

Instructions and Cautions for Safe Use of AC Servos

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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.

(1) Converter unit	Contents	Quantity	(2) Drive unit	Contents	Quantity
Converter unit	1	1	Drive unit	1	1
Eyebolt (55 kW or more)	2	2	Bus bar (30 kW or more)	2	2
Connector set (Note)	1	1	Eyebolt (30 kW or more)	2	2
MR-CV11K4/MR-CV11K4-4/ MR-CV75K4/ MR-CR55K/MR-CR55K-4/ MR-J4-DU700_4 to MR-J4-DU37K/ MR-J4-DU55K_4	1	1	MR-CV11K4/MR-CV11K4-4/ MR-CV75K4/ MR-CV30K4/MR-CV37K4/MR-CV45K4/ MR-CV55K4/MR-CV55K4-4/ MR-J4-DU30K/ MR-J4-DU37K/ MR-J4-DU55K_4	1	1

Note: A connector set for CN2 is packed together with MR-CV. A connector set for CN3 is packed together with MR-CV.

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

Converter unit	Drive unit
MODEL MR-CR55K	MODEL MR-J4-DU30K
Serial number	Serial number
Model	Model
Capacity	Capacity
Rated output power supply	Rated output power supply
Rated output current	Rated output current
Standard, Manual number	Standard, Manual number
IP rating	IP rating
IP certification number	IP certification number
The year and month of manufacture	The year and month of manufacture
Country of origin	Country of origin

Warning plate
The following shows an example of warning plate.



Model
The following describes what each block of a model name indicates.

(a) Converter unit	(b) Drive unit
MR-CR55K4	MR-J4-DU30K4
Series, MR-CRMR-CV	Series
Capacity	Capacity
Rated output power supply	Rated output power supply
Rated output current	Rated output current
Standard, Manual number	Standard, Manual number
IP rating	IP rating
IP certification number	IP certification number
The year and month of manufacture	The year and month of manufacture
Country of origin	Country of origin

1. About the manuals

To use the MELSERVO-J4 series safely, read each instruction manual carefully. Converter units and drive units are written as servo amplifiers in this guide under certain circumstances.

1.1 MELSERVO-J4 relevant manuals
This installation guide explains how to mount MR-J4 servo amplifiers. You can also check it with our website for free. <http://www.mitsubishielectric.com/ta/>
If you have any questions about the operation or programming of the equipment described in this guide, contact your local sales office.
In addition, when you mount a protective device, specific technical skills which are not detailed in the guide will be required.

1.2 Purpose of this guide
This installation guide explains the safe operation of MR-J4 servo amplifiers for engineers of machinery manufacturers and machine operators. This installation guide does not explain how to operate machines in which safety servo system is, or will be integrated. For detailed information of the products, refer to each servo amplifier instruction manual.

1.3 Terms related to safety
1.3.1 IEC 61800-5-2 Stop function
STO function (Refer to IEC 61800-5-2: 2007 4.2.2.2 STO.)
MR-J4 servo amplifiers have the STO function. The STO function shuts down energy to servo motors, thus removing torque. This function electronically cuts off power supply in the servo amplifier.

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.

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

2.1 Professional engineer
Only professional engineers should mount MR-J4 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 the devices
MR-J4 servo amplifiers comply with the following standards.
ISO/IEC 13849-1 Category 3 PL e, IEC/EN 62061 SIL CL 3, IEC/EN 61800-5-2 (STO), IEC/EN 61800-5-1/GB 12668.501, IEC/EN/KN 61800-3/GB 12668.3, IEC/EN 60204-1
MR-J4 servo amplifiers can be used with the MR-D30 functional safety unit, MR-J3-D05 safety logic unit, or safety PLCs. For combinations of the servo amplifiers and MR-D30, refer to "MR-D30 Instruction Manual". For combinations of the servo amplifiers and MR-J3-D05, refer to each servo amplifier instruction manual.

2.3 Correct use
Use the MR-J4 servo amplifiers with specifications. Refer to each instruction 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.

WARNING If you need to get close to the moving parts of the machine for inspection or others, ensure safety by confirming the power off, etc. Otherwise, it may cause an accident.
It takes 20 minutes maximum for capacitor discharging. Do not touch the unit and terminals immediately after power off.

