

YASKAWA General-purpose Inverter Technical Information

YASKAWA Electric Corporation



Classification	Correspondence to Standard/Model	Model	J7	Document No.	E-K-01-J7-01
Title	Control Terminal Insulation of VS mini J7 Series				

The control terminals of the general-purpose compact inverter VS mini J7 Series are provided only with basic insulation (protection class I, overvoltage category II). In order to meet the CE mark requirements, additional insulation is needed for the final products. The following describes how to provide additional insulation.

1. Contents of Additional Insulation

① When applied to overvoltage category II power supply

The control terminals are of the insulation specifications assuming overvoltage category II. When using the inverter in overvoltage category II, the following insulation is needed for the inverter control terminal metallic parts (conductive parts) and the parts where human bodies contact directly in the final products.

- Distance in space: 1.5 mm (200-V class inverter, pollution degree 2)

However, the human body contacting face is a conductive material and grounded, additional insulation is not needed.

- Creeping distance: 2.4 mm (200-V class inverter, pollution degree 2)

One of which tracking exponent (CTI) of the insulation material consisting the creeping exceeds 100 is needed.

(Example: $175 < CTI < 400$ in case of printed boards)

② When applied to overvoltage category II

Additional insulation in conformance to overvoltage category II is needed to the inverter control terminal metallic parts (conductive parts) and the parts where human bodies contact directly in the final products.

- Distance in space: 5.5 mm (200-V class inverter, pollution degree 2)

However, the human body contacting face is a conductive material and grounded, the distance in space of the required additional insulation is 3 mm.

- Creeping distance: 2.4 mm (200-V class inverter, pollution degree 2)

The creeping distance is of the same specifications as overvoltage category II, a priority is given to the distance in space to be assured.

Inserting EN or an insulation transformer in accordance with IEC or a surge absorber into the power supply can make the insulation equivalent to overvoltage category II. In this case, additional insulation is the same as item

①. Also the inverter must be applied under the environment of pollution degree 2. The pollution degrees are defined as shown below.

Definition of Pollution Degrees (Defined by EN50178 Table 2.)

Pollution Degree	Micro-environment
1	No pollution or only dryness. Non-conductive pollution exists.
2	Normally, only non-conductive pollution occurs. Primary conductive pollution by condensation rarely occurs while an electronics device is not operating.
3	Becomes conductive by expectable condensation. Conductive pollution or dry non-conductive pollution occurs.
4	For example, conductive dust, rain or snow makes it permanently conductive.



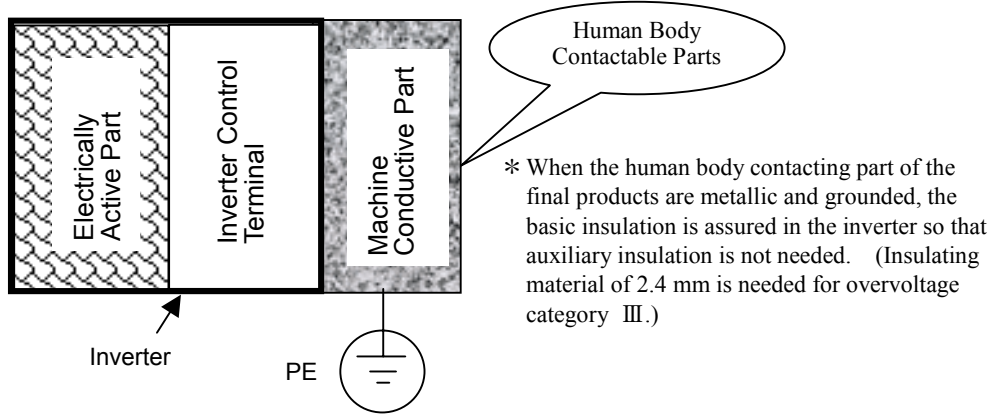
Classification	Correspondence to Standard/Model	Model	J7	Document No.	E-K-01-J7-01
Title	Control Terminal Insulation of VS mini J7 Series				

2. Example of Insulation Distance Including Additional Insulation

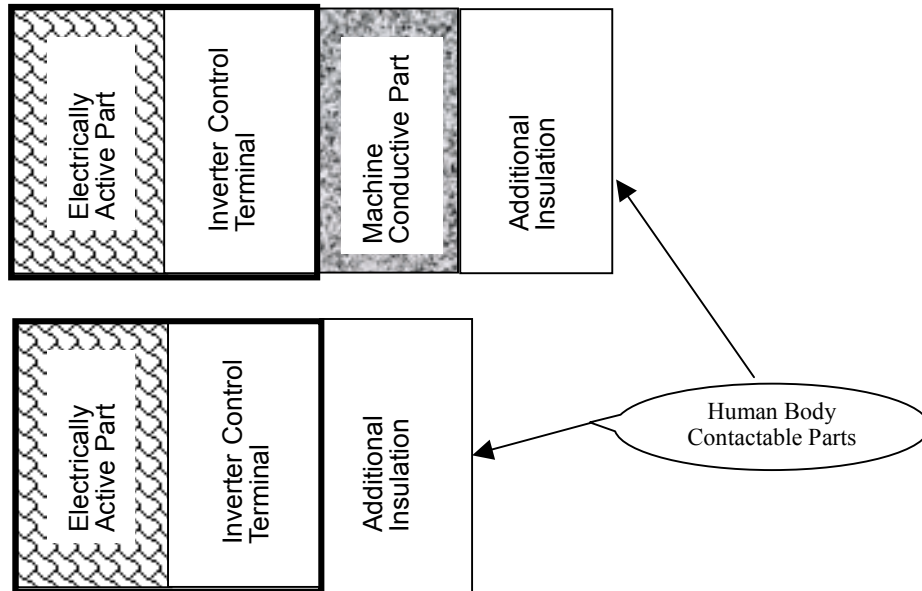
The following shows the case where the J7 series is applied to the example of protection for direct contact that is defined in figure 3 of EN50178.

(1) Solid (Liquid) Insulation

<A1>



<A2>



Additional insulation (insulator) by using solid or liquid needs 2.4 mm when the human body contacting parts are not grounded.

