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YASKAWA

Making SERVOPACK Products Conform with EMC Directive

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1. Introduction

EMC Directive will be enforced from 1, January 1996 after a 3-year transition period which started in 1992. Therefore, "EMC Directive" should be met in addition to the current "Machine Directive" in order to attach the CE Marking to products from 1 January 1996.

This document has been compiled as auxiliary material for use by each manufacturer to design and install control panels, operation panels, motors, etc. using SERVOPACK products, since CE Marking concerns only the final products.
We believe that the machine design following this document will allow products to be meet the level acceptable by the approval test.

2. Measures to make SERVOPACK products conform to EMC Direvtive

SERVOPACK products are to be used installed in a control panel. Therefore, we handle EMC countermeasures presupposing that the electric products are installed in control panels.
As control panel structures are in most cases variable depending on the machinery manufacturer and model, EMC countermeasures should be provided according to individual models (control panels).
However, it is impossible to describe the details of EMC measures taken for individual machines. Therefore, this document has been compiled to describe the general points of machine design when SERVOPACK products are used.

3. EMC approval

The EN standards related to the EMC Directive of electric and electronic equipment are EN50081 and 50082.
However, since there is no perfect EN standard related to the EMC, a self declaration by the manufacturer itself is not possible unlike with present Machine Directive (as of August '86).
As a result, compliance with the CE Marking should be approved by a CB (qualified organization).
Table 1 shows the applicable standards and points required for electric products for machines, obtained from the CB which is acting as our consultant.
Specific measures will be detailed in section 4 and later.

Please remember that the contents of this document may be subject to change following improvements in the product and the modification of EN standards.
Also, we would like to ask machinery manufacturers to continue to monitor the latest changes in the applicable EN standards by referring to latest official gazettes from EC.

Table 1 Applicable Standards and Points of Conformity Measures

Category	Common Standard	Item	Classification	Points
EMI emission	EN50061-2	Radiated interference Emitted as radio waves	EN55011 Class A Group 1	· To reduce emission from a control panel, the control equipment should be accommodated in a shielded cabinet. · Wiring condition specification.
		Conducted interference Emitted through powerline, etc.	EN55011 Class A Group 1	· To reduce emission from power lines, a line filter should be inserted in the power line. · Grounding (earthing) condition specification.
EMS immunity	EN50062-2	Electrostatic discharge (ESD) Malfunction due to static electricity	EN61000 -4-2	· To eliminate the influence of static electricity,the cabinet should be grounded (earthed) perfectly.
		Radiation immunity Malfunction due to radio waves	ENV50140	· To prevent malfunctions due to external radio waves, the control equipment should be accommodated in a shielded cabinet. · Wiring condition specification.
		Fast transients(bursts) Malfunction due to burst noise	EN61000 -4-2	· To prevent malfunctions due to burst noise on the lead lines from the control panel, the shielding of the lead lines should be improved.
		Lightning surge Malfunction due to induced lightning	IEC801-5	· To prevent malfunctions due to induced lightning, a surge absorber should be used.
		Magnetic field Malfunction due to magnetism	EN61000 -4-8	· To prevent malfunctions due to magnetism, the components which are affected by magnetism should have magnetic shielding.
		Conductance immunity Malfunction due to sine wave noise	ENV50141	· To prevent malfunctions due to high-frequency sine-wave noise on the lead lines from the control panel, the shielding of the lead lines should be improved.

4. Applicable standards and measures taken

(1) Radiated interference
This refers to spurious electromagnetic fields radiated from electric and electronic equipment, and is subject to regulations as a source of electromagnetic interference. It is measured by using a radio wave dark room or testing the equipment in a remote site. Typical sources of radiated interference are the components or wires on PC boards incorporated in equipment.
The countermeasures against this should be taken for the control panel so that it does not emit interference. Major points to be modified include modifications to the control panel structure, the use of EMI gaskets and ferrite cores, the specification of the in-panel wiring condition (separation between signal and power lines) and the enhancement of grounding (earthing).

(2) Conducted interference
This refers to the reverse flow of high-frequency noise components generated in equipment into the power line (through conductance or radiation from the power line).
The most typical countermeasure to deal with this is the use of a power line filter as a powerful trap preventing the outflow of noise.
The outflow of noise can also be reduced by specifying the in-panel wiring condition (separating the signal and power lines).

(3) Electrostatic discharge
This standard is applied in the evaluation of the immunity of electronic equipment against static electricity discharged from the operator directly or towards nearby objects.
A typical countermeasure against this is the improvement of grounding (earthing).

(4) Radiation immunity
This standard is applied to the immunity of electric and electronic equipment against the electromagnetic energy generated intentionally from a compact portable transceiver, radio station, radio equipment, etc.
Countermeasures against this are identical to those taken against the radiated interference described above.

(5) Fast transients (bursts)
This standard is applied in the evaluation of the immunity of electric and electronic equipment when it is exposed to transient interference with a high repetition rate which is generated by the interruptions of an inductance load or bouncing of relay contacts.
Countermeasures against this are taken for the cables led out from the control panel. Basically, they consist of the use of a power filter for the input power line and the use of shielded cables and grounding (earthing) of the housing of the signal lines.

(6) Lightning surges
This standard is applied in the performance evaluation of the electric and electronic equipment when its power, communications and signal lines are exposed to high-energy disturbances. As such, its purpose is to identify the phenomena caused by switching or lightning surge voltages on the equipment in the operating condition.
A typical countermeasure against this is to add a surge absorber in the power line. A surge trap filter incorporating the combination of a power noise filter and surge absorber can also be used.

(7) Magnetic field
This standard is applied to evaluate the immunity of electric and electronic equipment against magnetism.
The countermeasures against this consist of magnetic shielding of the components affected by magnetism. These components include the servo motor encoder, etc.

(8) Conductance immunity
This standard is applied to evaluate the immunity of electric and electronic equipment against sine-wave noise.
Countermeasures against this are taken for the cables led out from the control panel. Therefore, it can be dealt with by taking identical countermeasures to those taken against the fast transients described above.

5. Countermeasures for the cabinet

Radio waves with various wavelengths emitted by electric components are scattered inside the control panel, and the noise radiated or conducted from them is superimposed on the cables installed inside the control panel. When these cables are led out of the control panel, the cables containing high-frequency noise act as antennas and radiate noise externally.
If an electric product such as control equipment or a drive is connected to the AC input power line without using a power filter, high-frequency noise components generated in the equipment flow into the mains power line (through conductance or radiation from the power line).
Therefore, the problems posed related to these emissions include;

- Radiated noise from the electric components inside the control panel or from the cables connecting them;
- Radiated noise from the cables led out of the control panel;
- Conducted noise flowing in reverse from the control panel into the input power cable and the radiated noise from the input power cable due to conducted noise.

The basic countermeasures against the above include the modification of the control panel structure, the use of EMI gaskets and ferrite cores, the specification of the in-panel wiring condition (separation between signal and power lines), the shielding of cables, the use of a power filter and the enhancement of grounding (earthing).

As requirements related to immunity, the following items have been pointed out;

- Electrostatic discharge (ESD)
- Radiation immunity;
- Fast transient (burst);
- Magnetic field;
- Conductance immunity.

The basic countermeasures against the above include the shielding of cables, enhancement of grounding (earthing), the use of a power filter, modifications to the control panel structure and the use of EMI gaskets and ferrite cores.

5.1 Cabinet structure

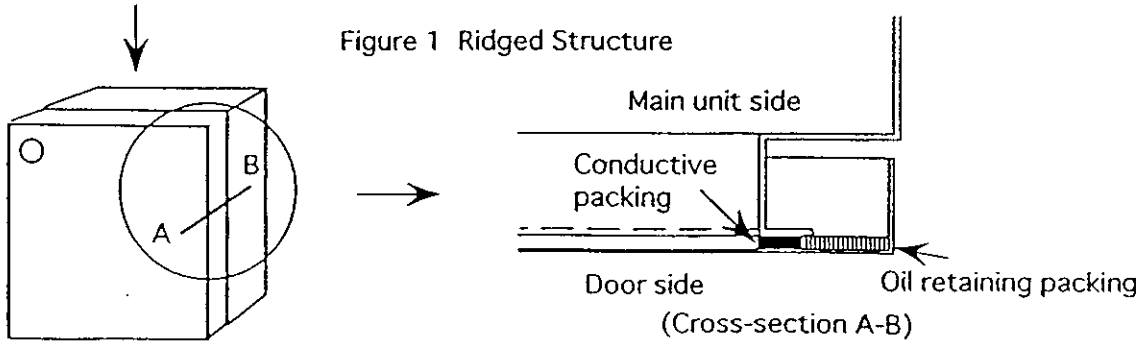
5.1.1 Control panel structure

With a control panel, it is required to prevent the leakage or penetration of radio waves through the openings of the cable inlets/outlets, installation holes in the operation panel, doors, etc.

The major points in control panel modification include the following (including modifications of internal electric components).

- The control panel should be made of metal material and the joints of the top, bottom and side panels should be welded to make them electrically conducting.
- In case of an assembled-type control panel, the paint on the joint sections should be masked to provide electrical conductance.
- Be careful to avoid gaps which could be opened when panels are warped due to the tightening of retaining screws, etc.
- The sections where the cabinet and door fit should have a ridged structure to avoid gaps (refer to Figure 1).
- There should be no conducting sections which are left floating electrically.
- With the units mounted inside cabinets, both the cabinet and main unit should be grounded (earthed).

Figure 1 Ridged Structure



5.1.2 Door structure

It is required to reduce radio waves by eliminating gaps around doors for opening/closing the control panel.

- The doors should be made of metal material.
- Conductive packing should be used between the doors and main unit.
  (With the conductive packing, assure conductivity by masking the paint on the sections which contact the door or main unit.).
- Be careful to avoid gaps which could be opened when panels are warped due to the tightening of retaining screws, etc.

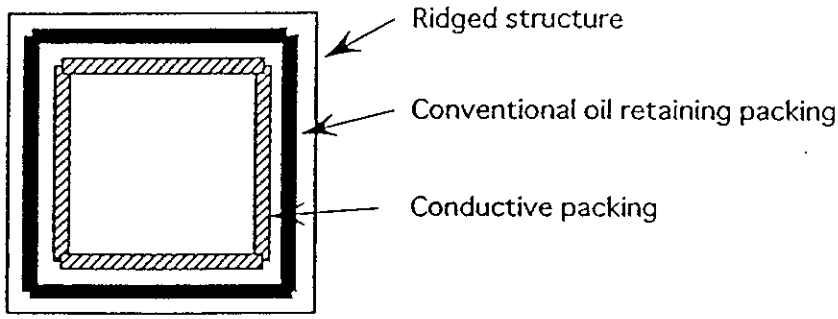


Figure 2 Door

5.1.3 Operation panel cabinet

Together with the measures described in section 5.1.1, the following measures are also required.

- The door and retaining panels should be made of metal material;
- Conductive packing should be used between the doors and main unit.
- Be careful to avaid gaps which could be opened when panels are warped due to the tightening of retaining screws, etc.
- When the operation panel is installed in an operation board ensure conductivity by masking the paint on the installation surface of the operation board and using conductive packing.
- In case the operation panel has a door, follow the instructions in section 4.1.2.;
- In case the back side of the operation panel is shielded with a cover, ensure conductivity by masking the paint on the contact surfaces of both the operation board and cover sides.
- Install a grounding (earthing) plate inside the operation board and shield the video signal cables, etc.;
- Connect the operation board and the main unit using a sufficiently thick cable. This is not applicable if the control panel and main unit are joined securely to each other.

Caution:

Although the ideal method to prevent conducted interference is to completely seal the equipment with metal plates, complete sealing is actually impossible because of the cable leading inlets and the doors necessary for handling the equipment.

As a result, it is necessary to use doors and covers made of conductive materials.

Therefore, do not use:

- Doors and cover made of nonconductive materials (plastic, etc.),
- Sections between the cabinet and cover or door of which are nonconductive due to painting,
- Covers which produce gaps when they are attached with screws.

5.2 Countermeasures for AC power supply and surroundings

5.2.1 Improving the shielding and grounding (earthing)

With regard to products manufactured by YASKAWA, countermeasures can be implemented by simply observing the methods of grounding (earthing) between units and shielding of cables which have been described in the connection manuals.
We believe that users have used such noise-prevention measures for inductive equipment such as relay contacts, but their use should be further ensured in the future.

5.2.2 Countermeasures against conducted interference

With regard to noise from electric components that is radiated outside through superimposition on the AC input line, a noise filter is used as a countermeasure. This is the most typical and effective method. A machine requires a considerably high power capacity because it uses a servo motor, main spindle and auxiliary drive.
The size of the noise filter varies depending on the power capacity, and the following table shows the standard sizes as reference.

Capacity	Size
30 A	230 x 110 x 70
50 A	270 x 150 x 80
75 A	310 x 180 x 80
150 A	440 x 210 x 160
200 A	80 x 240 x 180

* Recommended noise filters are currently being selected.

5.2.3 Countermeasures against lightning surges

With regard to the lightning surges, a surge absorber is to be used.