2.3.1 Selection of peripheral equipment and wire
The following are selected based on IEC/EN 61800-5-1, UL 508C, and CSA C22.2 No. 14.
(1) Local wiring and crimping tool
The following table shows the stranded wire sizes [AWG] and the crimp terminal symbols rated at 75 °C/60 °C.

Table 1. Recommended wire			
Converter unit	75 °C/60 °C stranded wire [AWG] (Note 2)	Drive unit	75 °C/60 °C stranded wire [AWG] (Note 2)
MR-CV11K (Note 1)	8: 16G-1	MR-J4-DU700 (Note 1)	8: 0.6 m
MR-CV18K (Note 1)	8: 16G-1	MR-J4-DU300 (Note 1)	8: 0.6 m
MR-CV30K (Note 1)	2: 11/10	MR-J4-DU11K (Note 1)	4: e/2-n
MR-CV37K (Note 1)	10: 1/10	MR-J4-DU15K (Note 1)	2: a/10/1
MR-CV45K (Note 1)	1/0: j/-	MR-J4-DU22K (Note 1)	1/0: j/-
MR-CV55K (Note 1)	3/0: k/-	MR-J4-DU30K (Note 1)	2: 0.2/0
MR-CV11K4 (Note 1)	10: 1/10	MR-J4-DU37K (Note 1)	2: 2/10 (Note 4)
MR-CV18K4 (Note 1)	8: 16G-1	MR-J4-DU37K4 (Note 1)	-
MR-CV30K4 (Note 1)	6: 14G-4	MR-J4-DU700 (Note 1)	10: p/10-p
MR-CV37K4 (Note 1)	4: e/2-n	MR-J4-DU300 (Note 1)	8: 0.6 m
MR-CV45K4 (Note 1)	4: e/2-n	MR-J4-DU11K (Note 1)	8: 0.6 m
MR-CV55K4 (Note 1)	2: 11/10	MR-J4-DU15K (Note 1)	6: 16G-6
MR-CV11K4-4 (Note 1)	14: g/14-g	MR-J4-DU22K (Note 1)	4: e/2-n
MR-CV18K4-4 (Note 1)	-	MR-J4-DU30K (Note 1)	3: e/2-f
MR-CV30K4-4 (Note 1)	-	MR-J4-DU37K (Note 1)	2: 2/1-c
MR-CV37K4-4 (Note 1)	-	MR-J4-DU37K4 (Note 1)	1/0: d/10-1
MR-CV45K4-4 (Note 1)	-	MR-J4-DU55K (Note 1)	1/0: d/20-1
MR-CV55K4-4 (Note 1)	-	MR-J4-DU55K4 (Note 1)	-

Note: 1. To connect these models to a terminal block, be sure to use the screws that come with the terminal block.
2. Alphabets in the table indicate crimping tools. For crimping terminals and applicable tools, refer to table 2.
3. Select wire sizes depending on the rated output of the servo motors. The values in the table are sizes based on rated output of the servo amplifiers.
4. When the rated current is less than 175 A, 2/0: d can also be used.

Table 2. Recommended crimp terminal			
Symbol	Servo amplifier-side crimp terminals	Applicable tool	Manufacturer
a	FVDS-5-T	YNT-1210S	JST (U.S.T. Mfg. Co. Ltd.)
b	FVDZ2-10	YF-1E-4	JST (U.S.T. Mfg. Co. Ltd.)
c (Note 1)	R38-10	YF-1E-2	JST (U.S.T. Mfg. Co. Ltd.)
d (Note 1)	R60-10	YPT-60-21	JST (U.S.T. Mfg. Co. Ltd.)
e	FVD22-8	YF-1E-4	JST (U.S.T. Mfg. Co. Ltd.)
f (Note 1)	R38-9	YPT-60-21	JST (U.S.T. Mfg. Co. Ltd.)
g	FV02-4	YNT-1210S	JST (U.S.T. Mfg. Co. Ltd.)

Note: 1. Coat the crimping part with an insulation tube.
2. Some crimp terminals may not be mounted depending on their sizes. Make sure to use the recommended ones or equivalent ones.

