

Safety Instructions and Precautions for AC Servos

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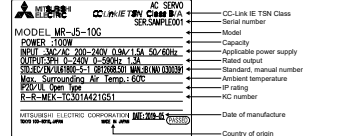
MITSUBISHI ELECTRIC CORPORATION
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 Specifications are subject to change without notice. Compliance with the indicated global standards and regulations is current as of the release date of this installation guide. The original instructions for Europe are in English.

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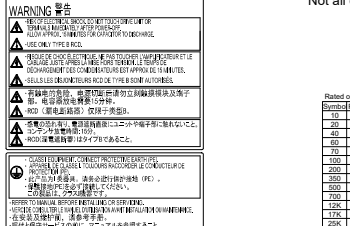
Contents of the package
 Unpack the product and check the rating plate to see if the servo amplifier is as you ordered.

Contents	Quantity
Servo amplifier	1
MELSERVO-J5 Series Safety Instructions and Precautions for AC Servos (This guide)	1

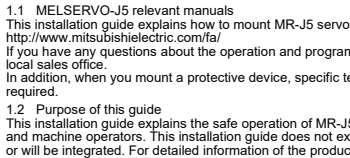
Rating plate
 The following shows an example of rating plate for explanation of each item.



Warning plate
 The following shows an example of warning plate.



Model
 The following describes what each block of a model name indicates. Not all combinations of the symbols are available.



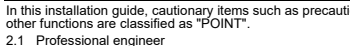
1. About the manuals
 To use the MELSERVO-J5 series safely, read MR-J5 User's Manual carefully.

1.1 MELSERVO-J5 relevant manuals
 This installation guide explains how to mount MR-J5 servo amplifiers. You can also check it with our website for free.

1.2 Purpose of this guide
 This installation guide explains the safe operation of MR-J5 servo amplifiers for engineers of machinery manufacturers and machine operators. This installation guide does not explain how to operate machines in which safe servo system is, or will be integrated. For detailed information of the products, refer to MR-J5 User's Manual.

1.3 Terms related to safety
 1.3.1 IEC 61800-5-2:2016 3 PL e, IEC/EN IEC 62061:2021 maximum SIL 3, IEC/EN 61800-5-2 (STO)
 STO function (Refer to IEC 61800-5-2:2016 3 PL e, IEC/EN IEC 62061:2021 maximum SIL 3, IEC/EN 61800-5-2 (STO))
 STO function shuts down energy to servo motors, thus removing torque. This function electronically cuts off power supply in the servo amplifier. The servo amplifiers without the CN8 connector do not support this function. STO function does not support Stop category 1 and 2 for IEC/EN 60204-1.

2. About safety
 This chapter explains safety of users and machine operators. Please read the chapter carefully before mounting the equipment. In this installation guide, the specific warnings and cautions levels are classified as follows.



In this installation guide, cautionary items such as precautions that may lead to property damages, and instructions for other functions are classified as "POINT".

2.1 Professional engineer
 Only professional engineers should mount MR-J5 servo amplifiers. Here, professional engineers should meet all the conditions below.

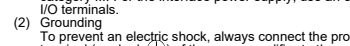
(1) Persons who took a proper training of related work of electrical equipment or persons who can avoid risk based on past experience.

(2) Persons who have read and familiarized himself/herself with this installation guide and operating manuals for the protective devices (e.g. light curtain) connected to the safety control system.

2.2 Applications of MR-J5 servo amplifiers
 MR-J5 servo amplifiers are used to drive servo motors, and comply with the standards shown below.

• IEC/EN 61800-5-1/GB 12668.501, IEC/EN 61800-3/GB 12668.3/KN 61800-3 (KS C 9800-3), IEC/EN 60204-1 (Stop category)
 • ISO/IEC 13849-1:2015 Category 3 PL e, IEC/EN IEC 62061:2021 maximum SIL 3, IEC/EN 61800-5-2 (STO)

2.3 Correct use
 Use the MR-J5 servo amplifiers within specifications. Refer to MR-J5 User's Manual for specifications such as voltage, temperature, etc. Mitsubishi Electric Co. accepts no claims for liability if the equipment is used in any other way or if modifications are made to the device, even in the context of mounting and installation.

