

HITACHI INVERTER AND FILTER

L100 SERIES / FFL100 SERIES

EMC PRECAUTION MANUAL

Inverter : L100-E,U series all models

Filter : FFL100 series all models

After reading this manual, keep it at hand for future reference.

Hitachi, Ltd.
Tokyo Japan

NBS42X

It is required to satisfy the EMC directive when using the Hitachi Inverters in EU country. To satisfy the EMC directive and to comply with standard, the following should be kept. If followed the instructions, the Inverter comply with following standards. Failure to observe this instruction makes no effect of CE marking.

- EN61800-3 (1996) : EMC product standard for adjustable speed electrical drive system
- AS / NZS 2064. 1 / 2 (1992) : Limits and method of measurement of electromagnetic disturbance characteristics of industrial and medical (ISM) radio frequency equipment.

SAFETY AND INSTRUCTIONS

Definitions and Symbol

A safety instruction is given with hazard alert symbol and a signal word ; **WARNING** or **CAUTION**. Each signal word has the following meaning throughout this manual.



WARNING

WARNING : personal danger

Warning notes indicate any condition or practice, which if not strictly observed, could result in personal injury or possible death.



WARNING

WARNING : personal danger

Warning notes indicate any condition or practice, which if not strictly observed, could result in personal injury or possible death.



CAUTION

CAUTION : possible damage to equipment

Caution notes indicate any condition or practice, which if not strictly observed or corrected, could result in damage or destruction of the equipment



This is the " Safety Alert Symbol ". This symbol is used to call your attention to item or operations that could be dangerous to you or other persons operating this equipment. Read these messages and follow these instructions carefully.

NOTE : NOTE : Note indicate an area or subject of special merit, emphasizing either the product's capabilities or common errors in operation or maintenance.

Precautions



WARNING

This equipment should be installed, adjusted and serviced by qualified electrical maintenance personnel familiar with the construction and operation of the equipment and the hazards involved. Failure to observe this precaution could result in bodily injury.



WARNING

For protection, install a proper leak breaker type with a high frequency circuit capable of large current to avoid an unnecessary operation. The ground fault protection circuit is not designed to protect personal injury.



WARNING

Hazard of electrical shock. Disconnect incoming power supply and wait for 5 minute before working on equipment. The filter contain capacitors between phase and phase, phase and ground, and also big capacitor in inverter



WARNING

Do not use a plug-in connection for protective conductor connection.



WARNING

1. Observe all national standards and local standards for the wiring.
2. Wiring work shall be carried out by electrical experts.
3. Risk of electric shock. Disconnect incoming power supply and wait for 5 minutes.

**WARNING**

1. The motor, line filter and inverter must be connected to appropriate safety earth. Failure to observe this precaution could result in electrical shock.
2. Do not use a plug-in connection for protective connection.

**CAUTION**

1. Phase failure protection of three phase input type inverter cannot be worked properly, and phase failure may cause a chattering of an electromagnetic contactor when a line filter is used.

NOTE : Maximum length of screened cable is 50 m.
It is required to set the carrier frequency in 5kHz or lower to conform to EMC requirement to be used in public environment.
Initial set of carrier frequency is 5 kHz .

NOTE : Withstand voltage test to filter

AC1500 V / 1 min. or AC1800 V / 1 sec. between terminal and case.
Do not conduct the test to inverter.

How to Use this Manual

This manual provides information of the EMC(Electro Magnetic Compatibility) set-up for Hitachi inverter and line filter. Read this manual carefully and follow the instructions. If necessary, provide this information to third party who is using Hitachi inverter and filter.

This manual does not provide operation method, programming etc. of the inverter. See the individual manual of an inverter for the detail.

CHAPTER 1 - Product overview

This chapter provides a brief description of the line filter and EMC. The purpose of this chapter is to familiarize the user with the purpose and scope of the equipment

CHAPTER 2 - Selection of Filter

This chapter provides how to select a line filter and notes

CHAPTER 3 - Installation and Wiring

This chapter provides installation and wiring of the line filter, inverter and motor.