(2) Selection example of MCCB and fuse
Use a fuse (T class) or the molded-case circuit breaker (UL 489 Listed MCCB) indicated in the table below. The T class fuses and molded-case circuit breakers in the table are selected examples based on rated I/O of the servo amplifiers. When you select a smaller capacity servo motor to connect to the servo amplifier, you can also use smaller capacity T class fuses or molded-case circuit breaker than ones in the table. For selecting ones other than Class T fuses and molded-case circuit breakers below, refer to each servo amplifier instruction manual.

Converter unit	Molded-case circuit breaker (240 V AC)	Fuse (300 V)
MR-CV11K	MF100-CV-FU-60A (100 A frame 60 A)	80 A
MR-CV18K	MF100-CV-FU-100A (100 A frame 100 A)	150 A
MR-CV30K	NP225-CV-FU-150A (225 A frame 150 A)	225 A
MR-CV37K	NP225-CV-FU-200A (225 A frame 200 A)	300 A
MR-CV45K	NP225-CV-FU-225A (225 A frame 225 A)	350 A
MR-CV55K	NP400-SW-300A (400 A frame 300 A)	400 A
MR-CR55K	NP225-CV-FU-175A (225 A frame 175 A)	300 A

(3) Power supply
This servo amplifier can be used on the condition of overvoltage category III set forth in IEC/EN 60664-1. For the interface power supply, use an external 24 V DC power supply with reinforced insulation on I/O terminals.

(4) Grounding
To prevent an electric shock, always connect the protective earth (PE) terminal (marked ⊕) 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. This product can cause a DC current in the protective earthing conductor. Where a residual current-operated protective (RCD: earth-leakage current breaker) device is used for protection in case of direct or indirect contact, only an RCD of Type B is allowed on the supply side of this product.

2.3.2 EU compliance
The EC directives were issued to standardize the regulations of the EU countries and ensure smooth distribution of safety-guaranteed products. The CE marking proves the compliance of the manufacturer with the EC directives, and this marking also applies to machines and equipment incorporating servos.

(1) EMC requirement
MR-J4 servo amplifiers comply with category C3 in accordance with EN 61800-3. As for I/O wires (max. length 10 m), however, 3 m for STO cable for CN3 and encoder cables (max. length 50 m), use shielded wires and ground the shields. Install an EMC filter and surge protector on the primary side of the servo amplifier. In addition, use a line noise filter for outputs of the servo amplifiers.
EMC filter: Soshin Electric HF3000A-UN series, TF3000C-TX series, COSSEL FTB series
Surge protector: Okaya Electric Industries RSPD series Line noise filter: Mitsubishi Electric FR-BIF
MR-J4 Series are not intended to be used on a low-voltage public network which supplies domestic premises; Radio frequency 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.
(2) For Declaration of Conformity (DoC)
Hereby, MITSUBISHI ELECTRIC EUROPE B.V. declares that the servo amplifiers are in compliance with EC directives (Machinery directive (2006/42/EC), EMC directive (2014/30/EU), Low voltage directive (2014/35/EU), and RoHS directive (2011/65/EU)). 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 508C and CSA C22.2 No. 14.

(1) Installation
The minimum cabinet size is 150% of each MR-J4 servo amplifier's volume. Also, design the cabinet so that the ambient temperature in the cabinet is 55 °C or less. The servo amplifier must be installed in a 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 chapter 8. The servo amplifier needs to be installed at or below pollution degree 2. Use only copper wires or copper bus bars for wiring.
(2) Short-circuit current rating (SCCR)
Suitable For Use On A Circuit Capable Of Delivering Not More Than 100 kA rms Symmetrical Amperes, 500 Volts Maximum.
(3) Overload protection characteristics
The MR-J4 servo amplifiers have servo motor overload protective function. (It is set on the basis (full load current) of 120% rated current of the servo amplifier.)
(4) Over-temperature protection for machinery
Motor Over temperature sensing is not provided by the drive. Integral thermal protection(s) is necessary for motor and refer to chapter 4 for the proper connection.
(5) 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 code.
For installation in Canada, branch circuit protection must be provided, in accordance with the Canada Electrical Code and any applicable provincial codes.