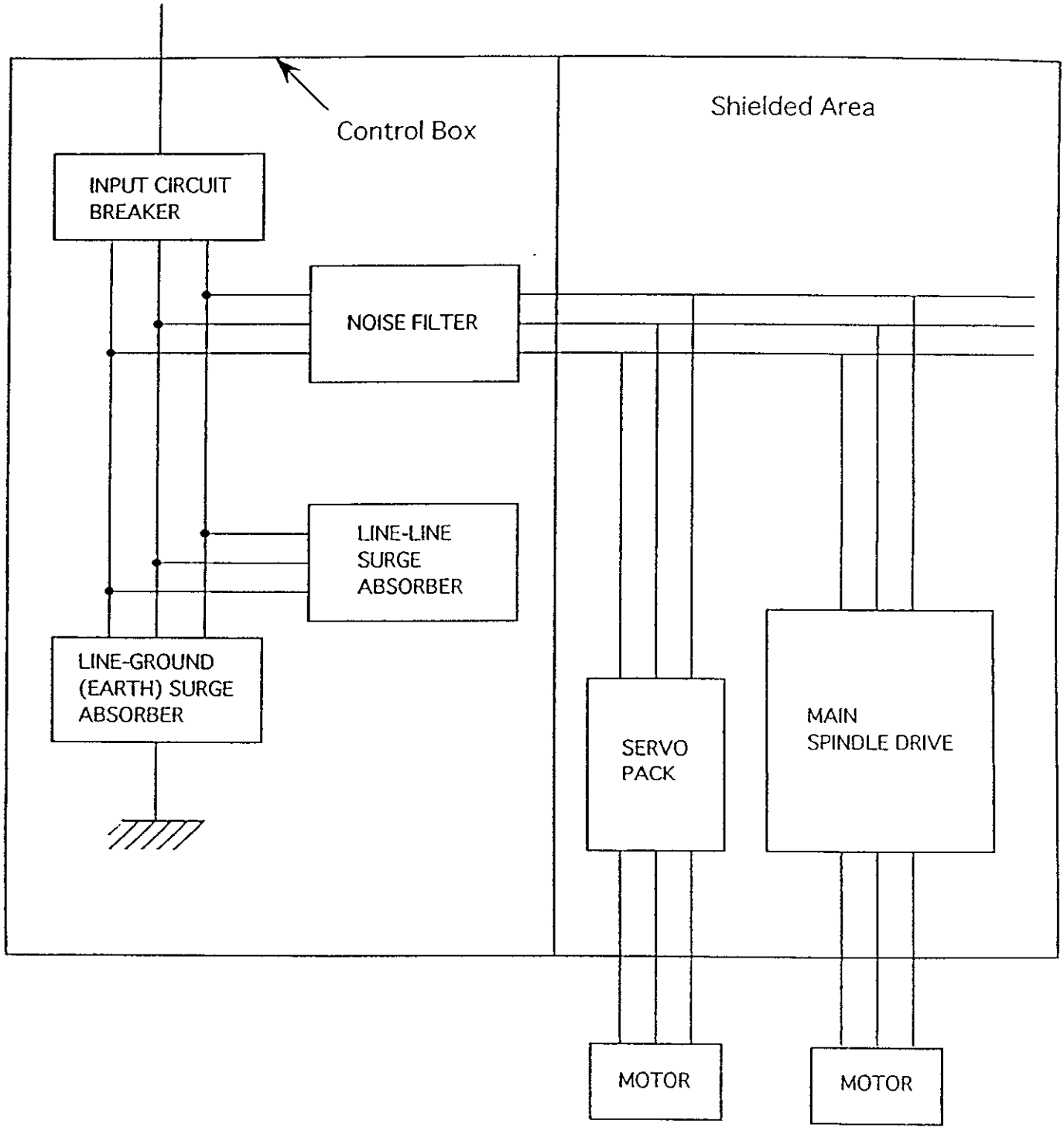
5.2.4 Countermeasures for motor cables and surroundings

In general, several AC motors are used in a machine and noise is generated by the cables between the drives and motors. Malfunctions due to external noise may also occur through the motor cables.
The recommended countermeasures against the above include:

- Arranging the motor cables to pass through metal conduits.
- Installing a noise filter on the inverter output side of the power line for the main spindle motor.
  (This is not applicable in case the cable between the inverter and motor is passed through a metal conduit and both ends are grounded (earthed).)

[Reference]

[Example of Recommended Layout of Noise Filter and Surge Absorbers]



5.3 Treatment of cables

5.3.1 Countermeasures against cable noise

The treatment of cables is the most important countermeasure. The grounding (earthing) and the treatment of gaps in the external connection sections between the control panel and machine are also important. Machinery manufacturers are requested to examine the current structure of the cable lead-in.

- Shielding
- Use cables with standard meshed shielding.
- For the shielding method, it is desirable to ground (earth) the cable shielding mesh sections by clamping the cable to the ground (earth) plate.
- Ferrite core insertion

For a video signal display unit or RS-232C interface cable, insert a ferrite core in the proximity of the unit connection section.

- Treatment of metal tubes and flexible tubes

The lead-out sections of the control panel, operation board, junction box, etc., should be treated to eliminate electrical leakages by eliminating clearances. The grounding (earthing) surfaces should be metal conductors and conductivity should be assured by masking the cabinets and paint.

- It is desirable to ground (earth) the flexible tube connectors at the two ends.
- The motor connector of the machine should be grounded (earthed).
- The flexible tube connected to a junction box should also be earthed.

* If a divided panel(WARITA) system is used in the flexible tube fixing sections, it should be reviewed.

The most effective treatment for cables is shielding. The connections to the cabinets can be protected from the influence of radio waves by grounding (earthing) electrically-floating conductors.

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5.3 Treatment of cables

5.3.2 Cable shielding methods

(1) Shield one-side grounding (earthing) (CNC side)

- The CNC side should be grounded (earthed) using an earth (ground) plate.



(2) Shield two-side grounding (earthing)

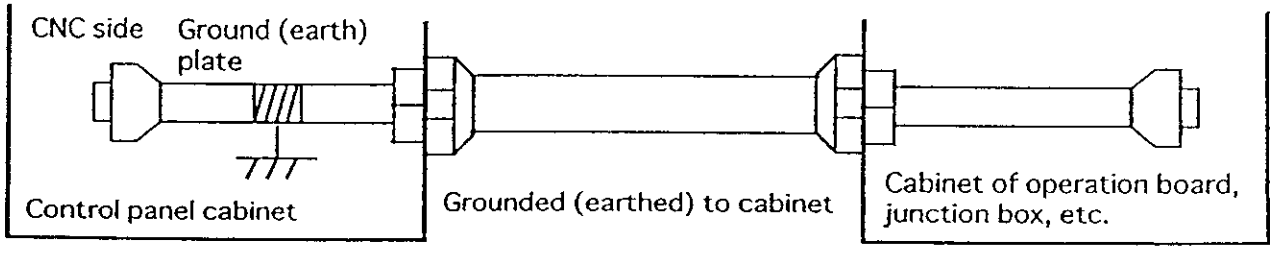
- Both the CNC and operation board sides should be grounded (earthed) using ground (earth) plates.

Applicable to CRT signal cables, etc.



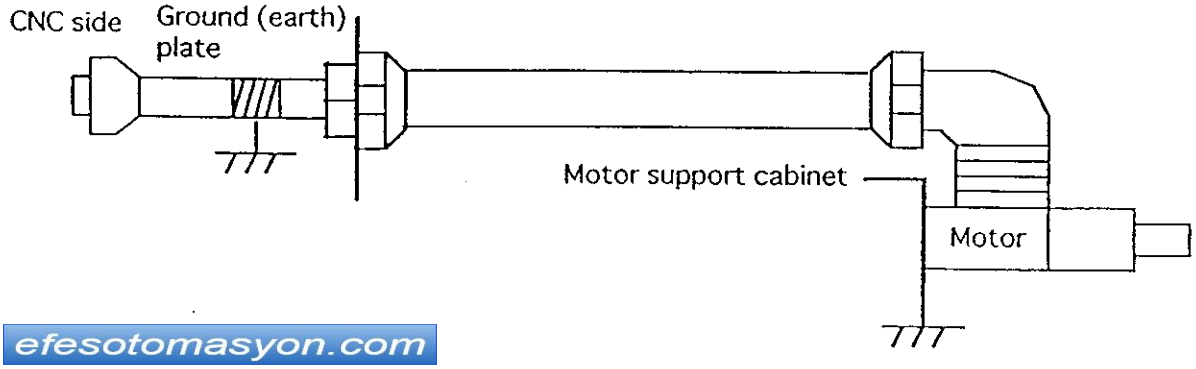
(3) Treatment of conduits

- The use of metal conduits is recommended.
- The two connector ends should be grounded (earthed).



(4) Treatment of feedback cables

- Use of metal conduits is recommended.
- Ground (earth) the machine side support cabinet.



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EMC DIRECTIVE SUPPLEMENTARY EXPLANATION

EMC Compatibility with SERVOPACK Products

1. Introduction

The following explanation has been compiled as detailed supplementary material to describe the measures taken by the SERVOPACK products to respond to EMC compatibility issues.

Contents

6.1 Cable Treatment Method (Signal Cables)
6.2 Cable Treatment Method (Power Cables)
6.3 Selection of Cables
6.4 Cable List (Inter-Equipment Connection Cables)
6.5 Selected Parts List
Reference Materials
Round Connectors for Motors
6.6 Representative Connection Examples
SGDA type
DR2 type
SGDB type
CACR-SR**VE type
CACR-SR**BE type
CACR-HR**VBC type

Note: Information in this manual is subject change due to product improvements or EN standard modifications.

GUIDELINES FOR USAGE WITH THE EMC DIRECTIVE

Cable Treatment Method

6.1 Signal Cables: Always use general-shielded, braided composite cables.

(1) When externally grounding the operator panel, pass the grounding cable through a braided conduit.

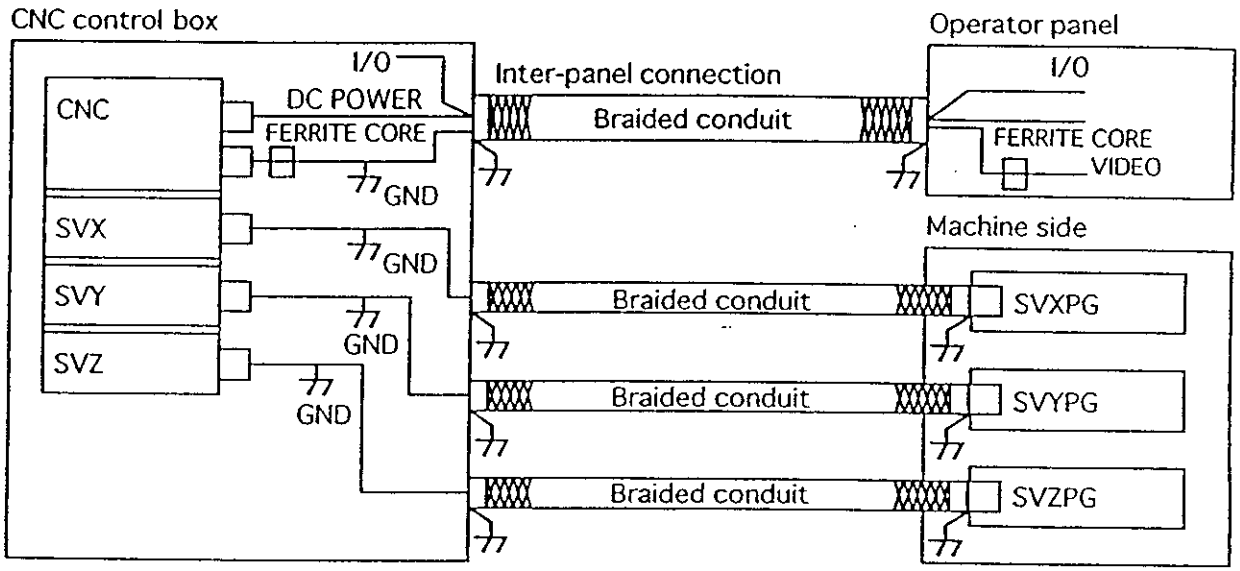
(2) The PG cables should also be treated in the same way as above.

(3) The two ends of each outside braided conduit should be grounded onto the cabinets. (See Fig. B.)

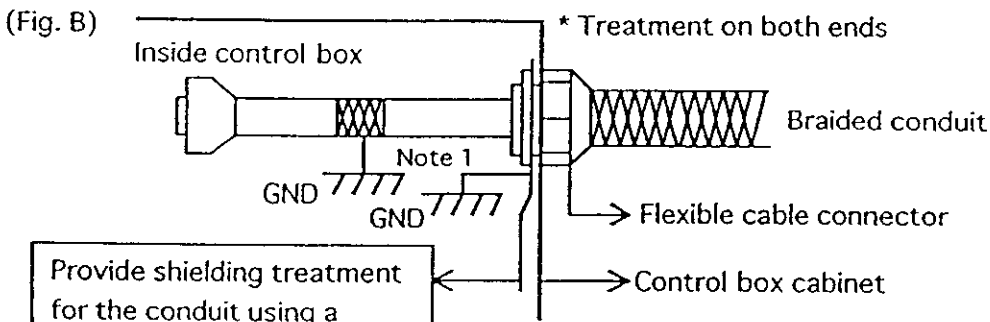
(4) The Cannon plug connectors should be grounded. (See Fig. C.)

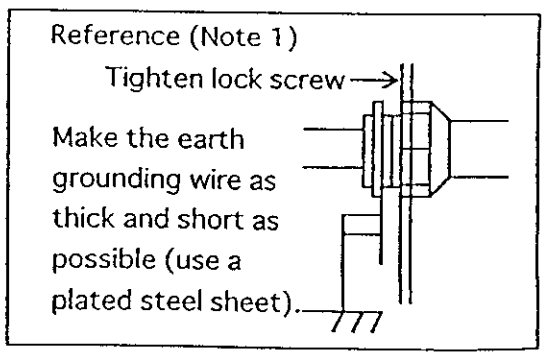
* When shielding a cable, connect only the NC side to the GND plate.

