Chapter 2

• System Design and Installation•

Installation and Wiring Precautions

⚠ Caution Do not step on or place a heavy object on the product. Doing so may result in injury.

⚠ Caution Do not cover the inlet or outlet ports and prevent any foreign objects from entering the product. Doing so may result in fire.

⚠ Caution Be sure to install the product in the correct direction. Not doing so may result in malfunction.

⚠ Caution Provide the specified clearances between the Servo Driver and the control panel or with other devices. Not doing so may result in fire or malfunction.

⚠ Caution Do not apply any strong impact. Doing so may result in malfunction.

⚠ Caution Be sure to wire correctly and securely. Not doing so may result in motor runaway, injury, or malfunction.

⚠ Caution Be sure that all the mounting screws, terminal screws, and cable connector screws are tightened to the torque specified in the relevant manuals. Incorrect tightening torque may result in malfunction.

⚠ Caution Use crimp terminals for wiring. Do not connect bare stranded wires directly to terminals. Connection of bare stranded wires may result in burning.

⚠ Caution Always use the power supply voltage specified in the User's Manual. An incorrect voltage may result in malfunction or burning.

⚠ Caution Take appropriate measures to ensure that the specified power with the rated voltage and frequency is supplied. Be particularly careful in places where the power supply is unstable. An incorrect power supply may result in malfunction.

⚠ Caution Install external breakers and take other safety measures against short-circuiting in external wiring. Insufficient safety measures against short-circuiting may result in burning.

⚠ Caution Provide an appropriate stopping device on the machine side to secure safety. (A holding brake is not a stopping device for securing safety.) Not doing so may result in injury.

⚠ Caution Provide an external emergency stopping device that allows an instantaneous stop of operation and power interruption. Not doing so may result in injury.

⚠ Caution Take appropriate and sufficient countermeasures when installing systems in the following locations:

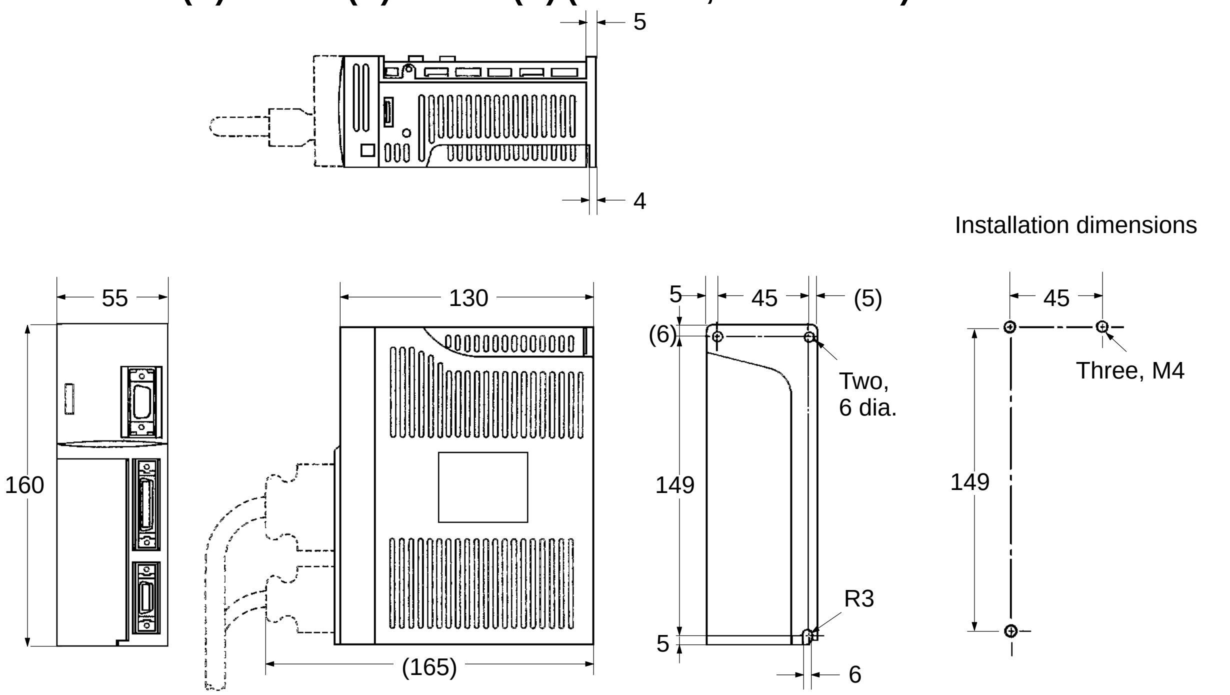
- Locations subject to static electricity or other forms of noise.
- Locations subject to strong electromagnetic fields and magnetic fields.
- Locations subject to possible exposure to radioactivity.
- Locations close to power supplies.

2-1 Installation

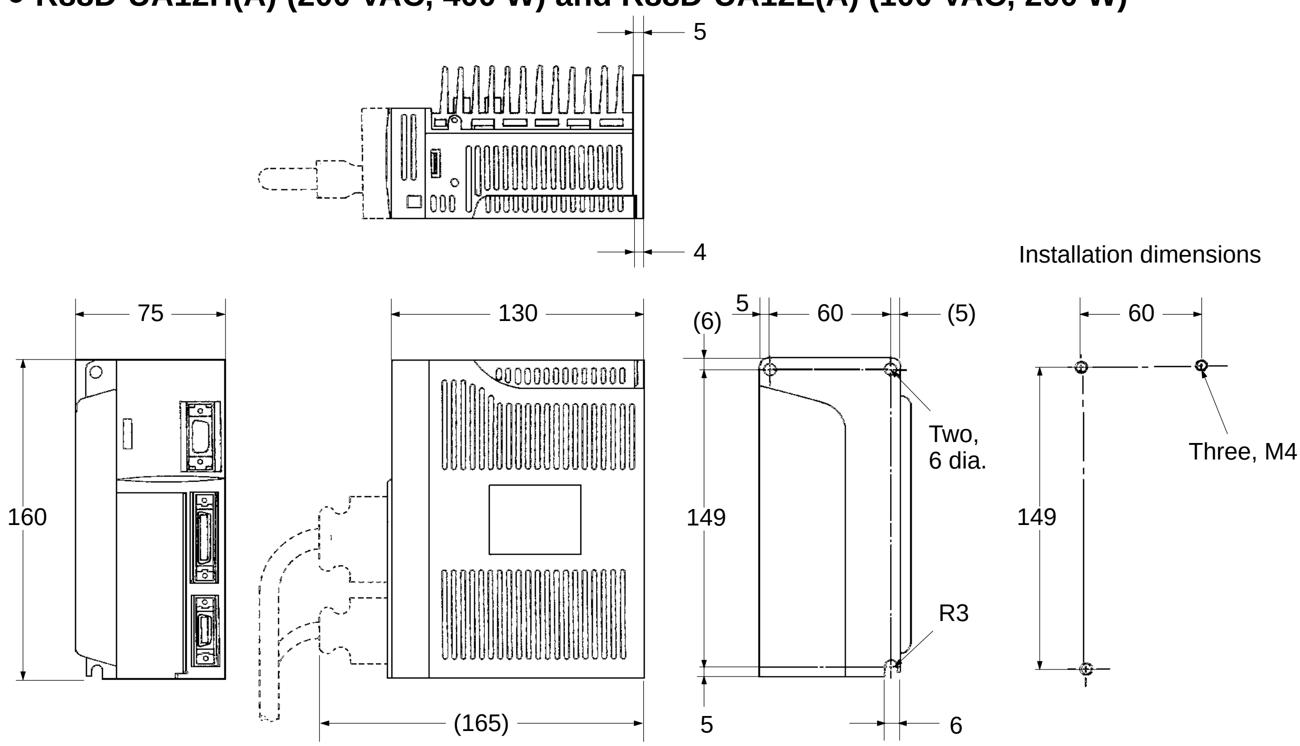
2-1-1 External Dimensions (Unit: mm)

■ AC Servo Drivers Conforming to UL/cUL Standards and AC Servomotors Not Conforming to Any Standards

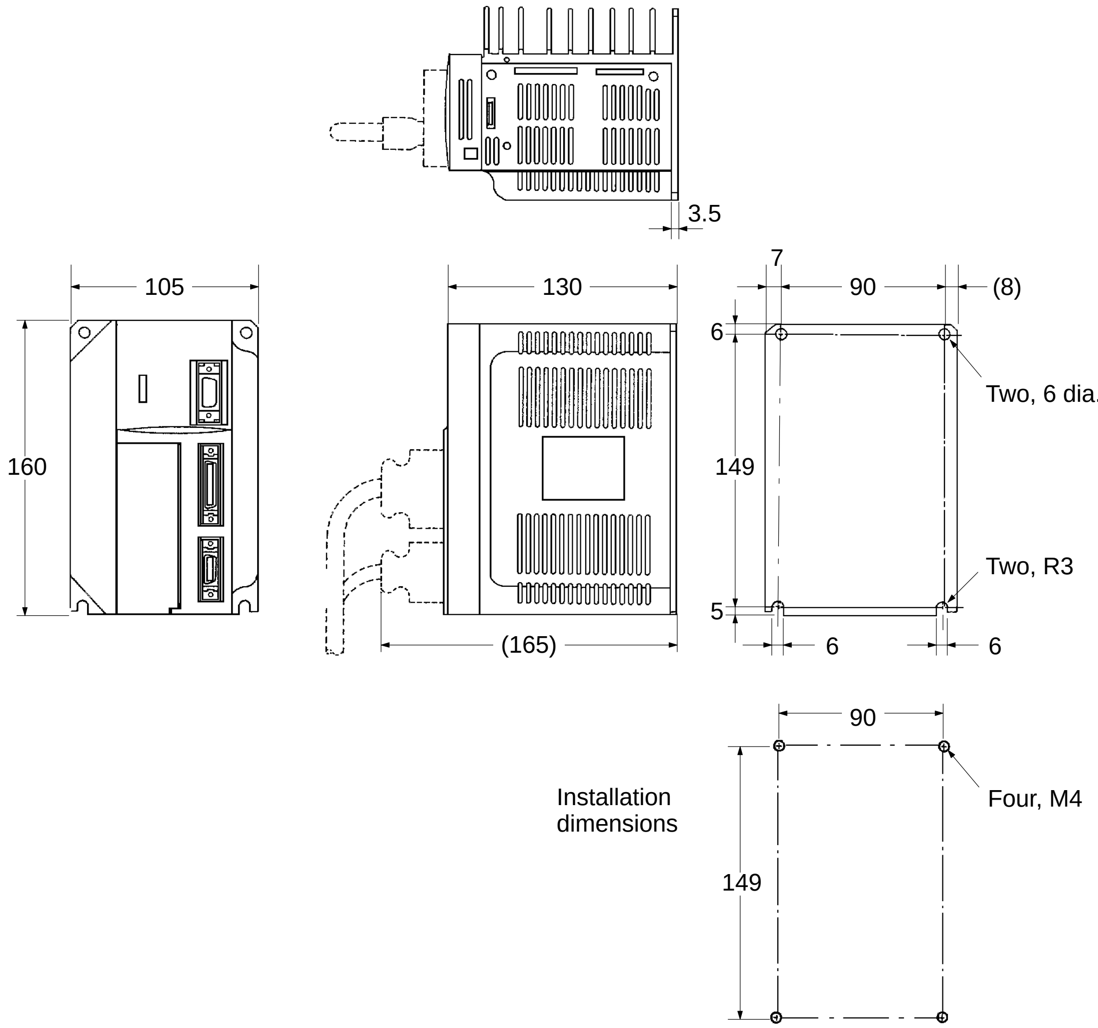
- **R88D-UA02H(A)/-UA03H(A)/-UA04H(A)/-UA08H(A) (200 VAC, 30 to 200 W)**
  R88D-UA03L(A)/-UA04L(A)/-UA10L(A) (100 VAC, 30 to 100 W)



- **R88D-UA12H(A) (200 VAC, 400 W) and R88D-UA12L(A) (100 VAC, 200 W)**

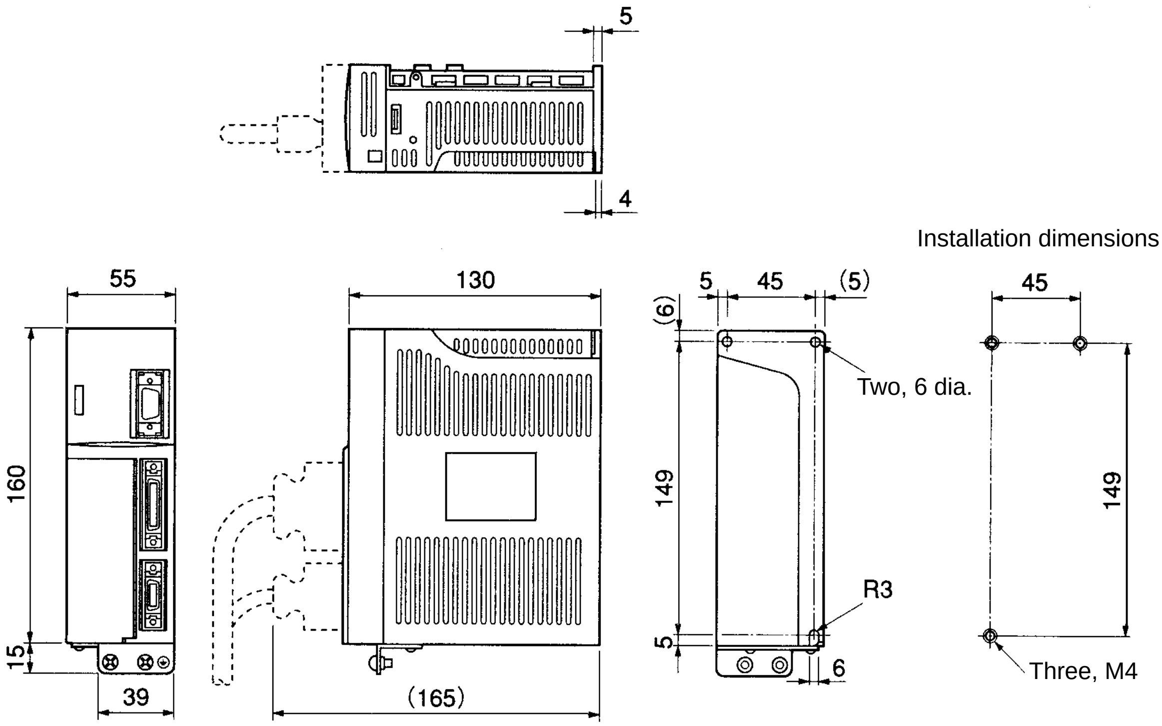


- **R88D-UA20H(A) (200 VAC, 750 W) and R88D-UA15LA (100 VAC, 300 W)**

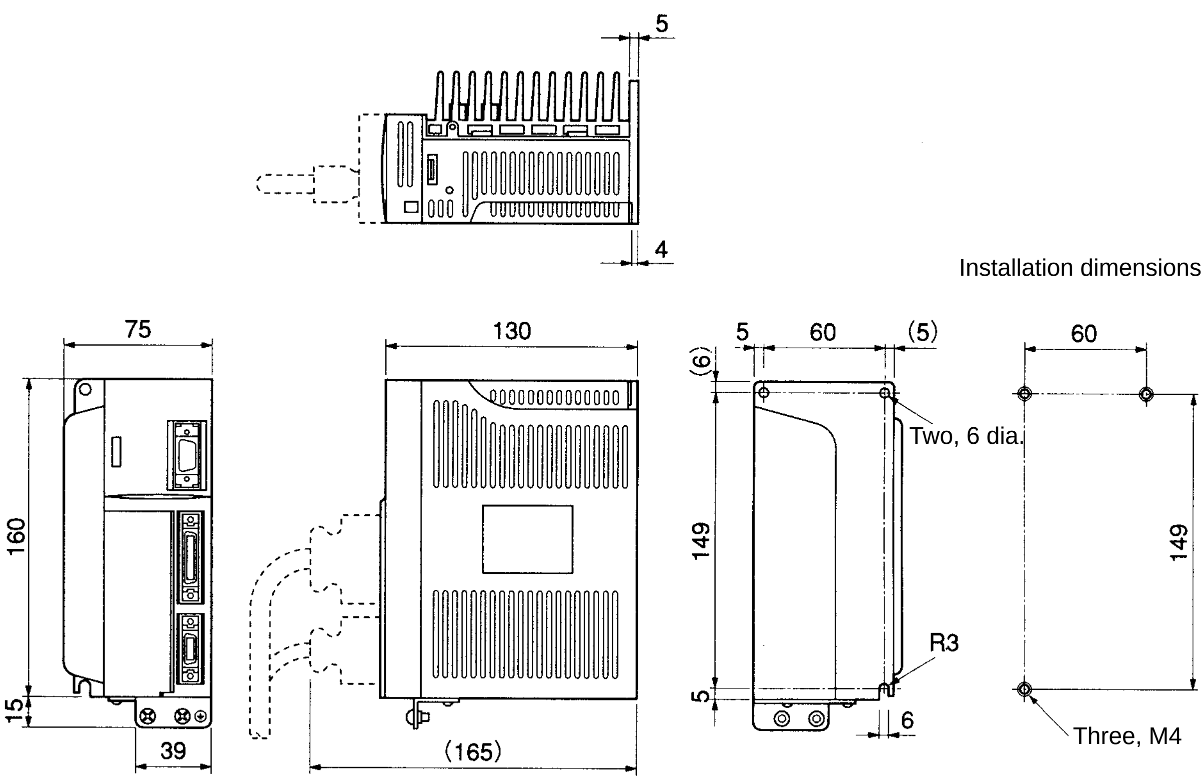


■ AC Servo Drivers Conforming to EC Directives

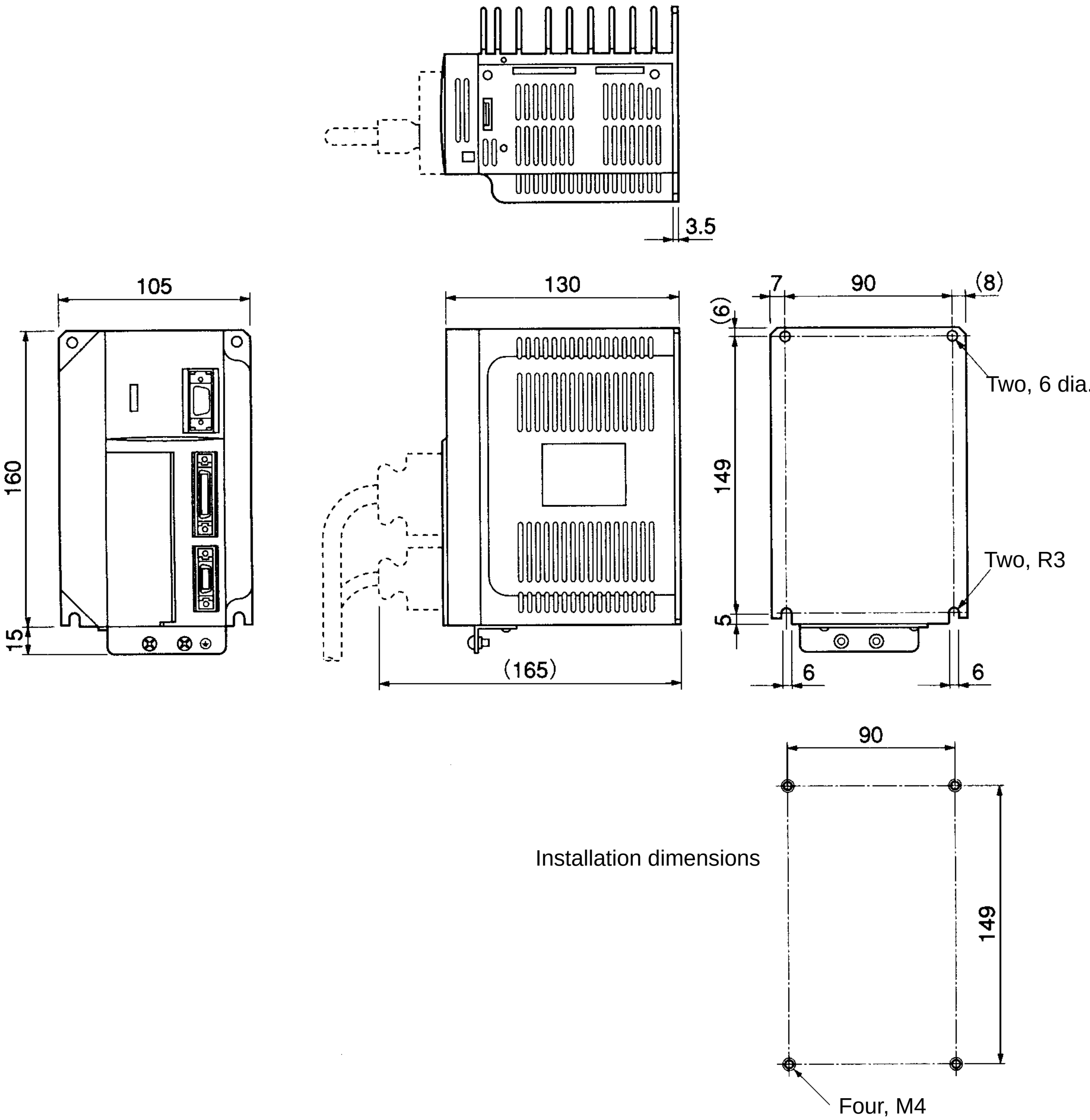
• R88D-UA02V/-UA03V/-UA04V/-UA08V (200 VAC, 30 to 200 W)
R88D-UA03W/-UA04W/-UA10W (100 VAC, 30 to 100W)



• R88D-UA12V (200 VAC, 400 W) and R88D-UA12W (100 VAC, 200W)

