 0 0 1 0.4 2 0.8 3 1.7 4 3.5 For manufacturer setting Do not change this value by any means. Zero speed Used to set the output range of the zero speed Used to set the speed at the maximum input speed command (VC). Set "0" to select the rated speed of the servo means of the zero speed Analog speed limit maximum speed Used to set the speed at the maximum input speed) is imported. voltage fluctuation et value to vary the inctuation. ime [ms] 44 88 77 55 4 (ZSP). voltage (10V) of the analog notor connected. voltage (10V) of the analog	50	r/min	to 10000 0 1 to 50000 0	S
Expansion pa	24		Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flux Set value Filtering t 0 0 1 0.4 2 0.8 3 1.7 4 3.5 For manufacturer setting Do not change this value by any means. Zero speed Used to set the output range of the zero speed Used to set the speed at the maximum input speed command (VC). Set "0" to select the rated speed of the servor n Analog speed limit maximum speed Used to set the speed at the maximum input speed limit (VLA). Set "0" to select the rated speed of the servor n Analog torque command maximum output) is imported. voltage fluctuation et value to vary the inctuation. ime [ms] 44 88 77 55 4 (ZSP). voltage (10V) of the analog notor connected. voltage (10V) of the analog notor connected.	50	r/min	to 10000 0 1 to 50000 0 1 to	S
Expansion pa	24	VCM	Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flux Set value Filtering t 0 0 1 0.4 2 0.8 3 1.7 4 3.5 For manufacturer setting Do not change this value by any means. Zero speed Used to set the output range of the zero speed Used to set the speed at the maximum input speed command (VC). Set "0" to select the rated speed of the servo n Analog speed limit maximum speed Used to set the speed at the maximum input speed limit (VLA). Set "0" to select the rated speed of the servo n Analog torque command maximum output Used to set the speed at the maximum input speed limit (VLA).) is imported. voltage fluctuation et value to vary the inctuation. ime [ms] 44 88 77 55 4 (ZSP). voltage (10V) of the analog notor connected. voltage (10V) of the analog notor connected.	50	r/min	to 10000 0 1 to 50000 0 1 to 50000 0 to	S
Expansion pa	24	VCM	Set 0 to vary the speed to in real time. Increase the s speed slower to voltage flux Set value Filtering t 0 0 1 0.4 2 0.8 3 1.7 4 3.5 For manufacturer setting Do not change this value by any means. Zero speed Used to set the output range of the zero speed Used to set the speed at the maximum input speed command (VC). Set "0" to select the rated speed of the servor n Analog speed limit maximum speed Used to set the speed at the maximum input speed limit (VLA). Set "0" to select the rated speed of the servor n Analog torque command maximum output) is imported. voltage fluctuation et value to vary the ictuation. ime [ms] 44 88 77 55 4 (ZSP). voltage (10V) of the analog notor connected. voltage (10V) of the analog notor connected. voltage (10V) of the analog notor connected.	50	r/min	to 10000 0 1 to 50000 0 1 to 50000 0	S

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Contro mode
4U.com	27	*ENR	Encoder output pulses Used to set the encoder pulses (A-phase or B-phase) output by the servo amplifier. Set the value 4 times greater than the A-phase or B-phase pulses. You can use parameter No.54 to choose the output pulse designation or output division ratio setting. The number of A · B-phase pulses actually output is 1/4 times greater than the preset number of pulses. The maximum output frequency is 1.3Mpps (after multiplication by 4). Use this parameter within this range. • For output pulse designation Set "0□□□" (initial value) in parameter No.54. Set the number of pulses per servo motor revolution. Output pulse = set value [pulses/rev] At the setting of 5600, for example, the actually A • B-phase pulses output are as indicated below. A • B-phase output pulses $= \frac{5600}{4} = 1400$ [pulse] • For output division ratio setting Set "1□□□" in parameter No.54. The number of pulses per servo motor revolution is divided by the set value. Output pulse $= \frac{\text{Resolution per servo motor revolution}}{\text{Set value}}$ [pulses/rev] At the setting of 8, for example, the actually A • B-phase pulses output are as indicated below. A • B-phase output pulses $= \frac{10000}{8} \cdot \frac{1}{4} = 313$ [pulse]	4000	pulse/ rev	1 to 65535	S·T
Expansion parameters 1	28	TL1	Internal torque limit 1 Set this parameter to limit servo motor torque on the assumption that the maximum torque is 100[%]. When 0 is set, torque is not produced. (Note) Torque limit 0 Internal torque limit 1 (Parameter No.28) 1 Analog torque limit < internal torque limit 1	100	%	0 to 100	S•T
	29	VCO	Analog speed command offset Used to set the offset voltage of the analog speed command (VC). For example, if CCW rotation is provided by switching on forward rotation start (ST1) with 0V applied to VC, set a negative value. When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to section 15.5.3.) The initial value is the value provided by the automatic VC offset function before shipment at the VC-LG voltage of 0V.	Depends on servo amplifier	mV	-999 to 999	S
			Analog speed limit offset Used to set the offset voltage of the analog speed limit (VLA). For example, if CCW rotation is provided by switching on forward rotation selection (RS1) with 0V applied to VLA, set a negative value. When automatic VC offset is used, the automatically offset value is set to this parameter. (Refer to section 15.5.3.) The initial value is the value provided by the automatic VC offset function before shipment at the VLA-LG voltage of 0V.				Т