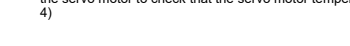


2.3.1 Peripheral device and power wiring
 The followings are selected based on IEC/EN/UL 61800-5-1, and CSA C22.2 No. 174.

(1) Power supply
 This servo amplifier can be supplied from star-connected supply with grounded neutral point of overvoltage category III. For the interface power supply, use an external 24 V DC power supply with reinforced insulation on I/O terminals.

(2) Grounding
 To prevent an electric shock, always connect the protective earth (PE) terminal (marked with a ground symbol) of the servo amplifier to the protective earth (PE) of the cabinet. Do not connect two grounding cables to the same protective earth (PE) terminal. Always connect cables to the terminals one-to-one.

(3) Motor overload and Over temperature protection
 The overload protection of the servo motor does not include a thermal memory function, and is not speed sensitive. The servo amplifier cannot detect overheating of the servo motor. The servo motors are protected by the servo motor overheat protection function of the servo amplifiers (a protection characteristic based on 120 % of the rated current). To provide the servo motor with overheat protection, use a magnetic contactor (electromagnetic switch) with a thermal relay. Alternatively, install a thermal sensor or equivalent equipment near the rating plate of the servo motor to check that the servo motor temperature is under 105 °C with sensing device. (Refer to Chapter 4)



(4) Power Wiring (local wiring and crimping tool)
 The following table shows the stranded wire sizes [AWG] and the crimp terminal symbols rated at 75 °C.

Servo amplifier *1	75 °C stranded wire [AWG] *1		Crimp terminal		Manufacturer
	L1/L2/L3	L1/L1/L21	P+/C	U/V/W/E *1	
MR-J5-10 / MR-J5-20 MR-J5-40 / MR-J5-60 (4) / MR-J5-100 (4) / MR-J5-200 (4) (T) MR-J5-25K	14: a *3			14: a *3	JST Co., Ltd.
MR-J5-350 MR-J5-200 (S)	12: b *3	14		12: b *3	
MR-J5-500 MR-J5-700 MR-J5-12K	10: c *3 8: d *3 4: e			8: d *3 4: e	
MR-J5-17K MR-J5-25K MR-J5-25K_4	10: j 10: l 14: a	14: k		10: j 10: l 14: a	
MR-J5-700_4 MR-J5W_4	12: b *3 14: a	14	14	12: b *3 14: a	
MR-J5-350_4 MR-J5-700_4 MR-J5-17K_4	8: g 12: i 12: i		14: m 12: i	8: g 12: i 12: i	
MR-J5-25K_4	4: p	12: l	4: p	12: l	

*1 Optional cables provided by Mitsubishi Electric and Mitsubishi Electric System Service Co., Ltd. are available. The wire sizes can be selected based on the rated current of the servo amplifiers. The values in the table are sizes based on rated output of the servo amplifiers.
 *2 "S" means 1-phase 200 V AC power input and "T" means 3-phase 200 V AC power input in the table.
 *3 The crimp terminals are used only for grounding.
 *4 The alphabetical letters in the table indicate the symbols of the recommended crimp terminals. Refer to Table 2 for recommended crimp terminals.

(5) Selection example of MCCB and semiconductor fuse
 Use UL recognized semiconductor fuses or molded-case circuit breaker (489 Listed MCCB) as the following table. The semiconductor fuses and molded-case circuit breakers in the table are selection examples based on rated I/O of the servo amplifiers and are suitable for output servo motor conductor protection. The maximum rating of the servo motor branch short-circuit/ground-fault protective device can be selected based on the rated input current of the servo amplifier. When you select a smaller capacity servo motor to connect to the servo amplifier, you can also use smaller capacity semiconductor fuses or molded-case circuit breaker than those listed in the table. To select different semiconductor fuses and molded-case circuit breakers from those listed in the table, and for selection of the motor circuit breaker (Type E combination motor controller), refer to "MR-J5 User's Manual (Hardware)".