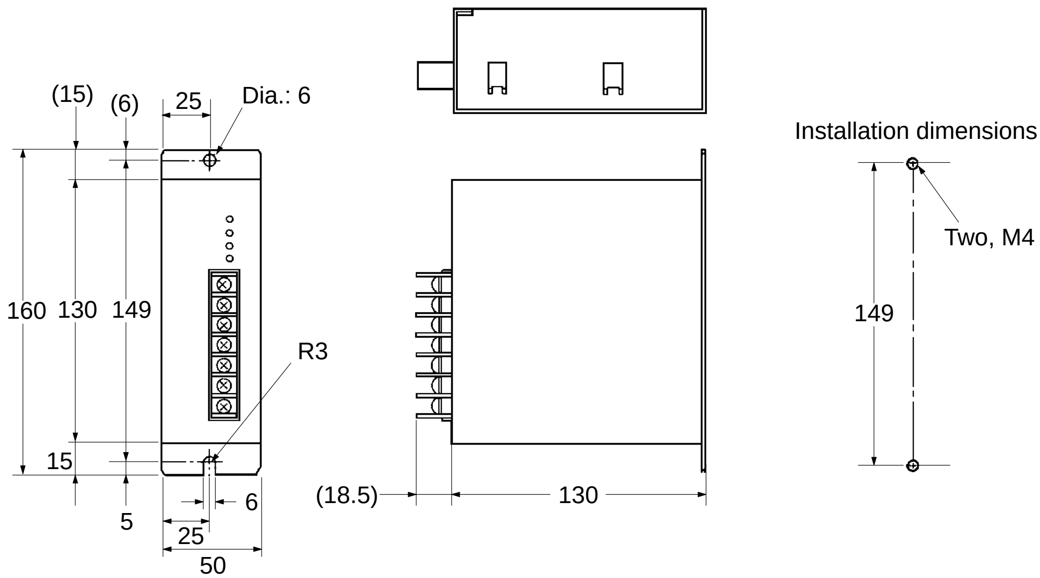


- **R88D-UA20V (200 VAC, 750 W) and R88D-UA15W (100 VAC, 300W)**



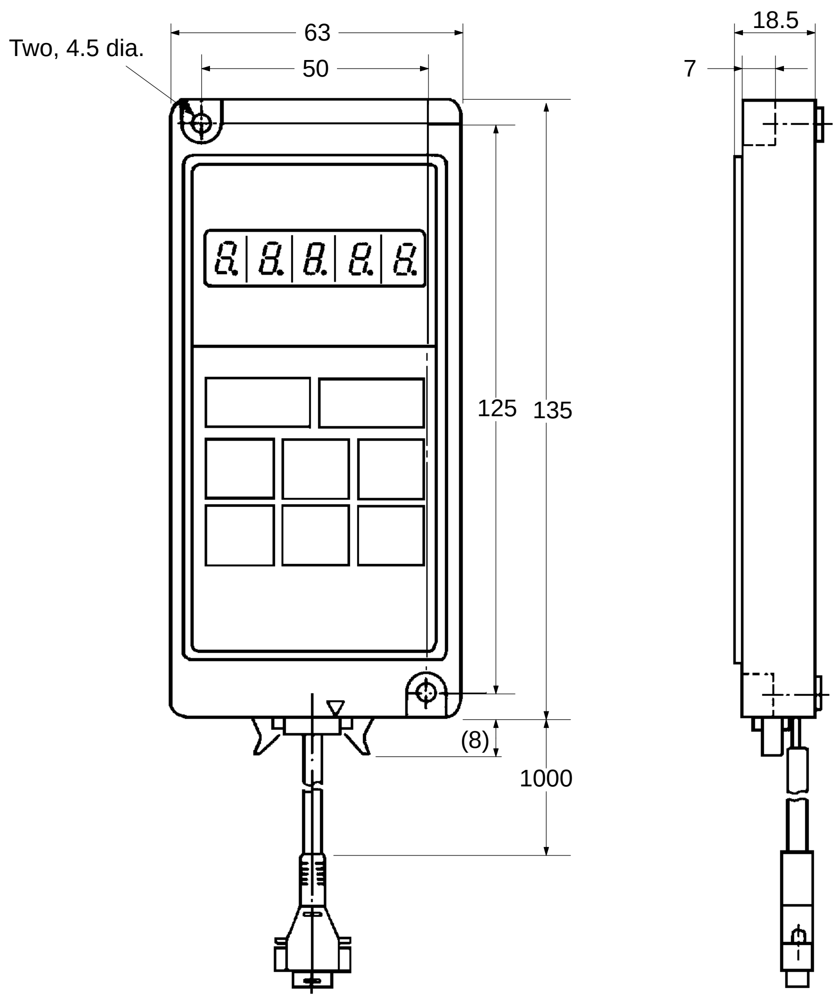
■ Regeneration Unit

● R88A-RG08UA

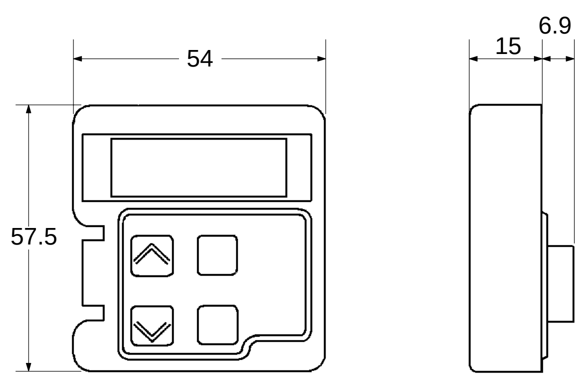


■ Parameter Units

● R88A-PR02U

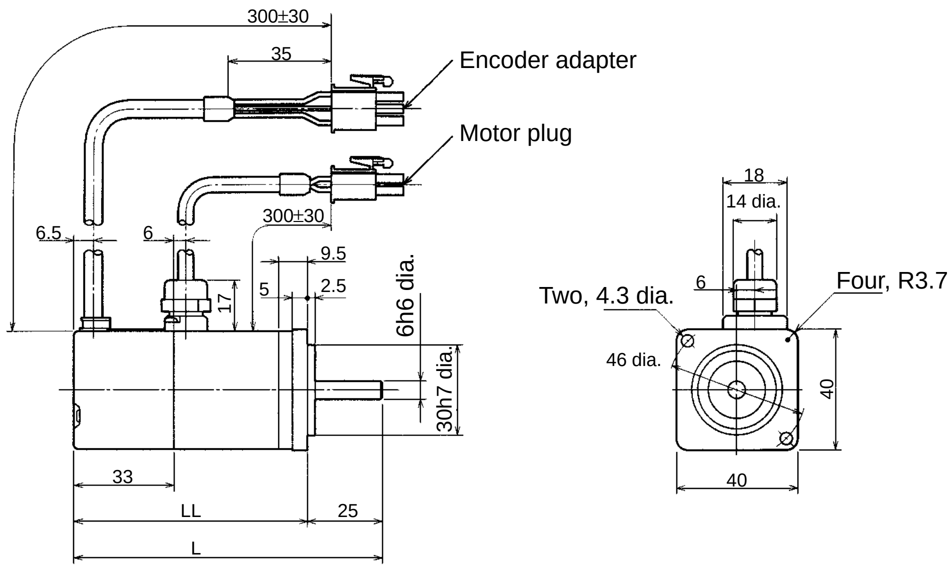


● R88A-PR03U

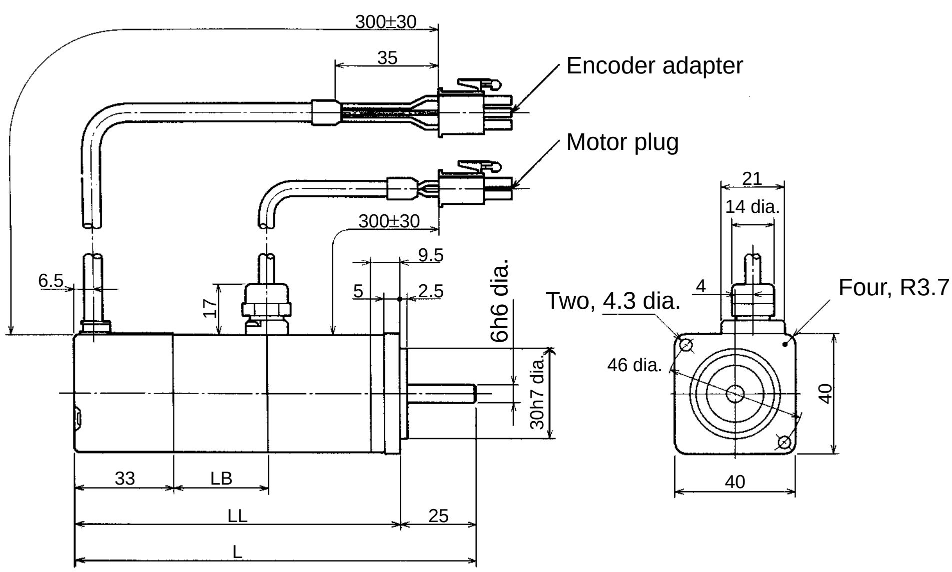


■ AC Servomotors with Incremental Encoders Conforming to UL/cUL Standards and AC Servomotors Not Conforming to Any Standards

● 30-W/50-W/100-W Standard Models: R88M-U03030HA, R88M-U05030HA, R88M-U10030HA R88M-U03030LA, R88M-U05030LA, R88M-U10030LA



● 30-W/50-W/100-W Models with Brake: R88M-U03030HA-B, R88M-U05030HA-B, R88M-U10030HA-B R88M-U03030LA-B, R88M-U05030LA-B, R88M-U10030LA-B

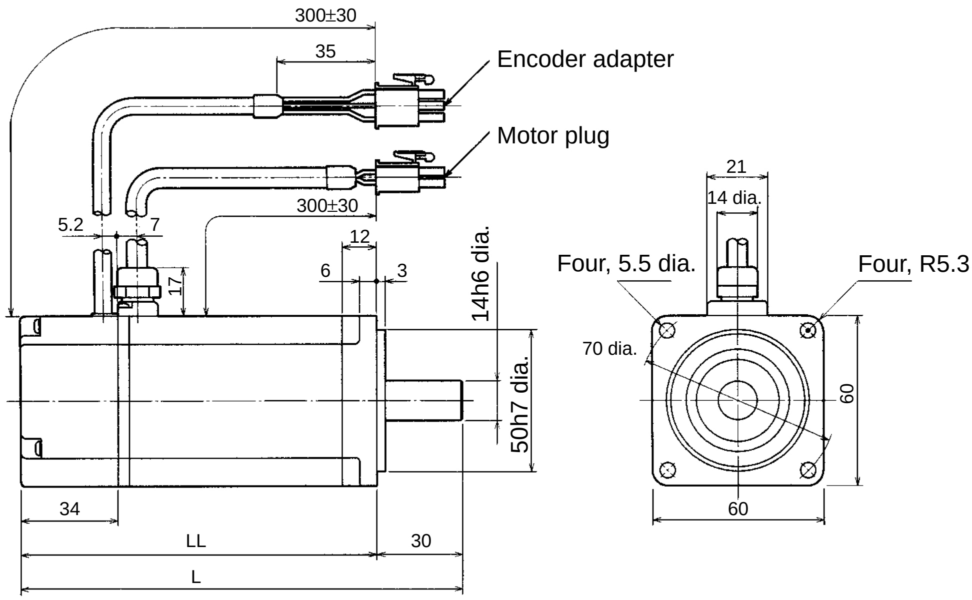


Standard Models			
Model	L	LL	S
R88M-U03030HA R88M-U03030LA	94.5	69.5	6
R88M-U05030HA R88M-U05030LA	102.0	77.0	6
R88M-U10030HA R88M-U10030LA	119.5	94.5	8

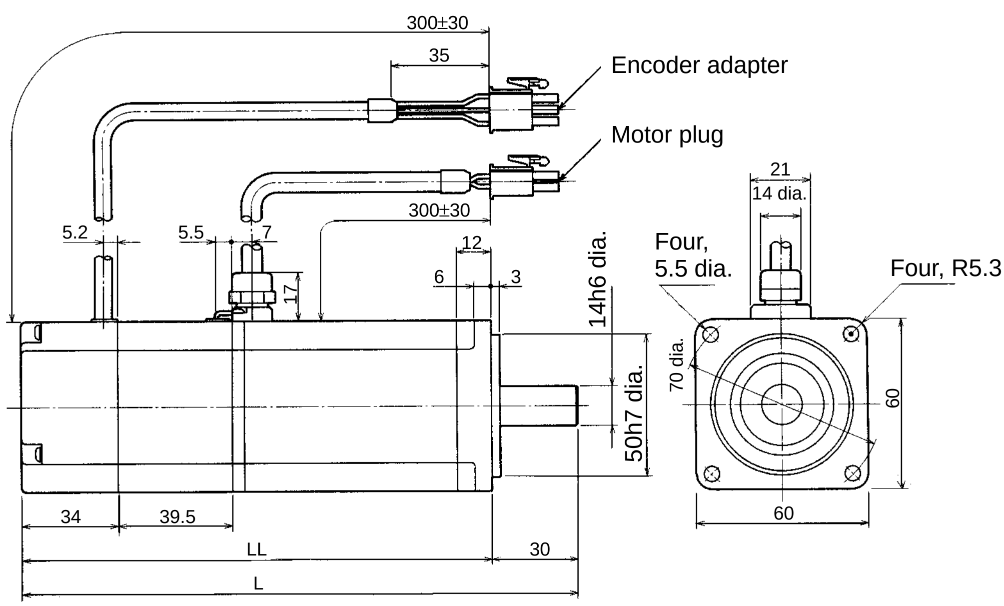
Models with Brake				
Model	L	LL	LB	S
R88M-U03030HA-B R88M-U03030LA-B	126	101	31.5	6
R88M-U05030HA-B R88M-U05030LA-B	133.5	108.5	31.5	6
R88M-U10030HA-B R88M-U10030LA-B	160	135	40.5	8

■ AC Servomotors with Incremental Encoders Conforming to UL/cUL Standards and Not Conforming to Any Standards (Contd.)

**• 200-W/300-W/400-W Standard Models:
R88M-U20030HA, R88M-U40030HA
R88M-U20030LA, R88M-U30030LA**



**• 200-W/300-W/400-W Models with Brake:
R88M-U20030HA-B, R88M-U40030HA-B
R88M-U20030LA-B, R88M-U30030LA-B**

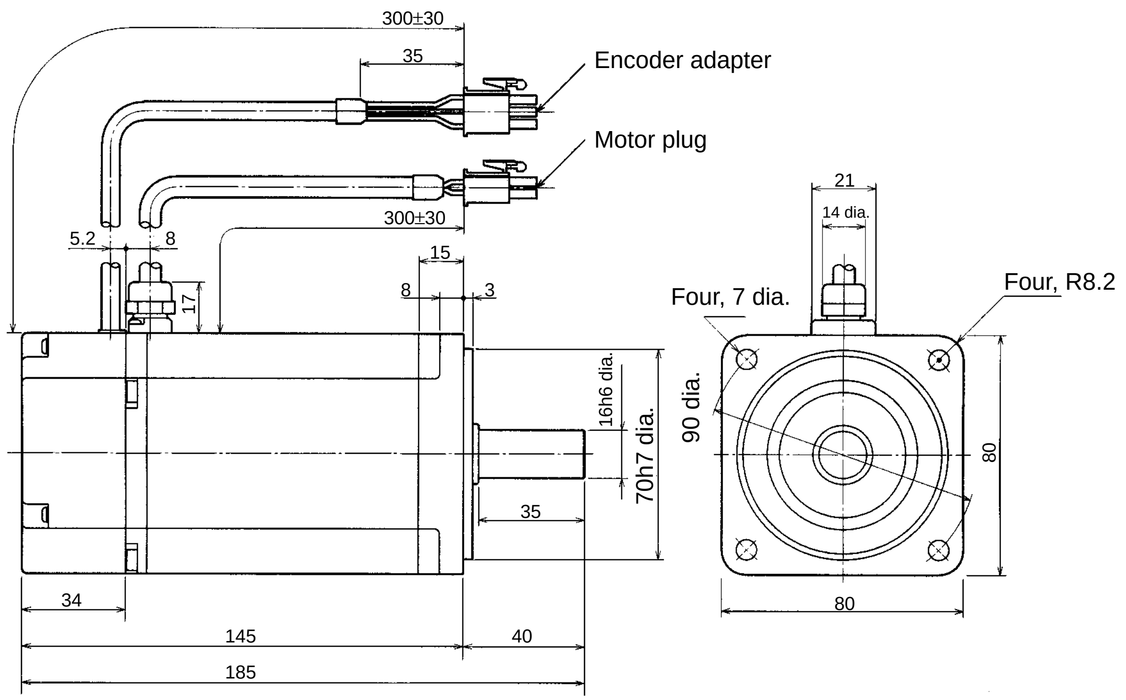


Standard Models		
Model	**L**	**LL**
R88M-U20030HA R88M-U20030LA	126.5	96.5
R88M-U40030HA R88M-U30030LA	154.5	124.5

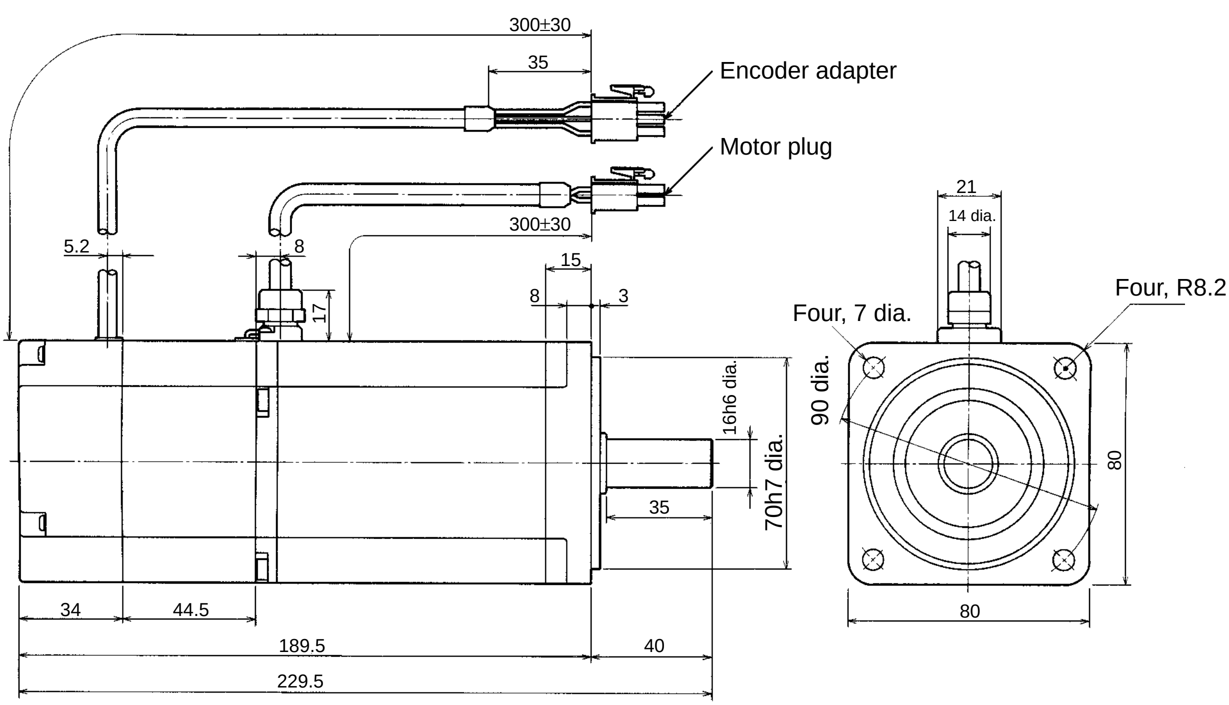
Models with Brake		
Model	**L**	**LL**
R88M-U20030HA-B R88M-U20030LA-B	166	136
R88M-U40030HA-B R88M-U30030LA-B	194	164

■ AC Servomotors with Incremental Encoders Conforming to UL/cUL Standards and Not Conforming to Any Standards (Contd.)

• 750-W Standard Models: R88M-U75030HA

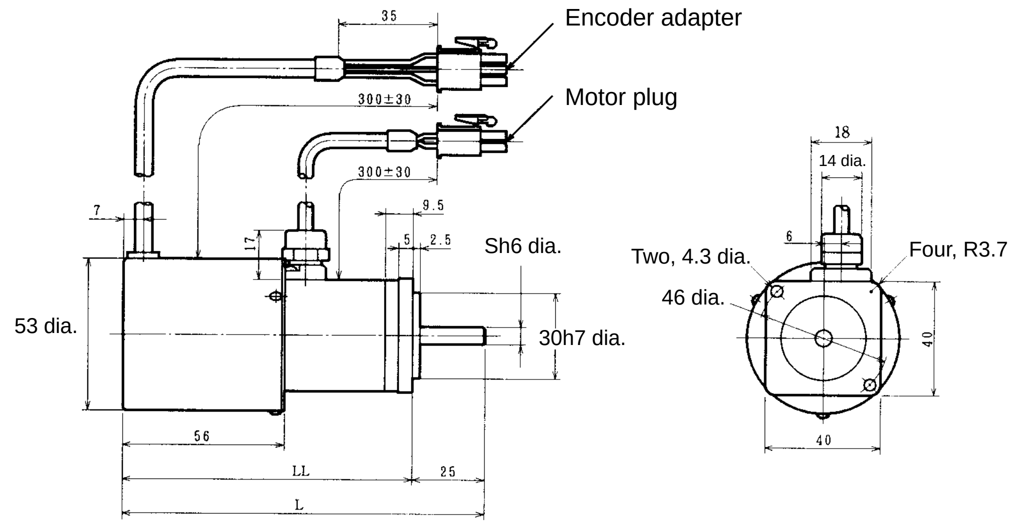


• 750-W Models with Brake: R88M-U75030HA-B

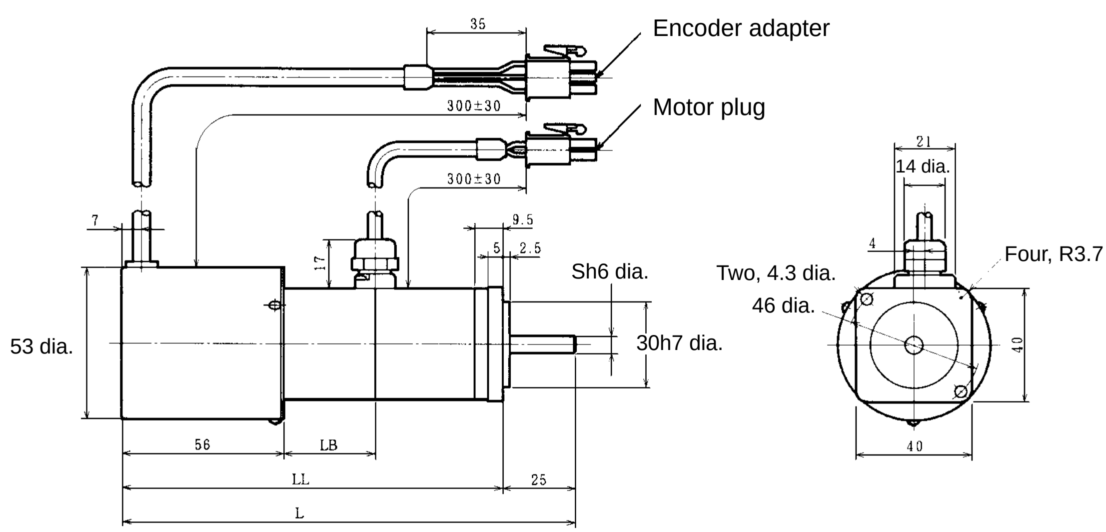


■ AC Servomotors with Absolute Encoders Conforming to UL/cUL Standards and Not Conforming to Any Standards

• 30-W/50-W/100-W Standard Models: R88M-U03030TA, R88M-U05030TA, R88M-U10030TA R88M-U03030SA, R88M-U05030SA, R88M-U10030SA