(Fig. A) Connection of Feedback Cables

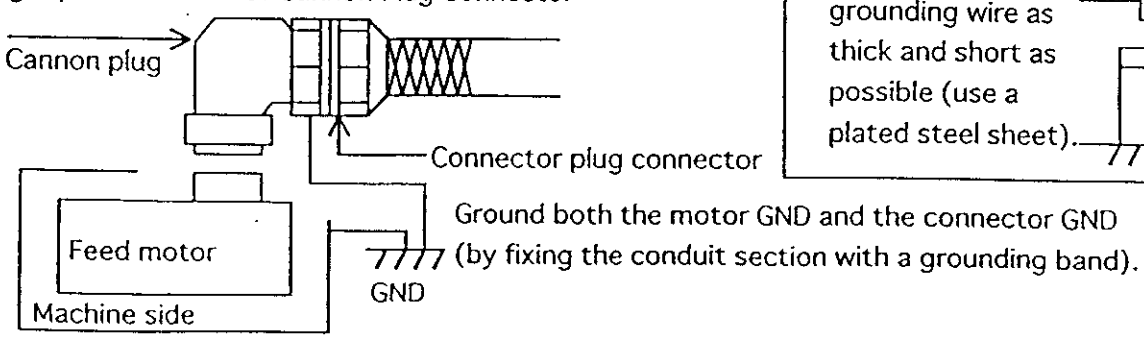


(Fig. B)





(Fig. C) Treatment of Cannon Plug Connector

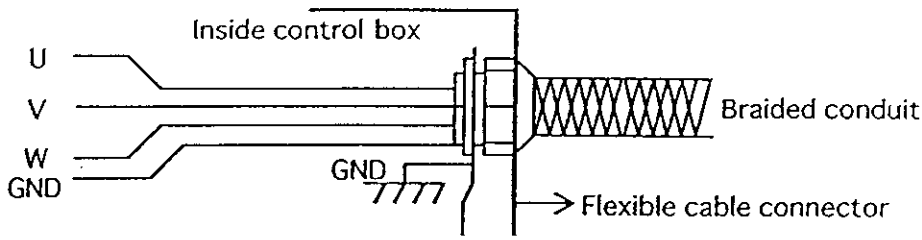


Types of conduits and connectors

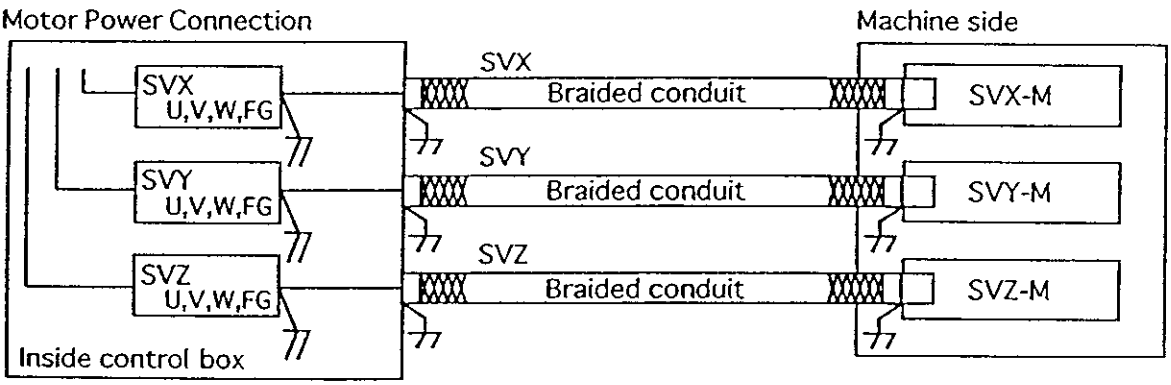
1. Vinyl braid-coated flexible cable	KBF	Daiwa Dengyo
2. KBF cable connector	KBSG, KBLG	Daiwa Dengyo
3. Cannon plug connector	BOS, BOL	Daiwa Dengyo
4. Nippolex conduit	VFCB	Nippon Flex
5. Nippolex connector	VFCB	Nippon Flex

6.2 Power Cables

(1) The SERVOPACK power cable should be passed through a braided conduit.
(2) The two ends of each outside braided conduit should be grounded onto the cabinets. (See figure below.)
(3) For the treatment of the Cannon plug cable connector, see (Fig. C).



(Fig. D) Motor Power Connection



6.3 Selection of Cables

Basically, external cables should be shielded using braided conduits as indicated in sections 1 and 2.
In view of machine compatibility issues, machinery manufacturers are requested to carefully confirm each specification.

(1) Take the following measures in case the conduits cannot be used.

- Signal cables: Use shielded braided cables and perform shield clamping with the cabinet on each end. In this case, use an order wire for the FG line.
- Power cables: Conventional captire cables can be used when a conduit is used, but in case the conduit cannot be used, use shielded braided cables and treat each end with shield grounding.

  Applicable cables: Research to compile a list is being conducted.

  Reference Advice: Vinyl insulated control cable (AWM2464CSA) by Furukawa Electric Co., Ltd. (See Reference Material 1.)

  Applicable size -- Series AWG20 ~ AW12 (3.5SQ).

  However, cables with GND wire color: Green-Yellow/Green SP are not available as standard products.

  Also, the heat-resistant PVC shielded cables (Hitachi Cable, Ltd.) have similar specifications.

(2) Other information

- Similar treatments are also required for solenoids. Each machinery manufacturer is requested to treat solenoids as required.
- If the remote I/O and/or 24V power cables are outside the contfoll box, they should also be shielded.
- The YE-NET compatible remote I/O cable needs a ferrite core on each end. (With the outside section, it is always recommended to use a braided conduit.)

6.4 Cable List (Inter-Equipment Connection Cables)

Cable No.	*Cable Name*	*Cable Spec.*	*Shielding + Ferrite Core*	*Remark*
	Remote I/O (panel)	Composite shielded braided cable	GND on NC side	(Refer to Figs. A and B.) Ground two ends of the conduits outside the control box.
	Remote I/O (YE-NET)	KEV-SB (DE9405671)	: Ferrite core on each end	
	RS232C signal cable	Composite shielded braided cable	GND each end: Ferrite core on each end	
	Servo drive signal cable (NC-servo)	Composite shielded braided cable	GND on NC side	
	PG cable, Power cable	Composite shielded braided cable + Captire cable (600 V) + Braided conduit	GND on NC side, GND on each braid end	(Refer to Figs. A, D, B and C.) Ground two ends of the conduits outside the control box. * Use identical conduits
	Remote I/O power cable (when distributed outside the control box)	Captire cable (shielded captire)	GND on each end	Shielding is not necessary if a conduit is used.

Notes) Regarding cable treatment

1. All cables outside the control box should be shielded braided cables whether they are signal or power cables.
   (The same power (captire) cables described previously can be used if their outside is grounded with a braided conduit or metallic tube.)
2. For the connections inside the control box, refer to the previous connection explanation. (Use a ferrite core on each end of YE-NET cable.)
3. The control circuit wiring of the primary side should be separated from that of the secondary side.
4. Use shielded braided cables with tin-plated soft copper wire braid.
5. When the outside conduit is not used, the GND shielding treatment should be performed on the cabinet on the other end (GND clamping).
6. GND clamping is more effective when it is performed at a site in close proximity to the connection section.

6.5 Selected Parts List

(1) Noise filter for EMC compatibility

·CNC + SERVOPACK

Rated current

30A filter: LF-3300 mfd. by Tokin

Approx. dimensions: (W)247 x (H)110 x (D)60 mm

50A filter: LF-3500 mfd. by Tokin

Approx. dimensions: (W)264 x (H)149 x (D)60 mm

Note)

Because filters for a capacity higher than 60 A are still under development by the manufacturer, please use a parallel connection for the present.

<Triphase 200 V>

Max. Motor Capacity	Filter (Input Side)	
	Tokin	Schaffner
0.3kw (5A)	LF-3200	FN351-16/29
0.5kw (5A)	LF-3200	FN351-16/29
0.7kw (8A)	LF-3200	FN351-16/29
1.0kw (8A)	LF-3200	FN351-16/29
1.5kw (10A)	LF-3200	FN351-16/29
2.0kw (12A)	LF-3200	FN351-25/29
3.0kw (18A)	LF-3300	FN351-36/33
4.4kw (24A)	LF-3400	FN351-50/33
5.0kw (28A)	LF-3500	FN351-50/33
6.0kw (32A)	LF-3500 ③	~~FN351-50/33~~ FN258-75/34
7.5kw (41A)	LF-3600 ③	~~FN351-80/34~~ FN258-75/34
11.0kw (60A)	③	~~FN351-80/34~~ FN258-100/35
15.0kw (80A)	③	~~FN351-110/35~~ FN258-100/35

<Single-phase 200 V>

Max. Motor Capacity	Filter (Input Side)
	Okaya
30W (1.3A)	SUP-P5H-EPR
50W (1.5A)	SUP-P5H-EPR
100W (2.5A)	SUP-P5H-EPR
200W (4.0A)	SUP-P5H-EPR
400W (6.0A)	SUP-P8H-EPR
800W (11.0A)	SOP-P10H-EPR

<Brake power filter>

Brake Power Capacity	Filter (Input Side)
	Okaya
1.0A	SUP-P5H-EPR

Because high leakage current is present in the line filters manufactured by Schaffner, care is required in selection of MCCB.

(2) Ferrite core

Available products include the following:

· Clamp filter manufactured by TDK: ZCAT3035-1330

· Round cable split core by Tokin: ESD-QR-25S

(Make selection based on the power wire and cable diameters.)

(3) Surge absorber (countermeasure for lightning surge)

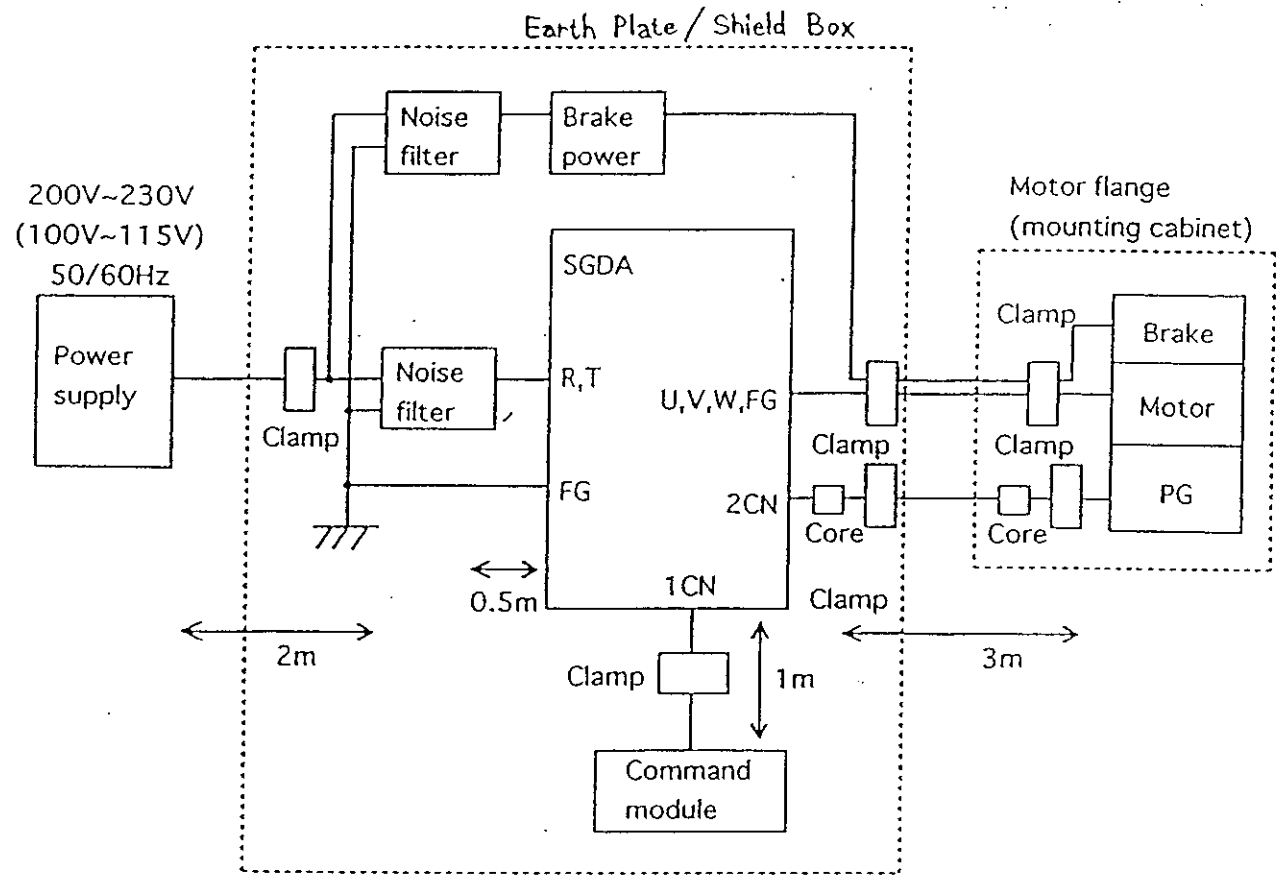
The available products include the following:

· Line-line absorber: R.A.V.-781BYZ- 2 (Mfd.by Okaya Co.Ltd)

· Line-GND absorber: R.A.V.-781BXZ-4 (Mfd.by Okaya Co.Ltd)

Connectors on the Motor Side

	Previous Product	*EMC-Compatible Products*
Receptacles	MS3102A14S-2P	JL04V-2E18-10PE-B
	MS3102A18-10P	JL04V-2E18-10PE-B
	MS3102A20-4P	JL04V-2E20-4PE-B
	MS3102A22-22P	JL04HV-2E22-22PE-B
	MS3102A32-17P	JL04V-2E32-17PE-B
	MS3102A14S-6P	JL04V-2E18-12PE-B
	MS3102A14S-6P	JL04V-2E18-12PE-B
	MS3102A20-15P	JL04V-2E20-15PE-B
	MS3102A20-17P	JL04V-2E20-15PE-B
	MS3102A24-10P	JL04V-2E24-10PE-B
	MS3102A20-29P	
Plugs	MS3108B18-10S	JL04V-8A18-10SE-EB
	MS3108B22-22S	JL04V-8A22-22SE-EB
	MS3108B32-17S	JL04V-6A32-17SE
	MS3108B14S-2S	JL04V-8A18-10SE-EB
	MS3108B20-15S	JL04V-8A20-15SE-EB
	MS3108B24-10S	JL04V-8A24-10SE-EB
	MS3108B14S-6S	JL04V-8A18-12SE-EB
	MS3108B20-4S	JL04V-8A20-4SE-EB
	MS3108B18-12S	JL04V-8A18-12SE-EB
	MS3108B20-17S	JL04V-8A20-15SE-EB
	MS3108B20-29S	JA08A-20-29S-J1-EB



Clamps: Ground the shield of each cable.
Cores: ESD-SR-25 (mfd. by Tokin)
Number of insertions: 1 per position
Number of turns: 1.5 turns

Applicable noise filters

	SERVOPACK Type SGDA/SGDE	*Noise Filter Type*	*Power Capacity (Input current Arms)*	*Brake Power Noise Filter Type*
200 V	A3V* / A3A*	SUP-P5H-EPR	1.3	SUP-P5H-EPR
	A5V* / A5A*		1.5	
	01V* / 01A*		2.5	
	02V* / 02A*		4.0	
	04V* / 04A*	SUP-P8H-EPR	6.0	
	08V* / 08A*	SUP-P15H-EPR	11.0	SUP-P15H-EPR
100 V	A3W* / A3B*	SUP-P5H-EPR	2.0	SUP-P5H-EPR
	A5W* / A5B*		2.6	
	01W* / 01B*		4.5	
	02W* / 02B*	SUP-P8H-EPR	8.0	
	03W* / 03B*	SUP-P15H-EPR	14.0	SUP-P15H-EPR

All of the above noise filters are manufactured by Okaya Co., Ltd.

② add this page 1997.1.25 N.Iwao

Applicable motors
Use EN standard-compatible motors manufactured by YASKAWA Electric Mfg. Co., Ltd.

Examples of servo motor types:
SGM-01V312 (200 V AC, 100 W)
SGM-01W312 (100 V AC, 100 W)

Cable specifications
· Motor cable (between SERVOPACK and motor)

$SGD^{A}_{E}-**^{V}_{W}*$

Connector is not supplied with motor power cable.
Check the cable current rating and consider the operating environment to select the cable and connector conforming to the EN Standard.