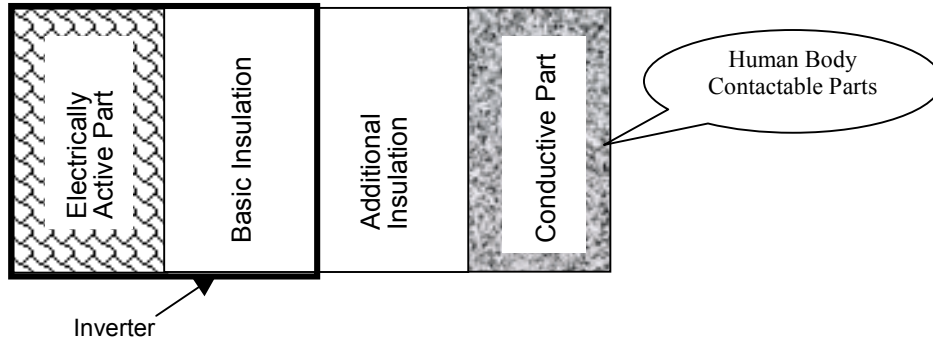
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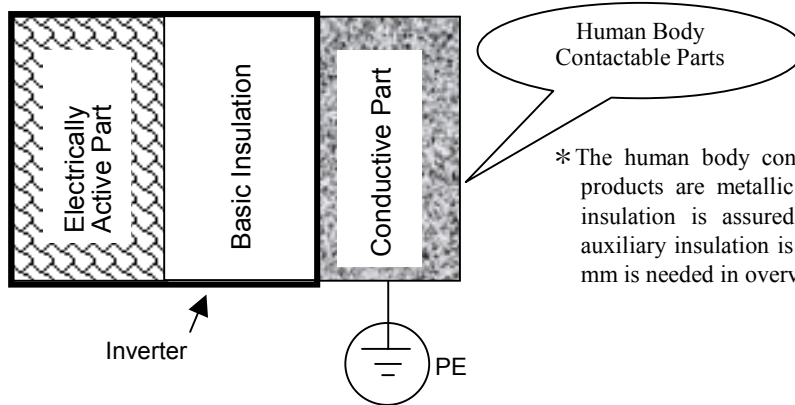
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When the machine surface is conductive and not grounded, additional insulation needs 2.4 mm.

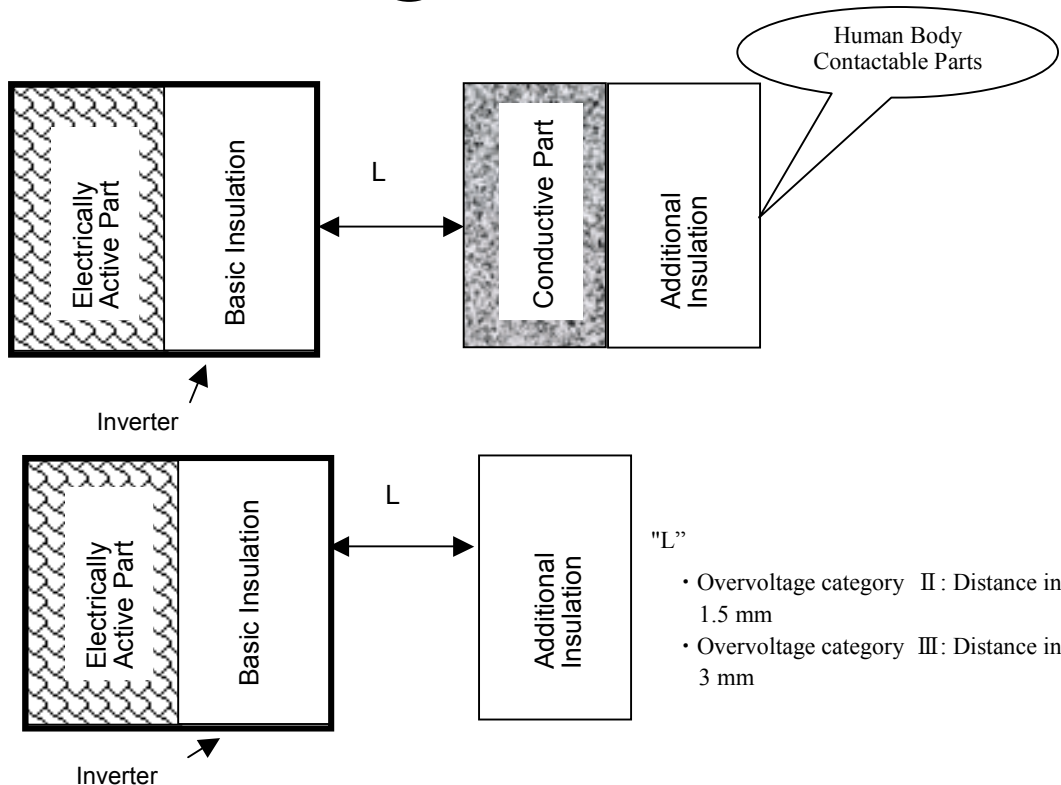
(2) Insulation by Whole or Partial Space

<B1>



*The human body contacting parts of the final products are metallic and grounded, the basic insulation is assured in the inverter so that auxiliary insulation is not needed. (Space of 3 mm is needed in overvoltage category III.)

<B2>



"L"

- Overvoltage category II : Distance in space 1.5 mm
- Overvoltage category III : Distance in space 3 mm

YASKAWA General-purpose Inverter Technical Information

YASKAWA Electric Corporation



Classification	Correspondence to Standard/Model	Model	V7	Document No.	E-K-01-V7-01
Title	Control Terminal Insulation of VS-606V7				

The control terminals of the general-purpose compact inverter VS-606V7 are provided only with basic insulation (protection class I, overvoltage category II). In order to meet the CE mark requirements, additional insulation is needed for the final products. The following describes how to provide additional insulation.

1. Contents of Additional Insulation

① When applied to overvoltage category II power supply

The control terminals are of the insulation specifications assuming overvoltage category II. When using the inverter in overvoltage category II, the following insulation is needed for the inverter control terminal metallic parts (conductive parts) and the parts where human bodies contact directly in the final products.

- Distance in space: 1.5 mm (200-V class inverter, pollution degree 2)

However, the human body contacting face is a conductive material and grounded, additional insulation is not needed.

- Creeping distance: 2.4 mm (200-V class inverter, pollution degree 2)

One of which tracking exponent (CTI) of the insulation material consisting the creeping exceeds 100 is needed.

(Example: $175 < CTI < 400$ in case of printed boards)

② When applied to overvoltage category II

Additional insulation in conformance to overvoltage category II is needed to the inverter control terminal metallic parts (conductive parts) and the parts where human bodies contact directly in the final products.

- Distance in space: 5.5 mm (200-V class inverter, pollution degree 2)

However, the human body contacting face is a conductive material and grounded, the distance in space of the required additional insulation is 3 mm.

- Creeping distance: 2.4 mm (200-V class inverter, pollution degree 2)

The creeping distance is of the same specifications as overvoltage category II, a priority is given to the distance in space to be assured.