• 30-W/50-W/100-W Models with Brake: R88M-U03030TA-B, R88M-U05030TA-B, R88M-U10030TA-B R88M-U03030SA-B, R88M-U05030SA-B, R88M-U10030SA-B

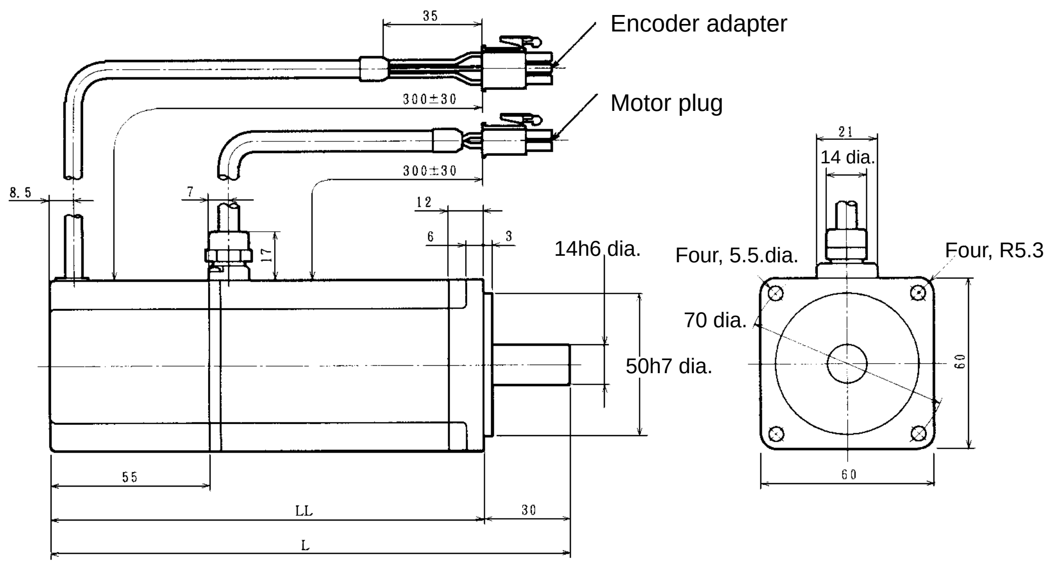


Standard Models			
Model	L	LL	S
R88M-U03030TA R88M-U03030SA	117.5	92.5	6
R88M-U05030TA R88M-U05030SA	125	100	6
R88M-U10030TA R88M-U10030SA	142.5	117.5	8

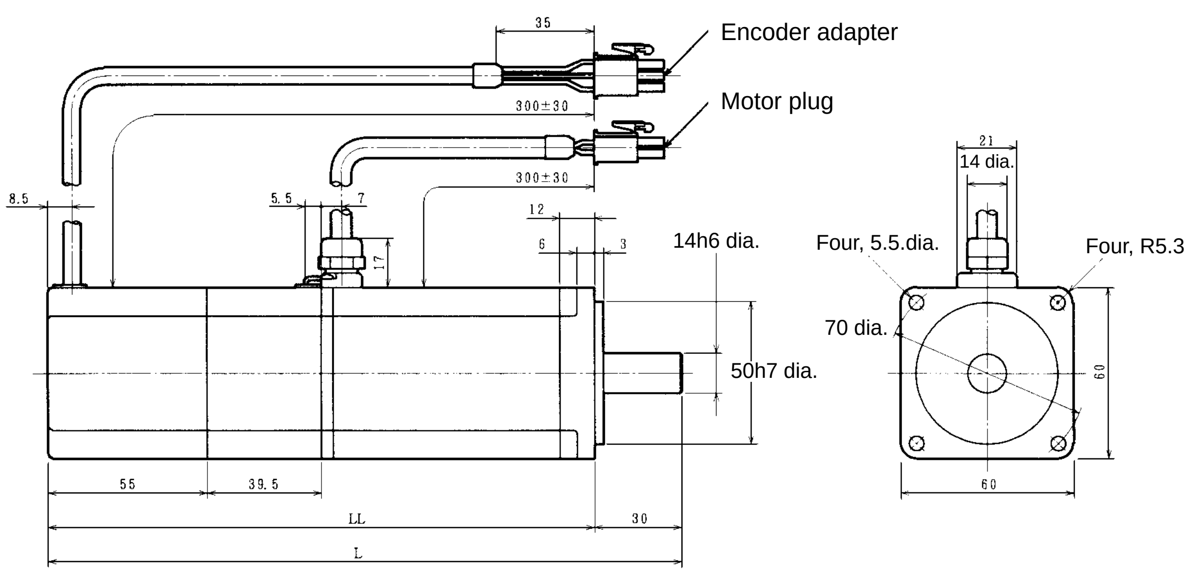
Models with Brake				
Model	L	LL	LB	S
R88M-U03030TA-B R88M-U03030SA-B	149	124	31.5	6
R88M-U05030TA-B R88M-U05030SA-B	156.5	131.5	31.5	6
R88M-U10030TA-B R88M-U10030SA-B	183	158	40.5	8

■ AC Servomotors with Absolute Encoders Conforming to UL/cUL Standards and Not Conforming to Any Standards (Contd.)

• 200-W/300-W/400-W Standard Models: R88M-U20030TA, R88M-U40030TA, R88M-U20030SA, R88M-U30030SA



• 200-W/300-W/400-W Models with Brake: R88M-U20030TA-B, R88M-U40030TA-B, R88M-U20030SA-B, U30030SA-B

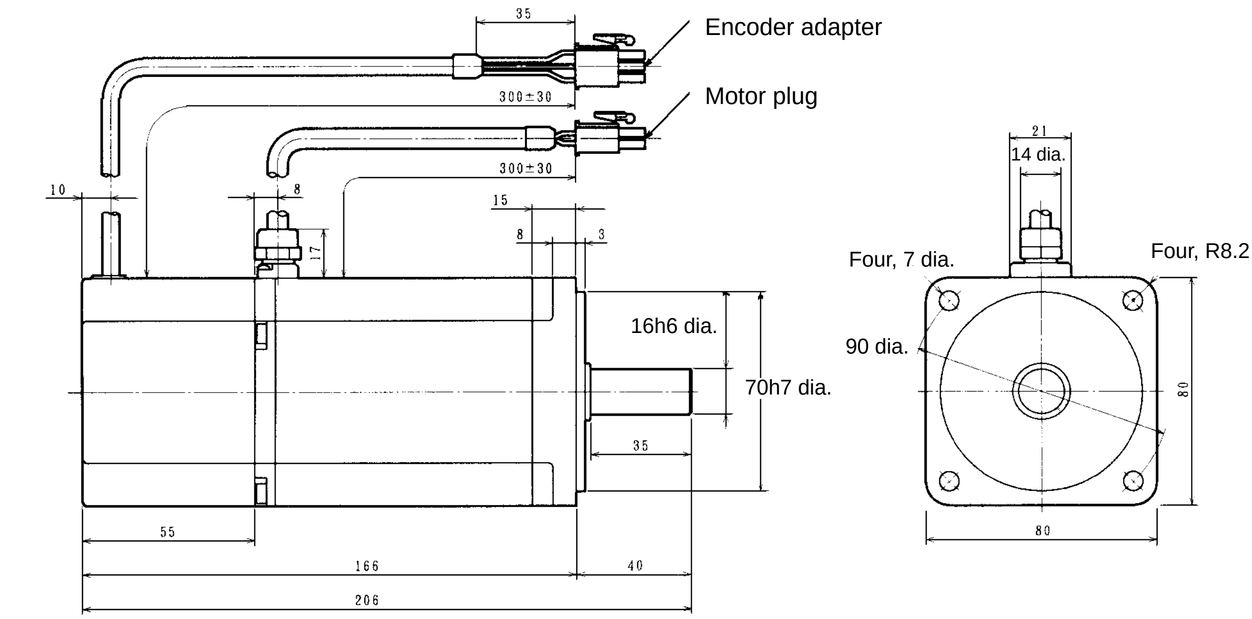


Standard Models		
Model	**L**	**LL**
R88M-U20030TA R88M-U20030SA	147.5	117.5
R88M-U40030TA R88M-U30030SA	175.5	145.5

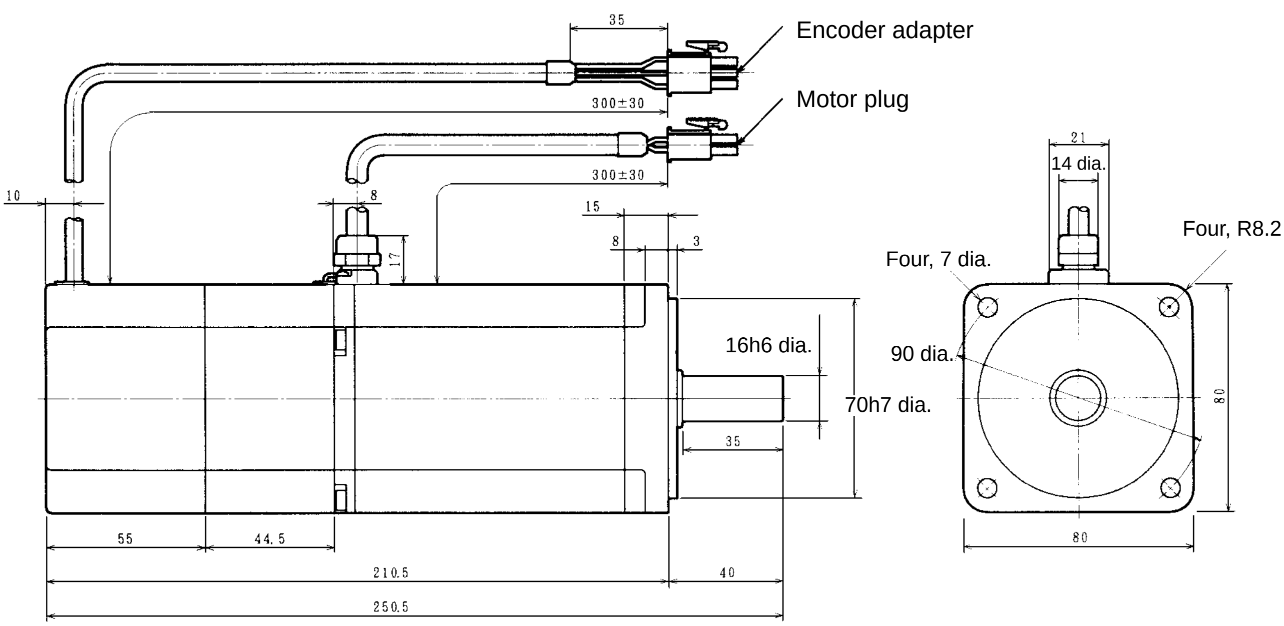
Models with Brake		
Model	**L**	**LL**
R88M-U20030TA-B R88M-U20030SA-B	187	157
R88M-U40030TA-B R88M-U30030-SA-B	215	185

■ AC Servomotors with Absolute Encoders Conforming to UL/cUL Standards and Not Conforming to Any Standards (Contd.)

• 750-W Standard Models: R88M-U75030TA

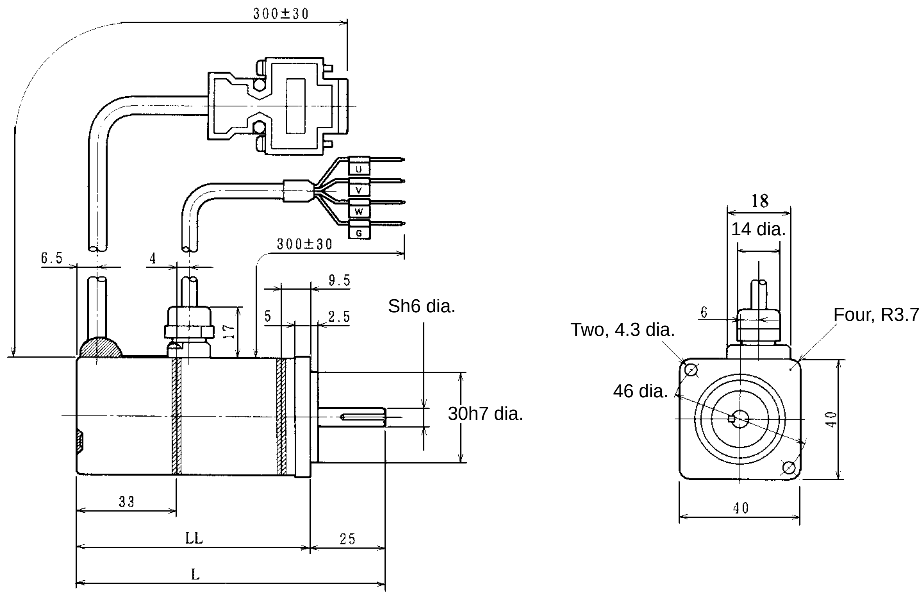


• 750-W Models with Brake: R88M-U75030TA-B

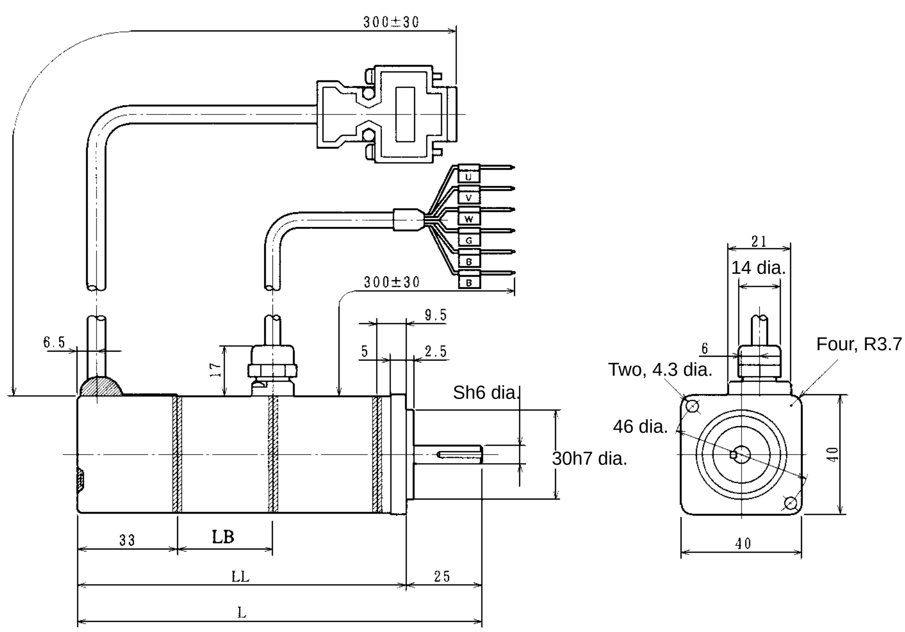


■ AC Servomotors, EC Directives with Incremental Encoders

**• 30-W/50-W/100-W Standard Models:
R88M-U03030VA-S1, R88M-U05030VA-S1, R88M-U10030VA-S1
R88M-U03030WA-S1, R88M-U05030WA-S1, R88M-U10030WA-S1**



**• 30-W/50-W/100-W Models with Brake:
R88M-U03030VA-BS1, R88M-U05030VA-BS1, R88M-U10030VA-BS1
R88M-U03030WA-BS1, R88M-U05030WA-BS1, R88M-U10030WA-BS1**

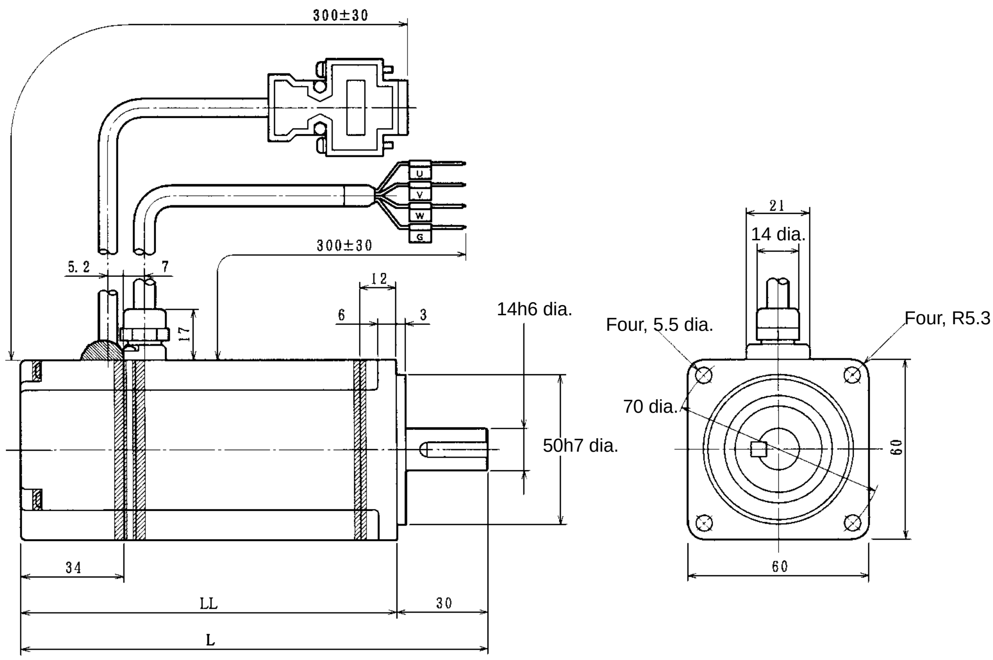


Standard Models			
Model	**L**	**LL**	**S**
R88M-U03030VA-S1 R88M-U03030WAS1	94.5	69.5	6
R88M-U05030VA-S1 R88M-U05030WA-S1	102.0	77.0	6
R88M-U10030VA-S1 R88M-U10030WA-S1	119.5	94.5	8

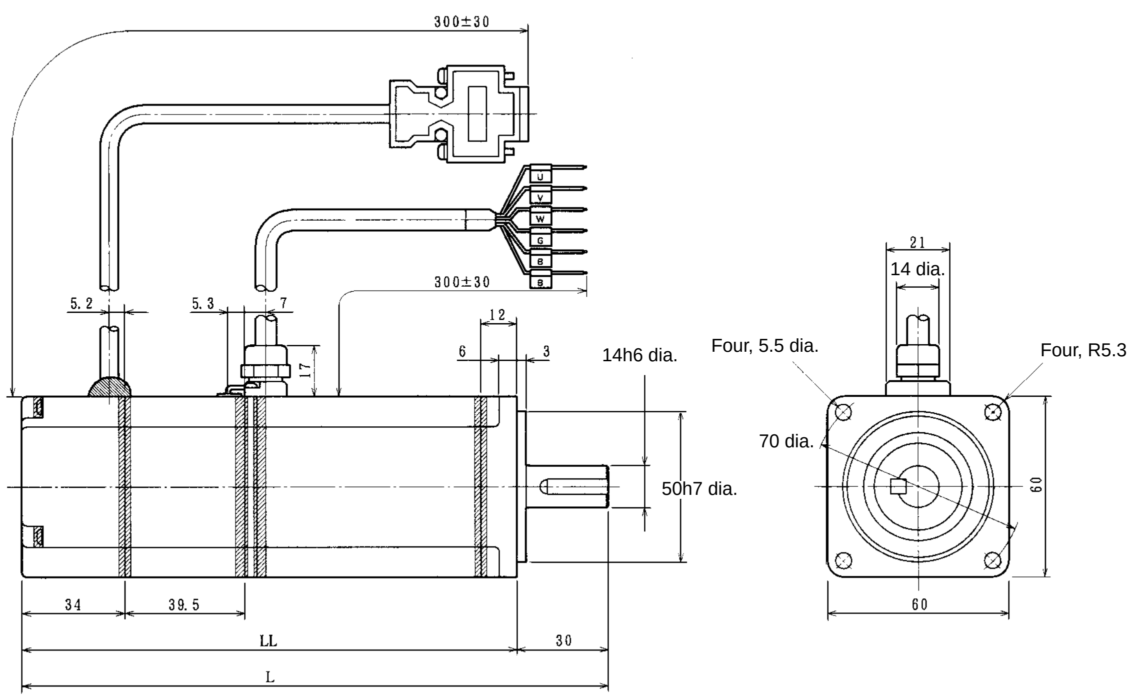
Models with Brake				
Model	**L**	**LL**	**LB**	**S**
R88M-U03030VA-BS1 R88M-U03030WA-BS1	126	101	31.5	6
R88M-U05030VA-BS1 R88M-U05030WA-BS1	133.5	108.5	31.5	6
R88M-U10030VA-BS1 R88M-U10030WA-BS1	160	135	40.5	8

■ AC Servomotors, EC Directives with Incremental Encoders (Contd.)