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
	30	TLO	Analog torque command offset Used to set the offset voltage of the analog torque command (TC).	0	mV	—999 to	Т
			Analog torque limit offset Used to set the offset voltage of the analog torque limit (TLA).			999	S
	31	MO1	Analog monitor 1 offset Used to set the offset voltage of the analog monitor 1 (MO1).	0	mV	-999 to 999	S·T
	32	MO2	Analog monitor 2 offset Used to set the offset voltage of the analog monitor 2 (MO2).	0	mV	-999 to 999	S•T
4U.com	33	MBR	Electromagnetic brake sequence output Used to set the delay time (Tb) between electronic brake interlock (MBR) and the base drive circuit is shut-off.	100	ms	0 to 1000	S•T
	34	GD2	Ratio of load inertia moment to servo motor inertia moment Used to set the ratio of the load inertia moment to the servo motor shaft inertia moment. When auto tuning mode 1 and interpolation mode is selected, the result of auto tuning is automatically used. (Refer to section 7.1.1.) In this case, it varies between 0 and 1000.	70	Multi- plier (×10 ⁻¹)	0 to 3000	S•T
Expansion parameters 1	35	PG2	Position loop gain 2 Used to set the gain of the position loop. Set this parameter to increase the position response to level load disturbance. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1,2 and interpolation mode is selected, the result of auto tuning is automatically used. To use this parameter, set "□□1□" to parameter No.20 to validate servo lock at stop.	35	rad/s	1 to 1000	S
Expansi	36	VG1	Speed loop gain 1 Normally this parameter setting need not be changed. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1 • 2, manual mode and interpolation mode is selected, the result of auto tuning is automatically used.	177	rad/s	20 to 8000	S
	37	VG2	Speed loop gain 2 Set this parameter when vibration occurs on machines of low rigidity or large backlash. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1 • 2 and interpolation mode is selected, the result of auto tuning is automatically used.	817	rad/s	20 to 20000	S
	38	VIC	Speed integral compensation Used to set the integral time constant of the speed loop. Higher setting increases the response level but is liable to generate vibration and/or noise. When auto tuning mode 1 • 2 and interpolation mode is selected, the result of auto tuning is automatically used.	48	ms	1 to 1000	S
·	39	VDC	Speed differential compensation Used to set the differential compensation. Made valid when the proportion control (PC) is switched on.	980		0 to 1000	S
-	40		For manufacturer setting Do not change this value by any means.	0	\square		

Class N	lo. Symbol	Name and function	Initial	Unit	Setting	Control
			value		range	mode
⊧4U.com	I *DIA	Input signal automatic ON selection Used to set automatic servo-on (SON) • forward rotation stroke end (LSP) • reverse rotation stroke end (LSN). O Servo-on (SON) input selection 0: Switched on/off by external input. 1: Switched on automatically in servo amplifier. (No need of external wiring) Forward rotation stroke end (LSP) input selection 0: Switched on/off by external input. 1: Switched on automatically in servo amplifier. (No need of external wiring) Reverse rotation stroke end (LSN) input selection 0: Switched on automatically in servo amplifier. (No need of external wiring) Ceverse rotation stroke end (LSN) input selection 0: Switched on/off by external input. 1: Switched on automatically in servo amplifier. (No need of external wiring)	0000		Refer to name and function column.	S•T S
Expansion parameters 1	¹² *DI1	Input signal selection 1 Used to assign the control mode changing signal input pins and to set the clear (CR). OOOOCCONTROL Change (LOP) input pin assignment Used to set the control mode change signal input connector pins. Note that this parameter is made valid when parameter No.0 is set to select internal speed/torque change mode. Set value Connector pin No. OCN1-4 1 CN1-3 2 CN1-5 3 CN1-6 4 CN1-7 If forward rotation stroke end (LSP) or reverse rotation stroke end (LSN) is assigned to any pin with parameter No.48, this parameter cannot be used.	0002		Refer to name and function column.	S/T