Inserting EN or an insulation transformer in accordance with IEC or a surge absorber into the power supply can make the insulation equivalent to overvoltage category II. In this case, additional insulation is the same as item

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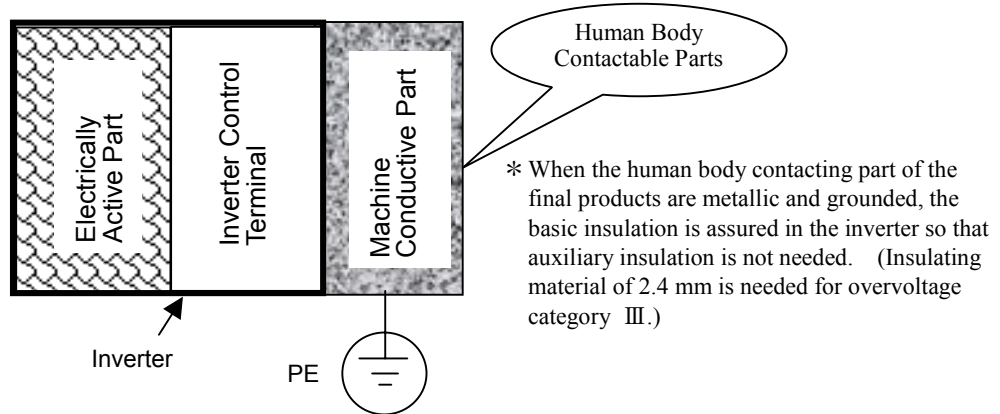
Classification	Correspondence to Standard/Model	Model	V7	Document No.	E-K-01-V7-01
Title	Control Terminal Insulation of VS-606V7				

2. Example of Insulation Distance Including Additional Insulation

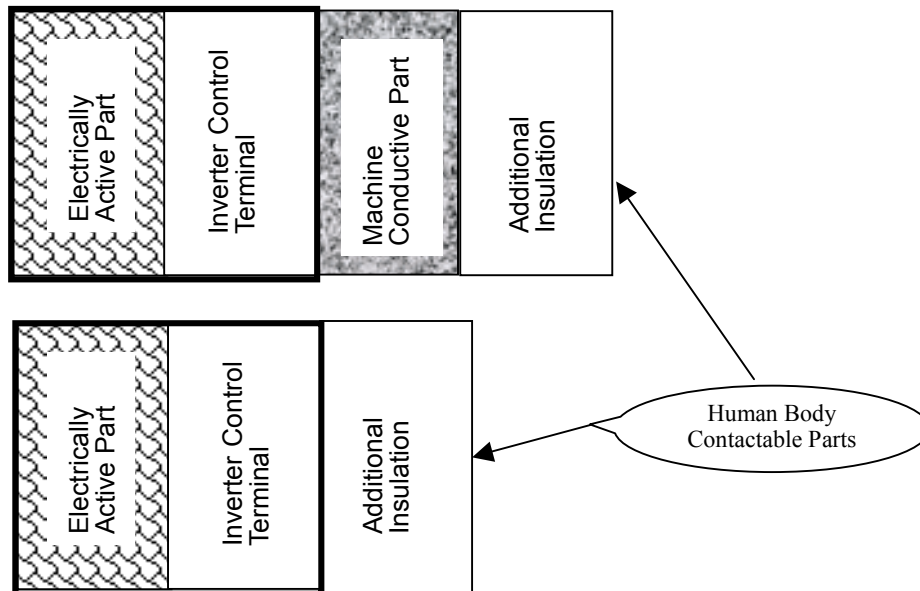
The following shows the case where the V7 series is applied to the example of protection for direct contact that is defined in figure 3 of EN50178.

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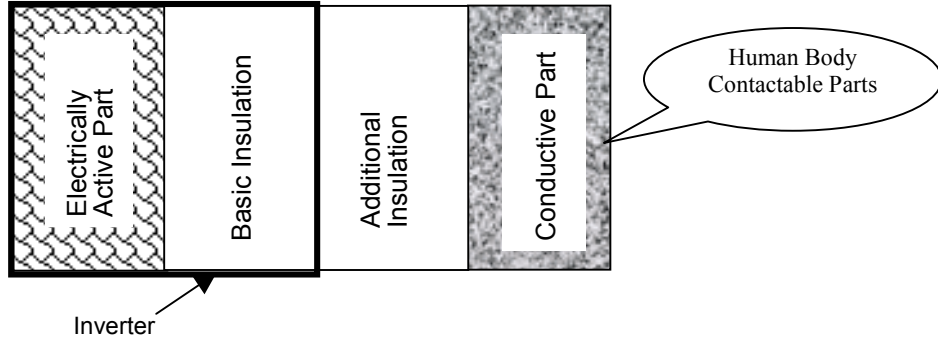
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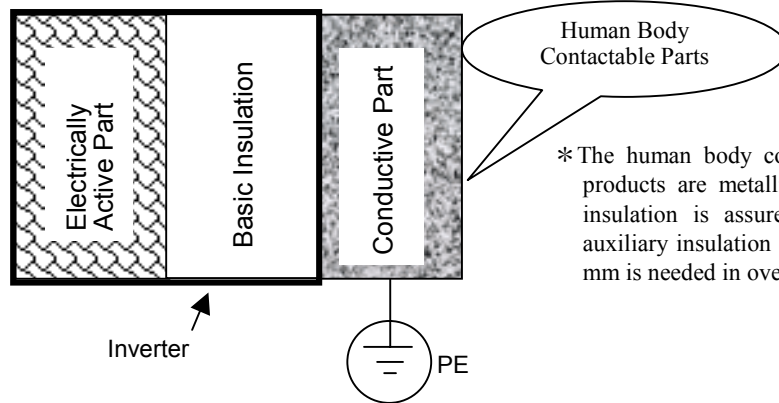
<A3>



When the machine surface is conductive and not grounded, additional insulation needs 2.4 mm.

