



EMC Installation Guidelines

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1. Introduction

The EMC Directive became mandatory in Europe From 1 January in 1996, and fixing of the CE mark to show compliance to EMC Directive is required on applicable products.

A motion controller is a component that has no intrinsic function. Instead it has been designed to be installed in a control panel to control machines or equipment in combination with other equipment. Thus, it is considered that a servo is not a direct target of the EMC Directive. Therefore, the CE mark will not be applied on motion controller. CEMEP, an association of power drive makers in Europe, is also taking this stance.

The final machine or equipment in which the motion controller is assembled is required to meet the EMC directive so the CE mark must be attached. This manual recommends the installation methods and EMC countermeasures so that the machine or equipment in which the motion controller is assembled can comply with EMC standards.

We have carried out EMC Standards compliance confirmation tests with our main models in the installation environment described in this manual. However, we have not confirmed the compliance in the user's machine. The EMC Performance will differ according to the configuration of the control panel in which the motion controller is assembled, the relation with the other assembled electric parts, the wiring state and the layout state, etc. Thus, the user must confirm the EMC compliance of the entire machine or equipment.

The details of this manual have a priority over the motion controller use's manual in respect to EMC measures.

2. EMC Directive

The EMC Directive largely regulates the following two withstand levels.

- (1) Emission ... Capacity to prevent output of obstructive noise that adversely affects external sources.
- (2) Immunity ... Capacity to not malfunction due to obstructive noise from external source.

The details of each level are classified below. It is assumed that the Standards and test details required for the final machine or equipment are the same as these.

Class	Name	Details	Generic Standard	Standards for determining test and measurement
Emission	Radiated noise	Electromagnetic noise radiated through the air	EN50081 – 2 (Industrial environment)	EN55011 (CLASS A)
	Conducted noise	Electromagnetic noise discharged from power supply line		
Immunity	Electro static discharge	Example) Noise from a charged human body	EN50082 – 2 (Industrial environment)	EN61000 – 4 – 2
	Radiated electromagnetic field	Example) Electromagnetic noise from wireless transmitters or broadcasting companies, etc.		ENV50140
	Burst wave noise	Example) Relay noise or electromagnetic noise caused by live electricity being turned on or off		EN61000 – 4 – 4
	Conducted immunity	Example) Electromagnetic noise flowed from power supply wires or earthing wires, etc.		ENV50141
	Power frequency magnetic field	Example) Electromagnetic noise of 50 /60Hz power supply frequency		EN61000 – 4 – 8

3. EMC Countermeasures

3.1 Basic EMC Countermeasures

Carrying out the following measures is effective for reducing Electro magnetic Interference(EMI).

- (1) Install the device in a sealed metal panel. (Seal radiated noise.)
- (2) Install a noise filter. (Reduce the conducted noise.)
- (3) Accurately earth the device. (Avoid becoming an antenna for noise.)
- (4) Shield the power line and control line. (Seal radiated noise.)
- (5) Lengthen the distance between the noise source and sensitive devices, or install noise source in a separate panel. (Seal radiated noise.)
- (6) Insulate the circuit. (Prevent the noise from being conducted.)

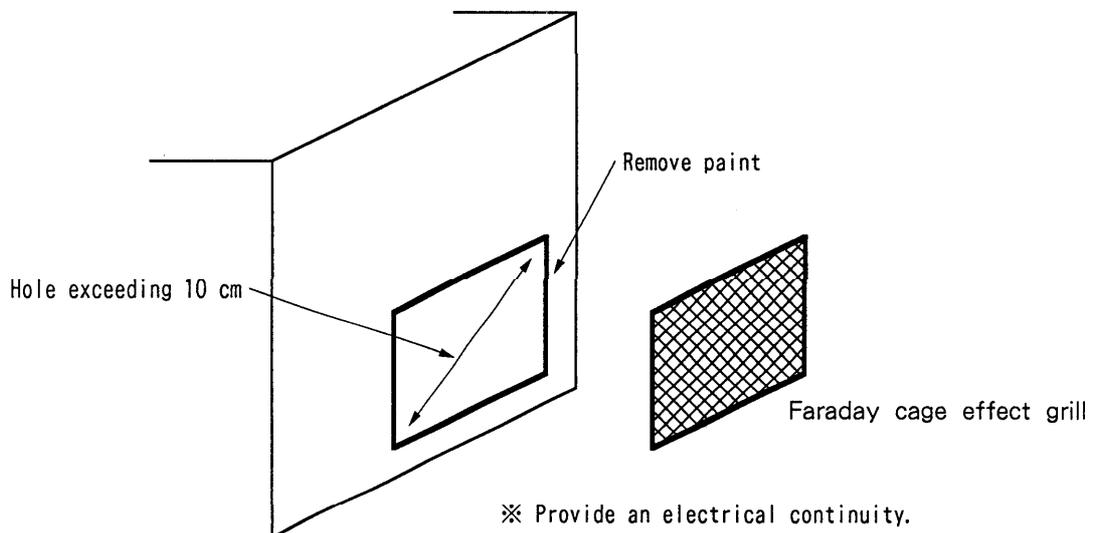
3.2 Control Panel Design

The Mitsubishi motion controller is a complex component incorporated into another machine. It must always be installed in a control panel.

The design of the panel is a very important factor for EMC countermeasures, so please take the following points into consideration.

- (1) Use a metal control panel.
- (2) Accurately earth the control panel unit with a thick and short cable.
- (3) Weld or screw close the joining sections of the panel's top plate and side plate.
Keep the joining clearance to 10 cm or less. The diameter of the openings on the panel such as the ventilation hole should be 10 cm or less. If there are holes larger then this, plug them with metal plates or punched metal. In this case, such as when painted surfaces are to be connected, make sure that there is a good electrical connection to prevent antenna effect.

Example)



(4) The control panel door must be accurately earthed with the control panel unit. If the door earthing is insufficient, the door itself will act as a large antenna and will radiate noise.

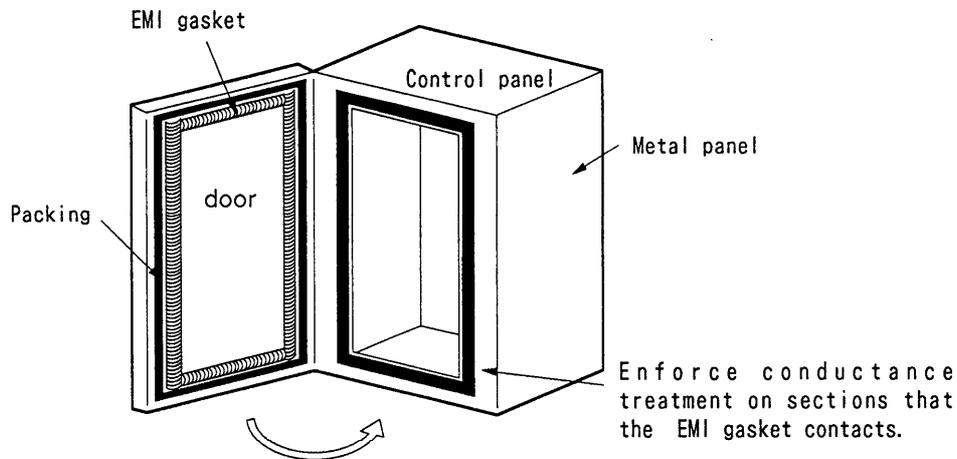
Take the following measures for this.

① Use a metal door.

② Connect the door and panel unit with thick braided wire at as many points as possible.

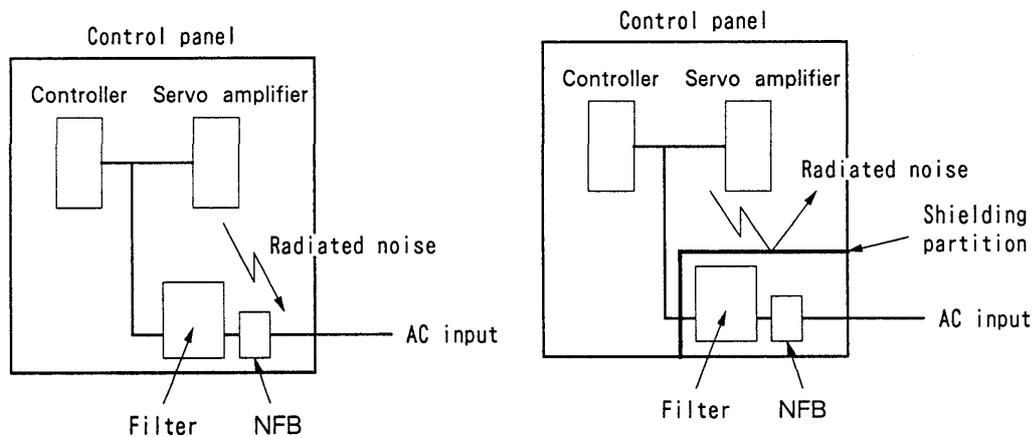
Method ③ can be used instead of method ② to provide securer earthing.

③ Use an EMI gasket or conductive packing for the contact between the door and control panel unit.



(5) The following methods can also be used as countermeasures for the input power supply cable.

Separate the input power supply section from other parts of the control panel so that the input power supply cable will not be contaminated by radiated noise.



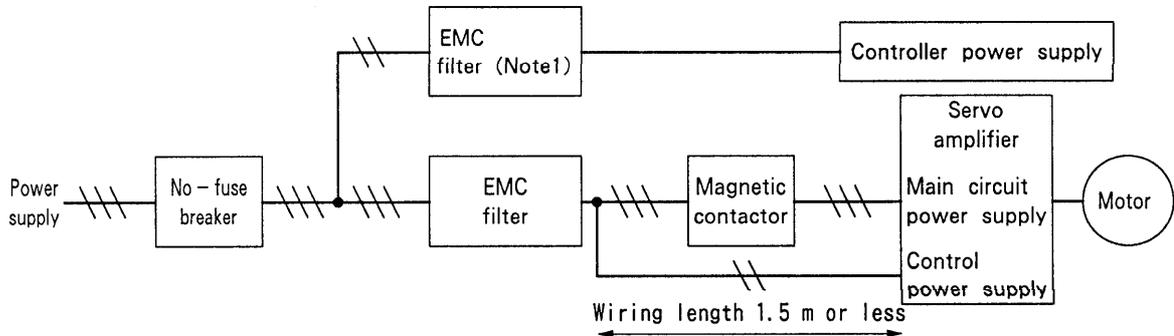
The power supply line noise is eliminated by the filter, but cable contains noise again because of the noise radiated in the control panel.