Servo amplifier (200 V class) *1	Molded-case circuit breaker (240 V AC) SCRR 50 kA	Semiconductor fuse (700 V) SCRR 100 kA
MR-J5-10 / MR-J5-20 / MR-J5-40 / MR-J5-60 / MR-J5-100 / MR-J5-200 (S) / MR-J5-200 (T) / MR-J5W2-22 (S) / MR-J5W2-1010 / MR-J5W3-222 (S) / MR-J5W3-444 (T)	NF125-SVU-15A (125 A frame 15 A)	170M1408 (10 A)
MR-J5-350 / MR-J5-500 / MR-J5-700 (S) / MR-J5-12K (S) / MR-J5-17K (S) / MR-J5-25K (S)	NF125-SVU-15A (125 A frame 15 A)	170M1409 (16 A)
MR-J5-100 (S) / MR-J5-200 (S) / MR-J5-350 (S) / MR-J5-500 (S) / MR-J5-700 (S) / MR-J5-12K (S) / MR-J5-17K (S) / MR-J5-25K (S)	NF125-SVU-20A (125 A frame 20 A)	170M1412 (32 A)
MR-J5-350_4 / MR-J5-700_4 / MR-J5-17K_4 / MR-J5-25K_4	NF125-SVU-30A (125 A frame 30 A)	170M1415 (63 A)
MR-J5-350_4 / MR-J5-700_4 / MR-J5-17K_4 / MR-J5-25K_4	NF125-SVU-40A (125 A frame 40 A)	170M1416 (80 A)
MR-J5-350_4 / MR-J5-700_4 / MR-J5-17K_4 / MR-J5-25K_4	NF125-SVU-75A (125 A frame 75 A)	170M1418 (125 A)
MR-J5-17K_4 / MR-J5-25K_4	NF125-SVU-100A (125 A frame 100 A)	170M1419 (160 A)
MR-J5-25K_4	NF250-SVU-150A (250 A frame 150 A)	170M1421 (250 A)

*1 "S" means 1-phase 200 V AC power input and "T" means 3-phase 200 V AC power input in the table.
 *2 For the use under the conditions of UL Listed, select a semiconductor fuse.
 *3 For the use under the conditions of UL Listed, select a semiconductor fuse.
 *4 For the use under the conditions of UL Listed, select a semiconductor fuse.

2.3.2 Europe/UK compliance
 The CE/UKCA marking proves the compliance of the servo product with the essential requirements specified in the relevant EU Directives and UK Regulations, and this marking also applies to machines and equipment incorporating servos.

(1) EMC requirement
 MR-J5 servo amplifiers comply with EN/BS EN IEC 61800-3. As for I/O wires (max. length 10 m), motor cables and encoder cables (max. length 50 m), use shielded wires and ground the shields. Install the surge protector on the primary side of the EMC filter. In addition, use a line noise filter BFE series for inputs and outputs of the 12 kW and 17 kW of 200 V class servo amplifiers. The recommended products are as follows.

EMC filter: COSEL FSB Series or Soshin Electric HF3000C-S2B series
 Surge protector: Okaya Electric Industries RSPD series or Soshin Electric LT-CS-W5 series
 Line noise filter: Mitsubishi Electric FR-Bif, Kitagawa Industries BRE Series

MR-J5 Series are recommended to be used on a low-voltage network which supplies domestic premises; electromagnetic interference is expected if used on such a network. The installer shall provide a guide for installation and use, including recommended mitigation devices. To avoid the risk of crosstalk to signal cables, the installation instructions shall either recommend that the power interface cable be segregated from signal cables. Install the DC power supply for I/O signals of the servo amplifiers in the same cabinet. Do not connect the other electric devices to the DC power supply.

(2) For Declaration of Conformity (DoC)
 We declare that the servo amplifiers are in compliance with EC directives (Machinery directive (2006/42/EC), EMC directive (2014/30/EU), Low-voltage directive (2011/65/EU), and RoHS directive (2011/65/EU), (EU) 2015/863) and applicable regulations of the UK. For the copy of Declaration of Conformity, contact your local sales office.

2.3.3 USA/Canada compliance
 This servo amplifier is designed in compliance with UL 61800-5-1 and CSA C22.2 No. 274.

(1) Installation
 The minimum cabinet size is 150 % of each MR-J5 servo amplifier's volume. Also, design the cabinet so that the ambient temperature in the cabinet is 60 °C or less. The servo amplifier must be installed in the metal cabinet. Additionally, mount the servo amplifier on a cabinet that the protective earth based on the standard of IEC/EN 60204-1 is correctly connected. For environment, the units should be used in open type (UL 50) and overvoltage category shown in table in section 8.1. The servo amplifier needs to be installed at or below pollution degree 2. For connection, use copper wires.