< Motor Power Cable Color >	< Phase >
Red	Phase-U
White	Phase-V
Blue	Phase-W
Green/Yellow	FG

The cable should be shielded with a shielding material such as a braided conduit.
The SERVOPACK side of the shielding material should be grounded to a GND plate.

$SGD^{A}_{E}-**^{A}_{B}*$

AWG-20 × 4 core
AWG-20 × 6 core

	W/o brake	With brake
Cable	~~DP8409359~~	~~DP8409360~~

* The above cable should be shielded with a shielding material such as a braided conduit. The two ends of the shielding material should be grounded to a GND plate or the cabinet.

· Motor connector

	W/o brake	With brake
Cap	172159-1 type	172160-1 type
Socket	170362-1 type or 170366-1 type	

* Mfd. by AMP Japan

· PG cable (between SERVOPACK 2CN and encoder) ·····Shield wire

incremental or

	~~For incremental PG~~	For absolute-value PG
Cable	~~B9400064~~	DP8409123

· Signal cable (between SERVOPACK 1CN and motion controller) ·····Shield wire
SSRFPVV-SB 28x18P

· Power cable (between power supply and noise filter) ·····Shield wire
SOR-VCT-SB

· Power cable (between noise filter and SERVOPACK)
UL1015 AWG16

Connector specifications

· 1CN

Connector: 10136-3000VE type, 36-pin *1

Case: 10336-52S0-00S type, 36-pin *1

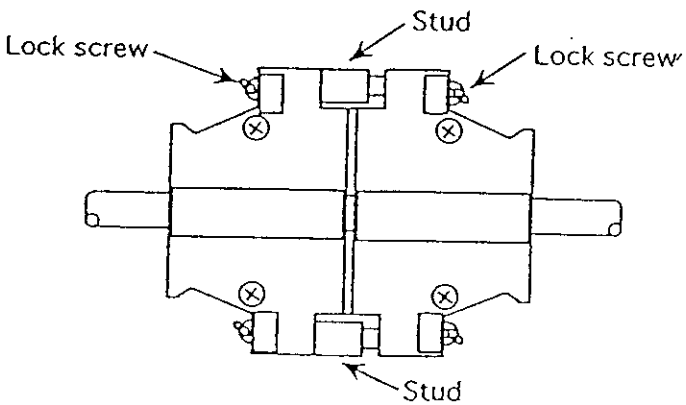
· 2CN

Encoder Type		Incremental	Absolute-Value
SERVOPACK side connector	Case	10320-52S0-00S *1	
	Connector	10120-3000VE *1	
Motor side connector		17JE13090-02D8A*2	17JE13150-02D8A*2
Motor side stud		17L-002A *2	

*1: Mfd. by Sumitomo 3M

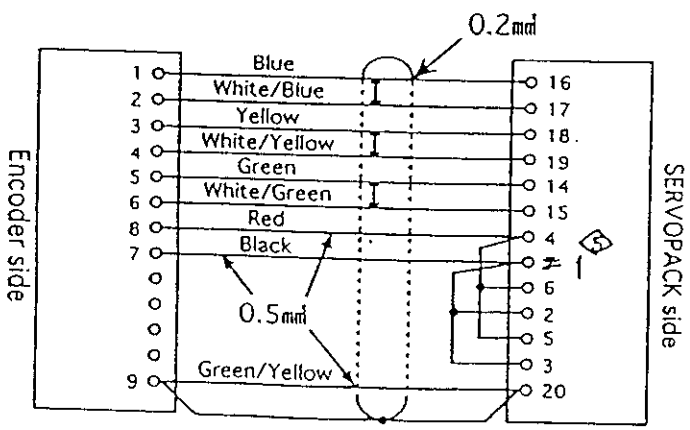
*2: Mfd. by DDK

The connector on the motor side should be connected using studs as shown below.



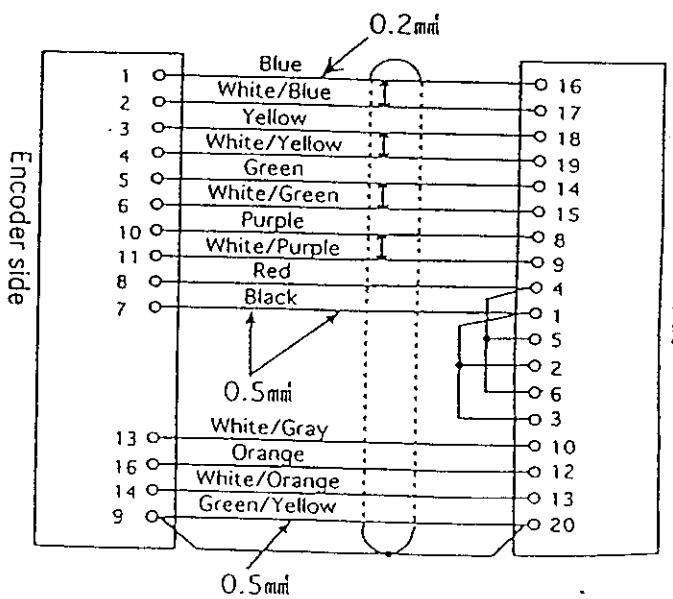
· PG cable connection method

For incremental encoder



: Twisted pair shield wire

For absolute-value encoder

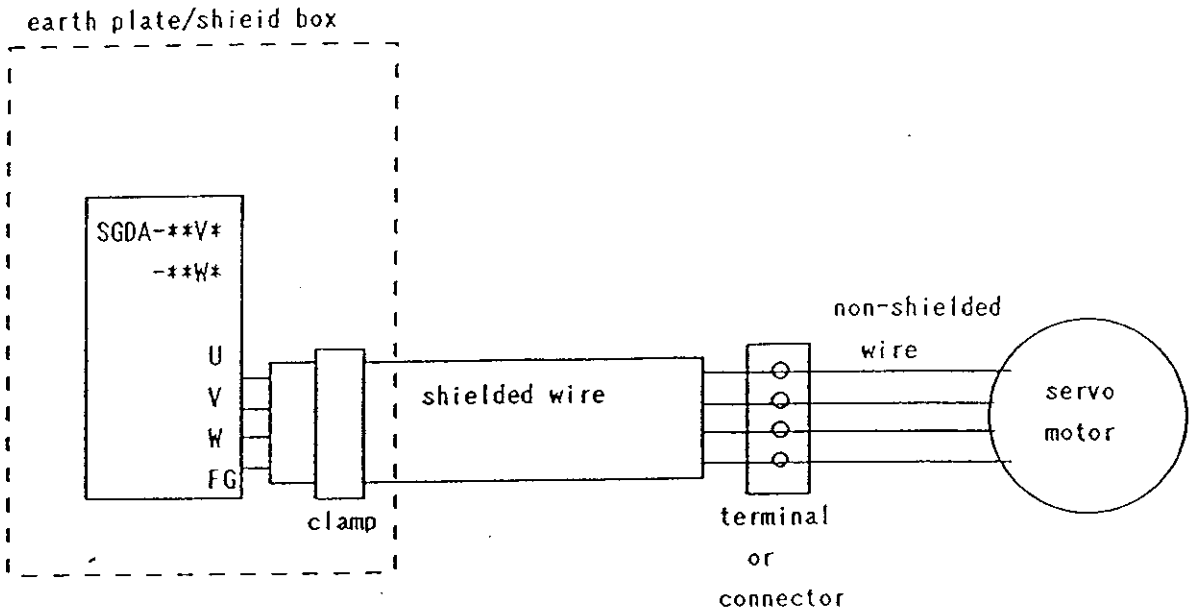


: Twisted pair shield wire

⑤ correct pin No. 1997.5.27 Nagai/Tsukahara

- Motor cable connection method when you use SGDA-**V* or SGDA-**W*

The cable between motor to connector should not be shielded.



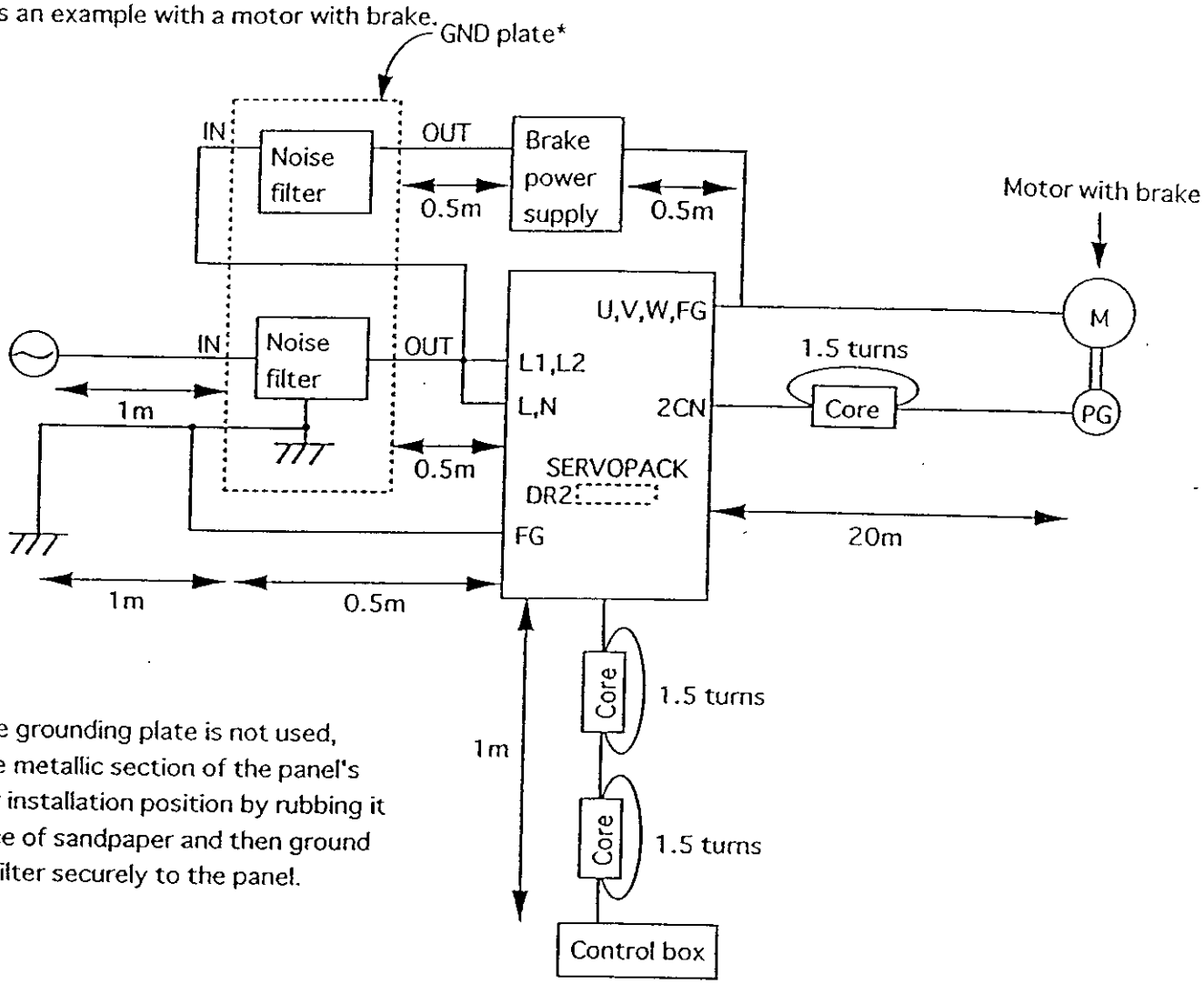
DR2 Type Installation Conditions

Recommended installation conditions

A cable connection example is shown below.

The following diagram also shows the noise filters and cores.

This is an example with a motor with brake.



* When the grounding plate is not used, expose the metallic section of the panel's noise filter installation position by rubbing it with a piece of sandpaper and then ground the noise filter securely to the panel.

Applicable noise filter types

* Mfd. by Okaya Electric

	SERVOPACK Type	Noise Filter Type & Spec.* (Input line)	Noise Filter Type & Spec.* (Brake power supply)	SERVOPACK Rated Input Current Arms
200 V	DR2-A3A*	SUP-P5H-EPR 250V 5A	SUP-P5H-EPR 250V 5A	1.3
	DR2-A5A*			1.5
	DR2-01A*			2.5
	DR2-02A*			4.0
	DR2-04A*	SUP-P8H-EPR 250V 8A		6.0
	DR2-08A*	SUP-P10H-EPR 250V 10A		11.0
100 V	DR2-A3B*	SUP-P5H-EPR 250V 5A		2.0
	DR2-A5B*			2.6
	DR2-01B*			4.5
	DR2-02B*	SUP-P8H-EPR 250V 8A		8.0
	DR2-03B*	SUP-P10H-EPR 250V 10A		14.0

Applicable motors

Use EN standard-compatible motors manufactured by YASKAWA Electric Mfg. Co., Ltd.

Examples of servo motor types:

SGM-01V312 (200 V AC, 100 W)

SGM-01W312 (100 V AC, 100 W)

PG Cables

Cable specifications (between SERVOPACK 2CN and encoder, wire only)

For incremental encoders: ~~B9400064 *1~~

For absolute-value encoders: DP8409123 *1

incremental or

Connector specifications

- Connector on the SERVOPACK side of PG cable

  Connector: MR-20F *2

  Connector case: MR-20L4 *2

- Connector on the motor side of PG cable

  For incremental encoders: 17JE13090-02D8A *2

  For absolute-value encoders: 17JE13150-02D8A *2

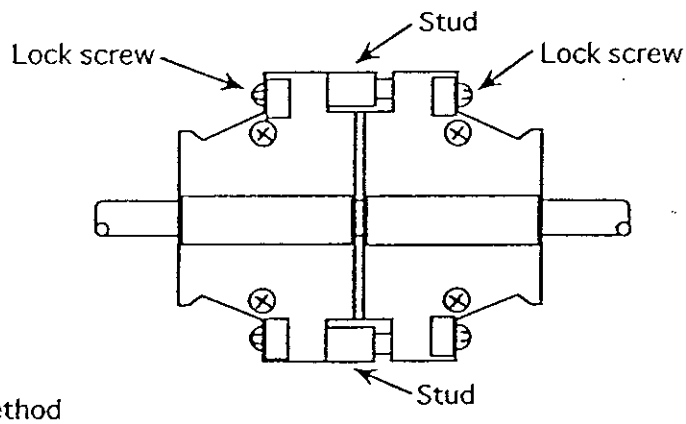
  Connector stud: 17L-002A *3

*1: Please consult us at YASKAWA Electric Mfg. Co. Ltd.

*2: Mfd. by Honda Tsushin Kogyo Co., Ltd.