2.3.4 South Korea compliance (MR-CR55K4) and 30 kW or more of MR-J4-DU
This product complies with the Radio Wave Law (KC mark) Please note the following to use the product.
이 기기는 업무용 (A급) 전자파적합기기로서 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 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. Use a distance greater than 30 m between the product and third party sensitive radio communications.

2.4 General cautions for safety protection and protective measures
Observe the following items to ensure proper use of the MR-J4 servo amplifiers.

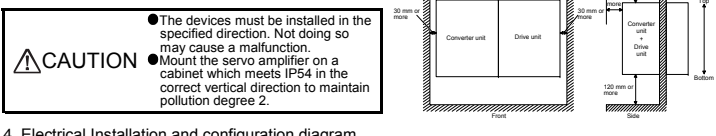
(1) For safety components and installing systems, only qualified personnel and professional engineers should perform.
(2) When mounting, installing, and using the MR-J4 servo amplifier, always observe standards and directives applicable in the country.
(3) The item about noises of the test notices in the manuals should be observed.

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 modules 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 adjust the machines in which these components are installed. Only trained engineers should install and operate the equipment. (ISO 13849-1 Table F.1 No. 5)
(5) Separate the wiring for safety overvoltage function from other signal wirings. (ISO 13849-1 Table F.1 No. 1)
(6) Protect the cables with appropriate ways (routing them in a cabinet, using a cable guard, etc.).
(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-BAT6V1, and MR-BAT6V1B) are assembled batteries from two batteries (lithium metal battery CR1735SA) which are not subject to the dangerous goods (Class 9) of the UN Recommendations.

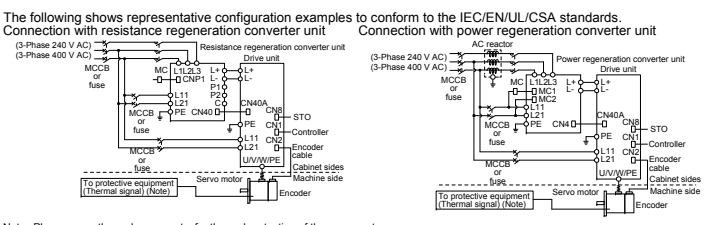
3. Mounting/dismounting
Installation direction and clearances



CAUTION The devices must be installed in the specified direction. Not doing so may cause a malfunction.
Mount the servo amplifier on a cabinet which meets IP54 in the correct vertical direction to maintain pollution degree 2.

4. Electrical installation and configuration diagram
WARNING Turn off the molded-case circuit breaker (MCCB) to avoid electrical shocks or damages to the product before starting the installation or wiring.

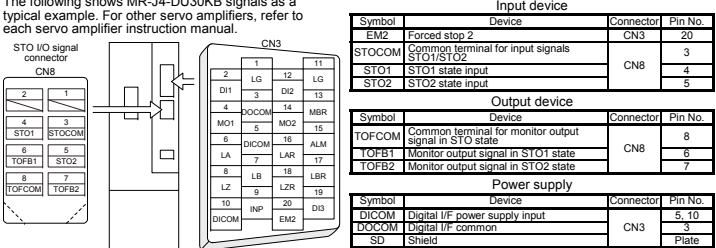
CAUTION The installation complies with IEC/EN 60204-1. The voltage supply to machines must be 20 ms or more of tolerance against instantaneous power failure as specified in IEC/EN 60204-1.
Connecting a servo motor of the wrong axis to U, V, W, or CN2, of the servo amplifier may cause a malfunction.
Securely connect the cables in the specified method and tighten them with the specified torque. Otherwise, the servo motor may operate unexpectedly.



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 described by circles. The connected motors will be limited as follows.

(1) HG/HF/HCH/HA series servo motors (Mfg.: Mitsubishi Electric)
(2) Using a servo motor complied with IEC 60034-1 and Mitsubishi Electric encoder (OBA, OSA)

5. Signals
5.1 Signal
The following shows MR-J4-DU30K signals as a typical example. For other servo amplifiers, refer to each servo amplifier instruction manual.



5.2 I/O device
The following shows MR-J4-DU30K signals as a typical example. For other servo amplifiers, refer to each servo amplifier instruction manual.