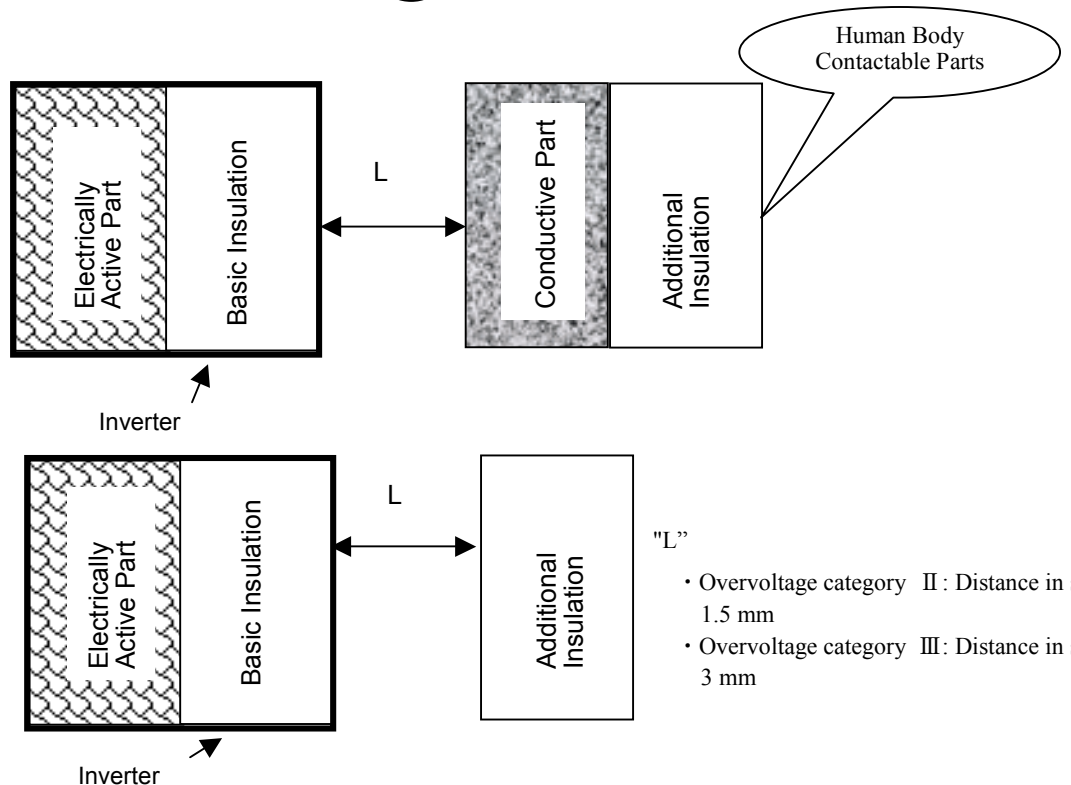
(2) Insulation by Whole or Partial Space

<B1>



*The human body contacting parts of the final products are metallic and grounded, the basic insulation is assured in the inverter so that auxiliary insulation is not needed. (Space of 3 mm is needed in overvoltage category III.)

<B2>



"L"

- Overvoltage category II : Distance in space 1.5 mm
- Overvoltage category III : Distance in space 3 mm

Yaskawa General-purpose Inverter Technical Information

Inverter Division
Yaskawa Electric Corporation



Classification	Correspondence to Standard/Model	Model	MX/MRX	Document No.	E-K-02-MX-01
Title	Varispeed MX/MRX Series "CE Marking" Installation Manual				

Varispeed MX/MRX Series "CE Marking" Installation Manual

— Contents —

1. Introduction	.....	2
2. Low Voltage Directive		
2.1 Description of LVD	.....	2
2.2 Wiring Diagram	.....	2-4
2.3 Selection of "MCCB"	.....	5
3. EMC Directive		
3.1 Installation method	.....	6
3.2 Applicable Standards and Point of Conformity Measures	.....	6
3.3 Countermeasures for Cabinet	.....	7
3.4 Cabinet structure	.....	7-8
3.5 Countermeasures of Conducted interference	.....	9-10
3.6 Treatment of cables	.....	10-11
3.7 EMC Test Condition	.....	12

EZZ009501

1. Introduction

The “CE Marking “ shows compliance with the standard (*1) in regards to safety, environment, etc, required for conducting business in Europe (production, import, and sales).

The CE Marking is a necessary requirement for conducting business in Europe.

(*1: As the Common European Standard, there are standards for mechanical products (machine directive), electronic products (low voltage directive), and electric noise (EMC directive).

The Varispeed MX/MRX Series has acquired the CE mark based on the low voltage and EMC directives.

Low voltage directive : 73/223/EEC

93/68/EEC

EMC directive : 89/336/EEC

92/31/EEC

93/68/EEC

Also, the final machine and equipment with the inverter built-in are subject to the CE mark.

Placing the CE mark on the final product becomes the responsibility of the customer who assembles the final product. Please confirm the European directive adaptability of the machine and equipment that becomes the final product at the customer site.

2. Low Voltage Directive

As the test method, Varispeed MX/MRX Series are tested according to the common European standard EN50178, and they confirm that the low voltage directive has met the standard.

2.1 Description of LVD

Varispeed MX/MRX Series conform to the low voltage directive under the following conditions.

- i) Please use it in conditions which fall below excessive voltage category 3 condition and contamination level 2 as stipulated in IEC664.
- ii) Please use it by the enclosed structure (IP4X or greater: Inside panel installation) that the foreign matter does not enter from the top and front of the enclosure.