Use a metal plate, etc., for the shielding partition. Make sure there are no gaps.

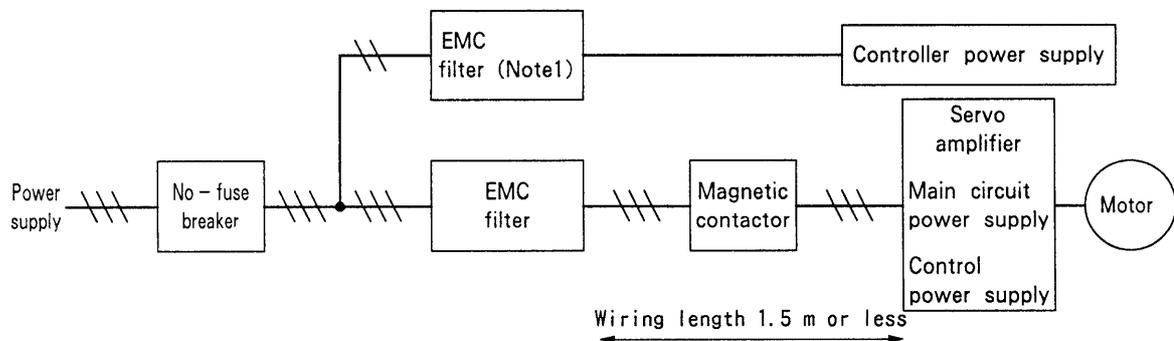
3.3 Filter wiring and installation

(1) Wire the servo and filter as shown below.

① When the servo amplifier has a separated control power supply input and main circuit power supply input (MR-H Series, MR-J2 Series)

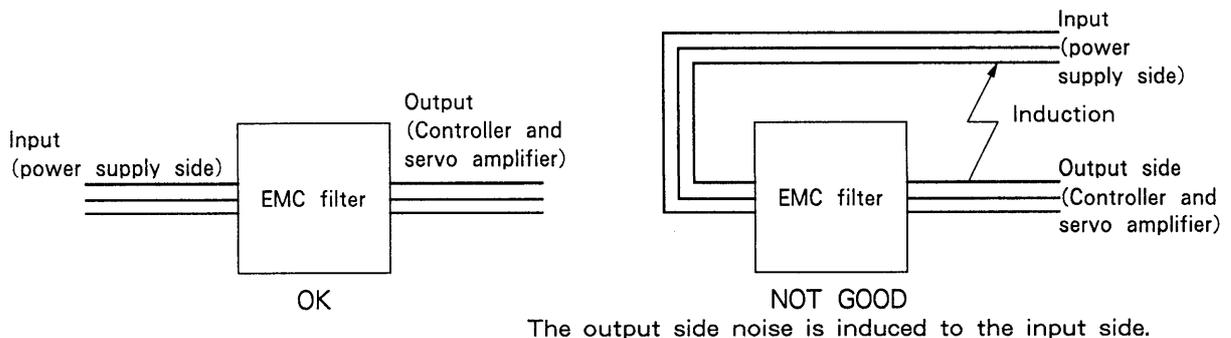


② When the servo amplifier does not have a control power supply input (MR-J)

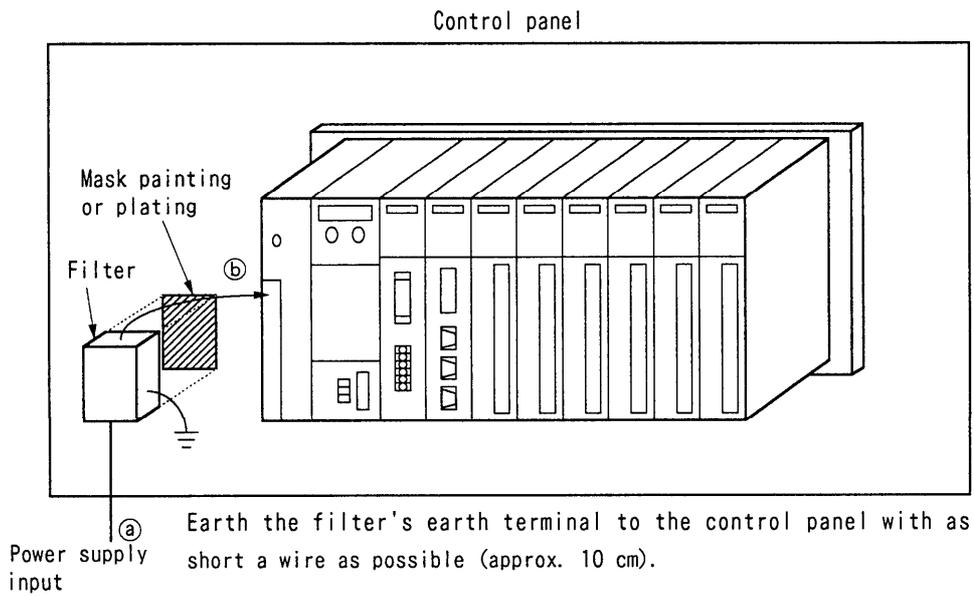


Note 1) The noise filter does not need to be installed on the controller power supply line except for some models (refer to section 4.1). However, noise can be controlled better by installing the noise filter. (The noise filter is effective for reducing conductive noise that is 10 MHz or less.)

(2) Arrange the EMC filter input cable and output cable as far apart as possible. If they are too close, the output line noise will be induced into the input cable, and effect of the filter will be lost. Separate these cables by at least 30 cm or more.



(3) Installation of controller filter



The filter is installed in the panel as shown above. Mask the painted surface of the panel where the filter is to be installed, or plate the surface, so that the rear surface securely contacts the panel.

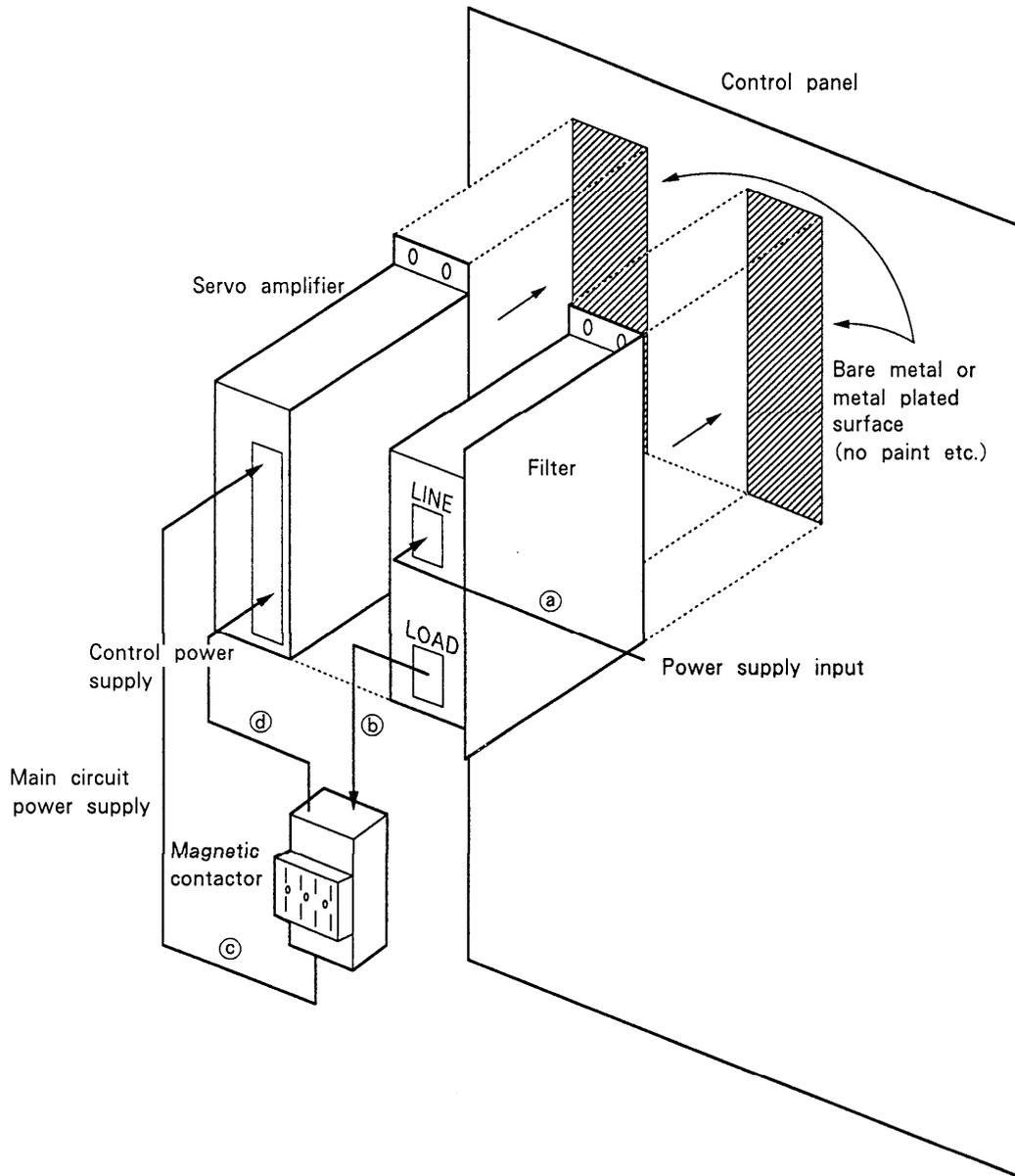
Wire the filter input wire a as far away from the output wire as possible.