(2) Short-circuit current rating (SCCR)
 Suitable For Use As A Circuit Capable Of Delivering Not More Than 100 kA rms Symmetrical Amperes, 240 Volts Maximum for 200 V AC servo amplifiers, or Not More Than 100 kA rms Symmetrical Amperes, 480 Volts Maximum for 400 V AC servo amplifiers. For SCRR (25 kA and 50 kA) when using a motor circuit breaker (Type E combination motor controller), refer to "MR-J5 User's Manual (Hardware)".

(3) Branch circuit 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 Canadian Electrical Code and any applicable provincial codes.

2.3.4 South Korea compliance
 Products that bear the KC mark comply with the Radio Wave Law. Please note the following to use the product. 이 기기는 업무용 (A급) 전자파 적합기기로서 판매자 또는 사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

(The product is for business use (Class A) and meets the electromagnetic compatibility requirements. The seller and the user must note the above point, and use the product in a place except for home.)
 In addition, use an EMC filter, surge protector, ferrite core, and line noise filter on the primary side for inputs. Use a ferrite core and line noise filter for outputs.

The self-declaration of conformity for the applicable models can be checked on the website at the address where the "KC number" of the rated nameplate is in the "KC number" field of the URL below.
 https://www.rta.go.kr/selformKC_number

2.4 General cautions for safety protection and protective measures
 Observe the following items to ensure proper use of the MR-J5 servo amplifiers.

(1) Only qualified personnel and professional engineers should perform the installation of safety components and systems.

(2) When mounting, installing, and using the MR-J5 servo amplifier, always observe the standards and directives applicable in the respective countries.

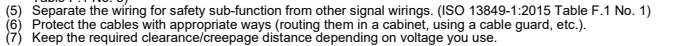
2.5 Residual risk
 (1) Be sure that all safety related switches, relays, sensors, etc., meet the required safety standards.
 (2) Perform all risk assessments and safety level certification to the machine or the system as a whole.
 (3) If the upper and lower power module in the servo amplifier are shorted and damaged simultaneously, the servo motor may make a half revolution at a maximum.
 (4) Only qualified personnel are authorized to install, start-up, repair or service the machines in which these components are installed. Only trained engineers should install and operate the equipment. (ISO 13849-1:2015 Table F.1 No. 5)

(5) Separate the wiring for safety sub-function from other signal wirings. (ISO 13849-1:2015 Table F.1 No. 1)
 (6) Protect the cables with appropriate wiring such as cable guard, etc. (F.1)
 (7) Keep the required clearance/creepage distance depending on voltage you use.

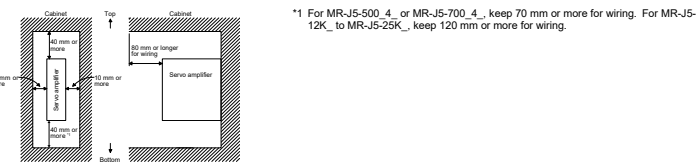
2.6 Disposal
 Disposal of unusable or irreparable devices should always occur in accordance with the applicable country-specific waste disposal regulations. (Example: European Waste 16 02 14)

2.7 Lithium battery transportation
 To transport lithium batteries, take actions to comply with the instructions and regulations such as the United Nations (UN), the International Civil Aviation Organization (ICAO), and the International Maritime Organization (IMO). The batteries (MR-BATV1SET, MR-BATV1SET-A, and MR-BATV1SET-B) are not subject to the dangerous goods (Class 9) of the UN Recommendations.

3. Mounting/disconnecting
 Installation direction and clearances



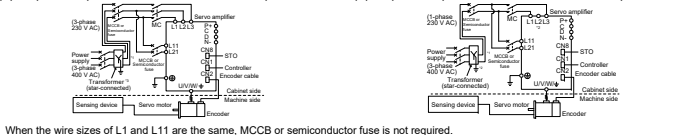
POINT
 ● To prevent malfunction, install the servo amplifier in the specified direction.
 ● Mount the servo amplifier on a cabinet which meets IP54 in the correct vertical direction to maintain pollution degree 2.
 ● The IP rating of the regenerative resistor supplied with the servo amplifier of 12 kW to 25 kW is IP00. Take appropriate safety measures according to the device configuration.