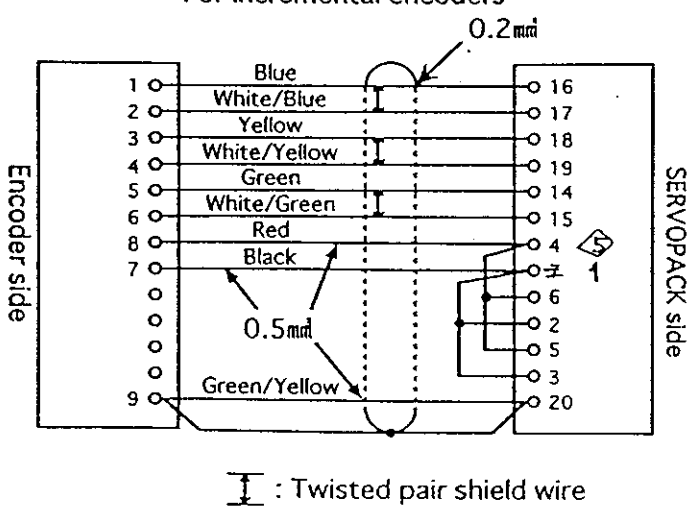
*3: Mfd. by DDK

The connector on the motor side should be connected using studs as shown below.



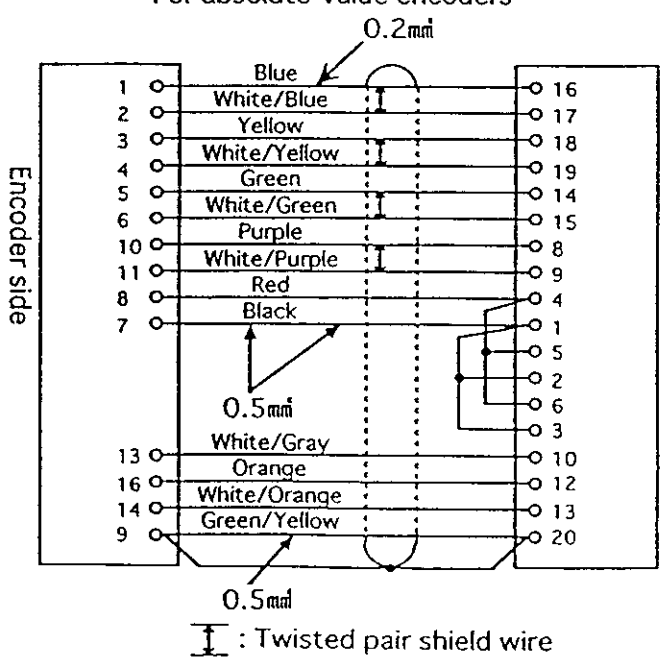
- PG cable connection method

For incremental encoders



: Twisted pair shield wire

For absolute-value encoders



: Twisted pair shield wire

Control Input/Output

Use the control input/output (1CN) connector described below. The connector case described below has been treated with plating.

Use a shielded wire as the 1CN cable and be certain to connect the section between the cable shield and connector case to the GND.

Also be certain to provide the higher-level controller with shielding treatment.

Connector: MR-50M*

Connector case: MR-50L4*

*: Mfd. by Honda Tsushin Kogyo Co., Ltd.

Digital Operator and PC Monitor

The digital operator and PC monitor should be used only in the test run. They should be disconnected in normal operation.

Cable Core

Attach the core described below to the cable.

Type: ESD-SR-25

Quantity: 1

Number of turns: 1.5 turns

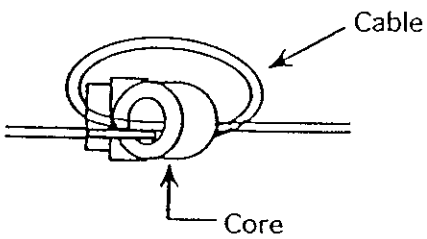
Manufacturer: Tokin

Core attaching position

PG line: SERVOPACK side

Control input/output line: Higher-level control and SERVOPACK side.

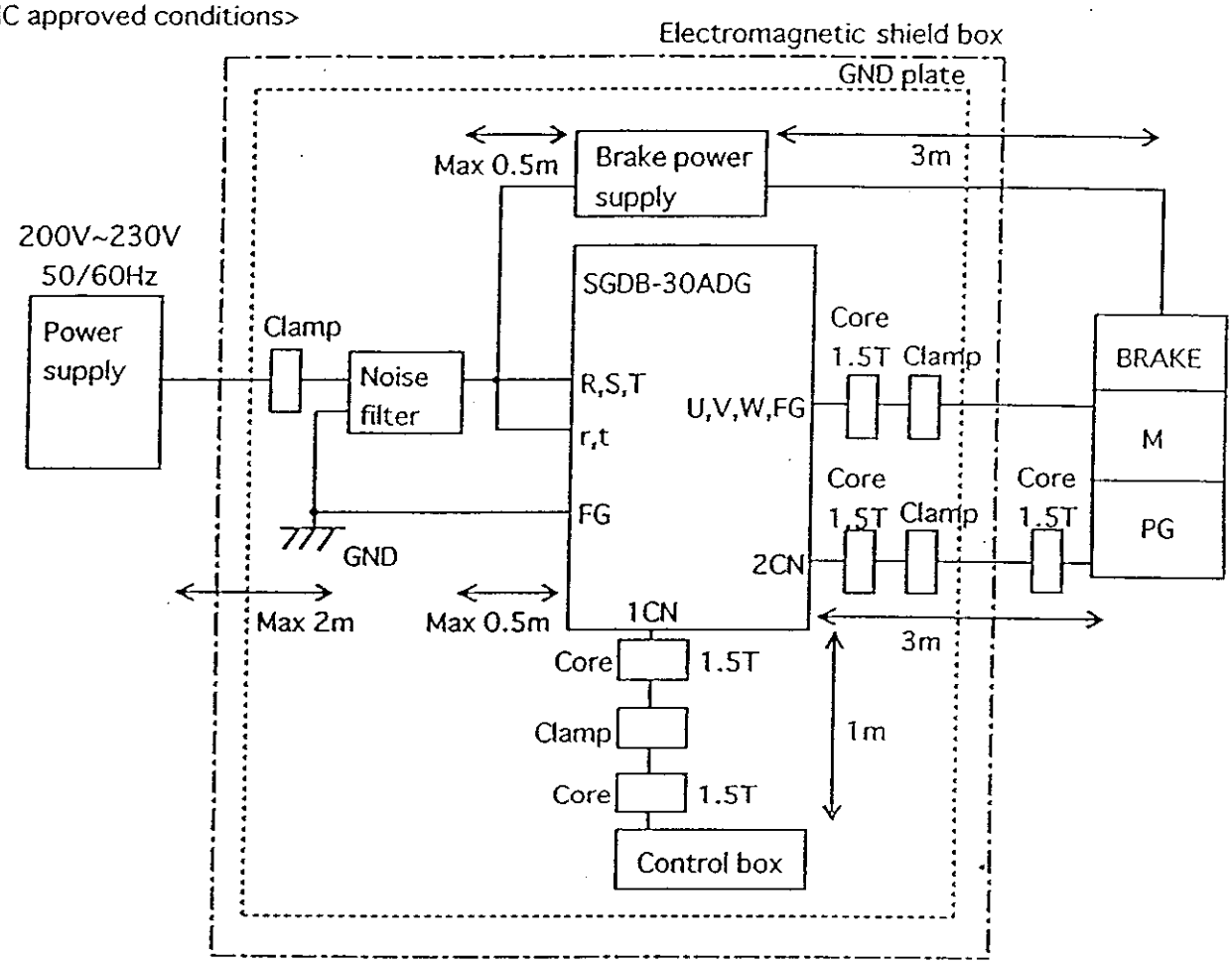
(Note) 1.5 turns refers to the treatment shown below.



· Installation conditions for an SGDB of 3.0 kW or less

– ✱✱ AD ✱

<EMC approved conditions>



Clamp: Fix and ground the cable shield using a piece of conductive metal.

(Note 1) Connect the electromagnetic shield box and GND plate securely to the GND.

(Note 2) To ensure a reliable connection between the GND plate and the FGs of installed parts (filters, SERVOPACK, clamps, etc.), be certain to take steps such as the removal of paint from the GND plate.

<Applicable noise filter types>

SERVOPACK type	Noise filter type	Power Capacity (A) *2
SGDB-03AD*	FN351-8/29 *1	5
SGDB-05AD*	FN351-8/29	5
SGDB-07AD*	FN351-16/29	8
SGDB-10AD*	FN351-16/29	8
SGDB-15AD*	FN351-16/29	10
SGDB-20AD*	FN351-25/33	12
SGDB-30AD*	FN351-36/33	18

*1: Mfd. by Schaffner

Because of the high leakage current, care is required in the selection of the power breaker.

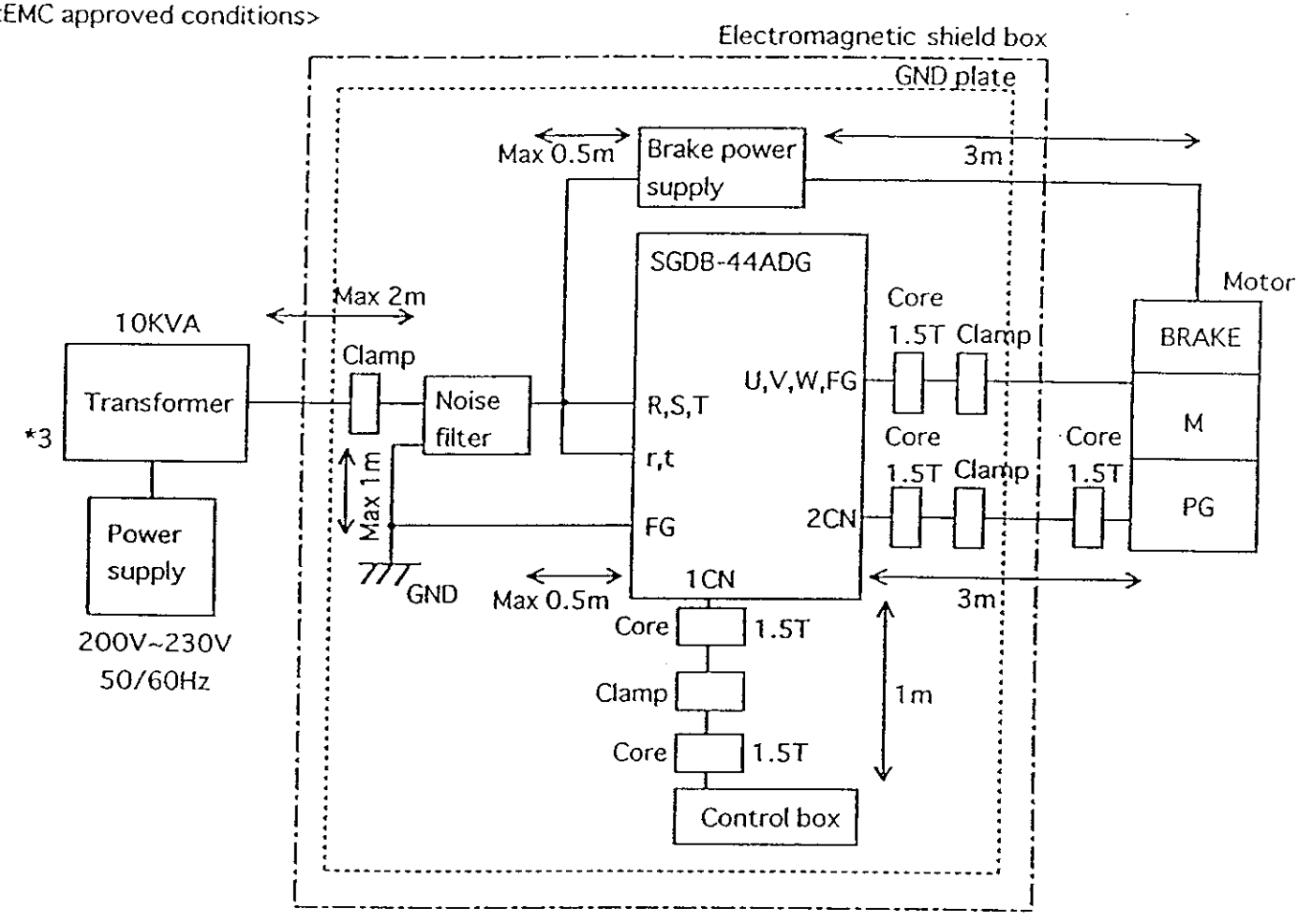
*2: Values in rated operation with a single SERVOPACK.

① SGDB-✱ SGDB ✱✱AD✱ 100/12 17 Daikin

· Installation conditions for an SGDB of 4.4 (5.0) kW

− ** AD *

<EMC approved conditions>



Clamp: Fix and ground the cable shield using a piece of conductive metal.

*3: A power transformer is also required with 200 V input.

(Note 1) Connect the electromagnetic shield box and GND plate securely to the GND.

(Note 2) To assure the connection between the GND plate and the FGs of installed parts (filters, SERVOPACK, clamps, etc.), take measures such as the removal of paint from the GND plate.

<Applicable noise filter types>

SERVOPACK type	Noise filter type	Power Capacity (A) *2
SGDB-44AD*	FN351-50/33 *1	24
SGDB-50AD*	FN351-50/33	28

*1: Mfd. by Schaffner

Because of the high leakage current, care is required in the selection of the power breaker.

*2: Values in rated operation with a single SERVOPACK.

① SGDP → SGDP-** AD *

<Cable specifications>

- Motor cable (between SERVOPACK and motor)
  SOR-VCT-SB
- PG cable (between SERVOPACK 2CN and encoder)
  For incremental encoders: B9400064-1 to 5
  For absolute-value encoders: DP8409123-1 to 5
- Signal cable (between SERVOPACK 1CN and motion controller)
  SSRFPVV-SB, AWG28, 25-pin, UL20286
- Power cable (between power supply and noise filter)
  SOR-VCT-SB
- Main circuit power cable (between noise filter and SERVOPACK)
  UL1015, AWG10
- Control power cable (between noise filter and SERVOPACK)
  UL1015, AWG16
- Brake power cable (between noise filter and brake power supply)
  UL1015, AWG16
- Brake power cable (between brake power supply and motor)
  UL1015, AWG16

All of the cables other than those between the noise filter and SERVOPACK and between the noise filter and brake (motor) should use shielded cables.