Keep the wiring between the filter and controller power supply as short as possible.

(4) Installation of filter for servo.

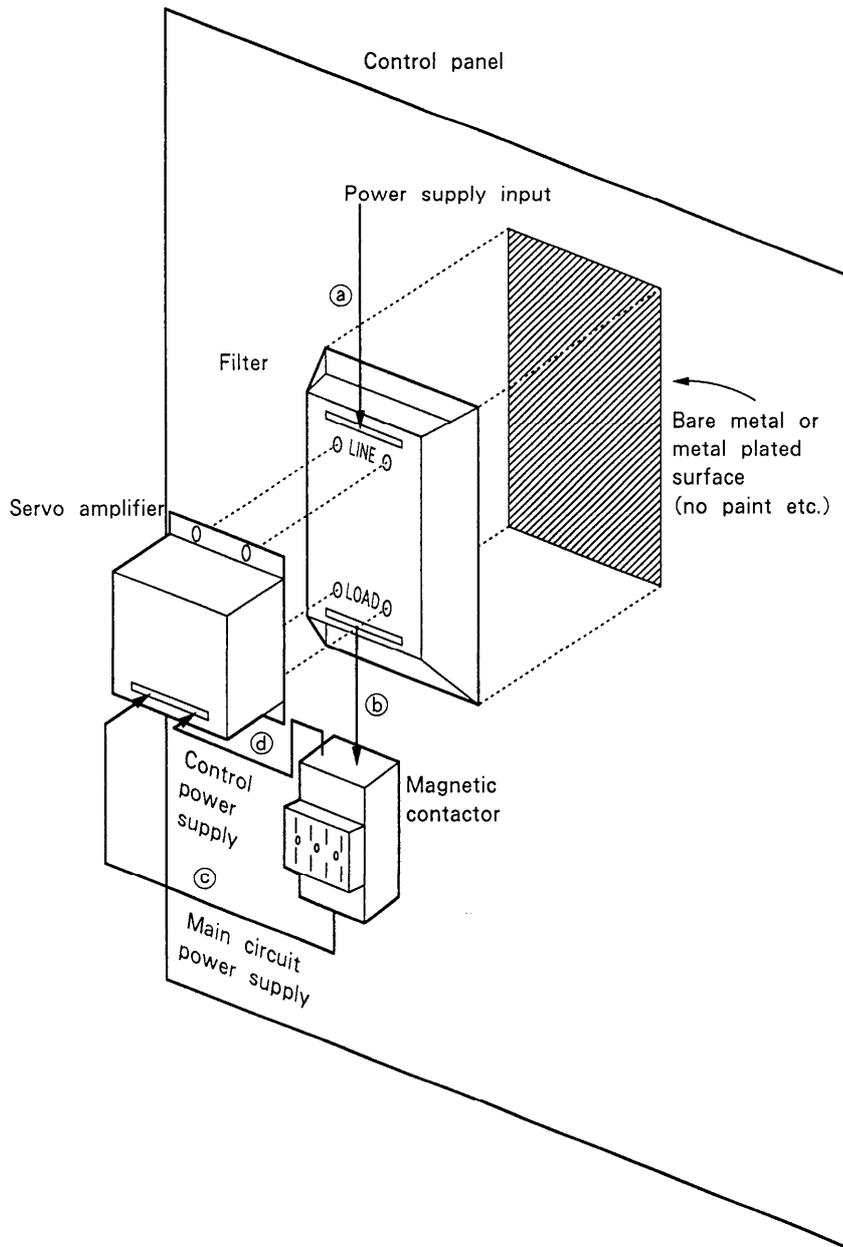
There are bookend type filters and base mount type filters for the servo according to the servo amplifier model. (Refer to section 4. EMC countermeasure parts for details.)

① Bookend type



The filter is installed on the right or left of the servo amplifier as shown above. The surface inside the panel where the filter is to be installed must be bare metal or metal plated surface so that the rear surface of the filter electrically contacts the panel. Treat the surface where the servo amplifier is installed in the same manner. The filter input wire (a) must be kept as far apart from the output wires (b), (c) and (d). Keep the wiring (b), (c), (d) between the filter and servo amplifier as short as possible. (Total 1.5 m or less.)

②Base mount type



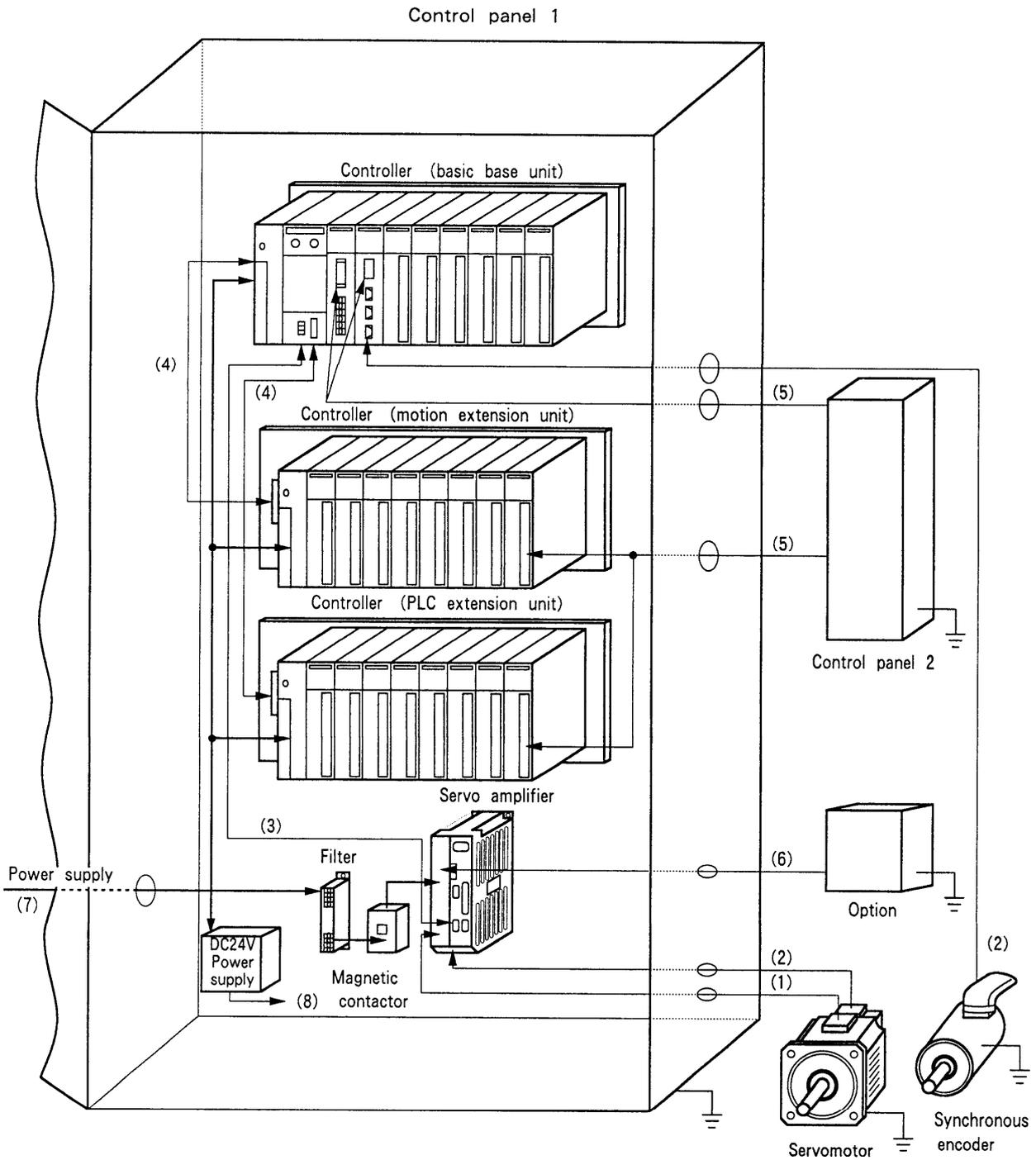
The filter is installed between the servo amplifier and panel as shown above. The surface inside the panel where the filter is to be installed must be bare metal or metal plated surface so that the rear surface of the filter electrically contacts the panel. The filter input wire (a) must be kept as far apart from the output wires (b), (c) and (d). Keep the wiring (b), (c), (d) between the filter and servo amplifier as short as possible. (Total 1.5 m or less.)

3.4 Cable treatment

The EMC installation example is shown below.

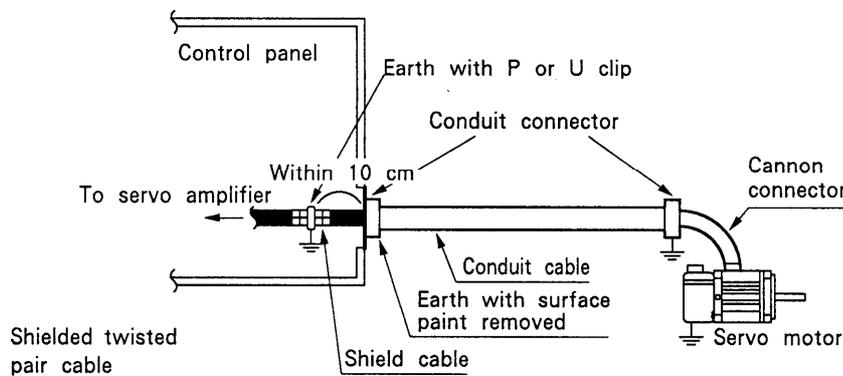
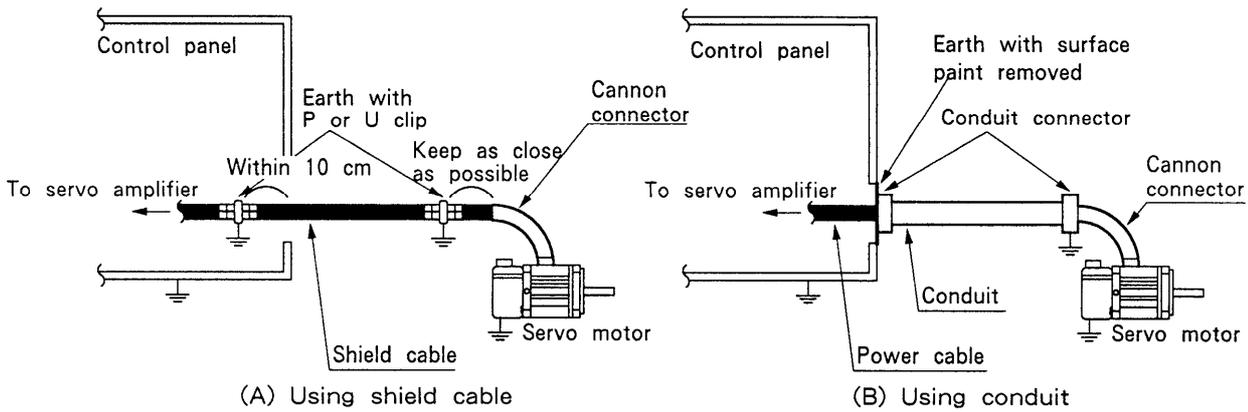
The methods for treating each cable are described separately.