4. Electrical Installation and configuration diagram
 POINT
 ● The installation complies with IEC/EN 60204-1. The voltage supply to machines must be 20 ms or more of tolerance against instantaneous power failure as specified in IEC/EN 60204-1.
 ● To prevent unexpected movement of the servo motor, securely connect the wire with the specified method and torque.

The following shows representative configuration examples to conform to the IEC/EN/UL/CSA standards. The connectors described by rectangles are safely separated from the main circuits by circles.

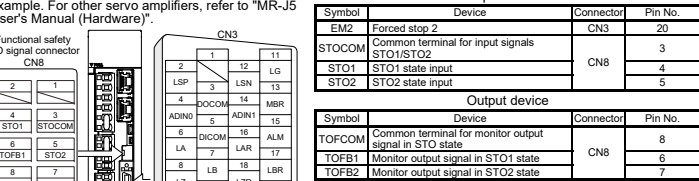
(1) 3-phase input for MR-J5 1-axis servo amplifier (2) 1-phase input for MR-J5 1-axis servo amplifier



*1 When the wire sizes of L1 and L11 are the same, MCCB or semiconductor fuse is not required.
 *2 For 1-phase 200 V AC servo amplifiers, connect the lines to L1 and L3.
 *3 For 400 V class, a step-down transformer is not required.

Connectable motors are limited as follows:
 (1) Servo motors manufactured by Mitsubishi Electric (HK/LM/TM series)
 (2) Other servo motors complying with IEC 60034-1 which are used with a Mitsubishi Electric serial interface-compatible encoder or with an A/B/Z-phase differential output type encoder

5. Signals
 5.1 Signal
 The following shows MR-J5-10G signals as a typical example. For other servo amplifiers, refer to "MR-J5 User's Manual (Hardware)".



5.2 I/O device
 Input device
 Symbol: EM2 Forced stop 2, STOCOM Common terminal for input signals STO1/STO2, STO1 STO state input, STO2 STO2 state input
 Device: CN3, CN8, CN8
 Connector: CN3, CN8
 Pin No.: 20, 3, 4, 5

Output device
 Symbol: TOFCOM Common terminal for monitor output signal in STO state, TOFB1 Monitor output signal in STO1 state, TOFB2 Monitor output signal in STO2 state
 Device: CN8, CN8
 Connector: CN8
 Pin No.: 8, 6, 7

5.3 Signals and STO state
 The following table shows the STO1 and STO2 states when the power is on in normal state and STO1 and STO2 are on (closed) or off (opened).

STO1	STO2	Monitoring STO1 state	Monitoring STO2 state
OFF	OFF	ON (STO state)	ON (STO state)
OFF	ON	ON (STO state)	OFF (STO release)
ON	OFF	OFF (STO release)	ON (STO state)
ON	ON	OFF (STO release)	OFF (STO release)

6. Maintenance, service and trouble shooting
 Only qualified personnel should attempt inspections. For repair and parts replacement, contact your local sales office.

6.1 Inspection items
 It is recommended that the following points should be checked.
 (1) Check for loose terminal block screws. Retighten any loose screws.

Servo amplifier	L1	L2	L3	N-	P3	P4	PA/A	P+	C	D	L11	L21	U	V	W
MR-J5-10 / MR-J5-20 / MR-J5-40 / MR-J5-60 (4) / MR-J5-100 (4) / MR-J5-200 (4) / MR-J5-350 (4) / MR-J5-500 (4) / MR-J5-700 (4)															
MR-J5W_4															
MR-J5-12K (4) / MR-J5-17K (4)					3.0						1.2				3.0
MR-J5-25K (4)					6.0						1.2				6.0

(2) Servo motor bearings, brake section, etc. for unusual noise.
 (3) Check the cables and the like for scratches or cracks. Perform periodic inspection according to operating conditions.
 (4) Check that the connectors are securely connected to the servo motor.
 (5) Check that the wires are not coming out from the connector.
 (6) Check for dust accumulation on the servo amplifier.
 (7) Check for unusual noise generated from the servo amplifier.
 (8) Check the servo motor shaft and coupling for connection.
 (9) Make sure that the emergency stop circuit operates properly such that an operation can be stopped immediately and a power is shut off by the emergency stop switch.