<Connector specifications>

- 1CN
  Connector: 10150-3000VE, 50-pin (mfd. by Sumitomo 3M)
  Hood: 10350-52A0-008
  (or 10350-A200-00 (aluminum diecast type))
- Motor connector
  Plug: JL04V-8A24-10SE-EB (mfd. by Japan Aviation Electronics Industry,Limited)
  Clamp: JL04-2428CK(17)

(Note 1) The motor connector size is dependent on the capacity. The above shows an example for the 4.4 kW capacity.
(Note 2) With an SGMP or SGM motor, use a connector of the standard specifications.
(Note 3) The connector on the motor side should be provided with a countermeasure for EMI.

- Encoder connector
  Plug: JA08A-20-29S-J1-EB (mfd. by Japan Aviation Electronics Industry,Limited)
  Clamp: JL04-2022CKE(12)

(Note) With a SGMP or SGM motor, use a connector of the standard specifications.

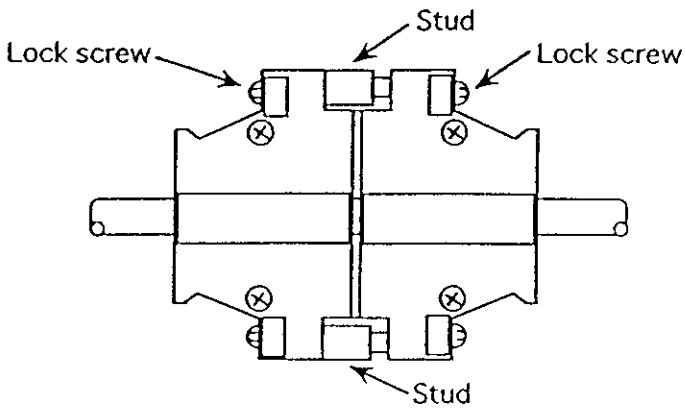
- 2CN
Connector: 10120-3000VE, 20-pin (mfd. by Sumitomo 3M)
Hood: 10320-52A0-008

(Note) When combined with an SGMP or SGM motor is used, use the connectors shown in the following table.

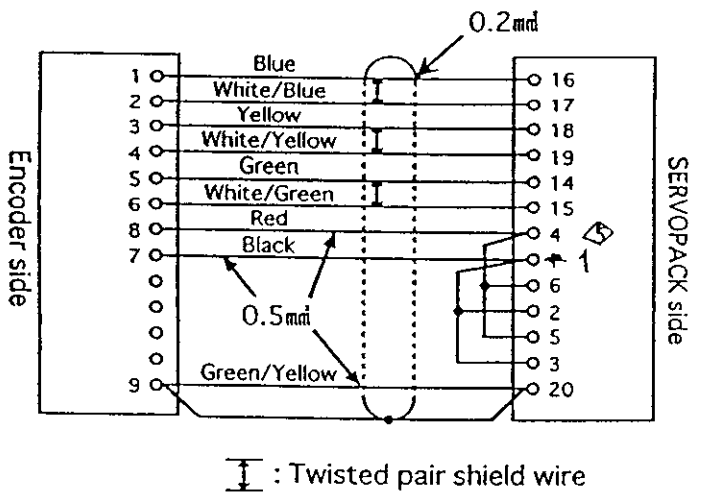
Encoder Type		Incremental	Absolute-Value
SERVOPACK side connector	Case	10120-3000VE 20P *1	
	Connector	10320-52A0-008	
Motor side connector		17JE13090-02D8A*2	17JE13150-02D8A
Motor side stud		17L-002A *2	

*1: Mfd. by Sumitomo 3M
*2: Mfd. by DDK

*** The connector on the motor side should be connected using studs as shown below. ***

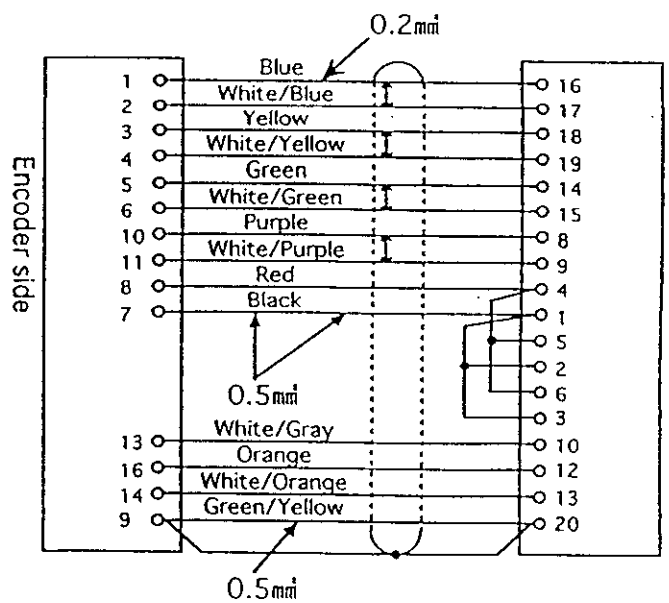


For incremental encoders



: Twisted pair shield wire

For absolute-value encoders



: Twisted pair shield wire

<Core specifications>

Motor Cable	PG Cable		Controller Cable	
	SERVOPACK side	Motor side	SERVOPACK side	Controller side
ESD-R-57 *1	ESD-R-57 *1	ESD-R-57E1 *1	ESD-SR-25 *1	ESD-SR-25 *1

*1: Mfd. by Tokin

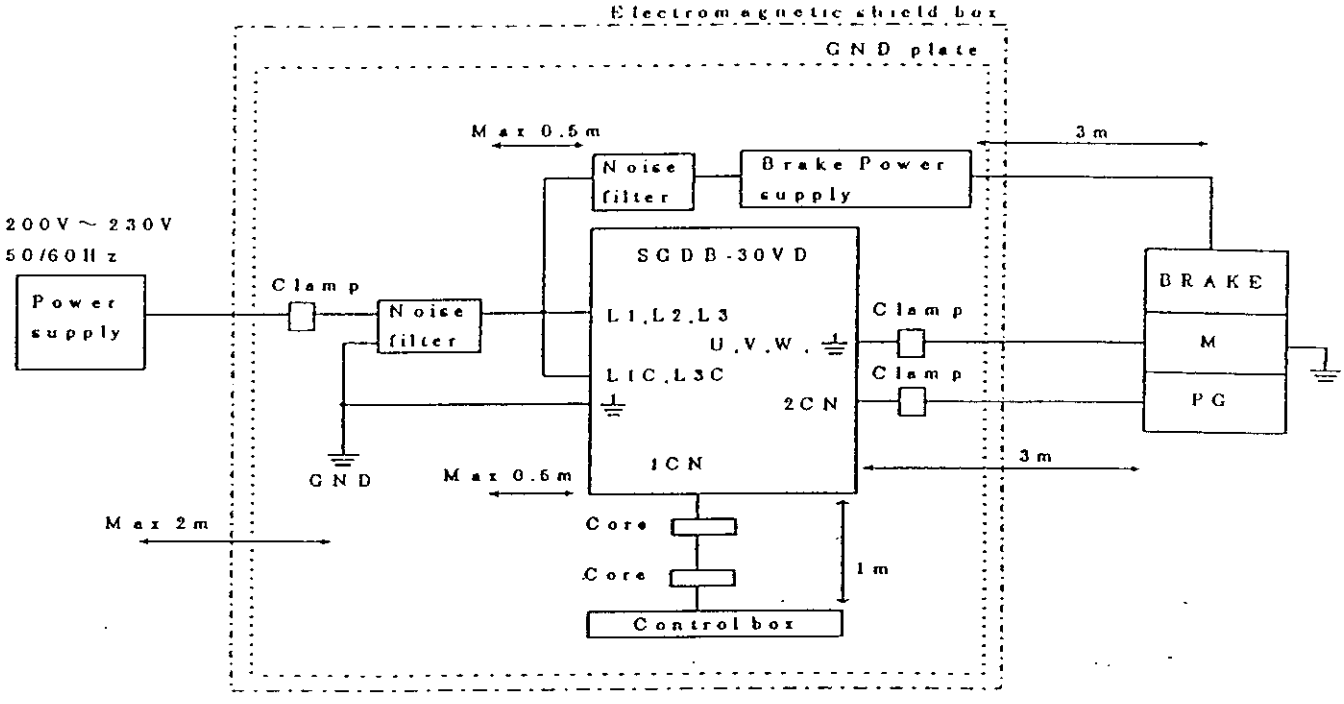
<Box specifications>

- Recommended electromagnetic shield box
  Shield enclosure, mfd. by Rittal Co., Ltd.

(Note) The box should have a structure which can assure the connection of the main body, door, cooling unit, etc. to the GND. The box opening should be as small as possible.

・Installation conditions for an SGDB-＊＊VD of 3.0 kW or less

〈EMC approved conditions〉



Clamp: Fix and ground the cable shield using a piece of conductive metal.

(Note1) Connect the electromagnetic shield box and GND plate securely to the GND.

(Note2) To ensure a reliable connection between the GND plate and the FGs of installed parts (filters, SERVOPACK, clamps, etc.), be certain to take steps such as the removal of paint from the GND plate.

〈Applicable noise filter types〉

(Noise filter for SERVOPACK)

SERVOPACK type	Noise filter type *1	Power Capacity(A)*2
SGDB-03VD	FN351-8/29	5
SGDB-05VD	FN351-8/29	5
SGDB-07VD	FN351-16/29	8
SGDB-10VD	FN351-16/29	8
SGDB-15VD	FN351-16/29	10
SGDB-20VD	FN351-25/33	12
SGDB-30VD	FN351-36/33	18

*1: Mfd. by Schaffner

Because of the high leakage current, care is required in the selection of the power breaker.

*2: Values in rated operation with a single SERVOPACK.

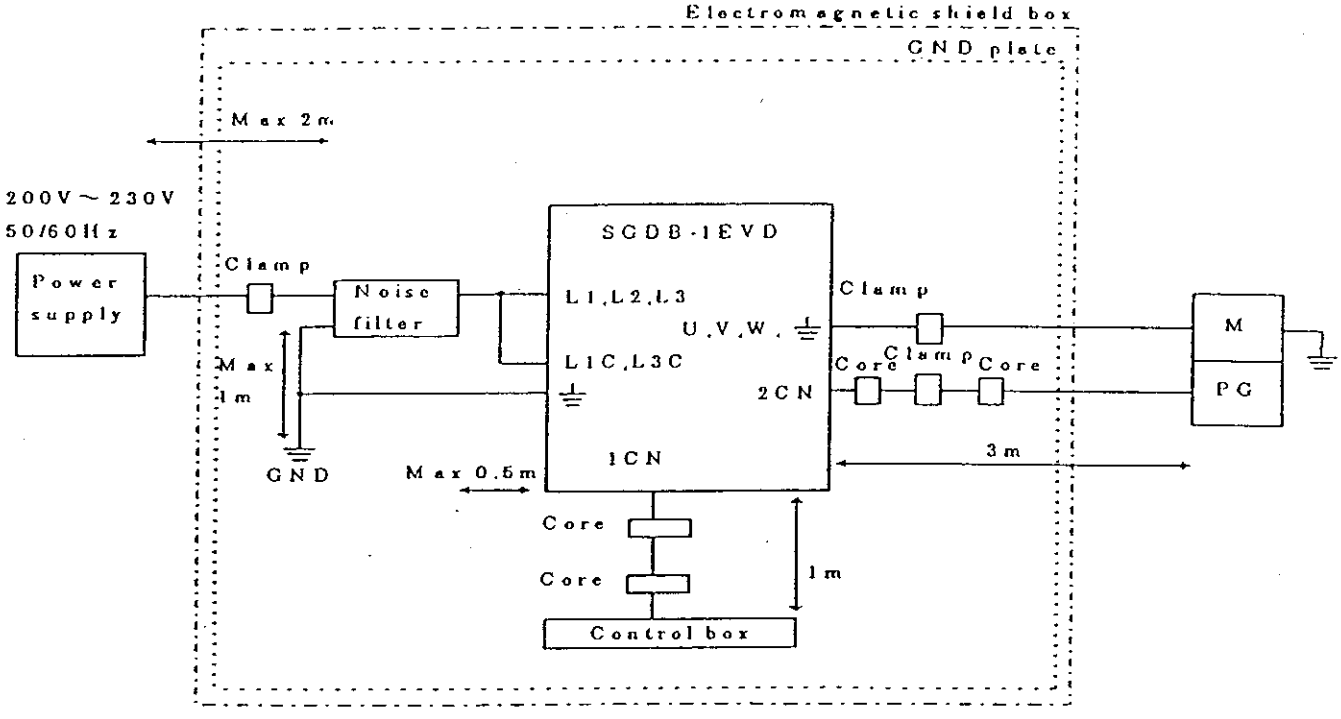
(Noise filter for Brake power supply)

Type: SUP-P5H-EPR (mfd. by OKAYA ELECTRIC INDUSTRIES CO., LTD.)

① add this page 1996.12.17 Doi / Nagai

・Installation conditions for an SGDB-＊＊VD of 6.0～15kW

〈EMC approved conditions〉



Clamp: Fix and ground the cable shield using a piece of conductive metal.

(Note1) Connect the electromagnetic shield box and GND plate securely to the GND.

(Note2) To ensure a reliable connection between the GND plate and the FGs of installed parts (filters, SERVOPACK, clamps, etc.), be certain to take steps such as the removal of paint from the GND plate.

〈Applicable noise filter types〉

(Noise filter for SERVOPACK)

SERVOPACK type	Noise filter type *1	Power Capacity(A)*2
SGDB-60VDY6 *3	FN351-50/33	24
SGDB-60VDY7 *3	FN351-50/33	28
SGDB-60VD	FN258-75/34	32
SGDB-75VD	FN258-75/34	41
SGDB-1AVD	FN258-100/35	60
SGDB-1EVD	FN258-100/35	80

*1: Mfd. by Schaffner

Because of the high leakage current, care is required in the selection of the power breaker.

*2: Values in rated operation with a single SERVOPACK.

*3: SGDB-60VDY6 is for SGDB-44VD

SGDB-60VDY7 is for SGDB-50VD

① add this page 1996.12.17 Doi/Nagai

<Cable specifications>

- Motor cable (between SERVOPACK and motor)
  SOR-VCT-SB
- PG cable (between SERVOPACK 2CN and encoder)
  For incremental encoders: B9400064-1 to 5
  For absolute-value encoders: DP8409123-1 to 5
- Signal cable (between SERVOPACK 1CN and motion controller)
  SSRFPVV-SB, AWG28, 25-pin, UL20286
- Power cable (between power supply and noise filter)
  SOR-VCT-SB
- Main circuit power cable (between noise filter and SERVOPACK)
  UL1015,AWG10
- Control power cable (between noise filer and SERVOPACK)
  UL1015,AWG16
- Brake power cable (between noise filter and brake power supply)
  UL1015,AWG16
- Brake power cable (between brake power supply and motor)
  UL1015,AWG16

All of the cables other than those between the noise filter and SERVOPACK and between the noise filter and brake (motor) should use shielded cables.