- **200-W/300-W/400-W Standard Models:**
R88M-U20030VA-S1, R88M-U40030VA-S1, R88M-U20030WA-S1, R88M-U30030WA-S1



- **200-W/300-W/400-W Models with Brake:**
R88M-U20030VA-BS1, R88M-U40030VA-BS1, R88M-U20030WA-BS1, U30030WA-BS1

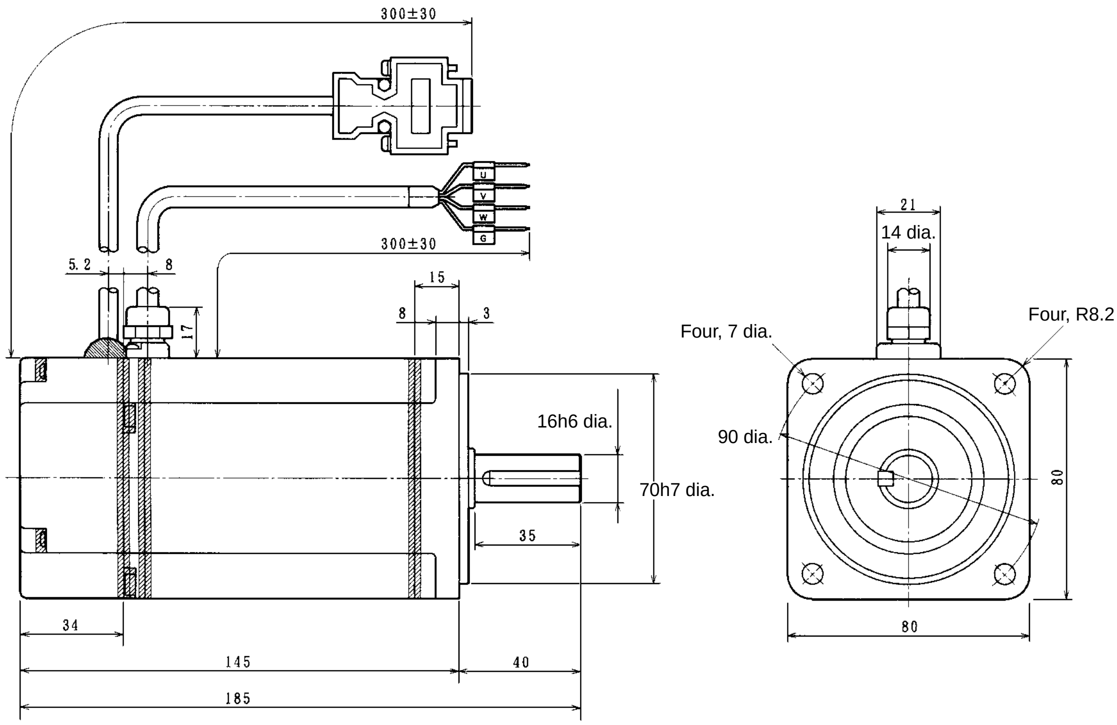


Standard Models		
Model	**L**	**LL**
R88M-U20030VA-S1 R88M-U20030WA-S1	126.5	96.5
R88M-U40030VA-S1 R88M-U30030WA-S1	154.5	124.5

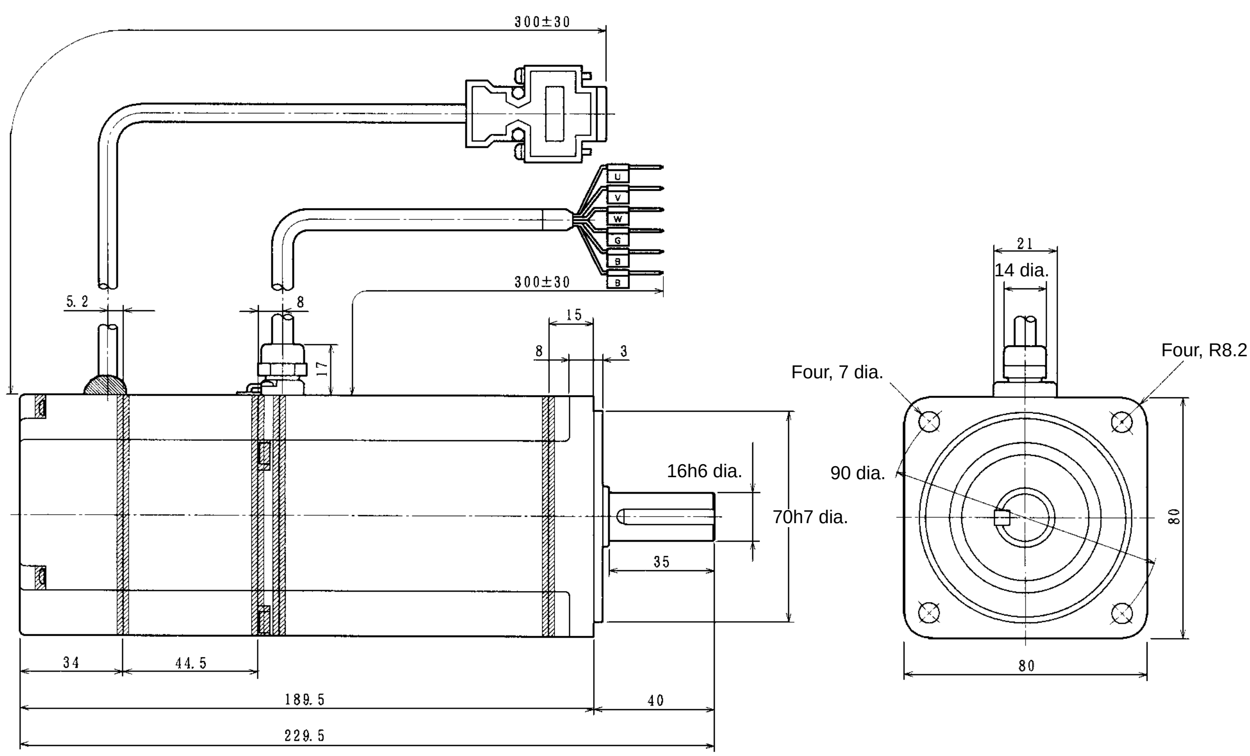
Models with Brake		
Model	**L**	**LL**
R88M-U20030VA-BS1 R88M-U20030WA-BS1	166	136
R88M-U40030VA-BS1 R88M-U30030WA-BS1	194	164

■ AC Servomotors, EC Directives with Incremental Encoders (Contd.)

• 750-W Standard Models: R88M-U75030VA-S1

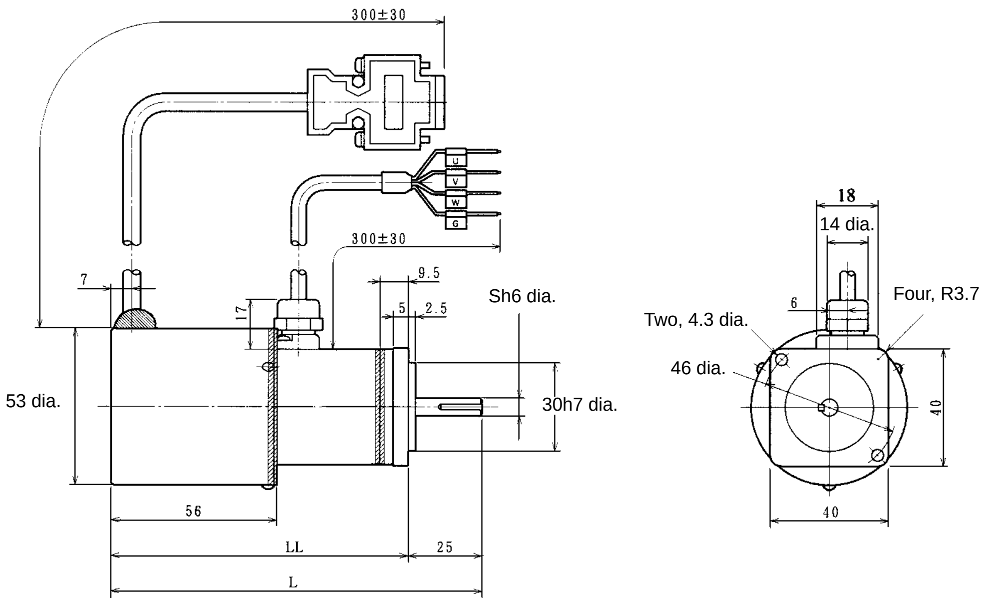


• 750-W Models with Brake: R88M-U75030VA-BS1

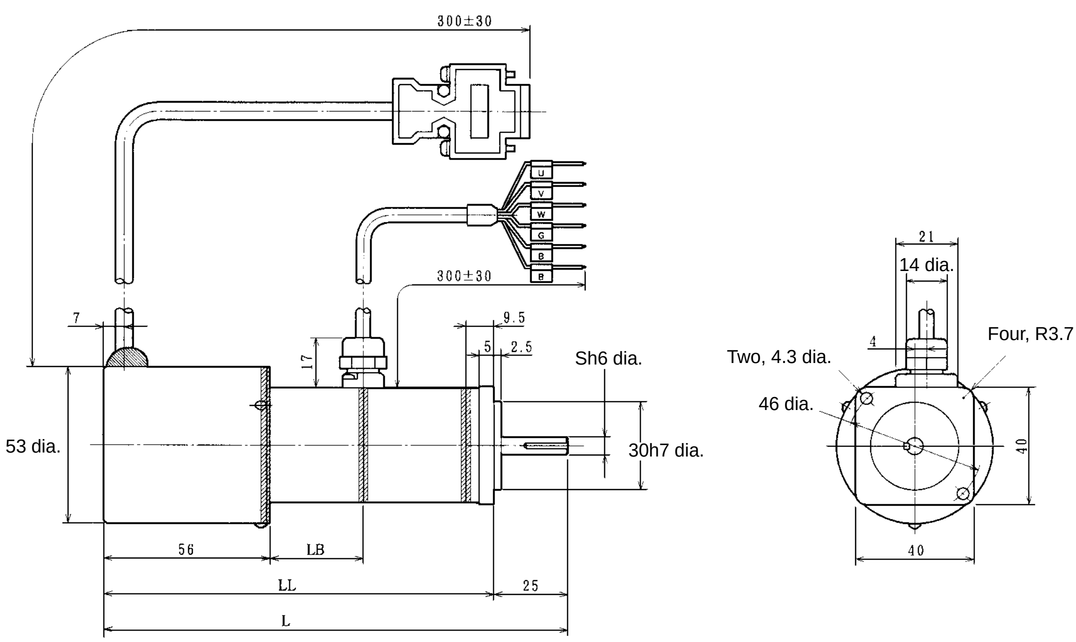


■ AC Servomotors, EC Directives with Absolute Encoders

- **30-W/50-W/100-W Standard Models:**
  R88M-U03030XA-S1, R88M-U05030XA-S1, R88M-U10030XA-S1
  R88M-U03030YA-S1, R88M-U05030YA-S1, R88M-U10030YA-S1



- **30-W/50-W/100-W Models with Brake:**
  R88M-U03030XA-BS1, R88M-U05030XA-BS1, R88M-U10030XA-BS1
  R88M-U03030YA-BS1, R88M-U05030YA-BS1, R88M-U10030YA-BS1

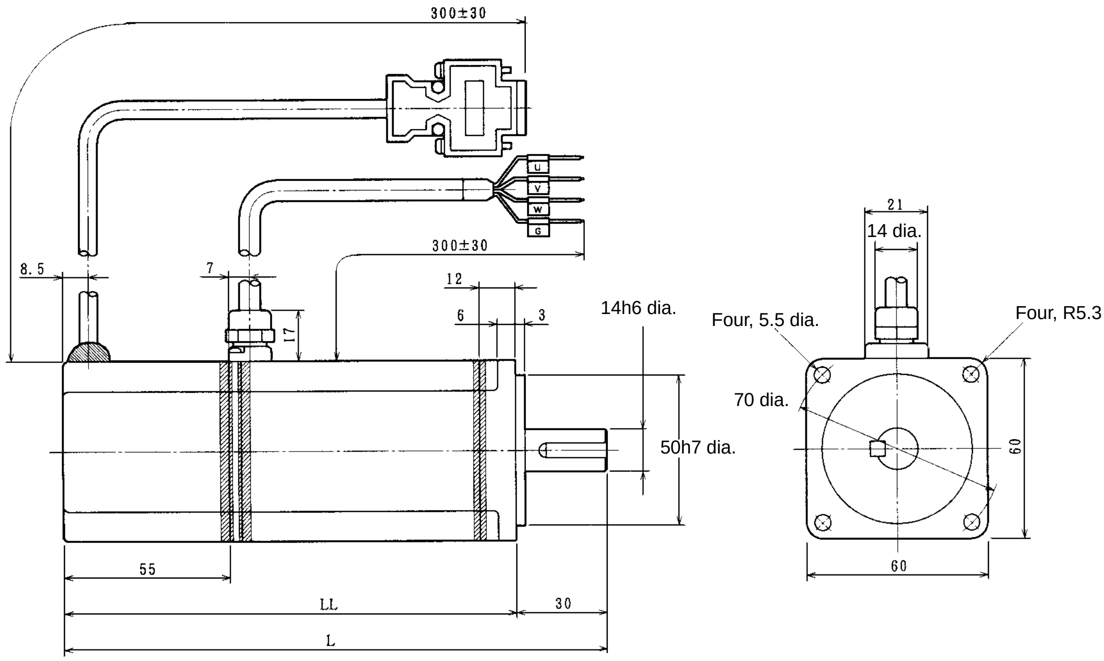


Standard Models			
Model	**L**	**LL**	**S**
R88M-U03030XA-S1 R88M-U03030YAS1	117.5	92.5	6
R88M-U05030XA-S1 R88M-U05030YA-S1	125	100	6
R88M-U10030XA-S1 R88M-U10030YA-S1	142.5	117.5	8

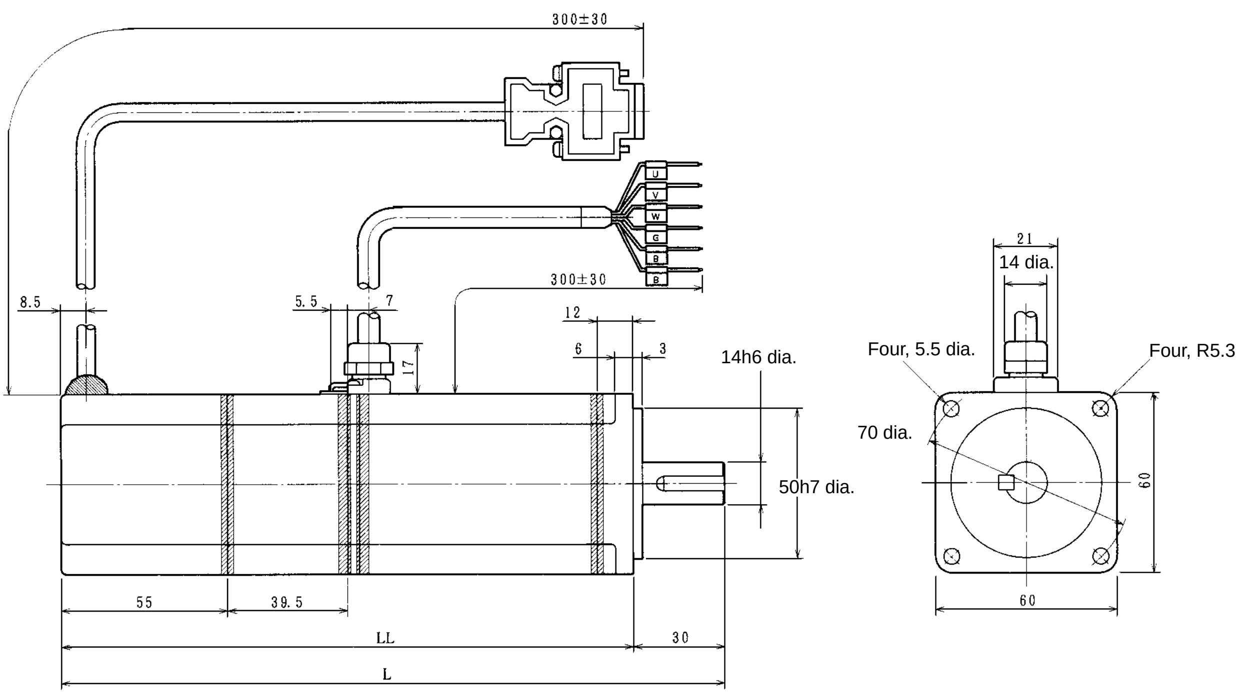
Models with Brake				
Model	**L**	**LL**	**LB**	**S**
R88M-U03030XA-BS1 R88M-U03030YA-BS1	149	124	31.5	6
R88M-U05030XA-BS1 R88M-U05030YA-BS1	156.5	131.5	31.5	6
R88M-U10030XA-BS1 R88M-U10030YA-BS1	183	158	40.5	8

■ AC Servomotors, EC Directives with Absolute Encoders (Contd.)

- **200-W/300-W/400-W Standard Models:**
  R88M-U20030XA-S1, R88M-U40030XA-S1, R88M-U20030YA-S1, R88M-U30030YA-S1



- **200-W/300-W/400-W Models with Brake:**
  R88M-U20030XA-BS1, R88M-U40030XA-BS1, R88M-U20030YA-BS1, U30030YA-BS1

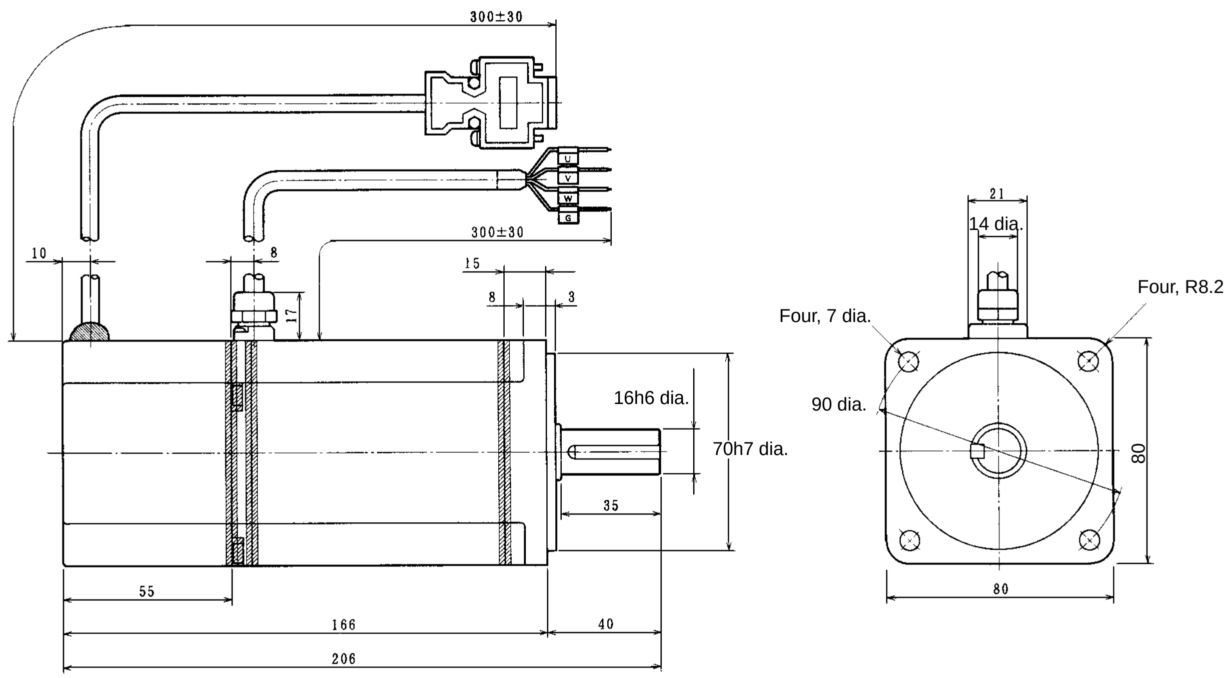


Standard Models		
Model	**L**	**LL**
R88M-U20030XA-S1 R88M-U20030YA-S1	147.5	117.5
R88M-U40030XA-S1 R88M-U30030YA-S1	175.5	145.5

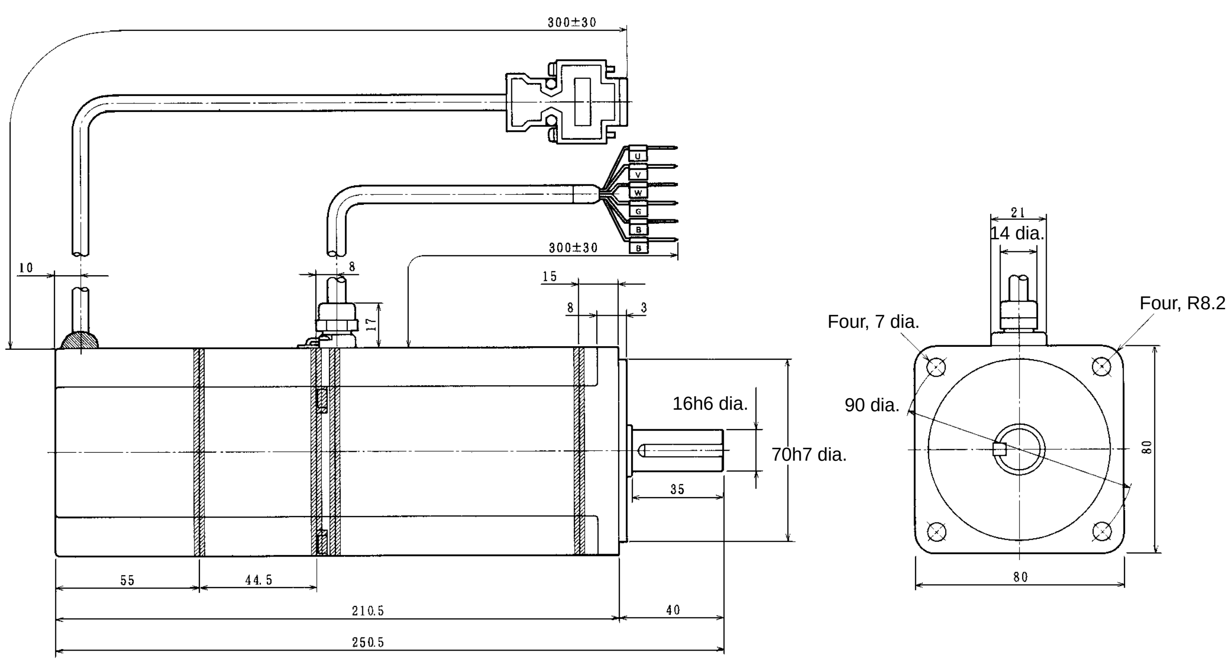
Models with Brake		
Model	**L**	**LL**
R88M-U20030XA-BS1 R88M-U20030YA-BS1	187	157
R88M-U40030XA-BS1 R88M-U30030YA-BS1	215	185

■ AC Servomotors, EC Directives with Absolute Encoders (Contd.)

● 750-W Standard Models: R88M-U75030XA-S1



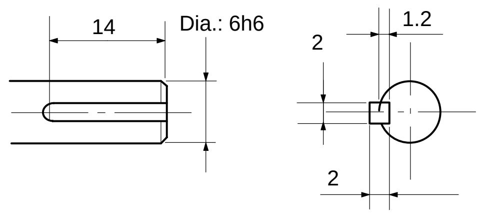
● 750-W Models with Brake: R88M-U75030XA-BS1



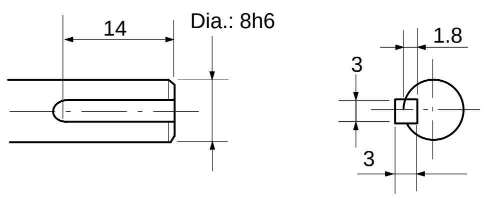
■ Shaft Dimensions of Motors With Keys (Incremental and Absolute)

Standard U-series AC Servomotors do not have keys on the shafts. The dimensions of motors with keys (produced on order) are shown below. Motors with keys are indicated by adding “-S1” to the end of the model number. Key slots are based on JIS B1301-1976.