CHAPTER 4 - Further technical note

This chapter provides the technical information to be considered.

CHAPTER 5 - Technical specification

This chapter provides the standard specification of line filters.

Revision History Table

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1 Product overview

This chapter provides information to give you basic knowledge to plane and install the equipment.

1.1 General description

FFL100 series line filter is specially designed for Hitachi L100 series inverter to comply with EMC (Electro magnetic Compatibility) directive of EU or EMI requirement in Australia. A frequency converter so called inverter is used to control the speed of an AC induction motor. The inverter converts AC mains to DC by using diode rectifiers, and transfer DC power to AC for supplying to motor by using switching devices such as IGBT (Insulated Gate Bipolar Transistor), and this switching of IGBT cause the emission noise. The line filter is effective to a conducted emission noise, but less effect to a radiated emission noise. Therefore, using a copper braid screened cable or and/or magnetic shield are necessary for a radiated emission noise to comply with EMC directive and / or EMI requirement.

1.2 Appearance and name of parts

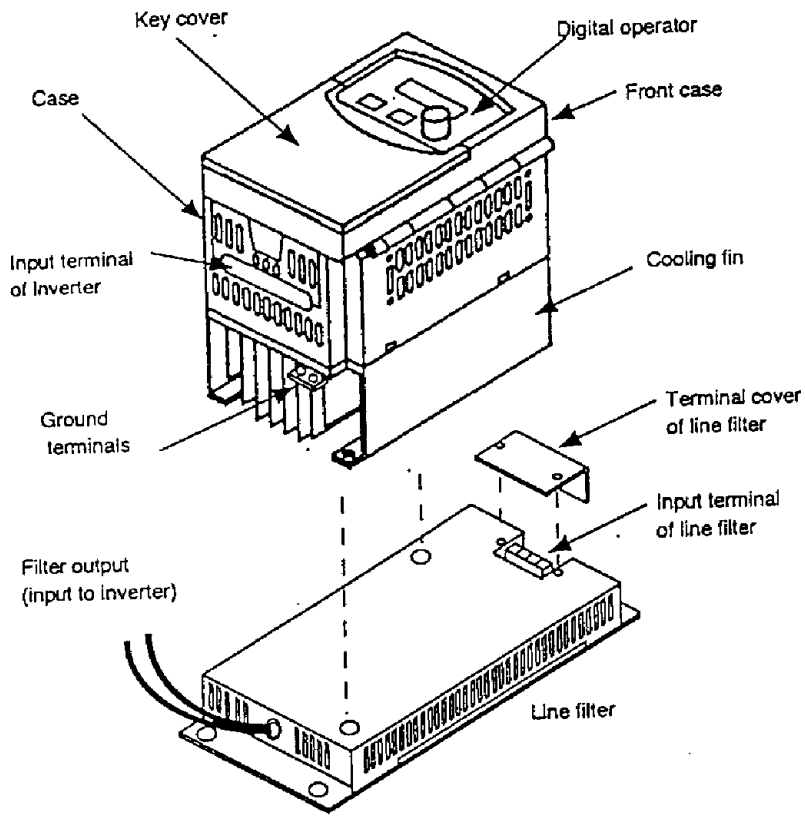
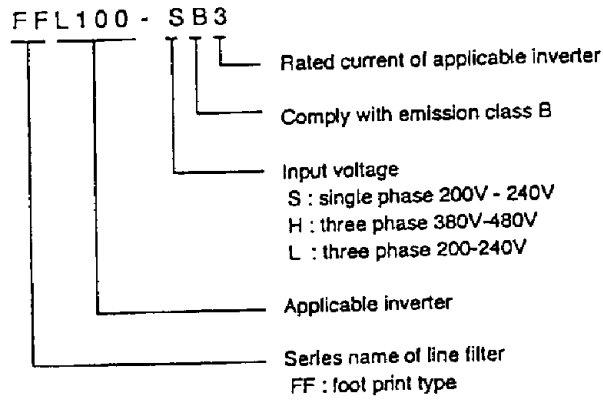