<Connector specifications>

- 1CN
  Connector: 10150-3000VE, 50-pin(mfd. by Sumitomo 3M)
  Hood: 10350-52S0-00S (treated with plating)
  (Note 1) 1CN-50pin doesn't connect with FG, then connect shield line and FG line to connector hood.

- Motor connector
  Plug: JL04V-8A24-10SE-EB (mfd. by Japan Aviation Electronics Industry, Limited)
  Clamp: JL04-2428CK (17)

  (Note 1) The motor connector size is dependent on the capacity. The above shows an example for the 3.0kW capacity.
  (Note 2) With an SGMP or SGM motor, use a connector of the standard specifications.
  (Note 3) The connector on the motor side should be provided with a countermeasure for EMI.

- Encoder connector
  Plug: JA08A-20-29S-J1-EB (mfd. by Japan Aviation Electronics Industry, Limited)
  Clamp: JL04-2022CKE (12)
  (Note) With a SGMP or SGM motor, use a connector of the standard specifications.

· 2CN

Connector: 10120-3000VE,20-pin (mfd. by Sumitomo 3M)

Hood: 10320-52A0-008 (treated with plating)

(Note1) 2CN-20pin doesn't connect with FG, then connect shield line to connector hood..

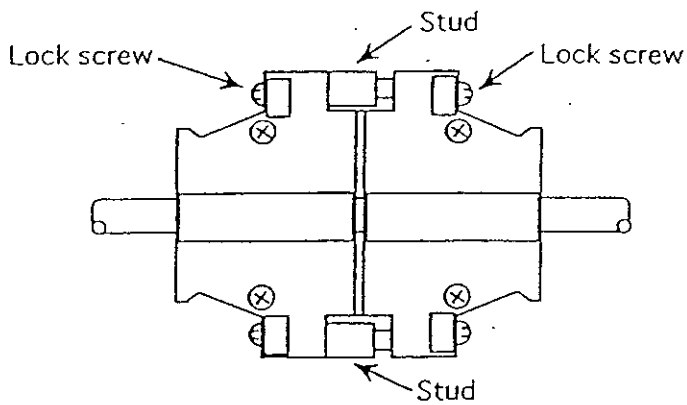
(Note2) When combined with an SGMP or SGM motor is used, use the connectors shown in the following table.

Encoder Type		Incremental	Absolute-Value
SERVOPACK side connector	Case	10120-3000VE, 20-pin *1	
	Connector	10320-52S0-00S	
Motor side connector		17JE13090-02D8A *2	17JE13150-02D8A
Motor side stud		17L-002A *2	

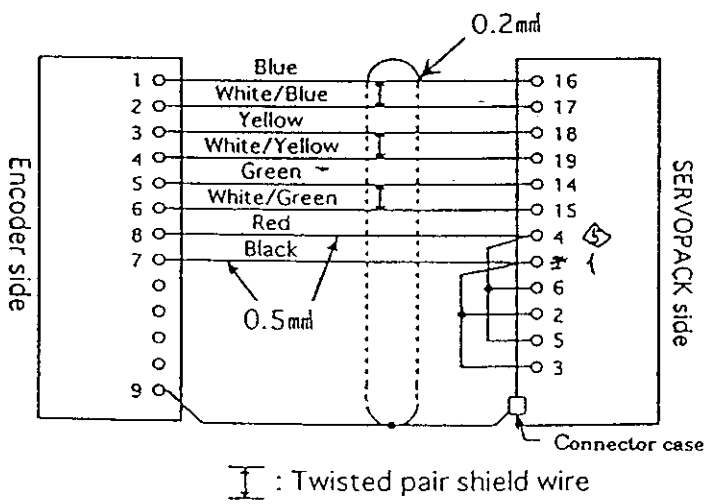
*1: Mfd. by Sumitomo 3M

*2: Mfd. by DDK

The connector on the motor side should be connected using studs as shown below.

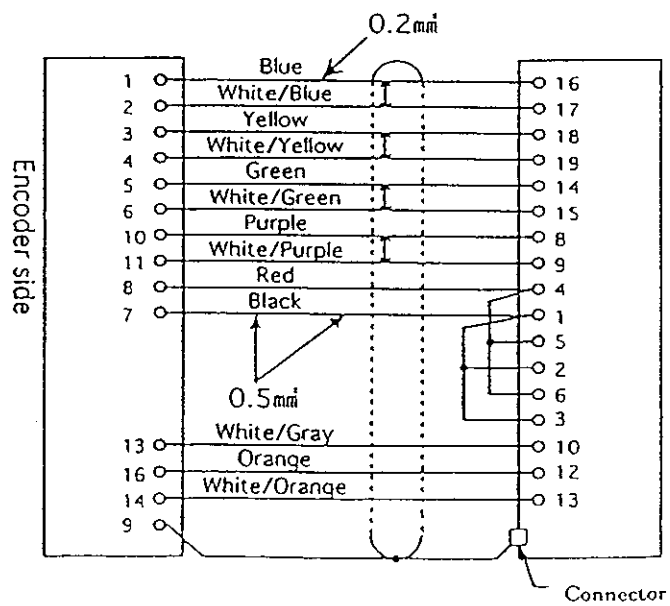


For incremental encoders



I : Twisted pair shield wire

For absolute-value encoders



I : Twisted pair shield wire

⑤

〈Core specifications〉

PG Cable	Controller Cable	
SREVOPACK side	SERVOPACK side	Controller side
ESD-SR-25 *1	ESD-SR-25 *1	ESD-SR-25 *1

*1: Mfd. by Tokin

〈Box specifications〉

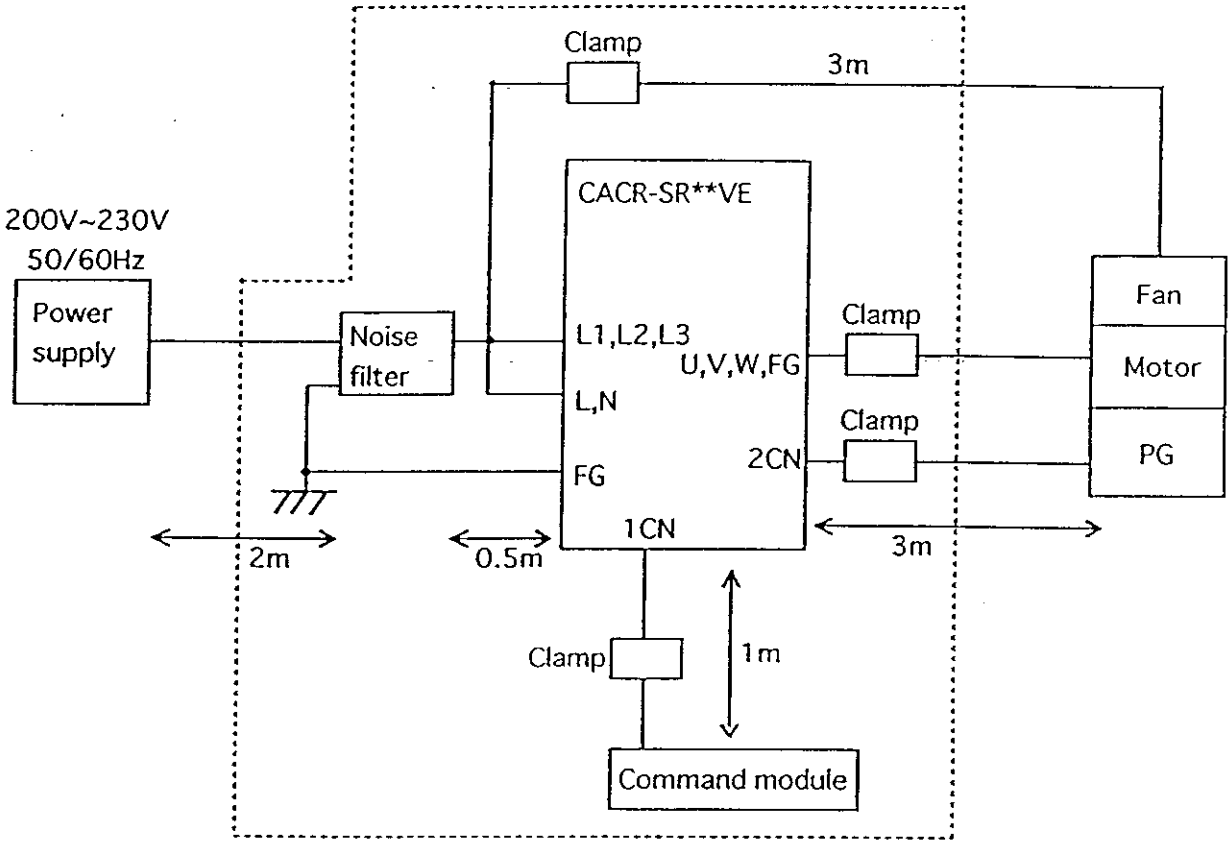
- Recommended electromagnetic shield box

  Shield enclosure, Mfd. by Rittal Co., Ltd.

  (Note) The box should have a structure which can assure the connection of the main body, door, cooling unit, etc. to the GND. The box opening should be as small as possible.

CACR-SR**VE Installation Conditions

EMC approved conditions



Clamp: Used for grounding the cable shield.

<Applicable noise filter types>

SERVOPACK type	Noise Filter Type *	Power Capacity (Input current Arms)
CACR-SR02VE1**	FN351-5/29	2
CACR-SR03VE1**	FN351-5/29	2
CACR-SR05VE1**	FN351-5/29	5
CACR-SR07VE1**	FN351-8/29	6
CACR-SR10VE1**	FN351-8/29	8
CACR-SR15VE1**	FN351-16/29	10
CACR-SR20VE1**	FN351-25/29	12
CACR-SR30VE1**	FN351-36/33	18
CACR-SR44VE1**	FN351-50/33	24

*: Mfd. by Schaffner

Because of the high leakage current, care is required in the selection of the power breaker.

Cable specifications

- Motor cable (between SERVOPACK and motor)
  SOR-VCT-SB
- PG cable (between SERVOPACK 2CN and encoder)
  DE8400093
- Command cable (between SERVOPACK 1CN and motion controller)
  SSRFPVV-SB, AWG28, 25-pin, UL20286
- Power cable (between power supply and noise filter)
  SOR-VCT-SB
- Main circuit power cable (between noise filter and SERVOPACK)
  UL1015, AWG10
- Control power cable (between noise filter and SERVOPACK)
  UL1015, AWG16
- Motor fan cable (between SERVOPACK and motor fan)
  DE8400093

All of the cables other than the cable between the noise filter and SERVOPACK should use shielded cables.

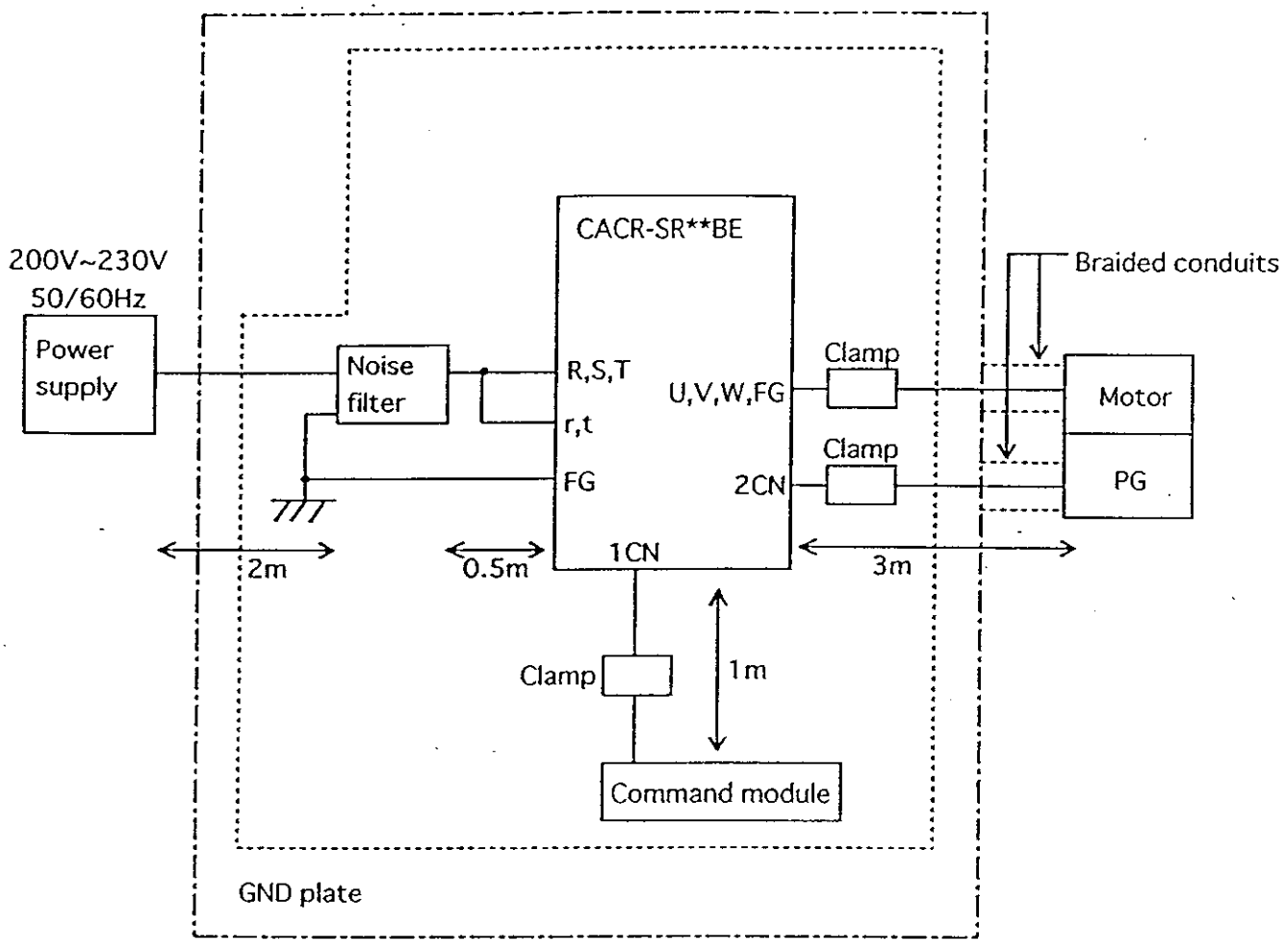
Connector specifications

- 1CN
  Connector: MR-50F
  Hood: MR-50L4
- 2CN
  Connector: MR-20F
  Hood: MR-20L4
- Motor connector
  Plug: JL04V-8A22-22SE-EB
  Clamp: JL04-2022CK(14)
- Encoder connector
  Plug: JA08A-20-29S-J1-EB
  Clamp: JL04-2022CKE(12)
- Fan connector
  Plug: JL04V-8A20-15SE-EB
  Clamp: JL04-2022CK(14)

The connector on the motor side should be provided with EMI countermeasures.
(The connector described above is an example of a connector for a capacity of 4.4 kW. The connector size varies according to the capacity.)