2.2 Wiring Diagram

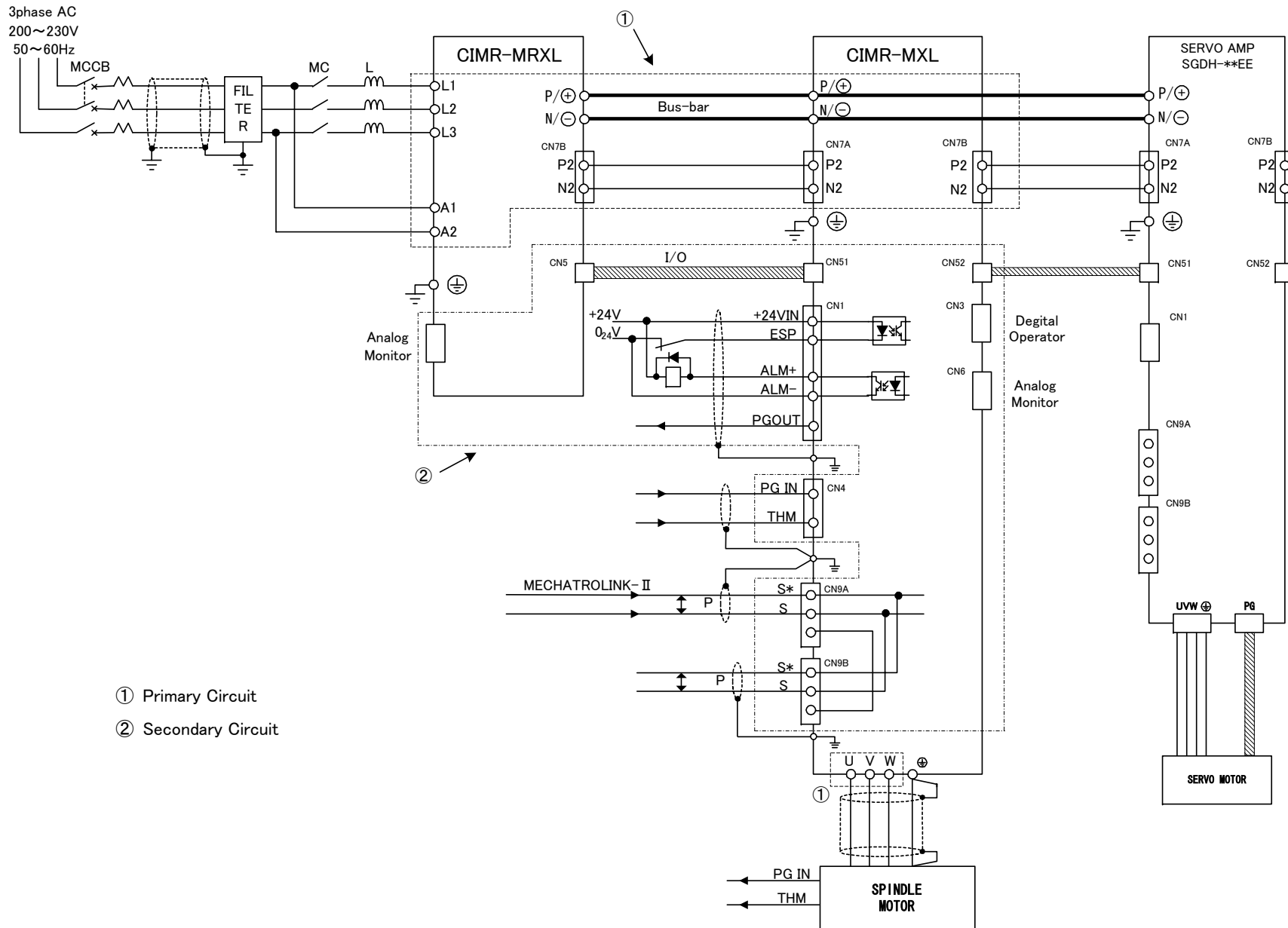
Figure-1, 2 shows the mutual connection diagram of Varispeed MX/MRX Series.

An internal circuit is separated to “Primary Circuit” and “Secondary Circuit”.

“Primary Circuit” is separated with the surface case which can come in contact.

“Secondary Circuit” is separated with “Primary Circuit” by Reinforced insulation, and can be connected with “Secondary Circuit” of other Equipments.

Mutual Connection Diagram



- ① Primary Circuit
- ② Secondary Circuit

Figure-1 : Connection Example in CIMR-MRXL + CIMR-MXL (+ SGDH-**EE)

Mutual Connection Diagram

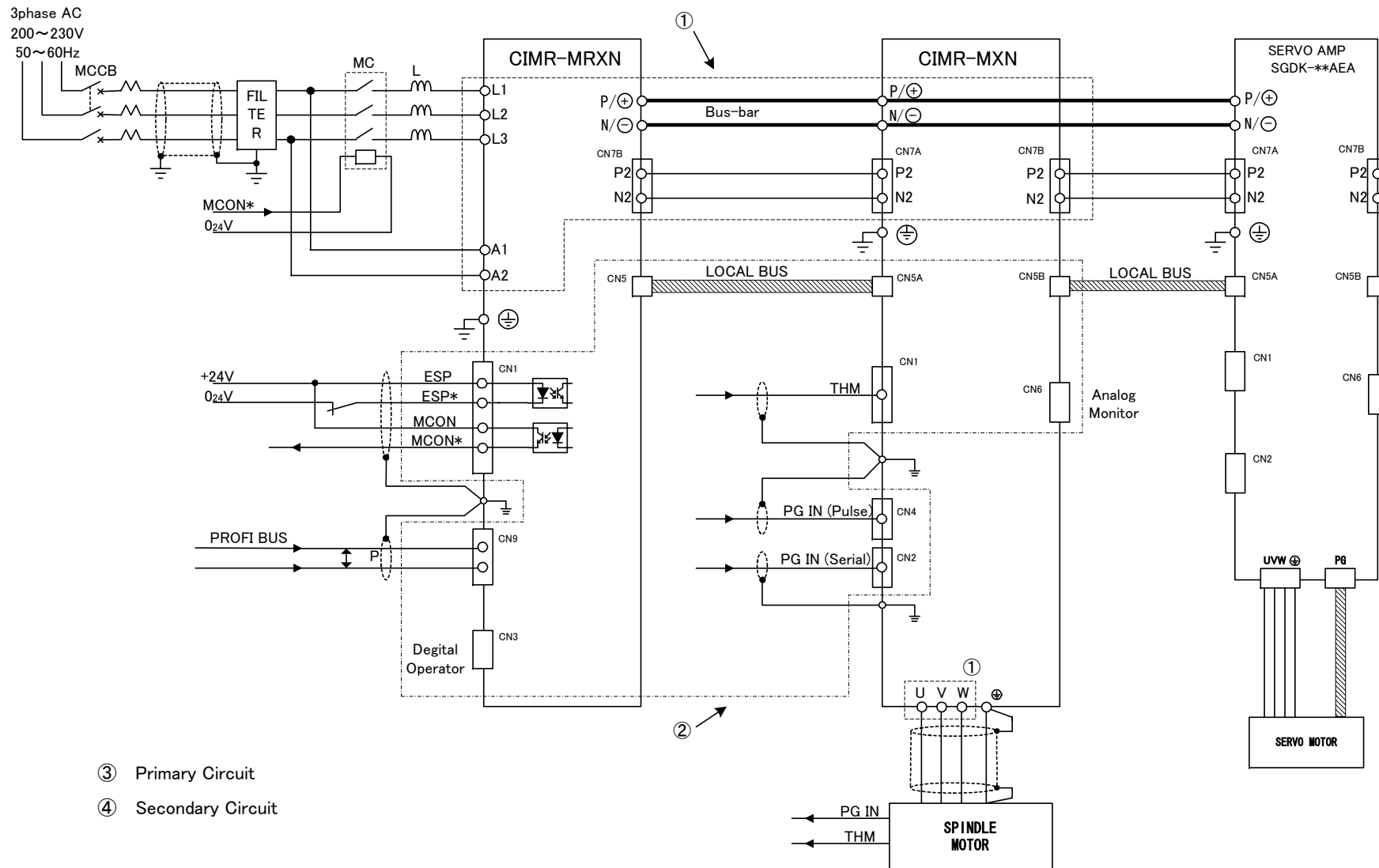


Figure-2: Connection Example in CIMR-MRXN + CIMR-MXN (+ SGDH-**EE)

2.3 Selection of “MCCB”

Please select MCCB of the rated current shown in Table-1, according to the capacity of Varispeed MRX.