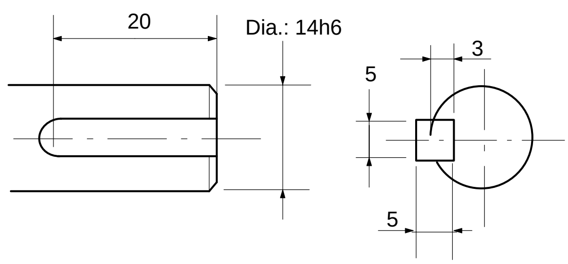
- **30-W/50-W Models**
  Standard: R88M-U03030□□-S1, R88M-U05030□□-S1
  With Brake: R88M-U03030□□-BS1, R88M-U05030□□-BS1



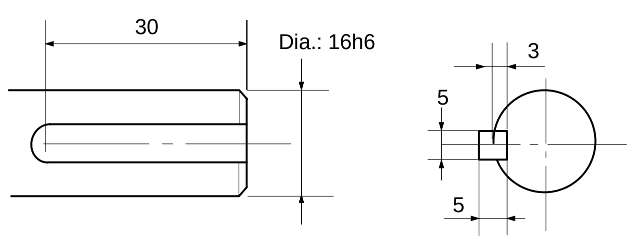
- **100-W Models**
  Standard: R88M-U10030□□-S1
  With Brake: R88M-U10030□□-BS1



- **200-W/300-W/400-W Models**
  Standard: R88M-U20030□□-S1, R88M-U40030□□-S1, R88M-U30030□□-S1
  With Brake: R88M-U20030□□-BS1, R88M-U40030□□-BS1, R88M-U30030□□-BS1



- **750-W Models**
  Standard: R88M-U75030□□-S1
  With Brake: R88M-U75030□□-BS1

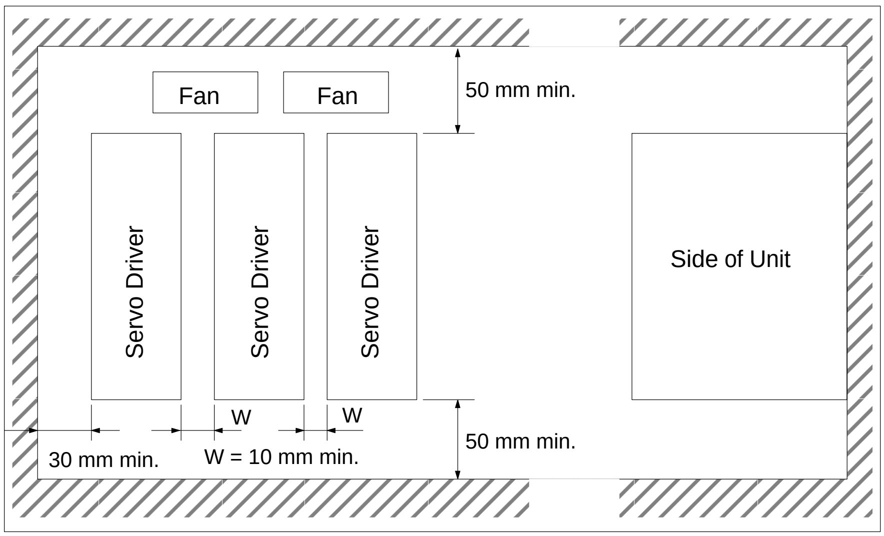


2-1-2 Installation Conditions

■ AC Servo Drivers

• Space Around Drivers

- Install Servo Drivers according to the dimensions shown in the following illustration to ensure proper heat dispersion and convection inside the panel. Also install a fan for circulation if Servo Drivers are installed side by side to prevent uneven temperatures from developing inside the panel.
- Mount the Servo Drivers vertically (so that the model number and writing can be read).



• Operating Environment

Be sure that the environment in which Servo Drivers are operated meets the following conditions.

- Ambient operating temperature: 0°C to +55°C
- Ambient operating humidity: 35% to 85% (RH, with no condensation)
- Atmosphere: No corrosive gases.

• Ambient Temperature

- Servo Drivers should be operated in environments in which there is minimal temperature rise to maintain a high level of reliability.
- Temperature rise in any Unit installed in a closed space, such as a control box, will cause the ambient temperature to rise inside the entire closed space. Use a fan or a air conditioner to prevent the ambient temperature of the Servo Driver from exceeding 55°C.
- Unit surface temperatures may rise to as much as 30°C above the ambient temperature. Use heat-resistant materials for wiring, and keep separate any devices or wiring that are sensitive to heat.
- The service life of a Servo Driver is largely determined by the temperature around the internal electrolytic capacitors. The service life of an electrolytic capacitor is affected by a drop in electrolytic volume and an increase in internal resistance, which can result in overvoltage alarms, malfunctioning due to noise, and damage to individual elements. If a Servo Driver is always operated at the maximum ambient temperature of 55°C, then a service life of approximately 50,000 hours can be expected. A drop of 10°C in the ambient temperature will double the expected service life.

• Keeping Foreign Objects Out of Units

- Place a cover over the Units or take other preventative measures to prevent foreign objects, such as drill filings, from getting into the Units during installation. Be sure to remove the cover after installation is complete. If the cover is left on during operation, heat buildup may damage the Units.
- Take measures during installation and operation to prevent foreign objects such as metal particles, oil, machining oil, dust, or water from getting inside of Servo Drivers.

■ AC Servomotors

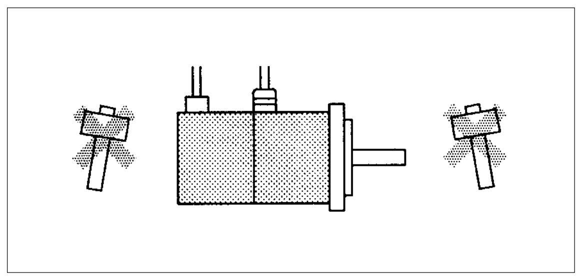
• Operating Environment

Be sure that the environment in which the Servomotor is operated meets the following conditions.

- Ambient operating temperature: 0°C to +40°C
- Ambient operating humidity: 20% to 80% (RH, with no condensation)
- Atmosphere: No corrosive gases.

• Impact and Load

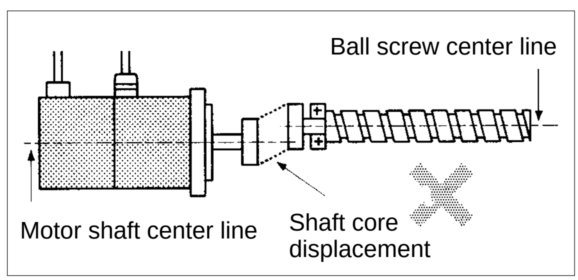
- The Servomotor is resistant to impacts of up to 10 G {98 m/s^2}. Do not subject it to heavy impacts or loads during transport, installation, or positioning. In addition, do not hold onto the encoder, cable, or connector areas when transporting it.
- Always use a pulley remover to remove pulleys, couplings, or other objects from the shaft.



- Secure cables so that there is no impact or load placed on the cable connector areas.

• Connecting to Mechanical Systems

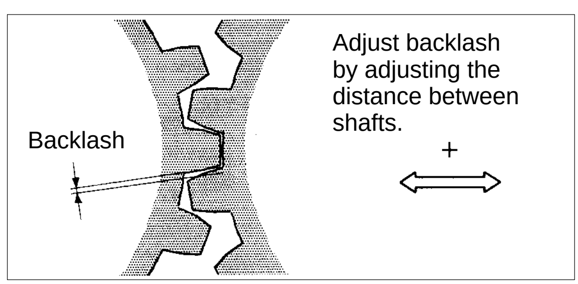
- The axial loads for Servomotors are specified in section 5-2-4. If an axial load greater than that specified is applied to a Servomotor, it will reduce the service life of the motor bearings and may damage the motor shaft. When connecting to a load, use couplings that can sufficiently absorb mechanical eccentricity and variation.

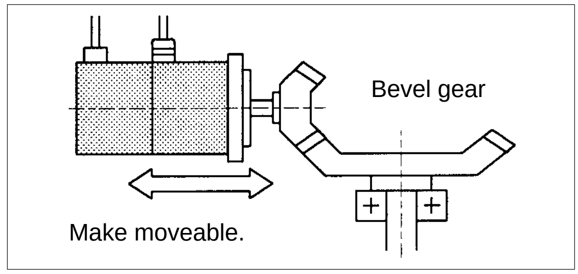


Recommended Coupling

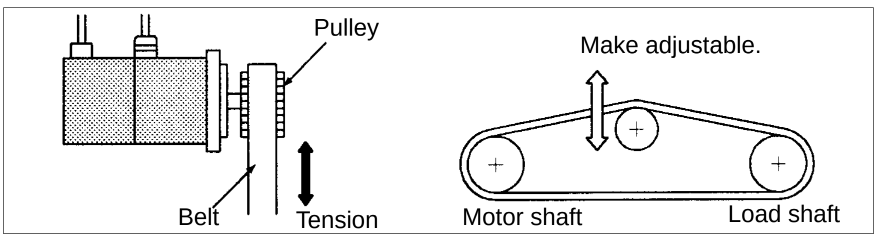
Name	Maker
Oldham coupling	Myghty Co., Ltd

- For spur gears, an extremely large radial load may be applied depending on the gear precision. Use spur gears with a high degree of accuracy (for example, JIS class 2: normal line pitch error of 6 µm max. for a pitch circle diameter of 50 mm). If the gear precision is not adequate, allow backlash to ensure that no radial load is placed on the motor shaft.





- Bevel gears will cause a load to be applied in the thrust direction depending on the structural precision, the gear precision, and temperature changes. Provide appropriate backlash or take other measures to ensure that no thrust load is applied which exceeds specifications.
- Do not put rubber packing on the flange surface. If the flange is mounted with rubber packing, the motor flange may separate due to the tightening strength.
- When connecting to a V-belt or timing belt, consult the maker for belt selection and tension. A radial load twice the belt tension will be placed on the motor shaft. Do not allow a radial load exceeding specifications to be placed on the motor shaft due to belt tension. If an excessive radial load is applied, the motor shaft may be damaged. Set up the structure so that the radial load can be adjusted. A large radial load may also be applied as a result of belt vibration. Attach a brace and adjust Servo Driver gain so that belt vibration is minimized.



• Water and Drip Resistance

- The Servomotor does not have a water-proof structure. Except for the connector areas, the protective structure is covered by the following JEM (The Japan Electrical Manufacturers' Association) standards.

  Models Conforming to UL/cUL Standards and Models Not Conforming to Any Standards: IP-42
  EC Directive Models: IP-44 (except shaft penetration point)
- If the Servomotor is used in an environment in which condensation occurs, water may enter inside of the encoder from the end surfaces of cables due to motor temperature changes. Either take measures to ensure that water cannot penetrate in this way, or use water-proof connectors. Even when machinery is not in use, water penetration can be avoided by taking measures, such as keeping the motor in servo-lock status, to minimize temperature changes.
- If machining oil with surfactants (e.g., coolant fluids) or their spray penetrate inside of the motor, insulation defects or short-circuiting may occur. Take measures to prevent machining oil penetration.

• Oil Seals

If the motor shaft is exposed to oil or grease, use a Servomotor with oil seals. (Contact your OMRON representative for details.)

• Other Precautions

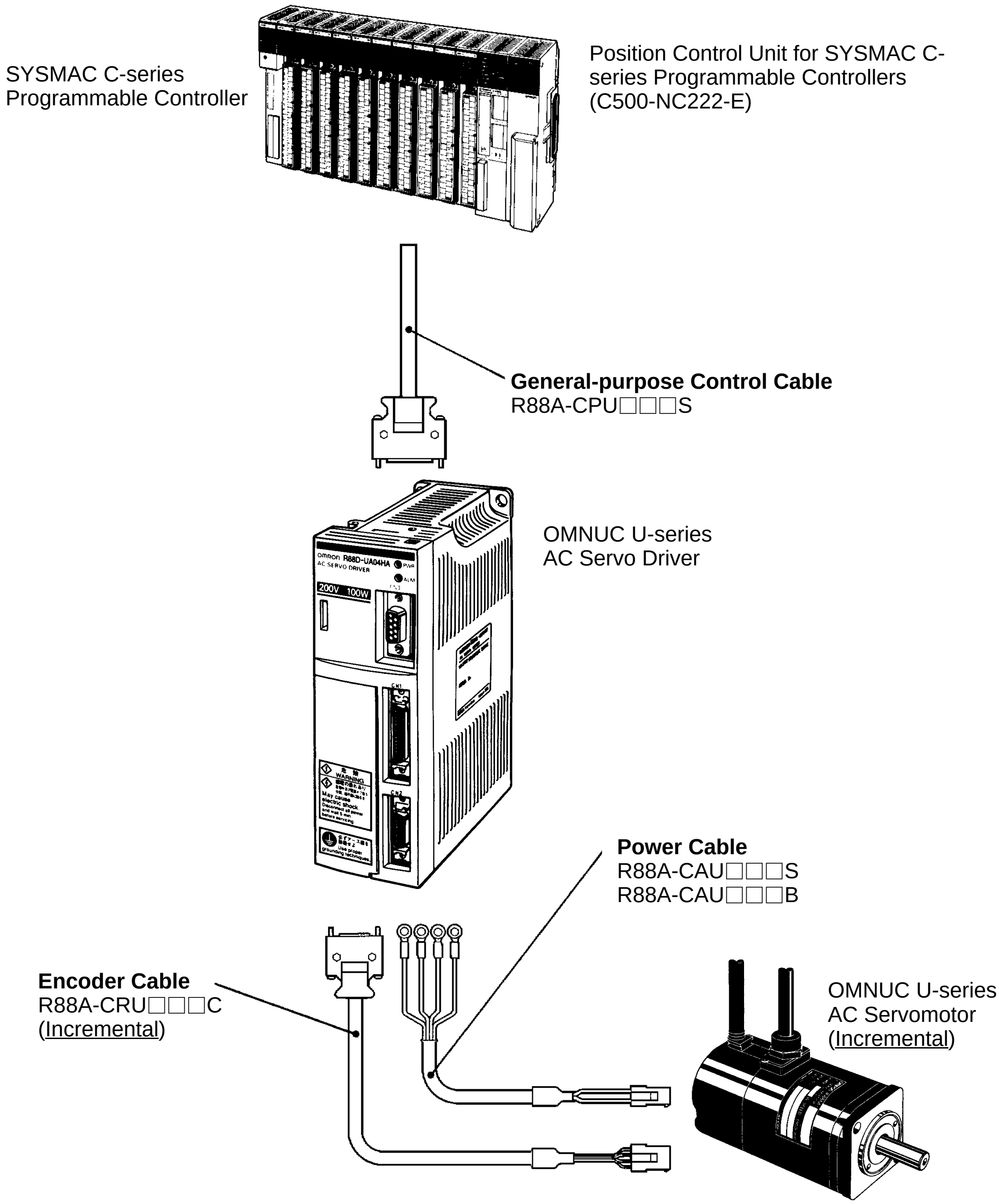
- Do not apply commercial power directly to the Servomotor. The Servomotors run on synchronous AC and use permanent magnets. Applying 3-phase power will burn out the motor coils.
- Do not carry the Servomotor by its cable, otherwise the cable may become disconnected or the cable clamp may become damaged.
- Take measures to prevent the shaft from rusting. The shafts are coated with anti-rust oil when shipped, but anti-rust oil or grease should also be applied when connecting the shaft to a load.
- Absolutely do not remove the encoder cover or take the motor apart. The magnet and the encoder are aligned in the Servomotor. If they become misaligned, the motor will not operate.

2-2 Wiring Products Conforming to UL/cUL and Wiring Products Not Confrorming to Any Standards

2-2-1 Wiring to an OMRON Controller

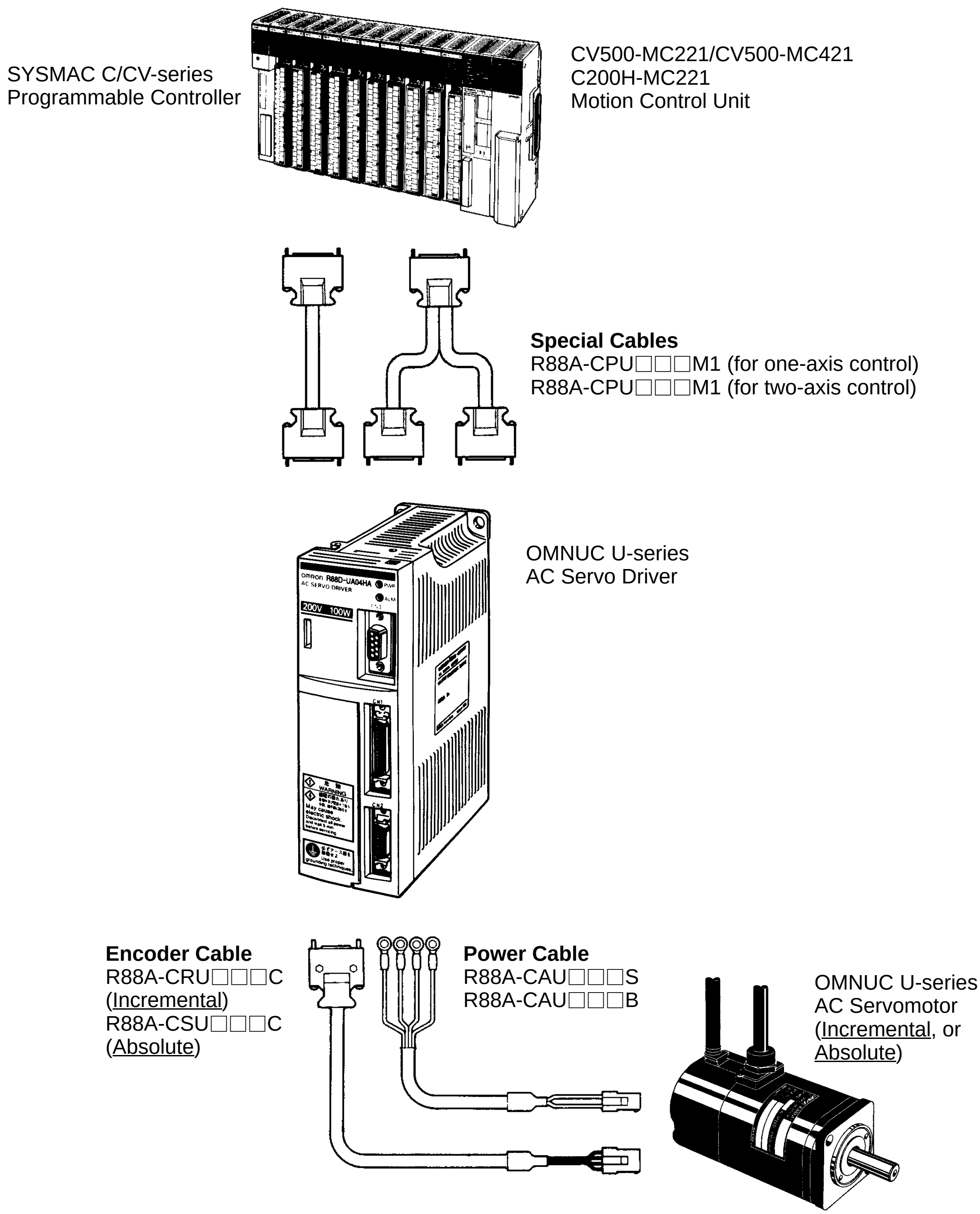
Use the dedicated control cables and a general-purpose control cable (purchased separately) to connect U-series AC Servomotors and Servo Drivers to Position Control Units.

■ SYSMAC C/CV-series Position Control Units



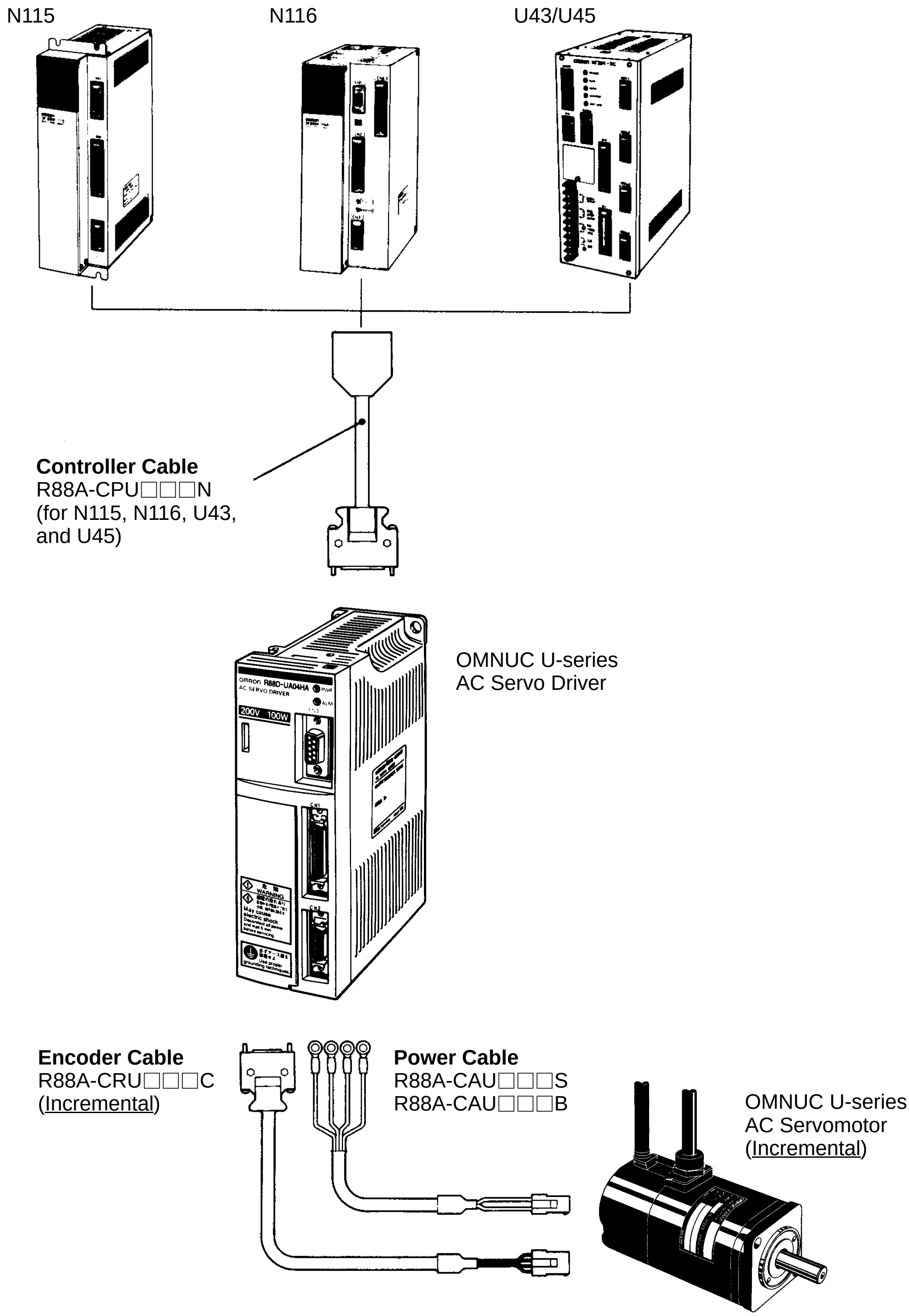
Note Refer to *Chapter 5 Specifications* for connector and cable specifications.

■ SYSMAC CV-series Motion Control Units



Note Refer to *Chapter 5 Specifications* for connector and cable specifications.