Class	No.	Symbol		Name and	d function		Initial value	Unit	Setting	Contr mode
	43	*DI2	Input signal selectio	n 2 (CN1_4)			0111		range Refer to	
	43	DIZ	Allows any input s		d to CN1-pin 4		0111		name	3-
						liffer according to the			and	
			control mode.	ang aigit and ast	signed signal c	and according to the			function	
			0 1]					column.	
]						
				-Speed	Input signals	of				
			т	control mode	CN1-pin 4					
				ontrol mode	selected.					
4U.com				-	h control mode	are indicated below by				
			their symbols.							
			Setting of any othe	er signal will be inv	alid.					
			Set value	(Note) Con	trol mode					
				S	Т					
			0							
-			1	SON	SON					
Expansion parameters 1			2	RES	RES					
Imet			3	PC	PC	-				
para			4	TL	TL					
ion			5	CR	CR					
ans			6	SP1	SP1					
Exp			7	SP2	SP2					
			8	ST1	RS2					
			9	ST2	RS1					
			А	SP3	SP3					
			В							
			С							
			D	TL1	TL1					
			E	CDP	CDP					
			F							
			Note: P: Position of	control modo		-				
				peed control mode	2					
			e. mondre		•					
			This parameter is	unavailable when	parameter No.	42 is set to assign the				
			control change (LC		-	Ŭ				
			If rotation stroke	end (LSP) or re	everse rotation	stroke end (LSN) is				
			assigned to pin 4	of CN1 with param	neter No.48, thi	s parameter cannot be				
			used.							

Cla	lass	No.	Symbol	Name and function	Initial value	Unit	Setting	Control mode
aShee <mark>i</mark> 4U.	l.com	44	*DI3	Input signal selection 3 (CN1-3) Allows any input signal to be assigned to CN1-pin 3. The assignable signals and setting method are the same as in input signal selection 2 (parameter No.43).	0882		range Refer to name and function column.	S•T
	Expansion parameters 1	45	*DI4	Input signal selection 4 (CN1-5) Allows any input signal to be assigned to CN1-pin 5. The assignable signals and setting method are the same as in input signal selection 2 (parameter No.43). 0 5 CN1-pin 5 selected. This parameter is unavailable when parameter No.42 is set to assign the control change (LOP) to CN1-pin 5. If forward stroke end (LSP) or reverse rotation stroke end (LSN) is assigned to pin 5 of CN1 with parameter No.48, this parameter cannot be used.	0995		Refer to name and function column.	S·T
		46	*DI5	Input signal selection 5 (CN1-6) Allows any input signal to be assigned to CN1-pin 6. The assignable signals and setting method are the same as in input signal selection 2 (parameter No.43).	0000		Refer to name and function column.	S•T

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
Sheei4U.con	47	*DI6	Input signal selection 6 (CN1-7) Allows any input signal to be assigned to CN1-pin 7. The assignable signals and setting method are the same as in input signal selection 2 (parameter No.43).	0000		Refer to name and function column.	S·T
Expansion parameters 1	48	*LSPN	LSP/LSN input terminal selection Select the pins where the forward rotation stroke end (LSP) and reverse rotation stroke end (LSN) will be assigned. If the signals have already been assigned using parameter No.42 to 47, this parameter setting has preference. However, if forward rotation stroke end (LSP) is assigned to pin 6 of CN1 (default setting), the setting of parameter No.46 takes priority. Similarly, if reverse rotation stroke end (LSN) is assigned to pin 7 of CN1 (default setting), the setting of parameter No.47 takes priority. 0 0 0 Select the pin where the forward rotation stroke end (LSP) will be assigned. Set value Connector pin No. 0 1 CN1-5 2 CN1-4 3 CN1-6 4 CN1-7 5 CN1-3 Select the pin where the reverse rotation stroke end (LSN) will be assigned. The settings are the same as those of the first digit.	0403		Refer to name and function column.	S

Class	No.	Symbol				Name	e and fund	ction	Initial value	Unit	Setting range	Contro mode
	40	*DO1	Output signs	Loolootia	un 1							
	49	*DO1	Output signa			otor ni	na ta aut	put the clarm code and warning	0000		Refer to	S•T
					conne	cior pi		put the alarm code and warning			name	
			(WNG).								and	
			0 0								function	
				╧┯┙							column.	
				L	-Setti	ing of a	alarm coo	le output				
					Sot	value	C	Connector pins				
					Oet	value	CN1-10	CN1-11 CN1-12				
						0	SA	RD ZP				
4U.com						1 A	Alarm code	is output at alarm occurrence.				
				(Note) Alarm	1 code						
				CN1	CN1	CN1	Alarm	Name				
						pin 12	display					
							88888	Watchdog				
							AL.12	Memory error 1				
							AL.13	Clock error				
							AL.15	Memory error 2				
				0	0	0	AL.17	Board error 2				
							AL.19	Memory error 3				
-							AL.37	Parameter error				
sters							AL.8A	Serial communication time-out error				
ame							AL.8E	Serial communication error				
Expansion parameters				0	1	0	AL.30	Regenerative error				
luo				<u> </u>		Ŭ	AL.33	Overvoltage				
ansi				1	0	0	AL.10	Undervoltage				
sdx							AL.45	Main circuit device overheat				
ш				1	1	0	AL.46	Servo motor overheat				
							AL.50	Overload 1				
							AL.51	Overload 2				
				0	0	1	AL.24	Main circuit				
				0	1	1	AL.32 AL.31	Overcurrent Overspeed				
				0	1	1	AL.31 AL.16	Encoder error 1				
				1	0	1	AL.10	Motor combination error				
				'	Ŭ			Encoder error 2				
				Note	0 [.] Pin-	-VIN of	f (open)					
					1: Pin-	VIN or	n (short)					
			l	- Settin	a of wa	arnina	(WNG) o	utput				
								o output warning. The old signal				
				befo	re sele	ection	will be ur	available.				
				Se	t value	Э	Connect	or pin No.				
					0		Not c	output.				
					1		CN	1-11				
					2		CN	11-9				
					3			1-10				
					4		CN	1-12				

(Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
Г		50		For manufacturer setting	0000			
		54	+0.00	Do not change this value by any means.	0000		Defeate	S·T
DataShee;4	U.com	51	*OP6	Function selection 6 Used to select the operation to be performed when the reset (RES) switches on. Operation to be performed when the reset (RES) switches on 0: Base circuit not switched off 1: Base circuit switched off	0000		Refer to name and function column.	<u> </u>
		52	\searrow	For manufacturer setting Do not change this value by any means.	0000	\backslash		
	arameters 2	53	*OP8	Function selection 8 Used to select the protocol of serial communication. 0 0 Protocol checksum selection 0: Yes (checksum added) 1: No (checksum not added) Protocol checksum selection 0: With station numbers 1: No station numbers	0000		Refer to name and function column.	S•T
	Expansion parameters	54	*OP9	Function selection 9 Use to select the command pulse rotation direction, encoder output pulse direction and encoder pulse output setting.	0000		Refer to name and function column.	S•T
		55		For manufacturer setting Do not change this value by any means.	0000			
		56	SIC	Serial communication time-out selection Used to set the communication protocol time-out period in [s].	0		0	S•T
	ŀ	57		When you set "0", time-out check is not made.	10	s	1 to 60	
		57	\backslash	For manufacturer setting Do not change this value by any means.	10			

Class	No.	Symbol	Name and function	Initial value	Unit	Setting	Control mode
Expansion parameters 2	No. 58	NH1	Machine resonance suppression filter 1 Used to selection the machine resonance suppression filter. (Refer to section 8.2.) Image: section 8.2.)	value 0000		range Refer to name and function column.	mode S • T
	59	NH2	Image: constraint of the second se	0000		Refer to name and function column.	S•T

	Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
DataSheet	Expansion parameters 2	60	LPF	Low-pass filter/adaptive vibration suppression control Used to selection the low-pass filter and adaptive vibration suppression control. (Refer to chapter 8.) Low-pass filter selection 0: Valid (Automatic adjustment) 1: Invalid When you choose "valid", $\frac{VG2 \text{ setting } \times 10}{2\pi(1 + GD2 \text{ setting } \times 0.1)}$ [Hz] bandwidth filter is set automatically. Adaptive vibration suppression control selection Choosing "valid" or "held" in adaptive vibration suppression control selection makes the machine resonance suppression filter 1 (parameter No.58) invalid. 0: Invalid 1: Valid Machine resonance frequency is always detected and the filter is generated in response to resonance to suppress machine vibration. 2: Held The characteristics of the filter generated so far are held, and detection of machine resonance is stopped. Adaptive vibration suppression control sensitivity selection Used to set the sensitivity of machine resonance detection. 0: Normal 1: Large sensitivity	0000		Refer to name and function column.	S·T
		61	GD2B	Ratio of load inertia moment to servo motor inertia moment 2 Used to set the ratio of load inertia moment to servo motor inertia moment when gain changing is valid.	70	Multi- plier (×10 ⁻¹)	0 to 3000	S
		62		For manufacturer setting Do not change this value by any means.	100	\square		
		63	VG2B	Speed control gain 2 changing ratio Used to set the ratio of changing the speed control gain 2 when gain changing is valid. Made valid when auto tuning is invalid.	100	%	10 to 200	S
		64	VICB	Speed integral compensation changing ratio Used to set the ratio of changing the speed integral compensation when gain changing is valid. Made valid when auto tuning is invalid.	100	%	50 to 1000	S

	Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
Sheel	4U.com	65	*CDP	Gain changing selection Used to select the gain changing condition. (Refer to section 8.5.) Gain changing selection Gains are changed in accordance with the settings of parameters No.61 to 64 under any of the following conditions: 0: Invalid 1: Gain changing (CDP) is ON 2: For manufacturer setting 3: For manufacturer setting 4: Servo motor speed is equal to higher than parameter No.66 setting	0000		Refer to name and function column.	S
		66	CDS	Gain changing condition Used to set the value of gain changing condition (command frequency, droop pulses, servo motor speed) selected in parameter No.65. The set value unit changes with the changing condition item. (Refer to section 8.5.)	10	kpps pulse r/min	10 to 9999	S
	leters 2	67	CDT	Gain changing time constant Used to set the time constant at which the gains will change in response to the conditions set in parameters No.65 and 66. (Refer to section 8.5.)	1	ms	0 to 100	S
	Expansion parameters	68 69 70 71		For manufacturer setting Do not change this value by any means.	0 1 1 1			
	Ê	72	SC4	Internal speed command 4 Used to set speed 4 of internal speed commands.	200	r/min	0 to in- stanta- neous	S
				Internal speed limit 4 Used to set speed 4 of internal speed limits.			permi- ssible speed	Т
		73	SC5	Internal speed command 5 Used to set speed 5 of internal speed commands.	300	r/min	0 to in- stanta- neous permi-	S
				Internal speed limit 5 Used to set speed 5 of internal speed limits.			ssible speed	Т
		74	SC6	Internal speed command 6 Used to set speed 6 of internal speed commands.	500	r/min	0 to in- stanta- neous	S
				Internal speed limit 6 Used to set speed 6 of internal speed limits.			permi- ssible speed	Т
		75	SC7	Internal speed command 7 Used to set speed 7 of internal speed commands.	800	r/min	0 to in- stanta- neous	S
				Internal speed limit 7 Used to set speed 7 of internal speed limits.			permi- ssible speed	Т

Class	No.	Symbol	Name and function	Initial value	Unit	Setting range	Control mode
	76	TL2	Internal torque limit 2 Set this parameter to limit servo motor torque on the assumption that the	100	%	0 to	S•T
			maximum torque is 100[%]. When 0 is set, torque is not produced.			100	
Expansion parameters 2			When torque is output in analog monitor output, this set value is the maximum output voltage (×8V).				
ram	77	Ν	For manufacturer setting	100		\backslash	\setminus
u ba	78	\backslash	Do not change this value by any means.	10000	\setminus	\setminus	\setminus
Isio	79			10		\setminus	\setminus
el4U ® on	80			10			
ш	81			100			
	82			100			
	83			100			
	84			0000			

15.5 Display and operation

POINT
 For the alarm mode, parameter mode output signal (DO) forcible output and
test operation mode, refer to chapter 6.

15.5.1 Display flowchart

Use the display (5-digit, 7-segment LED) on the front panel of the servo amplifier for status display, parameter setting, etc. Set the parameters before operation, diagnose an alarm, confirm external sequences, and/or confirm the operation status. Press the "MODE" "UP" or "DOWN" button once to move to the next screen. To refer to or set the expansion parameters, make them valid with parameter No.19 (parameter write disable).



Note. The initial status display at power-on depends on the control mode.

Speed control mode: Servo Motor speed(r),

Torque control mode: Torque command voltage (U)

Also, parameter No.18 can be used to change the initial indication of the status display at power-on.

15.5.2 Status display

(1) Status display list

The following table lists the servo statuses that may be shown.

Name	Symbol	Unit	Description	Display range
Cumulative feedback pulses	С	pulse	Feedback pulses from the servo motor encoder are counted and displayed. The value in excess of ±99999 is counted, bus since the servo amplifier display is five digits, it shows the lower five digits of the actual value. Press the "SET" button to reset the display value to zero. Reverse rotation is indicated by the lit decimal points in the upper four digits.	— 999999 to 99999
Servo motor speed	r	r/min	The servo motor speed is displayed. The value rounded off is displayed in $\times 0.1 \mathrm{r/min}.$	-5400 to 5400
Analog speed command voltage Analog speed limit voltage	F	V	 (1) Torque control mode Analog speed limit (VLA) voltage is displayed. (2) Speed control mode Analog speed command (VC) voltage is displayed. 	-10.00 to 10.00
Analog torque command voltage Analog torque limit voltage	U	V	 (1) Speed control mode Analog torque limit (TLA) voltage is displayed. (2) Torque control mode Analog torque command (TLA) voltage is displayed. 	0 to +10V -8.0 to
Regenerative load ratio	L	%	The ratio of regenerative power to permissible regenerative power is displayed in .	+8.0 0 to
Effective load ratio	J	%	The continuous effective load torque is displayed. The effective value in the past is seconds is displayed relative to the rated torque of 100%.	100 0 to 300
Peak load ratio	b	%	The maximum torque generated during acceleration/deceleration, etc. The highest value in the past 15 seconds is displayed relative to the rated torque of 100%.	0 to 400
Instantaneous torque	Т	%	Torque that occurred instantaneously is displayed. The value of the torque that occurred is displayed in real time relative to the rate torque of 100%.	0 to 400
Within one-revolution position low	Cy1	pulse	Position within one revolution is displayed in encoder pulses. The value returns to "0" when it exceeds the maximum number of pulses. The value is incremented in the CCW direction of rotation.	0 to 99999
Within one-revolution position high	Cy2	100 pulse	The within one-revolution position is displayed in 100 pulse increments of the encoder. The value returns to "0" when it exceeds the maximum number of pulses. The value is incremented in the CCW direction of rotation.	0 to 1310
Load inertia moment ratio	dC	Multiplier (×1)	The estimated ratio of the load inertia moment to the servo motor shaft inertia moment is displayed.	0.0 to 300.0
Bus voltage	Pn	V	The voltage (across P-N) of the main circuit converter is displayed.	0 to 450