(The numbers assigned to each cable in the drawing indicate section number of this manual where details are explained.)



Note) Securely earth the control panel, option 1 and 2, and the motor.

(1) Servo motor power cable



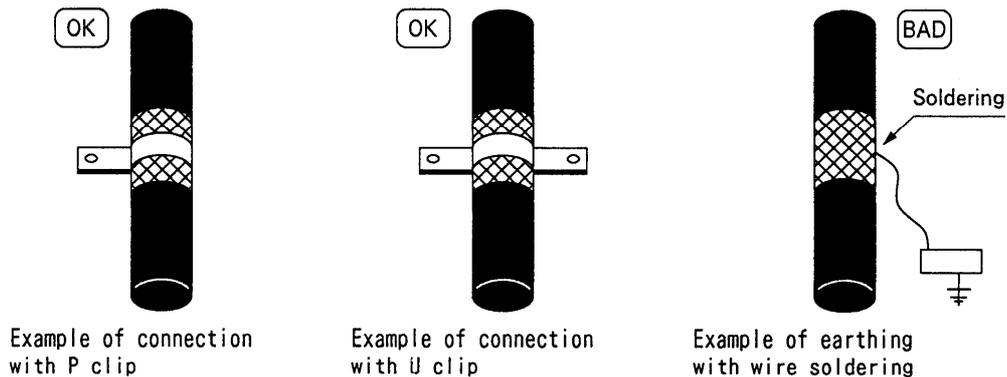
①Use four wires (3-phase + earth) , that is completely shielded and that has no breakage for the power cable. Connect the earth wire to the earth (\oplus) terminal on the servo amplifier and servo motor.

※Material of shield has to be copper.

②Connect the shield of the cable on both the control panel side and motor chassis side. Earth the shield on the amplifier side at a position within 10 cm from the control panel.

③Earth the shield with a metal P clip or U clip.

④Directly earth the shield. Do not take a method of earthing with wire soldered onto the shield.

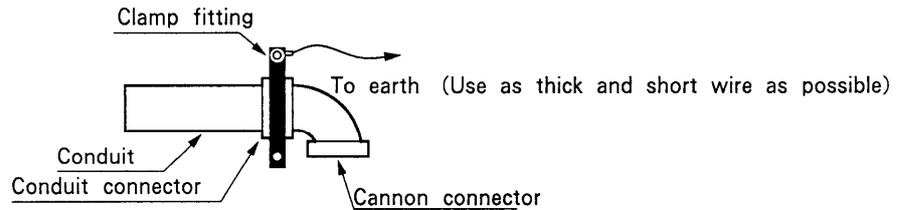


⑤When not using a shield cable for the power cable, use a conventional power cable.

Put the cable into a metal conduit.

⑥Earth the power cable on the control panel side with the conduit connector and control panel side wall. (Remove paint from the side wall of the control panel.)

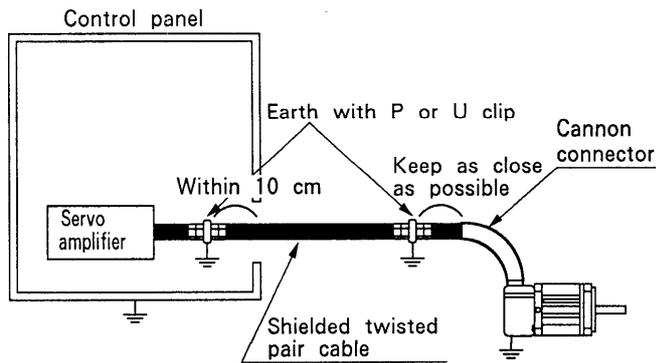
⑦Use the type of treatment shown in the example to earth the power cable on the motor side with conduit connector . (Example: Using a clamp fitting, etc.)



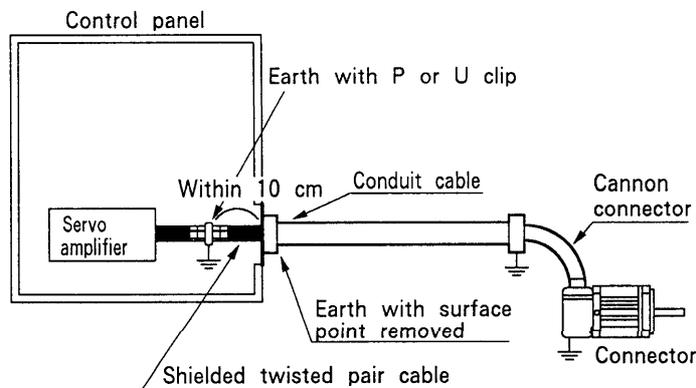
⑧When both a shield and conduit cable are used, the noise can be reduced more effectively.

⑨Keep the cable length at 30 m or less.

(2) Encoder cable (synchronous encoder)



(A) Using shield cable

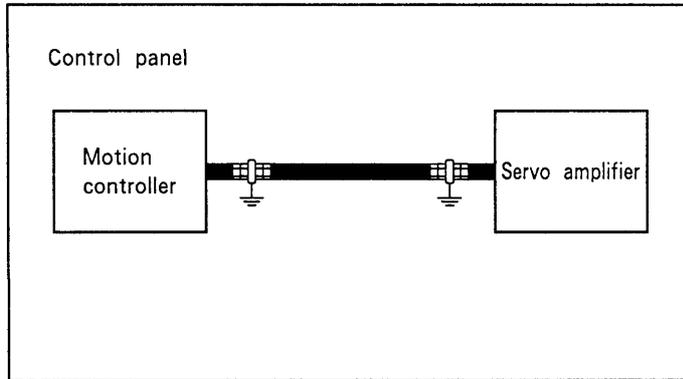


(B) Using shield cable and conduit

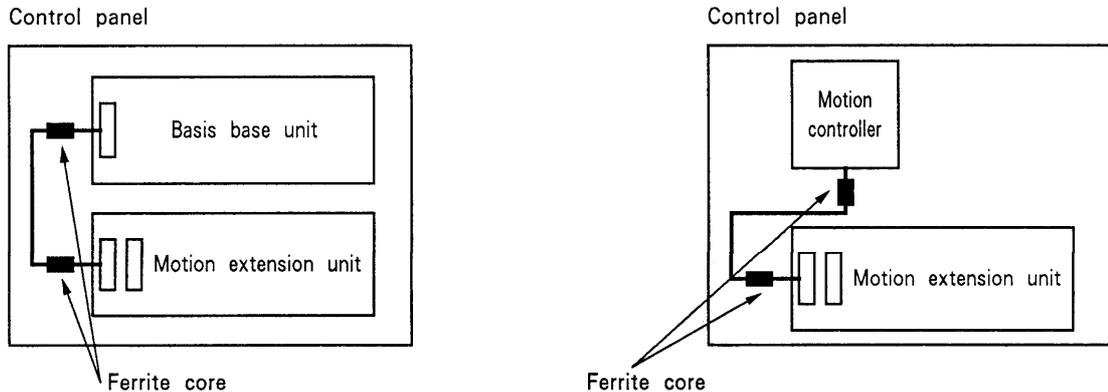
Use a shielded twisted pair cable, and earth on the amplifier and encoder side with a P clip or U clip. Keep the cable length at 30 m or less.

(3) Motion network cable

Use a shielded twisted pair cable, and earth on the motion controller and servo amplifier side with a P clip or U clip. If the cable length is 2 m or less, the earthing can be done at one position on the motion controller side.