6.2 Parts having service life
 Service life of the following parts is listed below. However, the service life varies depending on operation and environment. If any fault is found in the parts, they must be replaced immediately regardless of their service life. For parts replacement, please contact your local sales office.

Part name	Life guideline
Smoothing capacitor	10 years * 1</td
Relay	Total number of power-ons, stops by a dynamic brake, and forced stops: 100,000 times
Cooling fan	50,000 hours to 70,000 hours (7 years to 8 years)
Battery backup time **	Approximately 20,000 hours (equipment power supply; off; ambient temperature: 20 °C)
Battery life **	5 years from date of manufacture

*1 When MR-J5 1-axis servo amplifier is being used in combination with a rotary servo motor that requires battery to configure an absolute position detection system, and if being used with either MR-BATV1SET or MR-BATV1SET-A. For details and other battery backup time, refer to "MR-J5 User's Manual (Hardware)".
 *2 Quality of the batteries degrades by the storage condition. The battery life is 5 years from the production date regardless of the connection status. If a 3-phase power supply is used, the service life of the capacitor is 10 years under continuous operation in air-conditioned environments (ambient temperatures of 40 °C or less at altitudes of up to 1000 m and 30 °C or less at altitudes of over 1000 m and up to 2000 m). The characteristic smoothing capacitor is deteriorated due to ripple currents, etc. The service life of the capacitor greatly varies depending on ambient temperatures and operating conditions.

6.3 Trouble shooting for STO
 When the input signals status (STO1 / STO2) do not same, and the fault detected by the diagnostic function, the alarm number [AL 068 STO diagnosis error] is displayed on the LED of the servo amplifier.

7. Environment
 Transport the products correctly according to their mass.
 For detailed information on transportation and handling of the battery, refer to "MR-J5 User's Manual (Hardware)".
 Under conditions of a load-bearing place of servo amplifier and servo motor in accordance with the User's manual. Do not put excessive load on the machine.
 When you keep or use it, please fulfill the following environment.

	Operation	Transportation	Storage
Ambient temperature	0 °C to 60 °C (non-freezing) Class 3K3 (IEC 60721-3-3)	-25 °C to 70 °C (non-freezing) Class 2K2 (IEC 60721-3-2)	-25 °C to 70 °C (non-freezing) Class 1K4 (IEC 60721-3-1)
Ambient humidity	5 % RH to 95 % RH (non-condensing)	5 % RH to 95 % RH (non-condensing)	5 % RH to 95 % RH (non-condensing)
Ambience	Indoors (no direct sunlight); no corrosive gas, inflammable gas, oil mist or dust		
Altitude/ atmospheric pressure	Altitude: Max. 2000 m *1	Transportation conditions: Overland/sea transportation, or transportation by airplane whose cargo compartment is pressurized at 700 hPa or higher.	Atmospheric pressure: 700 hPa to 1060 hPa (Equivalent to altitudes from -400 m to 3000 m)
Vibration resistance	Under intermittent vibration: 10 Hz to 57 Hz, displacement amplitude 0.1 mm (single amplitude) 7.5 mm 57 Hz to 150 Hz, acceleration amplitude 0.8 m/s ² Class 3M1 (IEC 60721-3-3) Under continuous vibration (X, Y, Z axes): 10 Hz to 55 Hz, acceleration amplitude 5.9 m/s ²	2 Hz to 9 Hz, displacement amplitude 0.1 mm (single amplitude) 7.5 mm 9 Hz to 200 Hz, acceleration amplitude 20 m/s ² Class 2M3 (IEC 60721-3-2)	2 Hz to 9 Hz, displacement amplitude 0.1 mm (single amplitude) 1.5 mm 9 Hz to 200 Hz, acceleration amplitude 5 m/s ² Class 1M2 (IEC 60721-3-1)

*1 For the restrictions on the use of this product at altitude exceeding 1000 m, refer to MR-J5 User's Manual (Hardware).

8. Specifications
 8.1 MR-J5 servo amplifier

Item	MR-J5-10 / MR-J5-20 / MR-J5-40 / MR-J5-60 (4) / MR-J5-100 (4) / MR-J5-200 (4) / MR-J5-350 (4) / MR-J5W3-
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