Symbol	Device	Connector	Pin No.
EM2	Forced stop 2	CN3	20
STOCON	Common terminal for input signals	CN8	9
STO1	STO1 state input	CN8	4
STO2	STO2 state input	CN8	5
FOFCOM	Common terminal for monitor output signal in STO state	CN8	8
TOFB1	Monitor output signal in STO1 state	CN8	7
TOFB2	Monitor output signal in STO2 state	CN8	6
DICOM	Digital I/F power supply input	CN3	5/10
DOCOM	Digital I/F common	CN3	3
SD	Shield	Plate	-

6. Maintenance and service
WARNING To avoid an electric shock, 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 periodically be checked.
(1) Check for loose terminal block screws. Retighten any loose screws.

Part name	Life guideline
Smoothing capacitor	10 years (Note 3)
Relay	Number of power-on, forced stop and control forced stop times: 100,000 times Number of off, stop off for STO: 100,000 times
Cooling fan	10,000 hours to 30,000 hours (2 years to 3 years)
Battery backup time (Note 1)	Approximately 20,000 hours (equipment power supply off, ambient temperature: 20 °C)
Battery life (Note 2)	5 years from date of manufacture

Note: 1. The time is for using MR-J4 servo amplifier with a rotary servo motor using MR-BATV1SET or MR-BAT6V1B. For details and other battery backup time, refer to each instruction manual.
2. Quality of the batteries depends on the storage condition. The battery life is 5 years from the production date regardless of the connection status.
3. The characteristic of smoothing capacitor is deteriorated due to ripple currents, etc. The capacitor will be the end of its life in 10 years of continuous operation in air-conditioned environment (ambient temperature of 40 °C or less for use at the maximum 1000 m above sea level, 30 °C or less for over 1000 m to 2000 m).

6.2 Parts having service life
Service life of the following parts is listed below. However, the service life varies depending on operating methods 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.

(2) Check 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.

7. Transportation and storage
CAUTION Transport the products correctly according to their mass.
Stacking in excess of the limited number of product packages is not allowed.
Do not hold the front cover, cables, or connectors when carrying the servo amplifier. Otherwise, it may drop.
For detailed information on transportation and handling of the battery, refer to the servo amplifier instruction manual.
Install the product in a load-bearing place of servo amplifier and servo motor in accordance with the instruction manual.
Do not put excessive load on the machine.

When you keep or use it, please fulfill the following environment.

Item	Environment
Ambient temperature	Operation: 0 to 55 Class 3K3 (IEC/EN 60721-3-3) Transportation (Note): -20 to 65 Class 2K4 (IEC/EN 60721-3-2) Storage (Note): -20 to 65 Class 1K4 (IEC/EN 60721-3-1)
Ambient humidity	Operation, transportation, storage: 5 %RH to 90 %RH
Vibration resistance	Test condition: 10 Hz to 57 Hz with constant amplitude of 0.075 mm Operation: 5.9 m/s ² with constant acceleration of 9.8 m/s ² to IEC/EN 61800-5-1 Transportation (Note): Class 2M3 (IEC/EN 60721-3-2) Storage: Class 1M2 (IEC/EN 60721-3-2)
Pollution degree	2
IP rating	IP20 (IEC/EN 60529), Terminal block IP00
Altitude	Operation, storage: Max. 2000 m above sea level Transportation: Max. 10000 m above sea level

Note: In regular transportation packaging

8. Technical data
8.1 Converter unit

Item	CR		CV				MR		CV					
	55K	11K	18K	30K	37K	45K	55K	59K4	11K4	18K4	30K4	37K4	45K4	55K4
Output	Rated voltage: 270 V DC to 324 V DC													
Power supply	Rated current [A]													
	Main circuit voltage/frequency													
Pollution degree	Main circuit current [A]													
	Control circuit (line voltage)													
Overvoltage category	Control circuit (line voltage)													
	Interface (SELV)													
Protective class	Safety observation function													
	STO (IEC/EN 61800-5-2) (Note)													
Mean time to dangerous failure	Effectiveness of fault monitoring of a system or subsystem													
	Average probability of dangerous failures per hour													