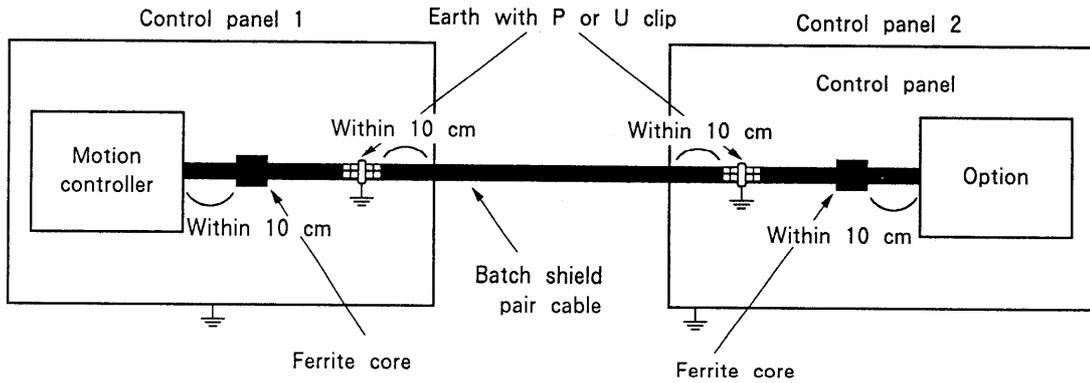
(4) Motion extension base connection cable, PLC extension base connection cable



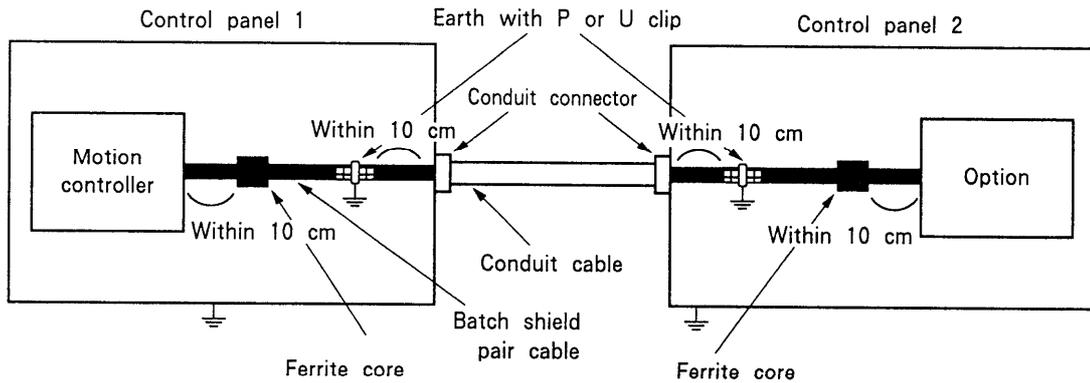
Always install one ferrite core to the motion extension base connection cable and PLC extension base connection cable using a batch shield cable. Place the ferrite core at a position within 10 cm from each basic base unit (motion controller). By installing a ferrite core on the extension side, the noise measures will be more effective.

(5) A287LX_CTRL cable, A273EX_PULSER cable, I/O cable

When a switch such as the limit switch, STOP input or near-point input, or an option such as the manual pulse generator is installed in a control panel that differs from the control panel, use a batch shield pair cable, and connect it on the motion controller side and option side using a P clip or U clip. Then, insert a ferrite core on each end. Place the ferrite core at a position within 10 cm from the motion controller and option.



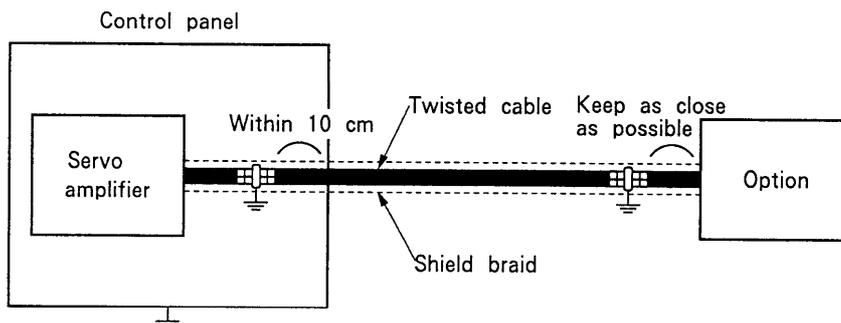
(A) Using shield cable



(B) Using shield cable and conduit

(6) Regeneration resistor option connection cable

For the regeneration resistor option cable, use a twisted cable with shield or a twisted cable covered with shield braid. Earth the shield on the option and servo amplifier with a P clip or U clip. The drawing shows the treatment for when the option is installed outside the panel.



(7) Input power supply cable

Use the conventional power cable.

(8) 24 VDC (for amplifier) cable

Use a vinyl wire or multi core cable.

(9) Keep distance between power line wire and control signal wire and between power line input wire and power line output wire as apart as possible (30 cm or more).

These must not be routed in parallel or bundled.

If unavoidable, intersect these wires at 90° to each other to minimise noise coupling.

4. EMC Countermeasure Parts

4.1 Filter (For controller power supply)

The noise filter is a part that is effective against conductive noise. For some models (A61PEU, A62PEU), the noise filter does not need to be installed on the power supply line, but the noise can be suppressed if installed. At Mitsubishi, an optimum filter was studied when carrying out tests to reduce conductive noise. As a result, we found that the duplex type filter as shown in Table 2 was effective.

Note) Mitsubishi recommends the installation of A61PEU and A62PEU on the controller power supply.

Table 1 shows the cautions for using the controller power supply unit. Always carry out the items given as cautions.

Table 1 Cautions for motion controller power supply unit

Controller	Power supply unit model	Cautions	LVD
A273UHCPU	A61PEU A62PEU	Installation of a noise filter is not required. 200 VAC input.	Compatible
	A61P A62P A63P	Always mount one of the following filters.	Not compatible
A171SCPUEU	–	Installation of a noise filter is not required. 200 VAC input.	Compatible
A171SCPU	–	Always mount one of the following filters.	Not compatible

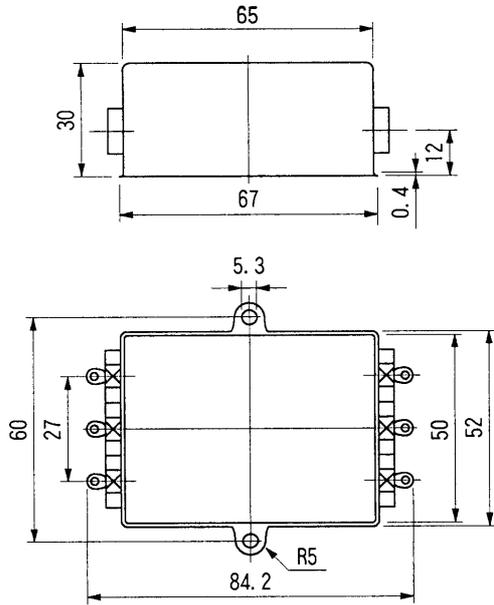
Table 2 Noise filters

Model	FN343 – 3/01	FN660 – 6/06	ZHC2203 – 11
Maker	SCHAFFNER	SCHAFFNER	TDK
Rated current	3A	6A	3A
Rated voltage	250V		

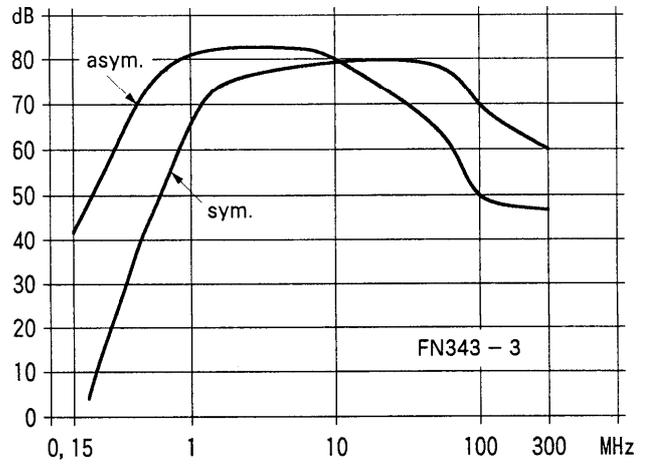
Noise filter

(1) SCHAFFNER FN343-3/01

Shape and dimensions (unit: mm)

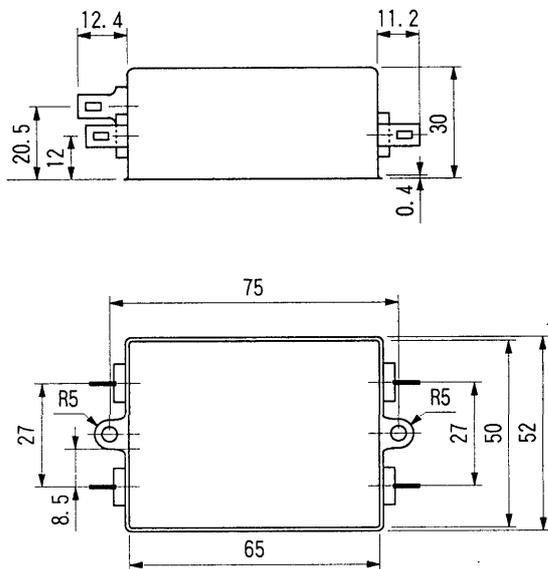


Attenuation characteristics diagram

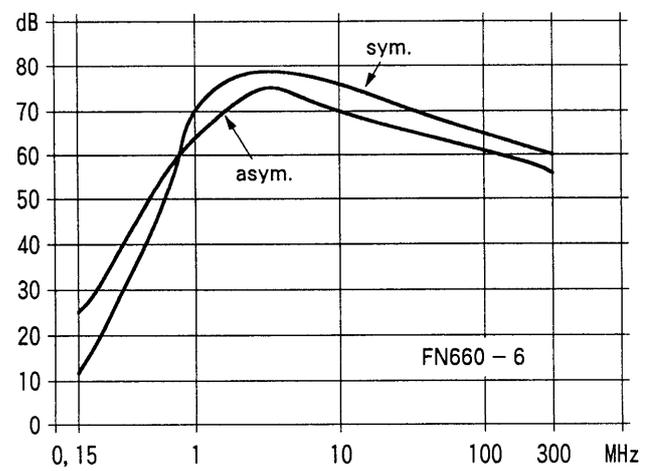


(2) SCHAFFNER FN660-6/06

Shape and dimensions (unit: mm)