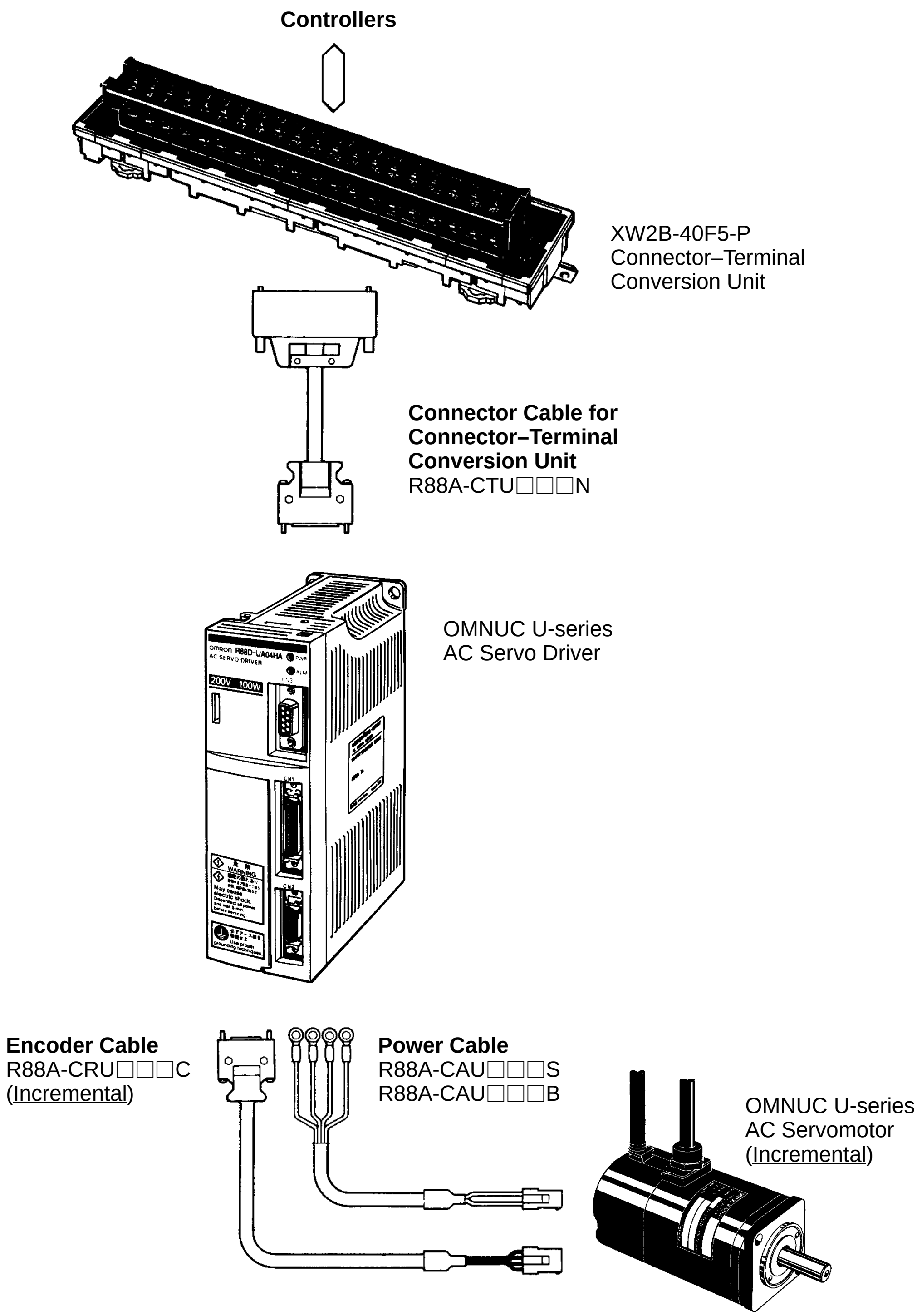
■ OMNUC N115, N116, U43, and U45



Note Refer to *Chapter 5 Specifications* for connector and cable specifications.

2-2-2 Connector–Terminal Conversion Unit

The AC Servo Driver can be easily connected to the Connector–Terminal Conversion Unit through a special cable without soldering.

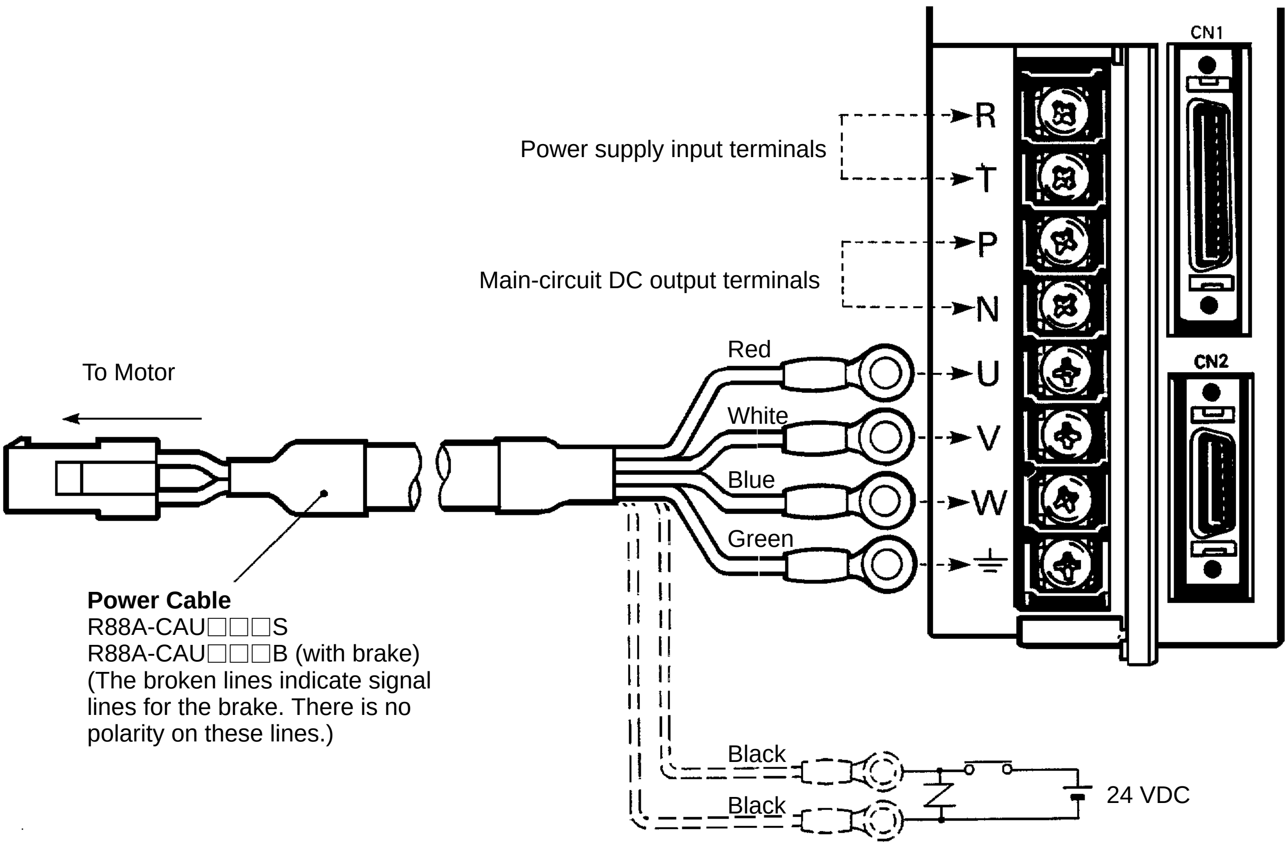


Note Refer to *Chapter 5 Specifications* for connector and cable specifications.

2-2-3 Wiring Terminal Blocks

Provide proper wire diameters, ground systems, and noise resistance when wiring terminal blocks.

■ Wiring Terminal Blocks



Terminal label	Name	Function	
R	Power supply input	The commercial power supply input terminals for the main circuit and the control circuitry.	
T		R88D-UA□□H(A): Single-phase 200/230 VAC (170 to 253 V) 50/60 Hz R88D-UA□□L(A): Single-phase 100/115 VAC (85 to 127 V) 50/60 Hz	
P	Main circuit DC output	The terminals for connecting Regeneration Units (R88A-RG08UA). Connect these terminals when there is a high level of regenerative energy.	
N			
U	Motor connection terminals	Red	These are the output terminals to the Servomotor. Be careful to wire them correctly.
V		White	
W		Blue	
⏚	Frame ground	Green	The ground terminal for both the motor output and power supply input. Ground to a class-3 ground (to 100 Ω or less) or better.

Note Refer to *3-8 Regenerative Energy Absorption* for the methods to calculate regenerative energy.

■ Terminal Block Current and Wire Sizes

The following table shows the rated effective currents flowing to the Servo Driver and the sizes of the electrical wires.

• Servo Drivers with 200-VAC Input (R88D-UA□□H(A))

Driver (Watts)	R88D-UA02H(A) (30 W)	R88D-UA03H(A) (50 W)	R88D-UA04H(A) (100 W)	R88D-UA08H(A) (200 W)	R88D-UA12H(A) (400 W)	R88D-UA20H(A) (750 W)
Power supply input current (R, T)	1.3 A	1.5 A	2.5 A	4.0 A	6.0 A	11.0 A
Motor output current (U, V, W)	0.42 A	0.6 A	0.87 A	2.0 A	2.6 A	4.4 A
Power supply input terminal wire size	0.75 mm^2 or AWG 18 min.				1.25 mm^2	2.0 mm^2
Motor output terminal wire size	0.5 mm^2 or AWG 20			AWG 20 (see note) to AWG 18		
	Use OMRON standard cable. The applicable wire size for motor connectors is AWG22 to AWG18.					
Ground terminal wire size	Use 2.0-mm^2 external ground wires. Use the same wire as used for the motor output.					

Note If the cable length is 15 meters or longer for a 750-W Servomotor, the momentary maximum torque at rotation speeds of 2,500 r/min or higher may drop by approximately 7%.

• Servo Drivers with 100-VAC Input (R88D-UA□□L(A))

Driver model (Watts)	R88D-UA03L(A) (30 W)	R88D-UA04L(A) (50 W)	R88D-UA10L(A) (100 W)	R88D-UA12L(A) (200 W)	R88D-UA15LA (300 W)
Power supply input current (R, T)	2.0 A	2.6 A	4.5 A	8.0 A	10.0 A
Motor output current (U, V, W)	0.63 A	0.7 A	2.2 A	2.7 A	3.7 A
Power supply input terminal wire size	0.75 mm^2 or AWG 18 min.			1.25 mm^2	2 mm^2
Motor output terminal wire size	0.5 mm^2 or AWG 20		AWG 20 to AWG 18		
	Use OMRON standard cable (AWG20). The applicable wire size for motor connectors is AWG22 to AWG18.				
Ground terminal wire size	Use 2.0-mm^2 external ground wires. Use the same wire as used for the motor output.				

■ Wire Sizes and Allowable Current

The following table shows allowable currents when there are three electrical wires. Use values equal to or lower than the specified values.

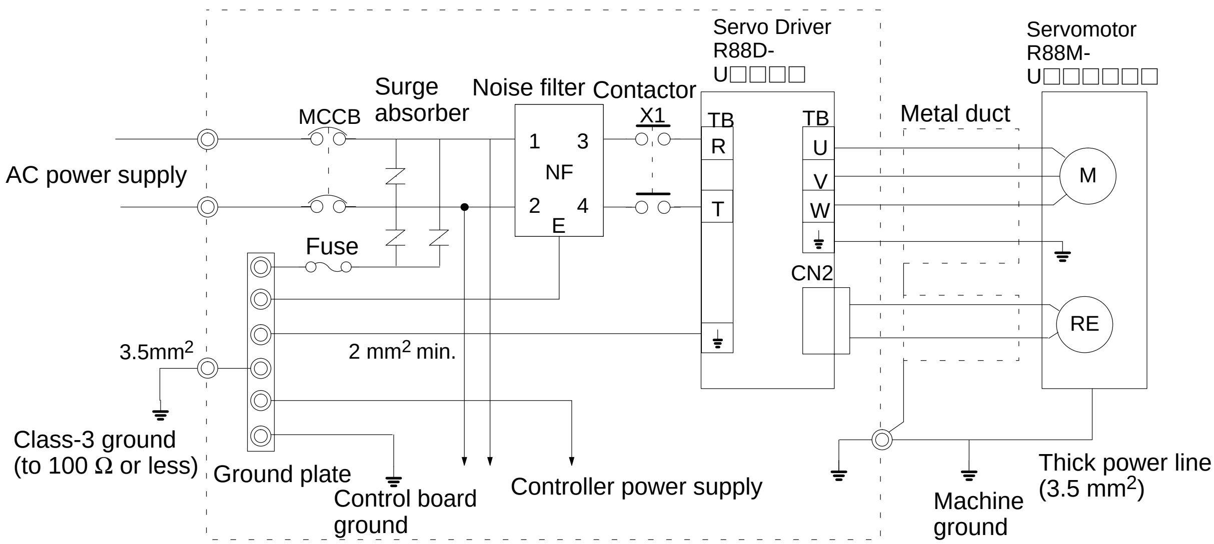
• Heat-resistant Vinyl Wiring, UL1007, Rated Temperature 80°C (Reference Value)

AWG size	Nominal cross-sectional area (mm^2)	Configuration (wires/mm^2)	Conductive resistance (Ω/km)	Allowable current (A) for ambient temperature		
				40°C	50°C	60°C
20	0.5	19/0.18	39.5	6.6	5.6	4.5
---	0.75	30/0.18	26.0	8.8	7.0	5.5
18	0.9	37/0.18	24.4	9.0	7.7	6.0
16	1.25	50/0.18	15.6	12.0	11.0	8.5

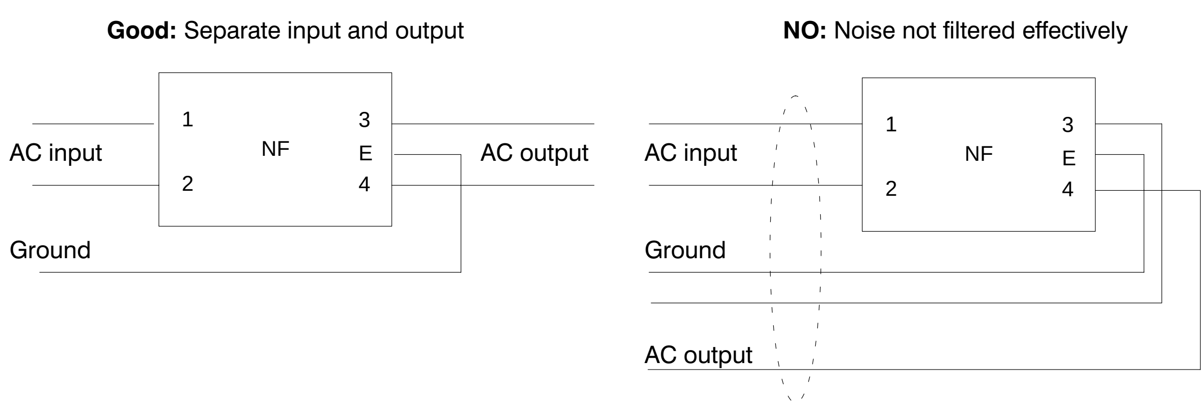
2-2-4 Wiring for Noise Resistance

■ Wiring Method

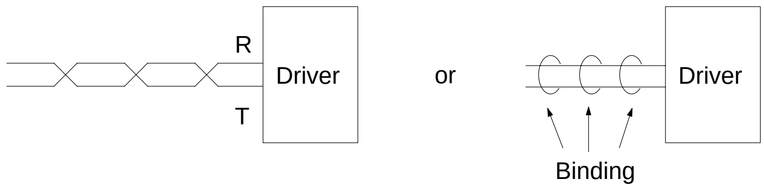
Noise resistance will vary greatly depending on the wiring method used. Resistance to noise can be increased by paying attention to the items described below.



- Ground the motor's frame to the machine ground when the motor is on a movable shaft.
- Use a grounding plate for the frame ground for each Unit, as shown in the illustration, and ground to a single point.
- Use ground lines with a minimum thickness of 3.5 mm^2, and arrange the wiring so that the ground lines are as short as possible.
- If no-fuse breakers (MCCB) are installed at the top and the power supply line is wired from the lower duct, use metal tubes for wiring and make sure that there is adequate distance between the input lines and the internal wiring. If input and output lines are wired together, noise resistance will decrease.
- No-fuse breakers (MCCB), surge absorbers, and noise filters (NF) should be positioned near the input terminal block (ground plate), and I/O lines should be isolated and wired using the shortest means possible.
- Wire the noise filter as shown at the left in the following illustration. The noise filter should be installed at the entrance to the control panel whenever possible.



• Use twisted-pair cables for the power supply cables whenever possible, or bind the cables.



• Separate power supply cables and signal cables when wiring.

■ Selecting Components

• No-fuse Breakers (MCCB)

When selecting no-fuse breakers, take into consideration the maximum output current and the inrush current. The momentary maximum output for a servo system is approximately three times that of the rated output, and a maximum output of three seconds can be executed. Therefore, select no-fuse breakers with an operating time of at least five seconds at 300% of the rated maximum output. General-purpose and low-speed no-fuse breakers are generally suitable. Refer to the table in *2-2-3 Terminal Block Wiring* for the power supply input currents for each motor, and then add the current consumption for the number of shafts, other controllers, etc., to make the selection.

The Servo Driver inrush current flows at a maximum of 50 A for 20 ms when 200 V is input. With low-speed no-fuse breakers, a inrush current 7 to 8 times the rated current flows for 0.1 second. When making the selection, take into consideration the entire inrush current for the system.

• Surge Absorbers

Use surge absorbers to absorb surges from power supply input lines due to lightning, abnormal voltages, etc. When selecting surge absorbers, take into account the varistor voltage, the amount of surge immunity, and the amount of energy resistance. For 200-VAC systems, use a varistor voltage of 470 V. The surge absorbers shown in the following table are recommended.

Maker	Model	Varistor voltage	Max. limit voltage	Surge immunity	Energy resistance	Fuse capacity	Type
Matsushita Electric Parts	ERZV10D471(W)	470 V	775 V	1,250 A	45 J	3 to 5 A	Disk
	ERZV14D471(W)	470 V	775 V	2,500 A	80 J	3 to 10 A	
	ERZV20D471(W)	470 V	775 V	4,000 A	150 J	5 to 15 A	
	ERZC20EK471(W)	470 V	775 V	5,000A	150 J	---	Block
Ishizuka Electronics Co.	Z10L471	470 V	773 V	1,000A	15 W•s	3 to 5 A	Disk
	Z15L471	470 V	738 V	1,250 A	20 W•s	3 to 5 A	
	Z21L471	470 V	733 V	3,000 A	30 W•s	5 to 10 A	
	Z25M471S	470 V	810 V	10,000 A	235 J	---	Block
Okaya Electric Ind.	R.A.V -781BWZ-2A	---	783 V	1,000 A	---	---	Block
	R.A.V -781BXZ-2A	---	783 V	1,000 A	---	---	
	R.A.V -401.621BYR-2	---	620 V	1,000 A	---	---	

Note 1. The (W) Matsushita models are UL and CSA certified.

Note 2. Refer to manufacturers documentation for operating details.

Note 3. The surge immunity is for a standard impulse current of 8/20 µs. If pulses are wide, either decrease the current or change to a larger-capacity surge absorber.

Note 4. The energy resistance is the value for 2 ms. It may not be possible to retard high-energy pulses at less than 700 V. In that case, absorb surges with an insulated transformer or reactor.

• Noise Filters for Power Supply Input

Use a noise filter to attenuate extraneous noise and to diminish noise radiation from the Servo Driver. Select a noise filter with a load current of at least twice the rated current. The following table shows noise filters that reduce by 40 dB noise between 200 kHz and 30 MHz.

Maker	Model	Rated current	Remarks
Tokin	LF-210N	10 A	For single-phase
	LF-215N	15 A	
	LF-220N	20 A	

To attenuate noise at frequencies of 200 kH or less, use an insulated transformer and a noise filter. For high frequencies of 30 MHz or more, use a ferrite core and a high-frequency noise filter with a through-type capacitor.

• Noise Filters for Motor Output

Use noise filters without built-in capacitors on the Servomotor output lines. The following table shows the noise filters that are recommended for motor output.

Maker	Model	Rated current	Remarks
Tokin	LF-310KA	10 A	Three-phase block noise filter
	LF-320KA	20 A	
	ESD-R-47B	---	EMI core for radiation noise
Fuji Electrochemical Co.	RN80UD	---	10-turn for radiation noise

Note 1. The Servomotor output lines cannot use the same noise filters used for power supplies.

Note 2. Typical noise filters are used with power supply frequencies of 50/60 Hz. If these noise filters are connected to outputs of 7.8 to 11 KHz (the Servo Driver's PWM frequency), a very large (about 100 times larger) leakage current will flow through the noise filter's condenser and the Servo Driver could be damaged.

• Surge Killers

Install surge killers for loads that have induction coils, such as relays, solenoids, brakes, clutches, etc. The following table shows types of surge killers and recommended products.

Type	Features	Recommended products
Diode	Diodes are relatively small devices such as relays used for loads when reset time is not an issue. The reset time is increased because the surge voltage is the lowest when power is cut off. Used for 24/48-VDC systems.	Use a fast-recovery diode with a short reverse recovery time. Fuji Electric Co., ERB44-06 or equivalent
Thyristor or Varistor	Thyristor and varistor are used for loads when induction coils are large, as in electromagnetic brakes, solenoids, etc., and when reset time is an issue. The surge voltage when power is cut off is approximately 1.5 times that of the varistor.	Select varistor voltage as follows: 24-VDC system varistor: 39 V 100-VDC system varistor: 200 V 100-VAC system varistor: 270 V 200-VAC system varistor: 470 V
Capacitor + resistor	Use capacitors and resistors for vibration absorption of surge when power is cut off. The reset time can be shortened by proper selection of the capacitor or resistor.	Okaya Electric Ind. CR-50500 0.5 µF-50 Ω CRE-50500 0.5 µF-50 Ω S2-A-0 0.2 µF-500 Ω

Note Thyristors and varistors are made by the following companies. Refer to manufacturers documentation for operating details. Thyristors: Ishizuka Electronics Co.
Varistors: Ishizuka Electronics Co., Matsushita Electric Parts

• Contactors

When selecting contactors, take into consideration the circuit's inrush current and the momentary maximum current. The Servo Driver inrush current is 50 A, and the momentary maximum current is approximately twice the rated current. The following table shows the recommended contactors.

Maker	Model	Rated current	Momentary maximum current	Coil voltage
OMRON	G6C-2BND	10 A	---	24 VDC
	LY2-D	10 A	---	24 VDC
	G7L-2A-BUBJ	25 A	---	24 VDC, 200 to 240 VAC
	J7AN-E3	15 A	120 A	24 VDC
	LC1-D093A60	11 A	200 A	24 VDC, 200/220 VAC, 200 to 240 VAC

• Leakage Breakers

- Select leakage breakers designed for inverters.
- Since switching operations take place inside the Servo Driver, high-frequency current leaks from the armature of the Servomotor. With inverter leakage breakers, high-frequency current is not detected, preventing the breaker from operating due to leakage current.
- When selecting leakage breakers, also remember to add the leakage current from devices other than the Servomotor, such as machines using a switching power supply, noise filters, inverters, and so on.
- For detailed information about the selection methods of leakage breakers, refer to catalogs provided by manufacturers.

- The following table shows the Servomotor leakage currents for each Servo Driver.