(2) Changing the status display screen

The status display item of the servo amplifier display shown at power-on can be changed by changing the parameter No.18 settings.

The item displayed in the initial status changes with the control mode as follows.

Control mode	Status display at power-on
Speed	Servo motor speed
Speed/torque	Servo motor speed/analog torque command voltage
Torque	Analog torque command voltage

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15.5.3 Diagnostic mode

E	N	ame	Display	Description
	Sequence			Not ready. Indicates that the servo amplifier is being initialized or an alarm has occurred.
				Ready. Indicates that the servo was switched on after completion of initialization and the servo amplifier is ready to operate.
	4U.com External I/O signal display		Refer to section 15.5.4.	Indicates the ON-OFF states of the external I/O signals. The upper segments correspond to the input signals and the lower segments to the output signals. Lit: ON Extinguished: OFF The I/O signals can be changed using parameters No.43 to 49.
	Output (DO output) signal forced		The digital output signal can be forced on/off. For more information, refer to section 6.7.
	Test operation mode	Jog feed		Jog operation can be performed when there is no command from the external command device. For details, refer to section 6.8.2.
				Screen for manufacturer setting. When this screen is being displayed, do not press any other buttons than "UP" and "DOWN".
		Motor-less operation		Without connection of the servo motor, the servo amplifier provides output signals and displays the status as if the servo motor is running actually in response to the external input signal. For details, refer to section 6.8.4.
		Machine analyzer operation		Merely connecting the servo amplifier allows the resonance point of the mechanical system to be measured. The MR Configurator (servo configuration software) is required for machine analyzer operation. Gain search cannot be used.
Ş	Software version low			Indicates the version of the software.
ę	Software version high			Indicates the system number of the software.
4	Automatic VC offset		H : []	If offset voltages in the analog circuits inside and outside the servo amplifier cause the servo motor to rotate slowly at the analog speed command (VC) or analog speed limit (VLA) of 0V, this function automatically makes zero-adjustment of offset voltages. When using this function, make it valid in the following procedure. Making it valid causes the parameter No.29 value to be the automatically adjusted offset voltage. 1) Press "SET" once. 2) Set the number in the first digit to 1 with "UP"/"DOWN". 3) Press "SET". You cannot use this function if the input voltage of VC or VLA is ±0.4V or more.

Name	Display	Description
Motor series ID		Press the "SET" button to show the motor series ID of the servo motor currently connected.
Motor type ID		Press the "SET" button to show the motor type ID of the servo motor currently connected.
Encoder ID		Press the "SET" button to show the encoder ID of the servo motor currently connected.

15.5.4 External I/O signal display

The ON/OFF states of the digital I/O signals connected to the servo amplifier can be confirmed.

(1) Operation

Call the display screen shown after power-on. Using the "MODE" button, show the diagnostic screen.



(2) Display definition



The 7-segment LED shown above indicates ON/OFF.

Each segment at top indicates the input signal and each segment at bottom indicates the output signal. The signals corresponding to the pins in the respective control modes are indicated below.

CN1	Input/Output (Note 2) Signal abbreviation		al abbreviation	Related parameter No.	
Pin No.	(Note 1) I/O	S	Т	Related parameter No.	
3	I	ST1	RS2	43 to 47	
4	I	SON	SON	43 to 47	
5	I	ST2	RS1	43 to 47	
6	I	LSP		43 to 48	
7	I	LSN		43 to 48	
8	I	EMG	EMG		
9	0	ALM	ALM	49	
10	0	SA		49	
11	0	RD	RD	49	
12	0	ZSP	ZSP	49	
21	0	OP	OP		

Note 1. I: Input signal, O: Output signal

2. S: Speed control mode, T: Torque control mode.

3. CN1B-4 and CN1A-18 output signals are the same.



15.6. Troubleshooting

15.6.1 Trouble at start-up

The following faults may occur at start-up. If any of such faults occurs, take the corresponding action. (1) Speed control mode