MR series: Mfd. by Honda Tsushin Kogyo Co., Ltd.
JL04V series: Mfd. by Japan Aviation Electronics Industry,Limited

CACR-SR**BE Installation Conditions



Clamp: Used for grounding the cable shield.

<Applicable noise filter types>

SERVOPACK type	Noise Filter Type *	Power Capacity (Input current Arms)
CACR-SR02BE1**	FN351-5/29	2
CACR-SR03BE1**	FN351-5/29	2
CACR-SR05BE1**	FN351-5/29	5
CACR-SR07BE1**	FN351-8/29	6
CACR-SR10BE1**	FN351-8/29	8
CACR-SR15BE1**	FN351-16/29	10
CACR-SR20BE1**	FN351-25/29	12
CACR-SR30BE1**	FN351-36/33	18
CACR-SR44BE1**	FN351-50/33	24

*: Mfd. by Schaffner

Because of the high leakage current, care is required in the selection of the power breaker.

Cable specifications

- Motor cable (between SERVOPACK and motor)
  SOR-VCT-SB
- PG cable (between SERVOPACK 2CN and encoder)
  DE8400093
- Signal cable (between SERVOPACK 1CN and motion controller)
  SSRFPVV-SB, AWG28, 25-pin, UL20286
- Power cable (between power supply and noise filter)
  SOR-VCT-SB
- Main circuit power cable (between noise filter and SERVOPACK)
  UL1015, AWG10
- Control power cable (between noise filter and SERVOPACK)
  UL1015, AWG16

All of the cables other than the cable between the noise filter and SERVOPACK should use shielded cables.

Connector specifications

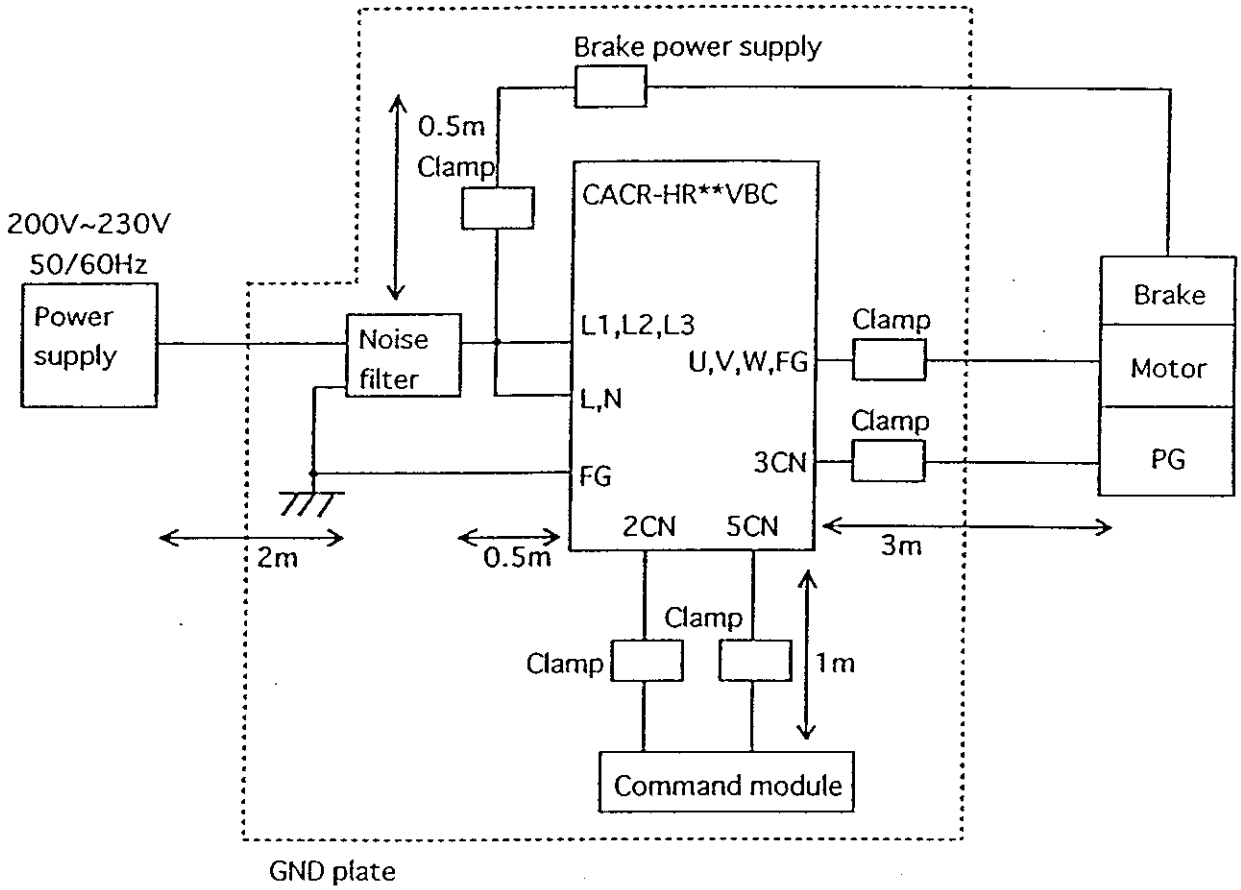
- 1CN
  Connector: MR-50F
  Hood: MR-50L4
- 2CN
  Connector: MR-20F
  Hood: MR-20L4
- Motor connector
  Plug: JL04V-8A22-22SE-EB
  Clamp: JL04-2022CK(14)
- Encoder connector
  Plug: JA08A-20-29S-J1-EB
  Clamp: JL04-2022CKE(12)

The connector on the motor side should be provided with EMI countermeasures.
(The connector mentioned above is an example of a connector for a capacity of 4.4 kW. The connector size varies according to the capacity.)

MR series: Mfd. by Honda Tsushin Kogyo Co., Ltd.
JL04V series: Mfd. by Japan Aviation Electronics Industry,Limited

CACR-HR**VBC Installation Conditions

EMC approved conditions



Clamp: Used for grounding the cable shield.

<Applicable noise filter types>

SERVOPACK type	Noise Filter Type *	Power Capacity (Input current Arms)
CACR-HR03VBC	FN351-5/29	2
CACR-HR05VBC	FN351-5/29	2
CACR-HR10VBC	FN351-8/29	8
CACR-HR15VBC	FN351-16/29	10
CACR-HR20VBC	FN351-25/29	12
CACR-HR30VBC	FN351-36/33	18
CACR-HR44VBC	FN351-50/33	24

*: Mfd. by Schaffner

Because of the high leakage current, care is required in the selection of the power breaker.

Cable specifications

- Motor cable (between SERVOPACK and motor)
  SOR-VCT-SB
- PG cable (between SERVOPACK 3CN and encoder)
  DE8400093
- Command cable (between SERVOPACK 2CN/5CN and motion controller)
  SSRFPVV-SB, AWG28, 25-pin, UL20286
- Power cable (between power supply and noise filter)
  SOR-VCT-SB
- Main circuit power cable (between noise filter and SERVOPACK)
  UL1015, AWG10
- Control power cable (between noise filter and SERVOPACK)
  UL1015, AWG16
- Brake power cable (between noise filter and brake power supply)
  UL1015, AWG16
- Brake power cable (between brake power supply and motor)
  UL1015, AWG16

All of the cables other than those between the noise filter and SERVOPACK and between the noise filter and brake (motor) should use shielded cables.

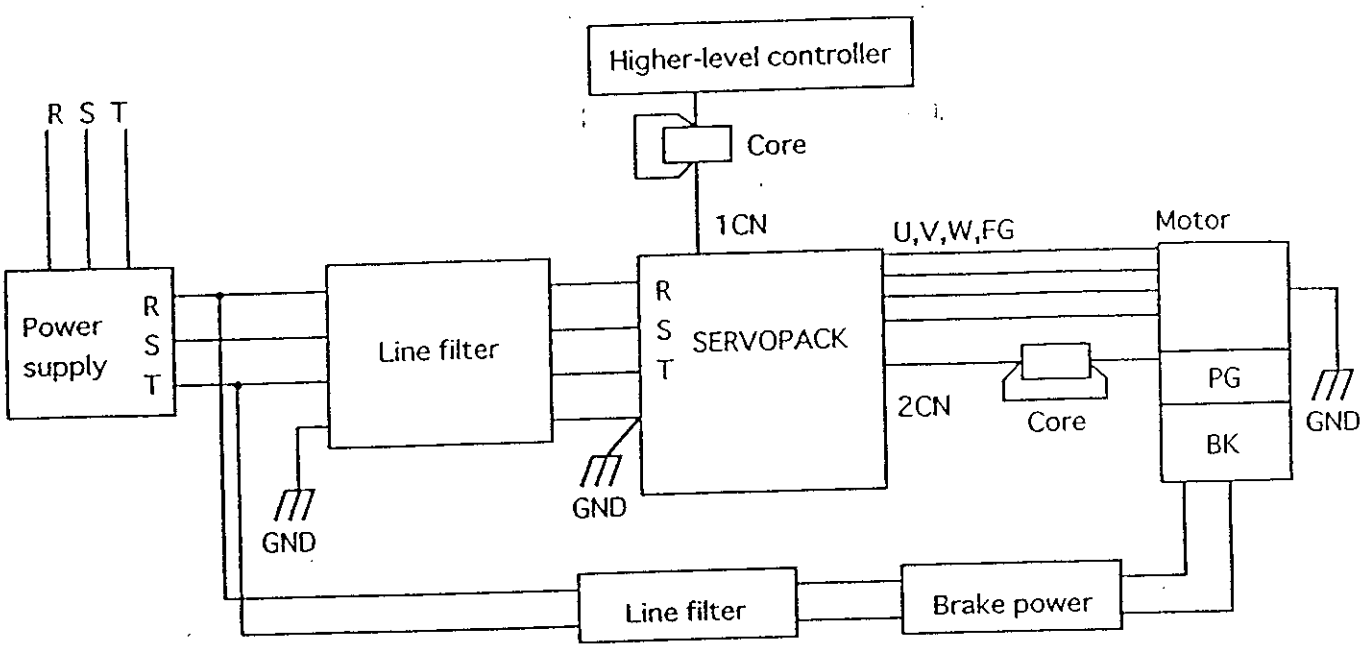
Connector specifications

- 5CN
  Connector: MR-50M
  Hood: MR-50L4
- 2CN
  Connector: MR-20M
  Hood: MR-20L4
- 3CN
  Connector: MR-20F
  Hood: MR-20L4
- Motor connector
  Plug: JL04V-8A24-10SE-EB
  Clamp: JL04-2428CK(17)
- Encoder connector
  Plug: JA08A-20-29S-J1-EB
  Clamp: JL04-2022CKE(12)

The connector on the motor side should be provided with EMI countermeasures.
(The connector described above is an example of a connector for a capacity of 4.4 kW. The connector size varies according to the capacity.)

MR series: Mfd. by Honda Tsushin Kogyo Co., Ltd.
JL04V series: Mfd. by Japan Aviation Electronics Industry,Limited

Typical Connection Example

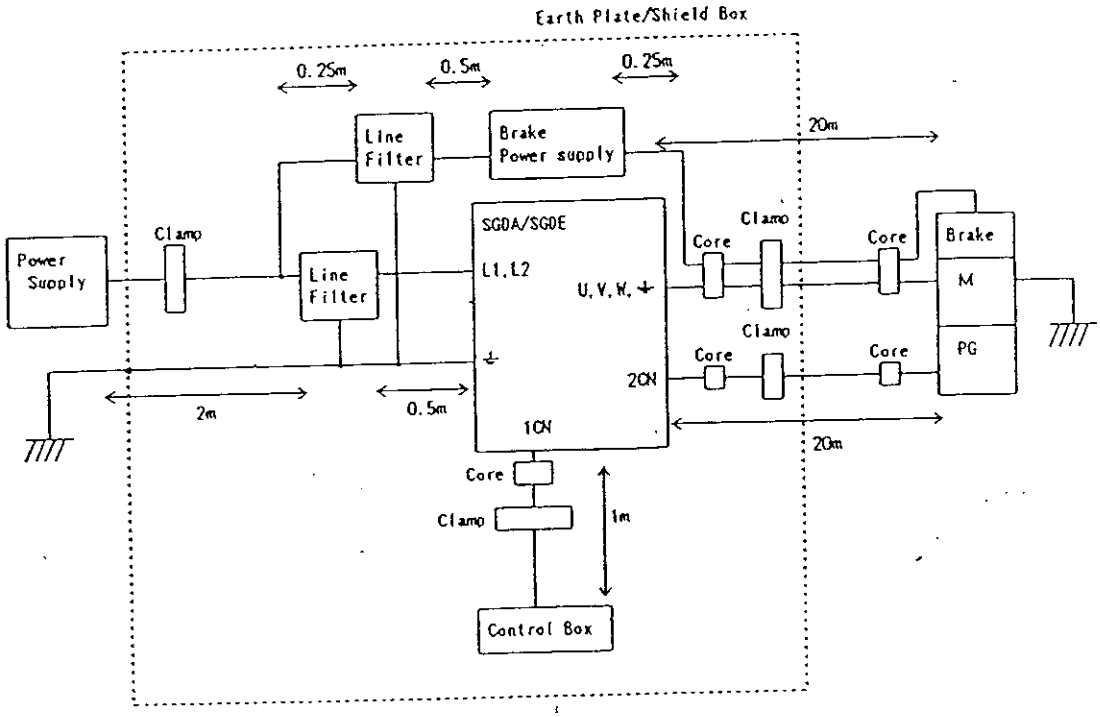


Wrap the control signal cable (1CN) and PG cable (2CN) by 1.5 turns around the core.
The line filter, SERVOPACK and motor flange must be connected to the GND.
The length of the cables between the line filter and SERVOPACK should be 1 m.

SGDA/SGDE Type Installation Conditions

Recommended installation conditions

A. SGDA-**V* (A3-04), SGDA-**W* (A3-02)
SGDE-**V* (A3-04), SGDE-**W* (A3-02)



B. SGDA-08V*, SGDA-03W*
SGDE-08V*, SGDE-03W*