Driver	Leakage current (direct) (including high-frequency current)	Leakage current (resistor-capacitor, in commercial power supply frequency range)
R88D-UA02H to -UA08H	80 mA	3 mA
R88D-UA12H	60 mA	4 mA
R88D-UA20H	110 mA	5 mA

Note 1. Leakage current values shown above are for motor power lines of 10 m or less. The values will change depending on the length of power cables and the insulation.

Note 2. Leakage current values shown above are for normal temperatures and humidity. The values will change depending on the temperature and humidity.

Note 3. Leakage current for 100-VAC-input Servomotors is approximately half that of the values shown above.

■ Improving Encoder Cable Noise Resistance

The following encoder signals are used.

Incremental Encoders:

A, B, and S phase. The frequency for A- or B-phase signals is 154 kHz max.; the transmission speed for S-phase signals is 616 kbps.

Absolute Encoders:

A, B, and Z phase, plus the absolute encoder signal. The frequency for A- or B-phase signals is 76.8 kHz max.; the transmission speed for absolute encoder signals is 9.6 kbps.

Follow the wiring methods outlined below to improve encoder noise resistance.

- Be sure to use dedicated encoder cables.
- If lines are interrupted in the middle, be sure to connect them with connectors, making sure that the cable insulation is not peeled off for more than 50 mm. In addition, be sure to use shielded wire.
- Do not coil cables. If cables are long and are coiled, mutual induction and inductance will increase and will cause malfunctions. Be sure to use cables fully extended.
- When installing noise filters for encoder cables, use ferrite cores. The following table shows the recommended ferrite core models.

Maker	Name	Model
Tokin	EMI core	ESD-QR-25-1
TDK	Clamp filter	ZCAT2032-0930
		ZCAT3035-1330
		ZCAT2035-0930A

- Do not wire the encoder cable in the same duct as power cables and control cables for brakes, solenoids, clutches, and valves.

■ Improving Control I/O Signal Noise Resistance

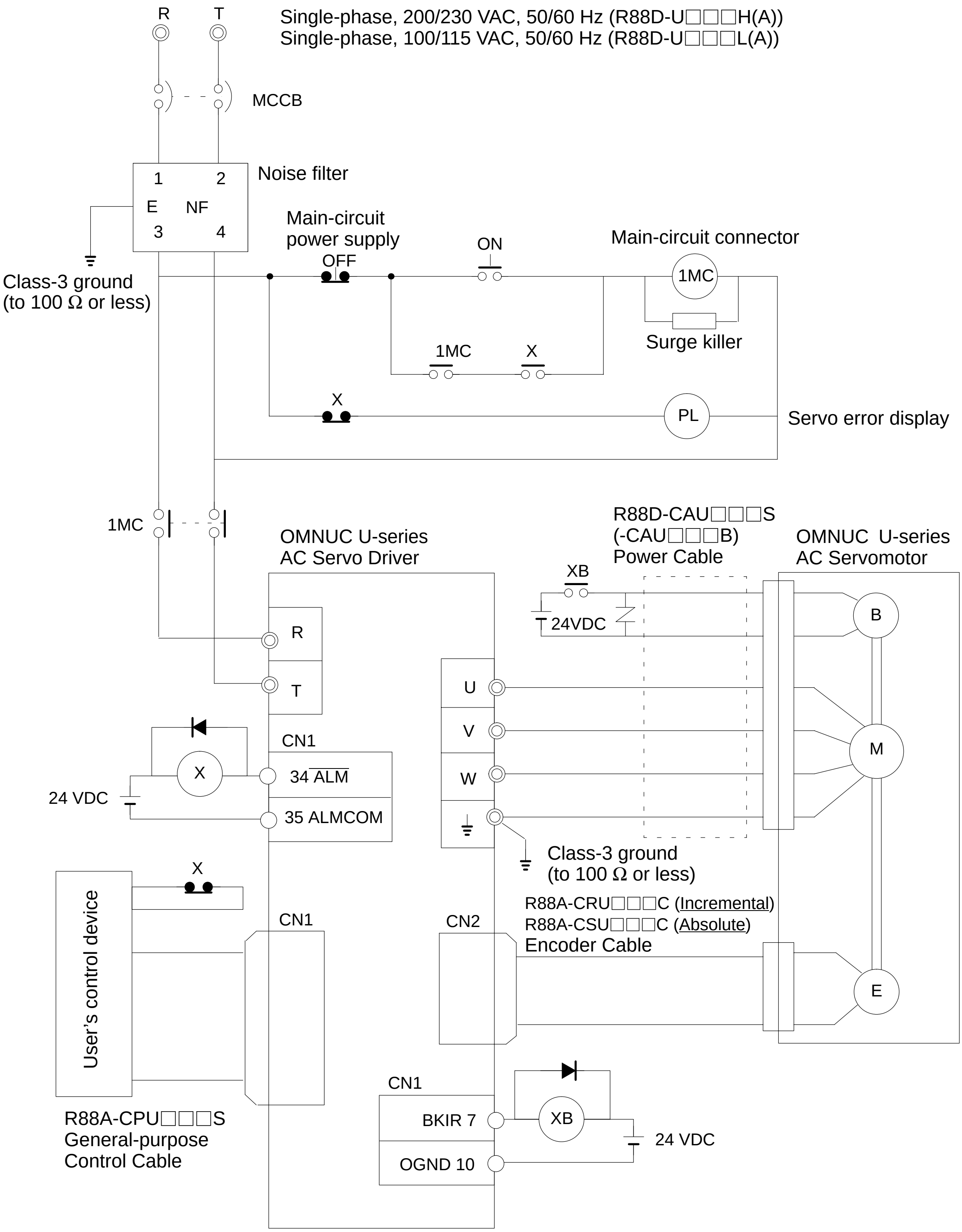
Position can be affected if control I/O signals are influenced by noise. Follow the methods outlined below for the power supply and wiring.

- Use completely separate power supplies for the control power supply (especially 24 VDC) and the external operation power supply. In particular, be careful not to connect two power supply ground wires. Install a noise filter on the primary side of the control power supply.

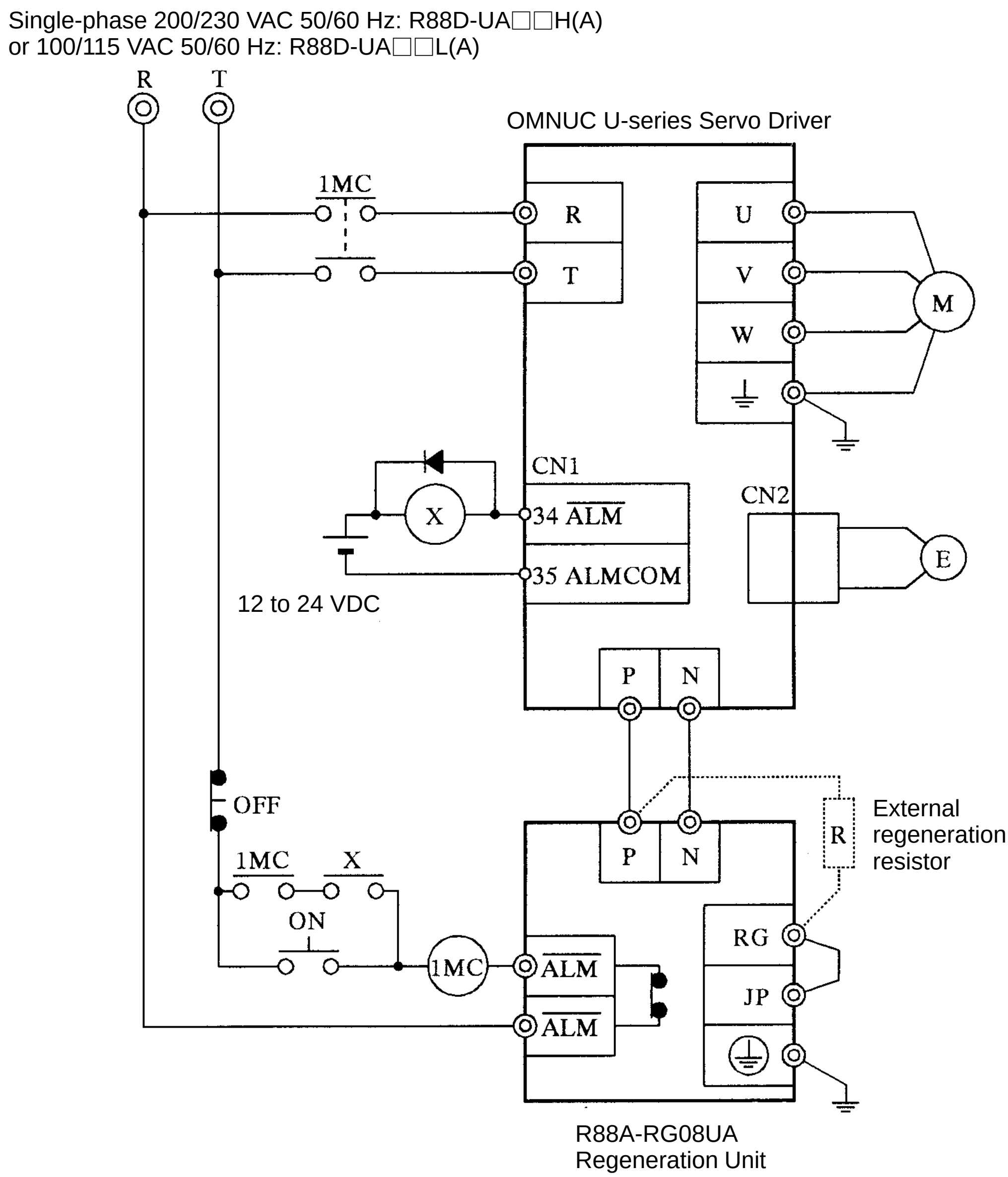
- For speed and torque command input lines, be sure to use twisted-pair shielded cable, and connect both ends of the shield wire to ground.
- If the control power supply wiring is long, noise resistance can be improved by adding 1-µF laminated ceramic capacitors between the control power supply and ground at the Servo Driver input section and the controller output section.
- For encoder output lines (A, B, and Z phases, plus the absolute encoder signal), be sure to use twisted-pair shielded cable, and connect both ends of the shield wire to ground.

2-2-5 Peripheral Device Connection Examples

■ Connecting to Peripheral Devices



■ Connecting a Regeneration Unit



Note 1. Remove the short bar from between the RG and JP terminals when connecting external regeneration resistor. If the external regeneration resistor is connected without removing the short bar, the internal circuitry will be damaged.

Note 2. Connect the external regeneration resistor to between the P and RG terminals.

Note 3. The Regeneration Unit does not conform to EC Directives.

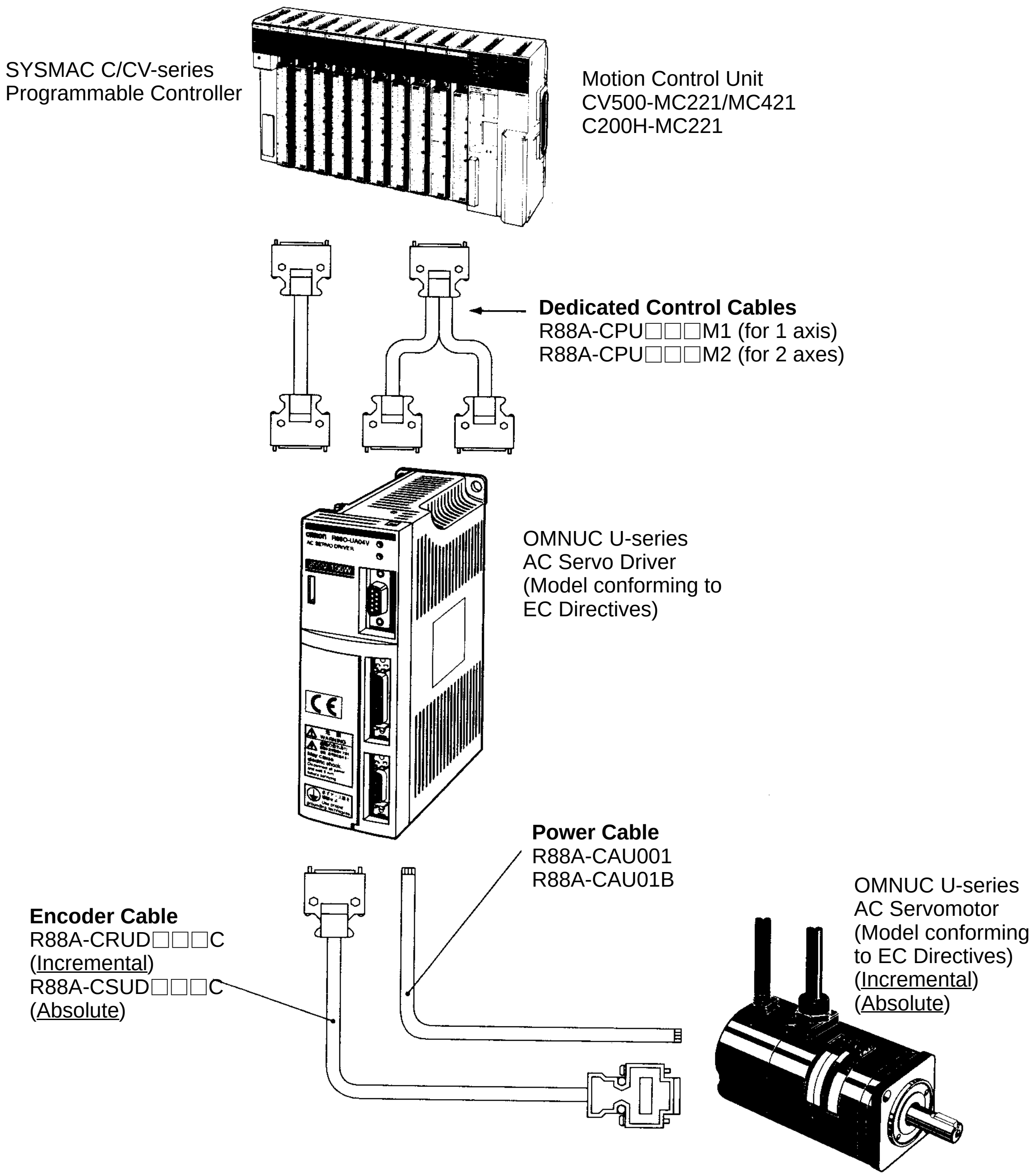
Note 4. Connect the ALM output so that the power supply will be interrupted when the contacts are opened. The Regeneration Unit may be damaged if it is used without including a power interruption sequence using the ALM output.

2-3 Wiring Products Conforming to EC Directives

2-3-1 Wiring to an OMRON Controller

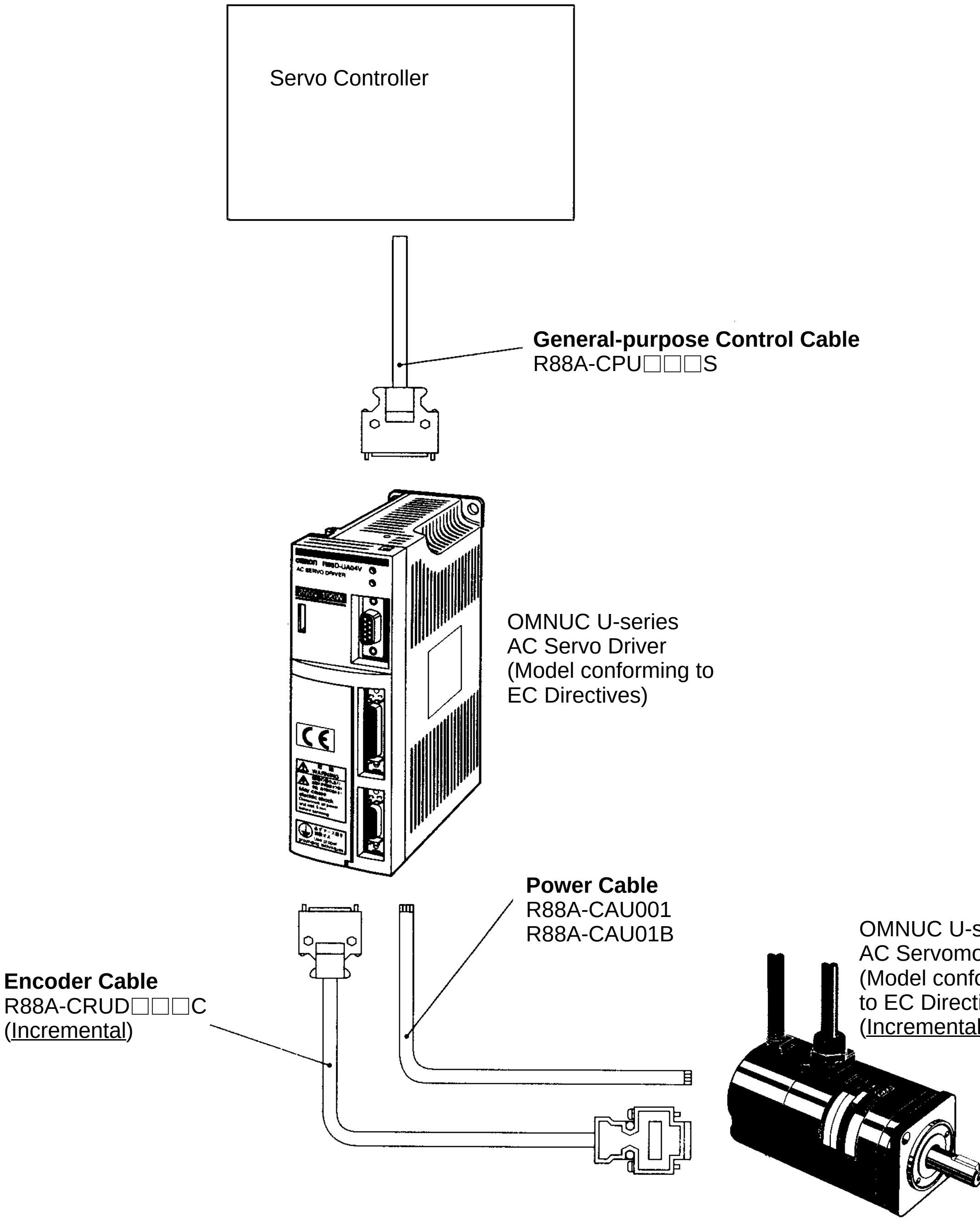
Use general-purpose control cable (purchased separately) to connect U-series AC Servomotors and Servo Drivers (models conforming to EC Directives) to Motion Control Units.

■ SYSMAC C/CV-series Motion Control Units



Note Refer to *Chapter 5 Specifications* for connector and cable specifications.

■ Connecting to a Servo Controller

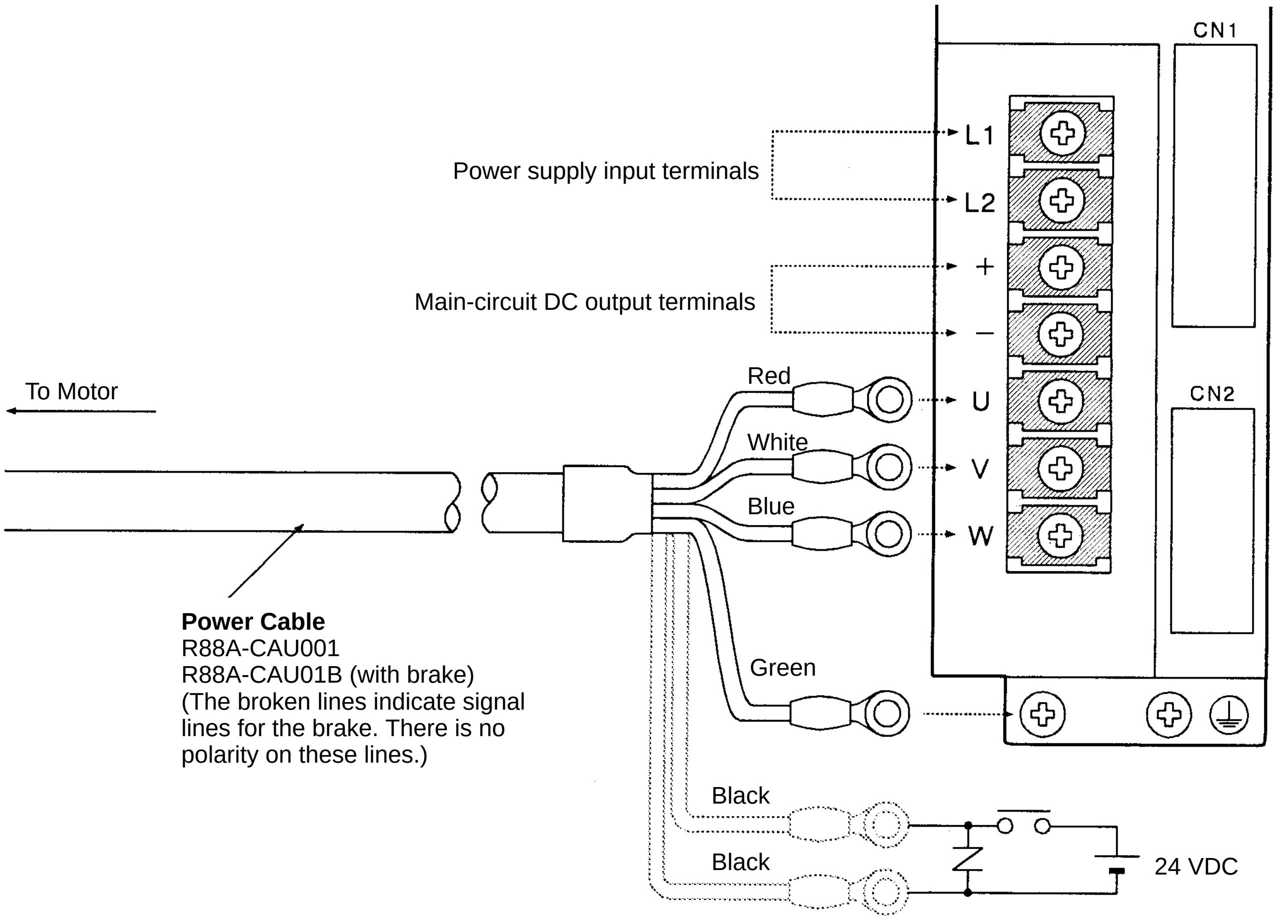


Note Refer to *Chapter 5 Specifications* for connector and cable specifications.

2-3-2 Wiring Terminal Blocks

Provide proper wire diameters, ground systems, and noise resistance when wiring terminal blocks.

■ Wiring Terminal Blocks



Terminal label	Name	Function	
L1	Power supply input	The commercial power supply input terminals for the main circuit and the control circuitry.	
L2		R88D-UA□□V: Single-phase 200/230 VAC (170 to 253 V) 50/60 Hz R88D-UA□□V: Single-phase 100/115 VAC (85 to 127 V) 50/60 Hz	
+	Main circuit DC output	When there is a high level of regenerative energy in a multi-axis system, the + terminals can be connected together and the – terminals can be connected together to increase the ability to absorb regenerative energy.	
–			
U	Motor connection terminals	Red	These are the output terminals to the Servomotor. Be careful to wire them correctly.
V		White	
W		Blue	
⏚	Frame ground	Green	Ground to a class-3 ground (to 100 Ω or less) or better.