Table-1 : Table of MCCB

Models CIMR-MRX□	Capacity [kW]	Circuit Breaker(MCCB) Rated Current [A]
CIMR-MRX□23P7	3.7	30
-MRX□25P5	5.5	40
-MRX□27P5	7.5	50
-MRX□2011	11	75
-MRX□2015	15	100
-MRX□2018	18.5	125
-MRX□2022	22	150
-MRX□2030	30	175
-MRX□2037	37	250
-MRX□2045	45	300

3. EMC Directive

「EN61000-6-2」<1>

The Varispeed MX/MRX Series are tested according to the common European standard ~~EN61000-3~~, and confirm that Varispeed MX/MRX Series satisfies that the EMC directive has met the standard.

3.1 Installation method

To meet the EMC Directive of machine and equipment which built in Varispeed MX/MRX Series, we recommend the following method of installation.

- Set up in the Metallic Cabinet of all closes.
- Insert a noise filter on the AC input side which complies with the European standards.
(Table-3: Filter list for EMC measures)
- The wiring between the inverter and the motor shall be shielded or enclosed in metal piping, and shorten wiring as much as possible.

3.2 Applicable standards and conformity measures

Table-2 shows the applicable standards and points of conformity measures.

Table-2: Applicable Standard and Points of Conformity Measures

Category	Common Standard	Item	Classification	Points
EMI Emission		Radiated interference	EN55011 ClassA Group1	<ul style="list-style-type: none"> •To reduce emission from a control panel, the control equipment should be accommodated in a shielded cabinet. •Wiring condition specification.
		Conducted interference	EN55011 ClassA Group1	<ul style="list-style-type: none"> •To reduce emission from power lines, a line filter should be inserted in the power line. •Grounding(earthing) condition specification.
EMS Immunity	EN61000-6-2 /2001	Electrostatic discharge (ESD)	IEC61000-4-2 /2001	<ul style="list-style-type: none"> •To eliminate the influence of static electricity, the cabinet should be grounded (earthed) perfectly.
		Radiation immunity (RS)	IEC61000-4-3 /2002	<ul style="list-style-type: none"> •To prevent malfunctions due to external radio waves, the control equipment should be accommodated in a shielded cabinet. •Wiring condition specification.
		Fast transients (Bursts)	IEC61000-4-4 /1995 A1/2000 A2/2001	<ul style="list-style-type: none"> •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 (SURGE)	IEC61000-4-5 /2001	<ul style="list-style-type: none"> •To prevent malfunctions due to induced lightning, a surge absorber should be used.
		Conductance immunity (CS)	IEC61000-4-6 /2001	<ul style="list-style-type: none"> •To prevent malfunction due to high-frequency sine-wave noise on the lead lines from the control panel, the shielding of the lead lines should be improved.
		Magnetic field	IEC61000-4-8 /2001	<ul style="list-style-type: none"> •To prevent malfunctions due to magnetism, the components which are affected by magnetism should have magnetic shielding.
		Voltage dips and interruptions	IEC61000-4-11 /2001	<ul style="list-style-type: none"> •To prevent malfunctions due to interception or change of power supply at moment, install the capacitor for backup.

3.3 Countermeasures for 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 following countermeasures are basic for these.

- Structural modification of control panel, and use of EMI gasket.
- Specification of the in-panel wiring condition. (Separation between signal conductors and power lines)
- Shielding of cables, and enhancement of earthing..
- Use of the line noise filter and clamping cores.

As requirements which related to EMS(immunity), the following items have been pointed out.

Electrostatic discharge(ESD), Radiation immunity, Fast transient(burst),
Lightning surge, Conductance immunity, Magnetic field, Voltage dips and interruptions

As these countermeasures, it becomes basic to do similar countermeasures to EMI.

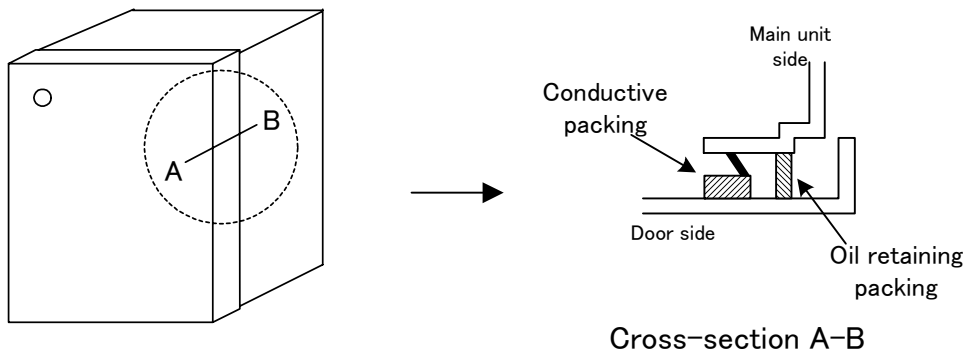
In a word, if EMI countermeasures were executed, measures were executed to EMS.

3.4 Cabinet structure

3.4.1 Control panel structure

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

- 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.
- The section where the cabinet and door fit should have a ridged structure to avoid gaps. (Refer to Figure-3)
- There should be no conducting sections which are left floating electrically.



Figuer-3: Ridged Structure

3.4.2 Door structure

It is 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, and the paint on the joint sections should be masked to provide electrical conductance. (Refer to Figure-4)
- Be careful to avoid gaps which could be opened when panels are warped due to the tightening of retaining screws, etc.

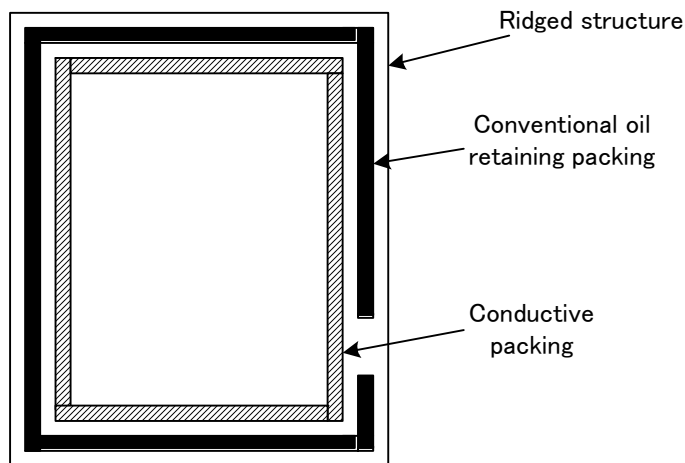


Figure-4: Door Structure (Inside)

3.4.3 Earthing of equipments

- In the equipments mounted in the cabinet, ground this equipment with not only the earth terminal but the installation screw.
- If the metal cases of the unit is painted, it is necessary to peel off the coating side.
- When you set up the fan, ground it with attached earth terminal.