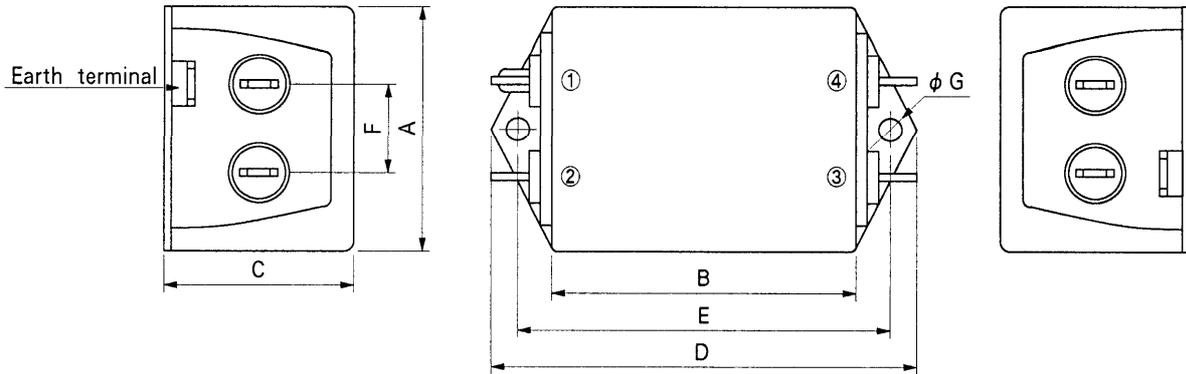


Attenuation characteristics diagram



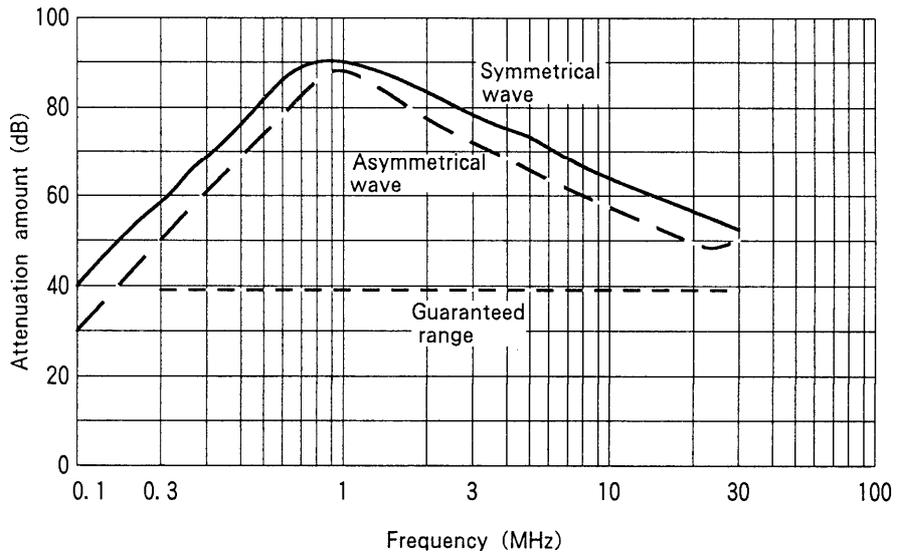
(3) TDK ZHC2203-11

Shape and dimensions (unit: mm)



A	B	C	D	E	F	G
45.5	49	29.5	75	60.4	18	4.8

Attenuation characteristics diagram



4.2 Filter (For servo amplifier power supply)

The following filters are available for the servo.

Type	Model	Outline drawing	Wire size	Weight (kg)	Terminal screw	Installation screw	Leakage Current (mA) as per EN60950 (at 230V/60HZ)	Applicable servo amplifier series		
								MR-J	MR-H	MR-J2
Bookend type	SF1252	①	2mm ² (AWG14)	0.75	—	M5	22	10~100	10~100	10~100
	SF1253	②	3.5mm ² (AWG12) <small>Note 3)</small>	1.37	—	M5	33	200~350	200~350	200~350
Base mount type	SF1254	③	5.5mm ² (AWG10)	2.32	M5	M5	39	—	500	—
	SF1255	④	8mm ² (AWG8)	3.16	M6	M6	39	—	700	—

Note 1) The same filter can be used for the single-phase 200 V input model.

Note 2) The power supply environment is the same as the corresponding servo amplifier series. (Refer to the servo amplifier specifications manual.)

Note 3) The SF1253 connection wire has a different size from the recommended wire size of the corresponding amplifier. However, use a 3.5 mm² wires with a current capacity of 27.5 A or more. For example, use a UL1015 wire (heat resistance 105°C) or hypalon wire LH (heat resistance 105°C).

SF1252

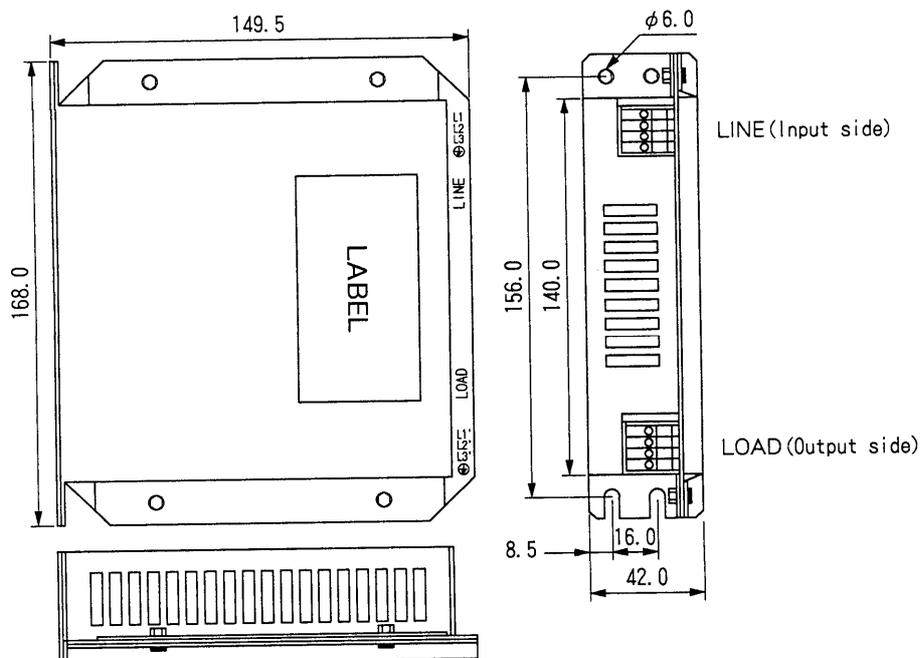


Fig. ①

SF1253

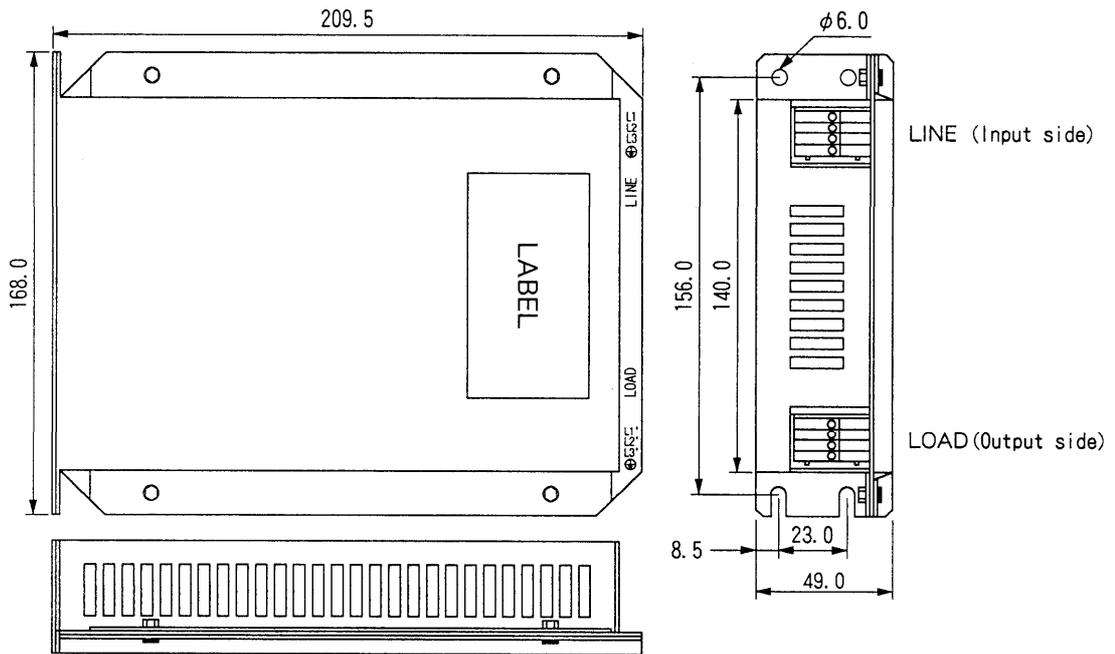
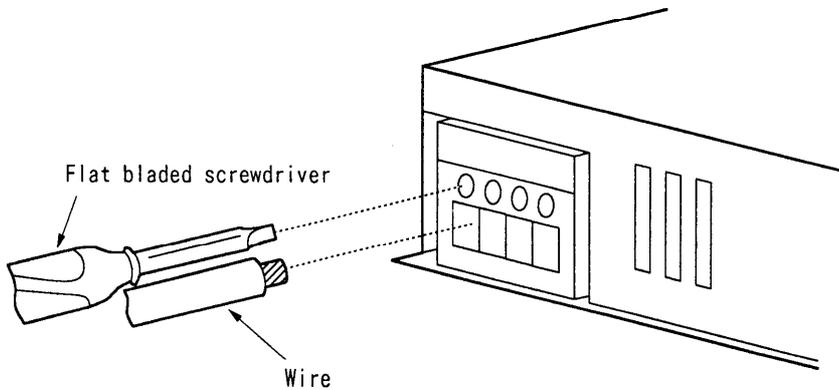
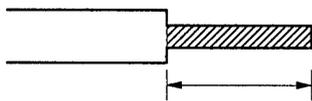


Fig. ②

[SF1252, SF1253 wire connection method]



① Peel the wire insulation.



9mm ···· For SF1252

14mm ···· For SF1253

② Insert the core section of the wire into the opening, and tighten with the flat bladed screwdriver.