Note Refer to *3-8 Regenerative Energy Absorption* for the methods to calculate regenerative energy.

■ Terminal Block Current and Wire Sizes

The following table shows the rated effective currents flowing to the Servo Driver and the sizes of the electrical wires.

• Servo Drivers with 200-VAC Input (R88D-UA□□V)

Driver (Watts)	R88D-UA02V (30 W)	R88D-UA03V (50 W)	R88D-UA04V (100 W)	R88D-UA08V (200 W)	R88D-UA12V (400 W)	R88D-UA20V (750 W)
Power supply input current (L1, L2)	1.3 A	1.5 A	2.5 A	4.0 A	6.0 A	11.0 A
Motor output current (U, V, W)	0.42 A	0.6 A	0.87 A	2.0 A	2.6 A	4.4 A
Power supply input terminal wire size	0.75 mm^2 or AWG 18 min.				1.25 mm^2	2.0 mm^2
Motor output terminal wire size	0.5 mm^2 or AWG 20			AWG 20 (see note) to AWG 18		
	Use OMRON standard cable. The applicable wire size for motor connectors is AWG22 to AWG18.					
Protective earth terminal wire size	Use 2.0-mm^2 external ground wires. Use the same wire as used for the motor output.					

Note If the cable length is 15 meters or longer for a 750-W Servomotor, the momentary maximum torque at rotation speeds of 2,500 r/min or higher may drop by approximately 7%.

• Servo Drivers with 100-VAC Input (R88D-UA□□W)

Driver model (Watts)	R88D-UA03W (30 W)	R88D-UA04W (50 W)	R88D-UA10W (100 W)	R88D-UA12W (200 W)	R88D-UA15W (300 W)
Power supply input current (L1, L2)	2.0 A	2.6 A	4.5 A	8.0 A	10.0 A
Motor output current (U, V, W)	0.63 A	0.7 A	2.2 A	2.7 A	3.7 A
Power supply input terminal wire size	0.75 mm^2 or AWG 18 min.			1.25 mm^2	2 mm^2
Motor output terminal wire size	0.5 mm^2 or AWG 20		AWG 20 to AWG 18		
	Use OMRON standard cable (AWG20). The applicable wire size for motor connectors is AWG22 to AWG18.				
Protective earth terminal wire size	Use 2.0-mm^2 external ground wires. Use the same wire as used for the motor output.				

■ Wire Sizes and Allowable Current

The following table shows allowable currents when there are three electrical wires. Use values equal to or lower than the specified values.

• Heat-resistant Vinyl Wiring, UL1007, Rated Temperature 80°C (Reference Value)

AWG size	Nominal cross-sectional area (mm^2)	Configuration (wires/mm^2)	Conductive resistance (Ω/km)	Allowable current (A) for ambient temperature		
				40°C	50°C	60°C
20	0.5	19/0.18	39.5	6.6	5.6	4.5
---	0.75	30/0.18	26.0	8.8	7.0	5.5
18	0.9	37/0.18	24.4	9.0	7.7	6.0
16	1.25	50/0.18	15.6	12.0	11.0	8.5

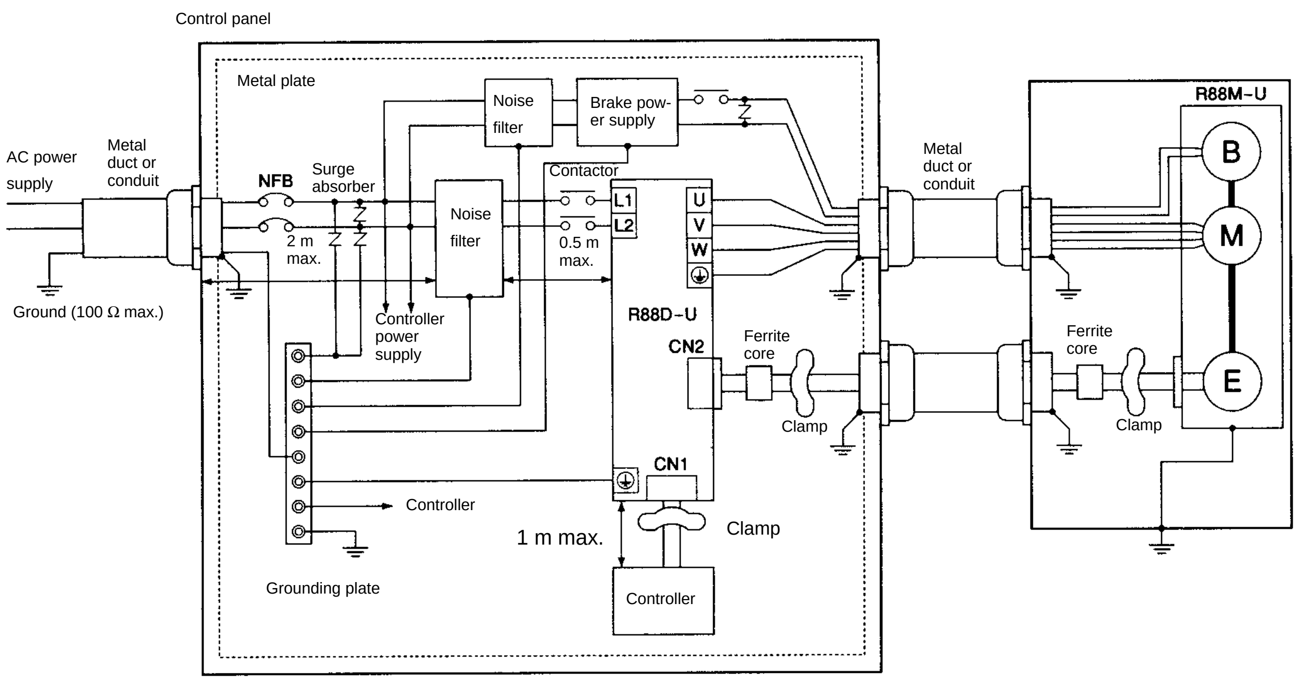
2-3-3 Wiring Products Conforming to EMC Directives

Model conforming to EC Directive will meet the requirements of the EMC Directives EN55011 Class A Group 1 (EMI) and EN50082-2 (EMS) if they are wired under the conditions described in this section. If the connected devices, wiring, and other conditions cannot be made to fulfill the installation and wiring conditions when the product is incorporated into a machine, the compliance of the overall machine must be confirmed.

The following conditions must be met to conform to EMC Directives.

- The Servo Driver must be installed in a metal case (control panel).
- Noise filters and surge absorbers must be installed on all power supply lines.
- Shielded cables must be used for all I/O signal lines and encoder lines. (Use tin-plated, soft copper wires for the shield weaving.)
- All cables leaving the control panel must be wired in metal ducts or conduits with blades.
- Ferrite cores must be attached to the shielded cable and the shield must be clamped directly to the ground plate to ground it.

■ Wiring Methods

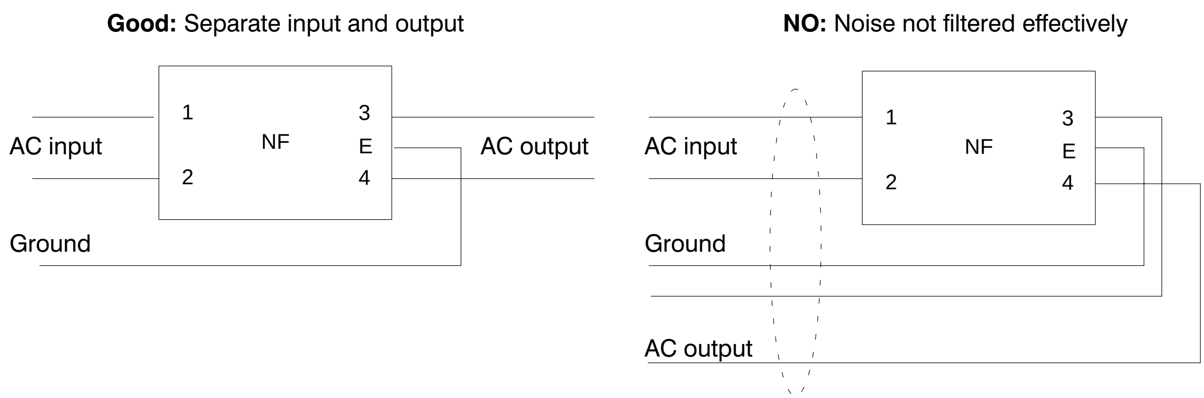


Note 1. The cable winding for the ferrite core must be 1.5 turns.

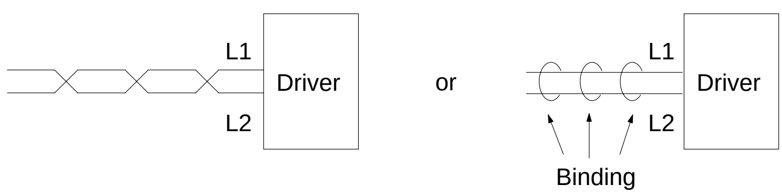
Note 2. Remove the sheath from the cable and ground it directly to the metal plate at the clamps.

- Ground the motor's frame to the machine ground when the motor is on a movable shaft.
- Use the grounding plate for the protective earth for each Unit, as shown in the illustration, and ground to a single point.
- Use ground lines with a minimum thickness of 3.5 mm^2, and arrange the wiring so that the ground lines are as short as possible.
- If no-fuse breakers (MCCB) are installed at the top and the power supply line is wired from the lower duct, use metal tubes for wiring and make sure that there is adequate distance between the input lines and the internal wiring. If input and output lines are wired together, noise resistance will decrease.

- No-fuse breakers (MCCB), surge absorbers, and noise filters (NF) should be positioned near the input terminal block (ground plate), and I/O lines should be isolated and wired using the shortest means possible.
- Wire the noise filter as shown at the left in the following illustration. The noise filter should be installed at the entrance to the control panel whenever possible.



- Use twisted-pair cables for the power supply cables whenever possible, or bind the cables.



- Separate power supply cables and signal cables when wiring.

■ Control Panel Structure

Any gaps in the cable entrances, mounting screws, cover, or other parts of a control panel can allow electric waves to leak from or enter the control panel. The items described in this section must be abided by in panel design and selection to ensure that electric waves cannot leak or enter the control panel.

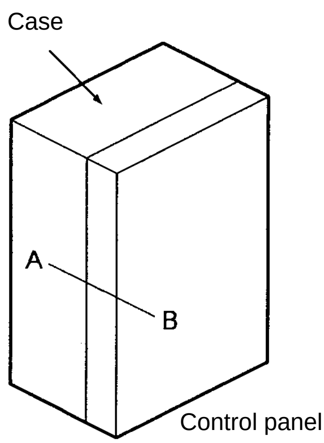
• Case Structure

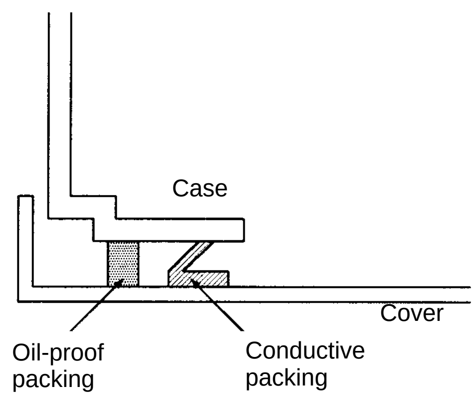
- Use a metal control panel with welded joints on the top, bottom, and all sides. The case must be electrically conductive.
- When assembling the control panel, remove the coating from all joints (or mask the joints when coating) to ensure electrical conductivity.
- Be sure that no gaps are created when installing the control panel, as gaps can be caused by distortion when tightening screws.
- Be sure there are not any electrically conductive parts that are not in electrical contact.
- Ground all Units mounted in the control panel to the panel case.

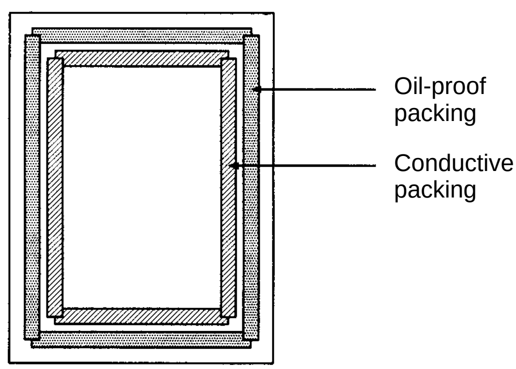
• Cover Structure

- Use a metal cover.
- Use a water-proof structure, as shown in the following diagram, and be sure there are no gaps.

- Use electrically conductive packing between the cover and the case, as shown in the following diagram. (Remove the coating the contact points of the packing (or mask the contact points when coating) to ensure electrical conductivity.)
- Be sure that no gaps are created when installing the cover, as gaps can be caused by distortion when tightening screws.







Case (inside)

■ Selecting Components

• No-fuse Breakers (MCCB)

When selecting no-fuse breakers, take into consideration the maximum output current and the inrush current. The momentary maximum output for a servo system is approximately three times that of the rated output, and a maximum output of three seconds can be executed. Therefore, select no-fuse breakers with an operating time of at least five seconds at 300% of the rated maximum output. General-purpose and low-speed no-fuse breakers are generally suitable. Refer to the table in *2-2-3 Terminal Block Wiring* for the power supply input currents for each motor, and then add the current consumption for the number of shafts, other controllers, etc., to make the selection.

The Servo Driver inrush current flows at a maximum of 50 A for 20 ms when 200 V is input. With low-speed no-fuse breakers, a inrush current 7 to 8 times the rated current flows for 0.1 second. When making the selection, take into consideration the entire inrush current for the system.

• Surge Absorbers

Use surge absorbers to absorb surges from power supply input lines due to lightning, abnormal voltages, etc. When selecting surge absorbers, take into account the varistor voltage, the amount of surge immunity, and the amount of energy resistance. For 200-VAC systems, use a varistor voltage of 470 V. The surge absorbers shown in the following table are recommended.

Maker	Model	Max. limit voltage	Surge immunity	Type	Remarks
Okaya Electric Ind.	R.A.V-781BYZ-2	783 V	1,000 A	Block	For power supply line
	R.A.V-781BXZ-4	783 V	1,000 A		For power supply line ground

Note 1. Refer to manufacturers documentation for operating details.

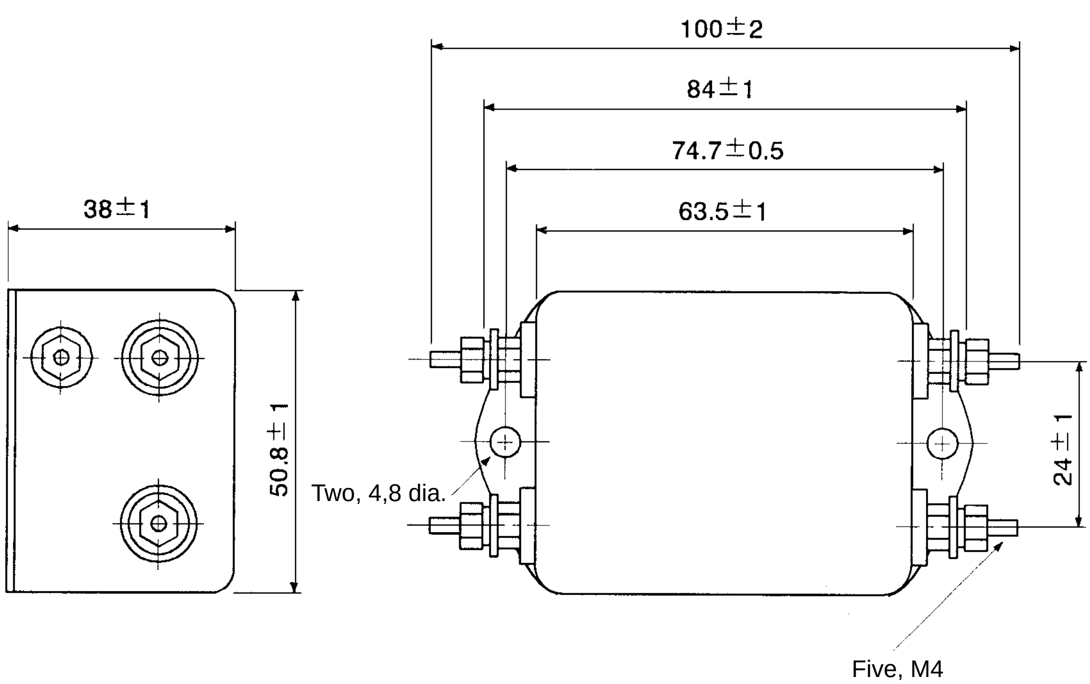
Note 2. The surge immunity is for a standard impulse current of 8/20 µs. If pulses are wide, either decrease the current or change to a larger-capacity surge absorber.

• Noise Filters

Use the following noise filters on the power supplies for the Servo Driver and brake. These filters are manufactured by Okaya Electric Ind.

Application	Model	Rated current	Test voltage	Insulation resistance	Leakage current (max.)	Attenuation characteristic	
						Normal (MHz)	Common (MHz)
200 V, 30 to 100 W 100 V, 30 or 50 W Brake power supply	SUP-P5H-EPR-4	5 A	Between terminals: 1,250 V rms, 50/60 Hz, 60 s	Between terminals and case: 6,000 MΩ min. (at 500 VDC)	0.6 mA (at 250 V rms 60 Hz)	0.5 to 30	0.2 to 30
200 V, 200 or 400 W 100 V, 100 W	SUP-P8H-EPR-4	8 A	Between terminals and case: 2,000 V rms, 50/60 Hz, 60 s			0.6 to 30	0.3 to 30
200 V, 750 W 100 V, 200 or 300W	SUP-P10H-EPR-4	10 A				0.7 to 30	0.4 to 30

The appearance of the noise filters is shown below. Screw terminals are used.



• Surge Killers

Install surge killers for loads that have induction coils, such as relays, solenoids, brakes, clutches, etc. The following table shows types of surge killers and recommended products.

Type	Features	Recommended products
Diode	Diodes are relatively small devices such as relays used for loads when reset time is not an issue. The reset time is increased because the surge voltage is the lowest when power is cut off. Used for 24/48-VDC systems.	Use a fast-recovery diode with a short reverse recovery time. Fuji Electric Co., ERB44-06 or equivalent
Thyristor or Varistor	Thyristor and varistor are used for loads when induction coils are large, as in electromagnetic brakes, solenoids, etc., and when reset time is an issue. The surge voltage when power is cut off is approximately 1.5 times that of the varistor.	Select varistor voltage as follows: 24-VDC system varistor: 39 V 100-VDC system varistor: 200 V 100-VAC system varistor: 270 V 200-VAC system varistor: 470 V
Capacitor + resistor	Use capacitors and resistors for vibration absorption of surge when power is cut off. The reset time can be shortened by proper selection of the capacitor or resistor.	Okaya Electric Ind. CR-50500 0.5 μF-50 Ω CRE-50500 0.5 μF-50 Ω S2-A-0 0.2 μF-500 Ω

Note Thyristors and varistors are made by the following companies. Refer to manufacturers documentation for operating details. Thyristors: Ishizuka Electronics Co.
Varistors: Ishizuka Electronics Co., Matsushita Electric Parts

• Contactors

When selecting contactors, take into consideration the circuit's inrush current and the momentary maximum current. The Servo Driver inrush current is 50 A, and the momentary maximum current is approximately twice the rated current. The following table shows the recommended contactors.

Maker	Model	Rated current	Momentary maximum current	Coil voltage
OMRON	J7AN-E3	15 A	120 A	24 VDC

• Leakage Breakers

- Select leakage breakers designed for inverters.
- Since switching operations take place inside the Servo Driver, high-frequency current leaks from the armature of the Servomotor. With inverter leakage breakers, high-frequency current is not detected, preventing the breaker from operating due to leakage current.
- When selecting leakage breakers, also remember to add the leakage current from devices other than the Servomotor, such as machines using a switching power supply, noise filters, inverters, and so on.
- For detailed information about the selection methods of leakage breakers, refer to catalogs provided by manufacturers.
- The following table shows the Servomotor leakage currents for each Servo Driver.

Driver	Leakage current (direct) (including high-frequency current)	Leakage current (resistor-capacitor, in commercial power supply frequency range)
R88D-UA02V to -UA08V	80 mA	3 mA
R88D-UA12V	60 mA	4 mA
R88D-UA20V	110 mA	5 mA

Note **1.** Leakage current values shown above are for motor power lines of 10 m or less. The values will change depending on the length of power cables and the insulation.

Note 2. Leakage current values shown above are for normal temperatures and humidity. The values will change depending on the temperature and humidity.

Note 3. Leakage current for 100-VAC-input Servomotors is approximately half that of the values shown above.

■ Improving Encoder Cable Noise Resistance

Incremental Encoders:

A, B, and S phase. The frequency for A- or B-phase signals is 154 kHz max.; the transmission speed for S-phase signals is 616 kbps.

Absolute Encoders:

A, B, and Z phase, plus the absolute encoder signal. The frequency for A- or B-phase signals is 76.8 kHz max.; the transmission speed for absolute encoder signals is 9.6 kbps.

Follow the wiring methods outlined below to improve encoder noise resistance.

- Be sure to use dedicated encoder cables.
- If lines are interrupted in the middle, be sure to connect them with connectors, making sure that the cable insulation is not peeled off for more than 50 mm. In addition, be sure to use shielded wire.
- Do not coil cables. If cables are long and are coiled, mutual induction and inductance will increase and will cause malfunctions. Be sure to use cables fully extended.
- When installing noise filters for encoder cables, use ferrite cores. The following table shows the recommended ferrite core models.

Maker	Name	Model
Tokin	EMI core	ESD-QR-25-1
TDK	Clamp filter	ZCAT2032-0930
		ZCAT3035-1330
		ZCAT2035-0930A

- Do not wire the encoder cable in the same duct as power cables and control cables for brakes, solenoids, clutches, and valves.

■ Improving Control I/O Signal Noise Resistance

Position can be affected if control I/O signals are influenced by noise. Follow the methods outlined below for the power supply and wiring.

- Use completely separate power supplies for the control power supply (especially 24 VDC) and the external operation power supply. In particular, be careful not to connect two power supply ground wires. Install a noise filter on the primary side of the control power supply.
- For speed and torque command input lines, be sure to use twisted-pair shielded cable, and connect both ends of the shield wire to ground.
- If the control power supply wiring is long, noise resistance can be improved by adding 1-µF laminated ceramic capacitors between the control power supply and ground at the Servo Driver input section and the controller output section.
- For encoder output (A, B, and Z phase, plus the absolute encoder signal) lines, be sure to use twisted-pair shielded cable, and connect both ends of the shield wire to ground.

2-3-4 Peripheral Device Connection Examples

■ Connecting to Peripheral Devices