In conventional conductive packing, an environmental tolerance (especially, oil resistance) is not confirmed. Varispeed MX/MRX series does not use conductive packing for the unit, because it might corrode according to the kind of oil.

3.5 Countermeasures of Cnducted interference

To decrease emission from the input power line, the noise filter is inserted in the electric power line.

The recommended noise filter is described in Table-3. Please select it according to capacity of converter(CIMR-MRX□). Earthing the noise filter surely.

Moreover, the insertion of the AC reactor is also effective in measures of the conducted interference(Table-4).

Table-3 List of noise filter

•FS5559 series (High attenuation, and low leakage current)

Converter Models CIMR-MRX□	Specification of Noise Filter				
	Model	Manufacturer	Current	Mass	Size
CIMR-MRX□23P7	FS5559-35-33	Schaffner	35A	3.8kg	110×370×85
-MRX□25P5	FS5559-35-33	Schaffner	35A	3.8kg	110×370×85
-MRX□27P5	FS5559-35-33	Schaffner	35A	3.8kg	110×370×85
-MRX□2011	FS5559-60-34	Schaffner	60A	7.6kg	170×410×95
-MRX□2015	FS5559-80-34	Schaffner	80A	7.6kg	180×460×95
-MRX□2018	FS5559-100-34	Schaffner	100A	9.7kg	170×410×155
-MRX□2022	FS5559-150-35	Schaffner	150A	11.0kg	200×480×150
-MRX□2030	FS5559-150-35	Schaffner	150A	11.0kg	200×480×150
-MRX□2037	FS5559-200-40	Schaffner	200A	13.3kg	200×480×170
-MRX□2045	FS5559-200-40	Schaffner	200A	13.3kg	200×480×170

•FN258L series (Low leakage current)

Converter Models CIMR-MRX□	Specification of Noise Filter				
	Model	Manufacturer	Model		Model
CIMR-MRX□23P7	FN258L-30/07	Schaffner	30	1.8kg	60×335×150
-MRX□25P5	FN258L-30/07	Schaffner	30	1.8kg	60×335×150
-MRX□27P5	FN258L-42/07	Schaffner	42	2.8kg	70×329×185
-MRX□2011	FN258L-55/07	Schaffner	55	3.1kg	80×329×185
-MRX□2015	FN258L-75/34	Schaffner	75	4.0kg	80×329×220
-MRX□2018	FN258L-100/35	Schaffner	100	5.5kg	90×379×220
-MRX□2022	FN258L-130/35	Schaffner	130	7.5kg	110×439×240
-MRX□2030	FN258L-180/35	Schaffner	180	11.0kg	110×438×240
-MRX□2037	FN258L-180/07	Schaffner	180	11.0kg	110×438×240
-MRX□2045	FN359P-250/99	Schaffner	250	16kg	300×564×160

•FN258 series (Standard)

Converter Models CIMR-MRX□	Specification of Noise Filter				
	Model	Manufacturer	Model		Model
CIMR-MRX□23P7	FN258-30/□□	Schaffner	30	1.8kg	60×335×150
-MRX□25P5	FN258-30/□□	Schaffner	30	1.8kg	60×335×150
-MRX□27P5	FN258-42/□□	Schaffner	42	2.8kg	70×329×185
-MRX□2011	FN258-55/□□	Schaffner	55	3.1kg	80×329×185
-MRX□2015	FN258-75/□□	Schaffner	75	4.0kg	80×329×220
-MRX□2018	FN258-100/□□	Schaffner	100	5.5kg	90×379×220
-MRX□2022	FN258-130/□□	Schaffner	130	7.5kg	110×439×240
-MRX□2030	FN258-180/□□	Schaffner	180	11.0kg	110×438×240
-MRX□2037	FN258-180/□□	Schaffner	180	11.0kg	110×438×240
-MRX□2045	FN359-250/99	Schaffner	250	16kg	300×564×160

Table-4 List of AC Reactor

Manufacturer: : SAO Electric

Converter Models CIMR-MRX□2	Code No.	Voltage [V]	Frequency [Hz]	Current [A]	Inductance [mH]	Electrical Insulation
CIMR-MRX□23P7	X010214	230	50/60	10	0.84	F
-MRX□25P5	X010215	230	50/60	16	0.56	F
-MRX□27P5	X010216	230	50/60	23	0.41	F
-MRX□2011	X010217	230	50/60	32	0.28	F
-MRX□2015	X010202	230	50/60	46	0.21	H
-MRX□2018	X010203	230	50/60	63	0.17	H
-MRX□2022	X010204	230	50/60	77	0.14	H
-MRX□2030	X010205	230	50/60	92	0.10	H
-MRX□2037	X010201	230	50/60	120	0.09	F
-MRX□2045	X010199	230	50/60	150	0.07	B

3.6 Treatment of cables

The treatment of cables is the most important countermeasure. The earthing and the treatment of gaps in the external connection sections between the control panel and machine are also important. And the connection to the cabinets can be protected from the influence of radio waves by earthing electrically-floating conductors.

3.6.1 Shielding method

The most effective treatment for cables is shielding.

- All signal cables must use cables with meshed shielding.
- The motor power cable must use shield cables or metallic piping, and it must be earthed both of the inverter side and the motor side.
- For the shielding method, it is desirable to earth the cable shielding mesh sections by clamping the cable to the earth plate.
- As for the earth clamping of the shielding wire, it is most effective at inlets/outletsof control panel.