Filter	Screw side	Tightening torque
SF1252	2.5mm	6.1kg · cm
SF1253	3mm	8.1kg · cm

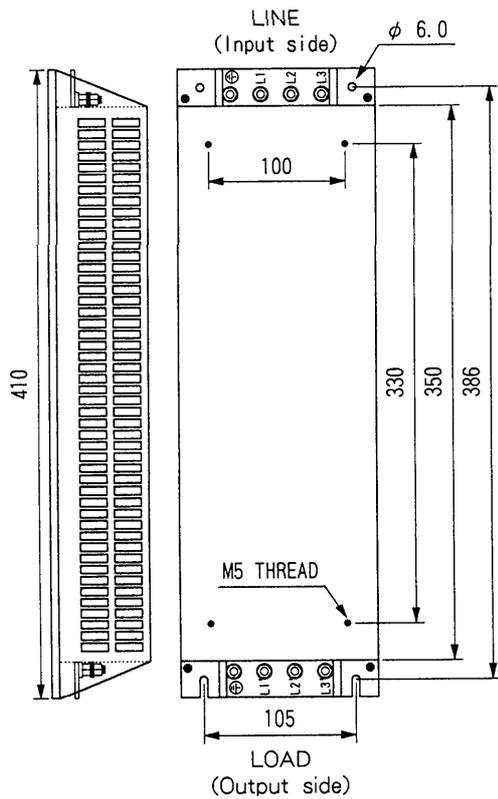


Fig. ③

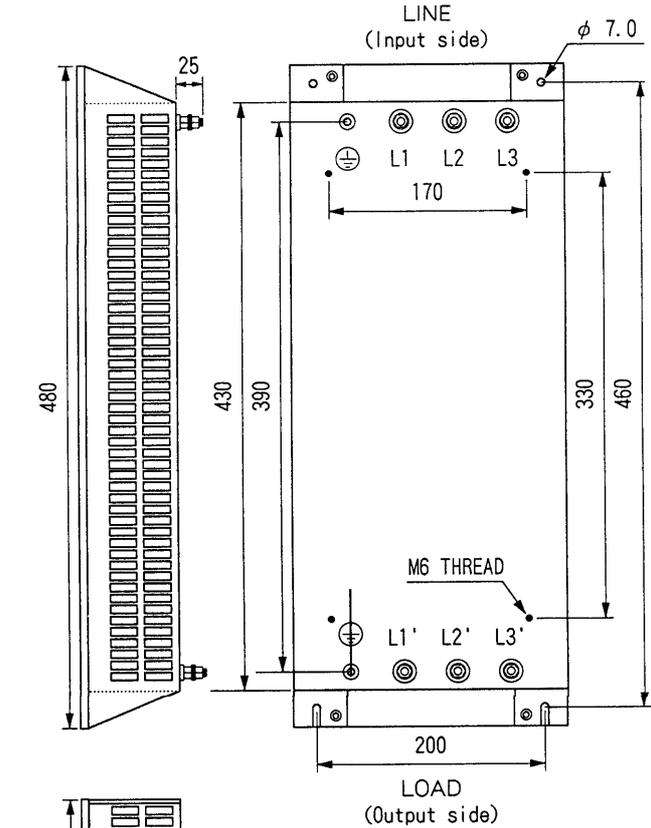
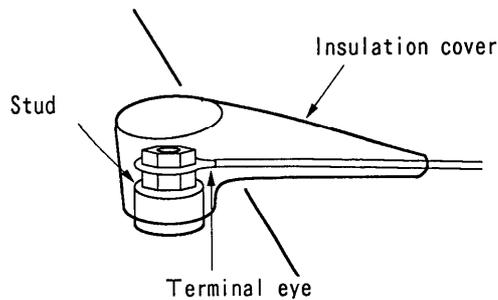


Fig. ④

[Precautions for connecting SF1254 and SF1255 wires]

To prevent electric shocks, always cover the filter with the enclosed insulation cover when installing the wire onto a stud.



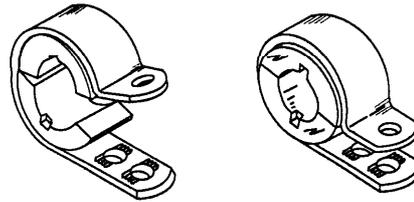
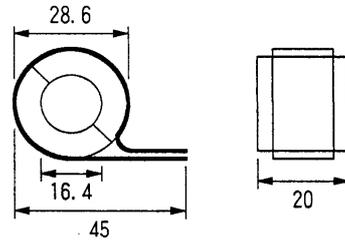
4.3 Ferrite core (Data line filter)

Install the following filter that matches each cable on the ferrite core.

(1) For motion extension base connection cable: TRCN-28-16-20 (Kitagawa Kogyo)

Impedance specifications (Ω)	
25MHz	100MHz
79	135

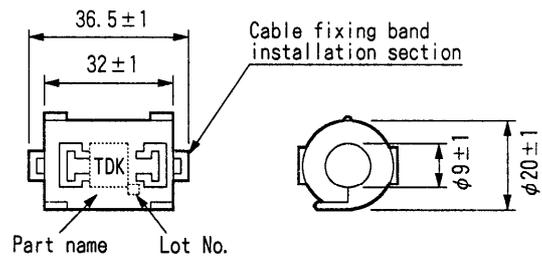
Note) The impedance value is the average measurement values.



(2) For PLC extension base connection cable: ZCAT2032-0930 (TDK)

Impedance specifications (Ω)	
10~100MHz	100~500MHz
50	100

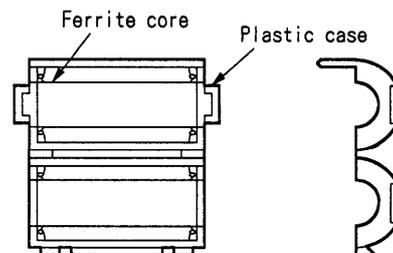
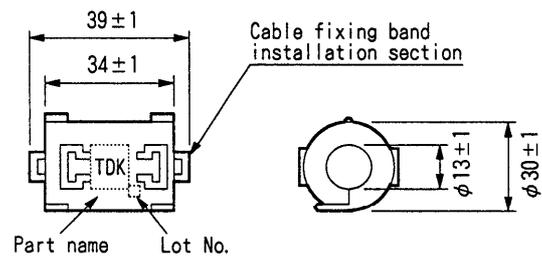
Note) The above impedance value includes the wire (measurement reference value) and is not the guaranteed value.



(3) For A278LX, A273EX, I/O cable and other cables: ZCAT3035-1330 (TDK)

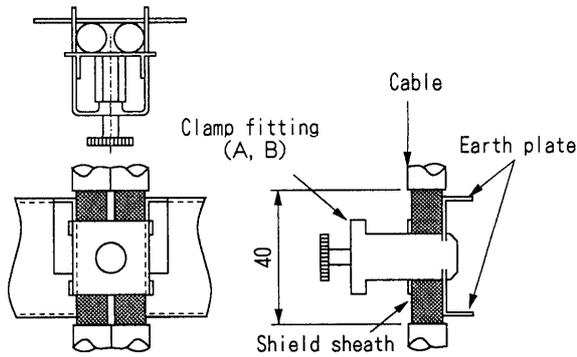
Impedance specifications (Ω)	
10~100MHz	100~500MHz
80	150

Note) The above impedance value includes the wire (measurement reference value) and is not the guaranteed value.



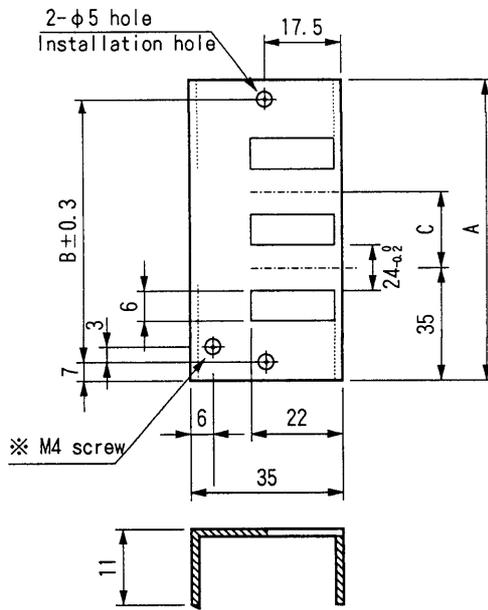
4.4 Shield clamp fitting

The shield clamp fittings prepared by Mitsubishi are shown below.

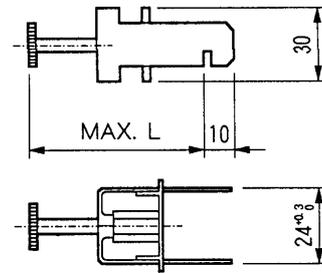


Clamp section drawing

Outline diagram



Earth plate



Clamp fitting

※) This is the screw hole for earthing. Connect to the earth plate on the control panel.

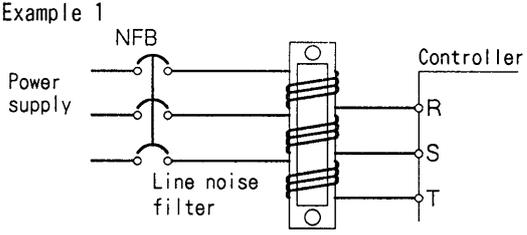
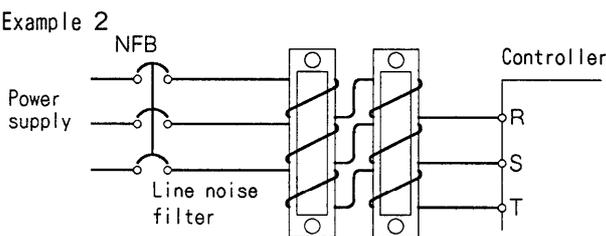
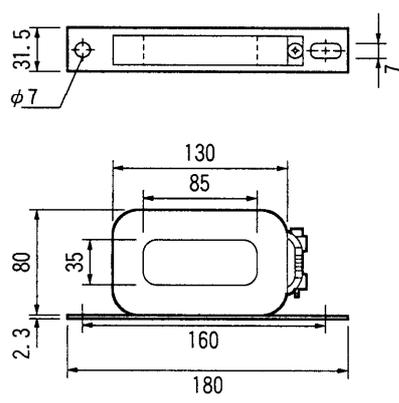
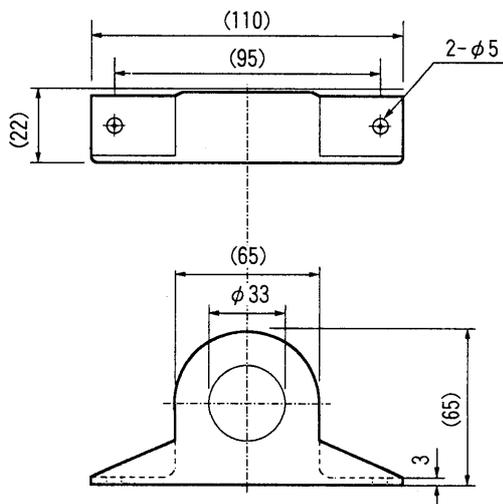
Model	A	B	C	Enclosed fitting
AERSBAN - DSET	100	86	30	Two clamp fittings A
AERSBAN - ESET	70	56	-	One clamp fitting B

	L
Clamp fitting A	70
Clamp fitting B	45

The P clip and U clip includes the Kitagawa Kogyo FG clamp, etc.