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on (Note)	 LED is not lit. LED flickers. 	Not improved if connectors CN1, CN2 and CN3 are disconnected.	 Power supply voltage fault Servo amplifier is faulty. 	
			Improved when connectors	Power supply of CN1 cabling is	1 \
eet4U.co	m		CN1 is disconnected.	shorted.	
			Improved when connector	1. Power supply of encoder	1 \
			CN2 is disconnected.	cabling is shorted.	
				2. Encoder is faulty.	
			Improved when connector	Power supply of CN3 cabling is	
			CN3 is disconnected.	shorted.	
		Alarm occurs.	Refer to section 10.2 and remov	e cause.	Section 10.2
2	Switch on servo-on	Alarm occurs.	Refer to section 10.2 and remov	e cause.	Section 10.2
	(SON).	Servo motor shaft is	1. Check the display to see if	1. Servo-on (SON) is not input.	Section 6.6
		not servo-locked	the servo amplifier is ready	(Wiring mistake)	
		(is free).	to operate.	2. 24VDC power is not supplied	
			2. Check the external I/O	to COM.	
			signal indication to see if the		
		-	servo-on (SON) is ON.		
3	Switch on forward	Servo motor does not	Call the status display and	Analog speed command is 0V.	Section 6.2
	rotation start (ST1) or	rotate.	check the input voltage of the		
	reverse rotation start		analog speed command (VC).		
	(ST2).		Call the external I/O signal	LSP, LSN, ST1 or ST2 is off.	Section 6.6
			display and check the ON/OFF		
			status of the input signal.	Set value is 0.	Castian
			Check the internal speed commands 1 to 7	Set value is 0.	Section 5.1.2 (1)
			(parameters No.8 to 10 • 72 to		5.1.2 (1)
			75).		
			Check the internal torque limit	Torque limit level is too low as	
			1 (parameter No.28).	compared to the load torque.	
			When the analog torque limit	Torque limit level is too low as	-
			(TLA) is usable, check the	compared to the load torque.	
			input voltage on the status		
			display.		
4	Gain adjustment	Rotation ripples	Make gain adjustment in the	Gain adjustment fault	Chapter 7
		(speed fluctuations)	following procedure.		-
		are large at low	1. Increase the auto tuning		
		speed.	response level.		
			2. Repeat acceleration and		
			deceleration several times		
			to complete auto tuning.		
		Large load inertia	If the servo motor may be run	Gain adjustment fault	Chapter 7
		moment causes the	with safety, repeat acceleration		
		servo motor shaft to	and deceleration several times		
		oscillate side to side.	to complete auto tuning.		

Note. Switch power on again after making sure that the change lamp has turned off completely.

(2) Torque control mode

No.	Start-up sequence	Fault	Investigation	Possible cause	Reference
1	Power on (Note)	 LED is not lit. LED flickers. 	Not improved if connectors CN1, CN2 and CN3 are disconnected.	 Power supply voltage fault Servo amplifier is faulty. 	
			Improved when connectors CN1 is disconnected.	Power supply of CN1 cabling is shorted.	
r4U cor	n		Improved when connector CN2 is disconnected.	 Power supply of encoder cabling is shorted. Encoder is faulty. 	
			Improved when connector CN3 is disconnected.	Power supply of CN3 cabling is shorted.	
		Alarm occurs.	Refer to section 10.2 and remove cause.		Section 10.2
2	Switch on servo-on	Alarm occurs.	Refer to section 10.2 and remov	efer to section 10.2 and remove cause.	
	(SON).	Servo motor shaft is free.	Call the external I/O signal display and check the ON/OFF status of the input signal.	 Servo-on (SON) is not input. (Wiring mistake) 24VDC power is not supplied to COM. 	Section 6.6
3	Switch on forward rotation start (RS1) or reverse rotation start	Servo motor does not rotate.	Call the status display and check the analog torque command (TC).	Analog torque command is 0V.	Section 6.2
	(RS2).		Call the external I/O signal display and check the ON/OFF status of the input signal.	RS1 or RS2 is off.	Section 6.6
			Check the internal speed limits 1 to 7 (parameters No.8 to 10 • 72 to 75).	Set value is 0.	Section 5.1.2 (1)
			Check the analog torque command maximum output (parameter No.26) value.	Torque command level is too low as compared to the load torque.	
			Check the internal torque limit 1 (parameter No.28).	Set value is 0.	

Note. Switch power on again after making sure that the change lamp has turned off completely.

15.6.2 Alarms and warning list

POINT	
- Configure ι	ip a circuit which will detect the trouble (ALM) signal and turn off
the servo-c	n (SON) signal at occurrence of an alarm.

When a fault occurs during operation, the corresponding alarm or warning is displayed. If any alarm or warning has occurred, refer to section 10.2.2 or 10.2.3 and take the appropriate action. When an alarm occurs, the current circuit between ALM and VIN opens.