Table-4 List of Shiedling Cable

Manufacturer: Furukawa Electric

Code NO.	Line	Conductor		Insulator		Shield		Outside diameter (mm)	Conductor resistance (Ω km)	Insulation resistance (MΩ km)	Voltage proof (V AC)
		AWG	Diameter (mm)	Thickness (mm)	Diameter (mm)	Thickness (mm)	Diameter (mm)				
DC16269-2PB	2	20	0.95	0.46	1.87	0.3	4.41	6.11	35.2	10	2000
16272-2PB		18	1.21	0.46	2.13	0.3	4.93	6.63	22.2		
16275-2PB		16	1.53	0.46	2.45	0.3	5.57	7.27	14.0		
16278-2PB		14	1.92	0.89	3.70	0.3	8.07	9.77	8.79		
16280-2PB		12	2.42	0.89	4.20	0.3	9.07	10.77	5.53		
DC16269-3PB	3	20	0.95	0.46	1.87	0.3	4.70	6.40	35.3	10	2000
16272-3PB		18	1.21	0.46	2.13	0.3	5.26	6.96	22.2		
16275-3PB		16	1.53	0.46	2.45	0.3	5.95	7.65	14.0		
16278-3PB		14	1.92	0.89	3.70	0.3	8.94	10.34	8.79		
16280-3PB		12	2.42	0.89	4.20	0.3	9.72	11.42	5.53		
DC16269-4PB	4	20	0.95	0.46	1.87	0.3	5.18	6.88	35.3	10	2000
16272-4PB		18	1.21	0.46	2.13	0.3	5.81	7.51	22.2		
16275-4PB		16	1.53	0.46	2.45	0.3	6.58	8.28	14.0		
16278-4PB		14	1.92	0.89	3.70	0.3	9.60	11.30	8.79		
16280-4PB		12	2.42	0.89	4.20	0.3	10.81	12.51	5.53		

3.6.2 Treatment of metal tubes and flexible tubes

The lead-out section of control panel, operation board, junction box, etc., should be treated to eliminate electrical leakage by eliminating clearances.

- The earthing surfaces should be metal conductors and conductivity should be assured by masking the cabinets and paint.
- It is desirable to earth the flexible tube connectors at the two ends.

3.6.3 Clamping core

The installation of the clamping core is effective to reduce radiated interference wave from the signal cable and the motor power line.

Please select it in consideration of the outside diameter of the electric wire, if necessary.

Clamping Core Model : F6045GB (Hitachi Metals)

F11080GB (Hitachi Metals)

3.7 EMC Test conditions

3.7.1 Test equipments (Grouping)

Varispeed MX/MRX series were examined according to European common format “EN61800-3” based on grouping of TUV Product Service which is attestation organization (CB), so it is confirmed that the Varispeed MX/MRX series satisfies EMC instruction.

Table-4 List of test equipment

Group	Name	Model	Capacity [kW]
Group A	Varispeed MRX	CIMR-MRXN20305	30
	Varispeed MX	CIMR-MXN20305	30
	Spindle Motor	UAKA-22SZ1	22
Group B	Varispeed MRX	CIMR-MRXN20305	30
	Varispeed MX	CIMR-MXN20305	30
	Spindle Motor	UAKA-06AZ1	5.5

3.7.2 Connection condition

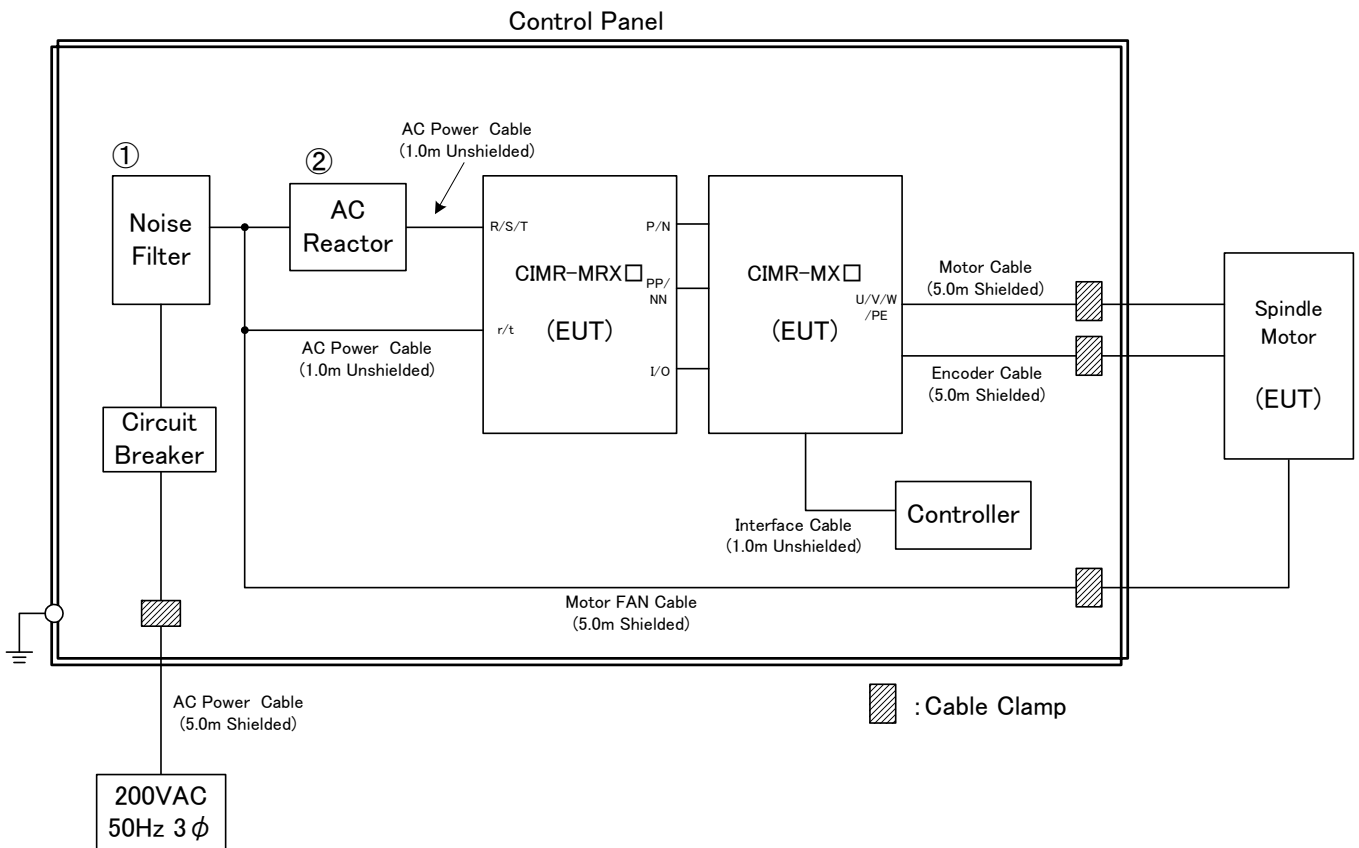


Figure-5: Connection condition on EMC test

<Peripherals>

	Name	Model	Manufacture
①	Noise Filter	FS5559-150-35	SHAFFNER
②	AC Reactor	X010205	SAO