4.5 Line noise filter (FR – BLF, FR – BSF01)

This filter is effective for suppressing the noise radiated from the servo amplifier power supply or the output side, and is also effective in suppressing the high frequency leakage current (zero phase current). It is particularly effective for 0.5 MHz to 5 MHz ranges.

Connection diagram	Outline dimension diagram (unit: mm)
<p>• Wind the 3-phase current in the same direction with the same number of windings, and insert into the controller's power supply side and output side.</p> <p>• The more times the power supply side is wound, the higher the effect will be, but generally, the number of penetrations is four times.</p> <p>Always wind four or more times on the output side.</p> <p>Note 1. Do not wind the earth wire with the 3-phase wires. Doing so will cause the filter effect to drop. Note that particular care is required when using a 4-core cable. Use a separate wire for the earthing.</p> <p>Note 2. If the wire is thick and can not be wound, use two or more filters, so that the total number of penetrations is more than that listed above.</p> <p>Example 1</p>  <p>(No. of penetrations: 4 times)</p> <p>Example 2</p>  <p>When two filters are used (Total No. of penetrations: 4 times)</p>	<p>FR – BLF (for MR-H350AC or higher)</p>  <p>FR – BSF01 (For MR-H200AC or lower)</p> 

This noise line filter can be used on the feedback cable and control signal cable, etc., in addition to the power line and output line. In this case, the No. of penetrations is approx. 4 times.

5. EMC Data

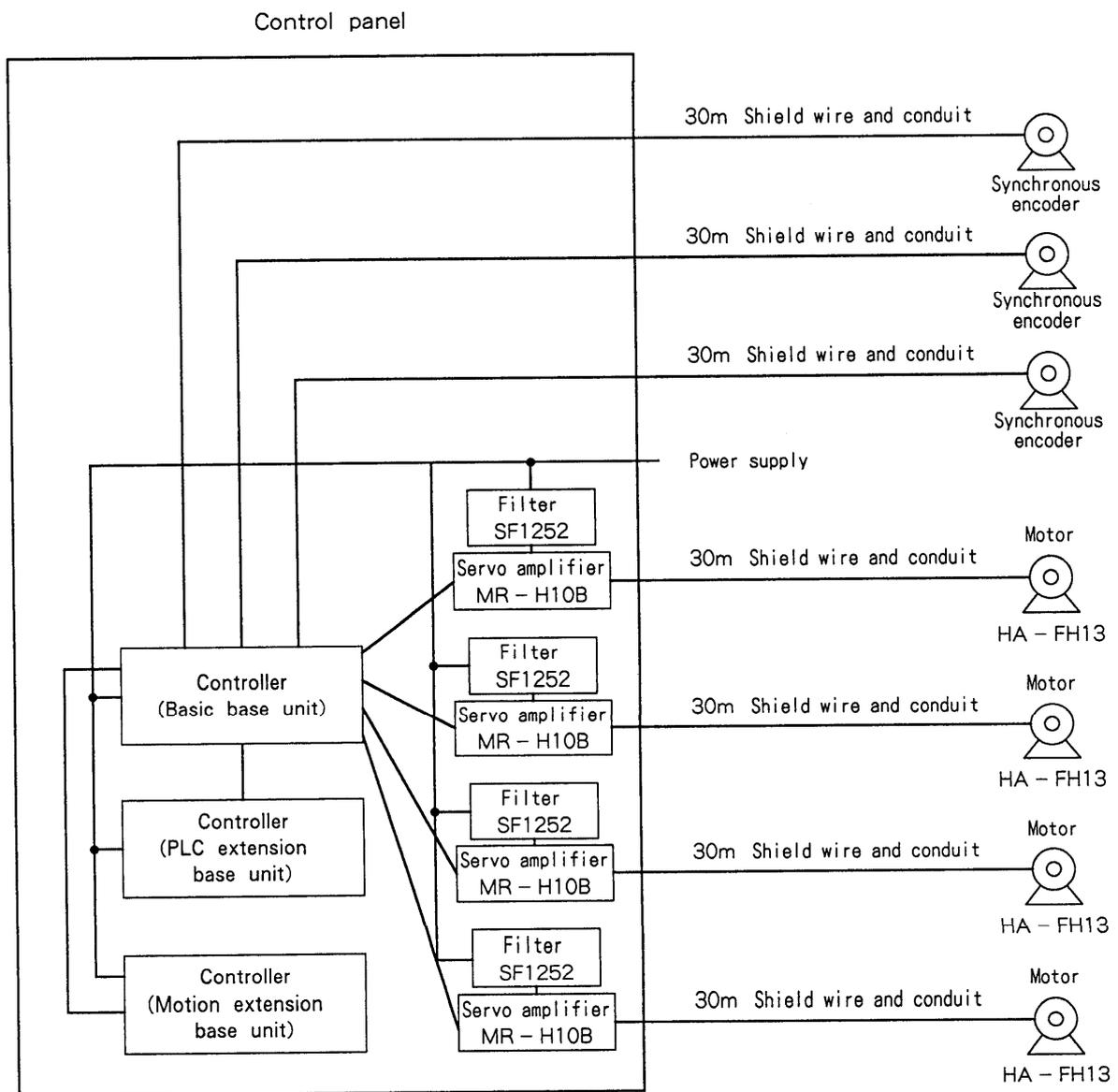
Examples of EMC data for the main models are given below.

This data is representative examples of when the measures described in this manual are implemented.

The following installation also passed tests according to the Immunity Standards (EN50082-2).

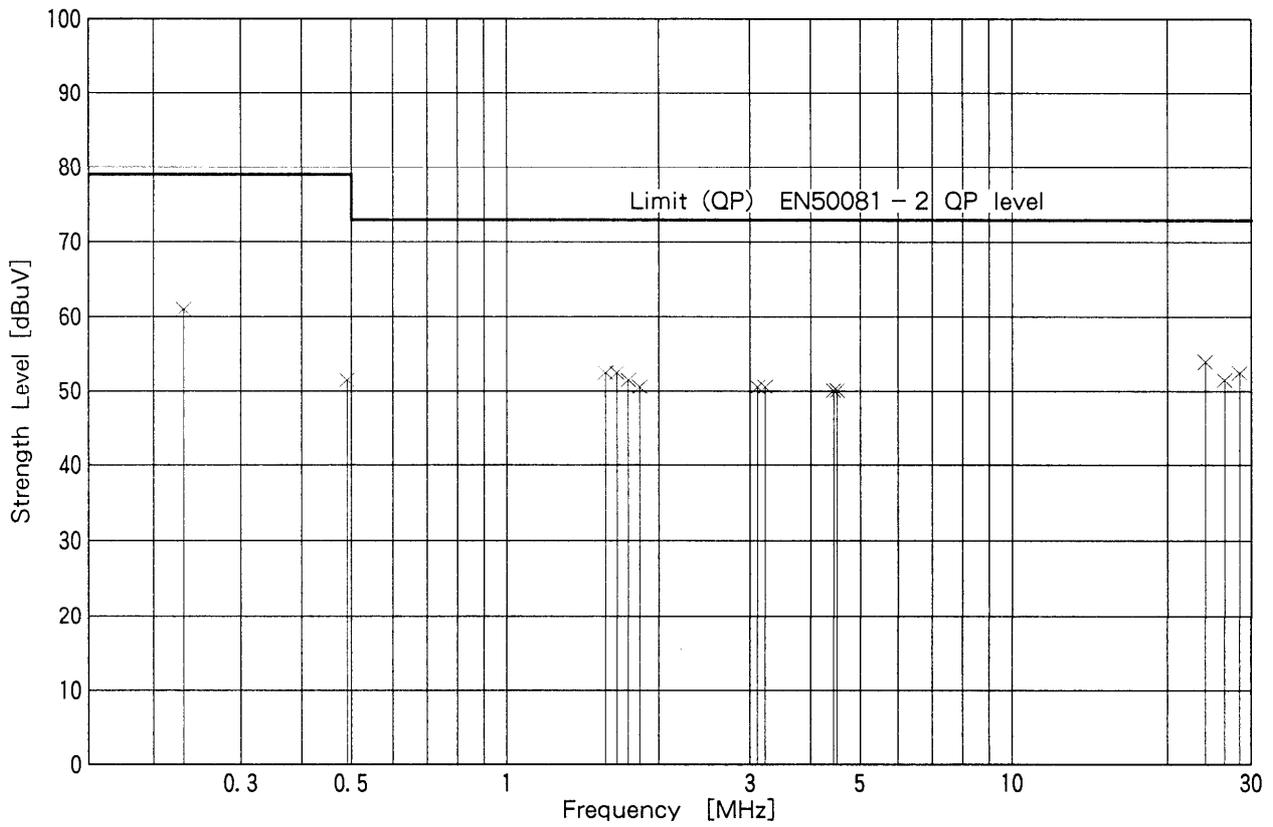
(1) Condition

- | | |
|--|-------------------|
| • Standards | EN50081-2 Class A |
| • Servo amplifier capacity | 100 W |
| • Length of output wiring from control panel | 30 m |
| • Controller | A273UHCPU |
| • System configuration | As shown below |



(2) Measurement results

[Conducted noise]



[Radiated noise] 10 m method