Set "DDD1" in parameter No.49 to output the alarm code in ON/OFF status across the corresponding pin and VIN. Warnings (AL.E0 to AL.E9) have no alarm codes. Any alarm code is output at occurrence of the corresponding alarm. In the normal status, the signals available before alarm code setting (CN1-12: ZSP, CN1-11: RD, CN1-10: SA) are output.

After its cause has been removed, the alarm can be deactivated in any of the methods marked O in the alarm deactivation column.

\setminus		(No	te 2) Alarm c	ode		Ala	arm deactivat	ion
	Display	CN1-10 pin	CN1-11 pin	CN1-12 pin	Name	Power OFF→ON	Press "SET" on current alarm screen.	Alarm reset (RES) signal
	AL.10	0	1	0	Undervoltage	0	0	0
1	AL.12	0	0	0	Memory error 1	0		
	AL.13	0	0	0	Clock error	0		
	AL.15	0	0	0	Memory error 2	0		
	AL.16	1	0	1	Encoder error 1	0		
	AL.17	0	0	0	Board error	0		
1	AL.19	0	0	0	Memory error 3	0		
1	AL.1A	1	0	1	Motor combination error	0		
1	AL.20	1	1	0	Encoder error 2	0		
	AL.24	0	0	1	Main circuit error	0		
Alarms	AL.30	0	1	0	Regenerative error	O (Note 1)	O (Note 1)	O (Note 1)
Alaı	AL.31	0	1	1	Overspeed	0	0	0
	AL.32	0	0	1	Overcurrent	0	0	0
	AL.33	0	1	0	Overvoltage	0		
	AL.37	0	0	0	Parameter error	0		
	AL.45	1	1	0	Main circuit device overheat	0	0	0
	AL.46	1	1	0	Servo motor overheat	0	0	0
	AL.50	1	1	0	Overload 1	○ (Note 1)	O (Note 1)	O (Note 1)
	AL.51	1	1	0	Overload 2	○ (Note 1)	O (Note 1)	O (Note 1)
	AL.8A	0	0	0	Serial communication time-out error	0	0	0
	AL.8E	0	0	0	Serial communication error	0	0	0
	88888	0	0	0	Watchdog	0		
s	AL.E0				Excessive regenerative warning	Demonstration of the		
Warnings	AL.E1				Overload warning		the cause of o	currence
/arr	AL.E6				Servo emergency stop warning	deactivates the alarm automatically.		
\leq	AL.E9				Undervoltage warning	automatical	y.	

Note 1. Deactivate the alarm about 30 minutes of cooling time after removing the cause of occurrence.

2. 0: off

App. Change of connector sets to the RoHS compatible products

The following connector sets have been changed to RoHS compliant since September 2006. RoHS compliant and non-RoHS compliant connector sets may be mixed based on availability. Only the components of the connector set that have changed are listed below.

	Model	Current product	RoHS compatible product
	MR-ESCBL⊡M-L	Encoder cable (DDK)	Encoder cable (DDK)
	MR-ESCBL⊡M-H	MS3106B20-29S (Plug)	D/MS3106B20-29S (Plug)
		MS3057-12A (Cable clump)	D/MS3057-12A (Cable clump)
heel	MR-ENECBL□M-L	Encoder cable (DDK)	Encoder cable (DDK)
	4U.com	MS3106A20-29S(D190) (Plug)	D/MS3106A20-29S(D190) (Plug)
		CE3057-12A-3(D265) (Cable clump)	CE3057-12A-3-D (Cable clump)
		CE02-20BS-S (Back shell)	CE02-20BS-S-D (Back shell)
	MR-ECNS	Encoder cable (DDK)	Encoder cable (DDK)
		MS3106B20-29S (Plug)	D/MS3106B20-29S (Plug)
		MS3057-12A (Cable clump)	D/MS3057-12A (Cable clump)
	MR-ENECNS	Encoder cable (DDK)	Encoder cable (DDK)
		MS3106A20-29S (D190) (Plug)	D/MS3106A20-29S (D190) (Plug)
		CE3057-12A-3 (D265) (Cable clump)	CE3057-12A-3-D (Cable clump)
		CE02-20BS-S (Back shell)	CE02-20BS-S-D (Back shell)
	MR-PWCNS4	Motor power supply connector (DDK)	Motor power supply connector (DDK)
		CE05-6A18-10SD-B-BSS (Connector and Back shell)	CE05-6A18-10SD-D-BSS (Connector and Back shell)
		CE3057-10A-1 (D265) (Cable clump)	CE3057-10A-1-D (Cable clump)
	MR-PWCNS5	Motor power supply connector (DDK)	Motor power supply connector (DDK)
		CE05-6A22-22SD-B-BSS (Connector and Back shell)	CE05-6A22-22SD-D-BSS (Connector and Back shell)
		CE3057-12A-1 (D265) (Cable clump)	CE3057-12A-1-D (Cable clump)

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