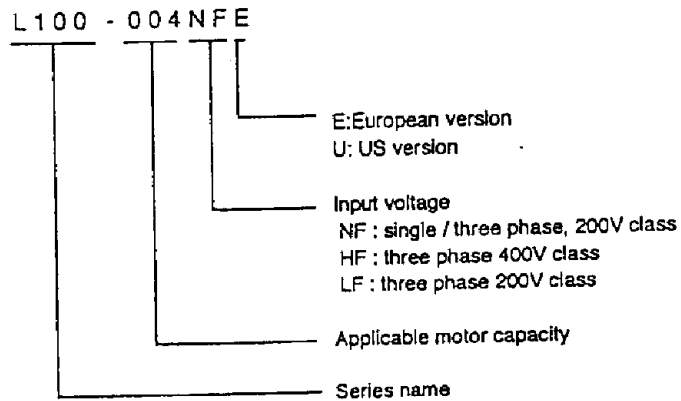
Fig. 1-1 Appearance and name of parts

1.3 Description of model name

1-3-1 Description of line filter model name



1-3-2 Description of inverter model name



2. Selection of line filter

This chapter provides you information to select the appropriate line filter.

FFL100 series line filter is specially designed for Hitachi L100 series inverter to comply with EMC (Electro magnetic Compatibility) directive. To reduce an emission noise, use the appropriate line filter for each inverter. Table 2-1, 2-2 and 2-3 show you appropriate combination of the line filter and inverter.

2.1 Combination of line filter and inverter

Table 2-1 Combination for single phase 200V class use

Line filter model name	Input voltage	Motor (kW)						
		0.2	0.4	0.55	0.75	1.1	1.5	2.2
FFL100-SB3	single phase 200V-240V	L100-002N	L100-004N	—	—	—	—	—
FFL100-SB5	single phase 200V-240V	—	—	L100-005N	L100-007N	—	—	—
FFL100-SB11	single phase 200V-240V	—	—	—	—	L100-011N	L100-015N	L100-022N

Table 2-2 Combination for three phase 200V class use

Line filter model name	Input voltage	Motor (kW)							
		0.2	0.4	0.55	0.75	1.1	1.5	2.2	3.7
FFL100-LB3	three phase 200V-240V	L100-002N	L100-004N	—	—	—	—	—	—
FFL100-HB6	three phase 200V-240V	—	—	L100-005N	L100-007N	—	—	—	—
FFL100-HB11	three phase 200V-240V	—	—	—	—	L100-011N	L100-015N	L100-022N	—
FFL100-HB17	three phase 200V-240V	—	—	—	—	—	—	—	L100-037L

Table 2-3 Combination for three phase 400V class use

Line filter model name	Input voltage	Motor (kW)					
		0.4	0.75	1.5	2.2	3.0	4.0
FFL100-HB6	three phase 380V-480V	L100-004H	L100-007H	L100-015H	—	—	—
FFL100-HB11	three phase 380V-480V	—	—	—	L100-022H	L100-030H	L100-040H

3. Installation

This chapter provides you information to install a FFL100 series line filter and L100 series inverter. To reduce an interference caused by emission noise, follow the instruction.



WARNING

This equipment should be installed, adjusted and serviced by qualified electrical maintenance personal familiar with the construction and operation of the equipment and the hazards involved. Failure to observe this precaution could result in bodily injury.

3.1 Mechanical Installation

3.1.1 Mounting

Mounting dimension and fixing screw are shown in dimension of chapter 5 (technical specification). Mount the line filter vertically to the flat and well grounded metal surface. If the surface is painted, remove paint before mounting the line filter. The line filter must be fixed by four (4) screws of the correct size. The inverter must be fixed by two (2) or four (4) screws of correct size.

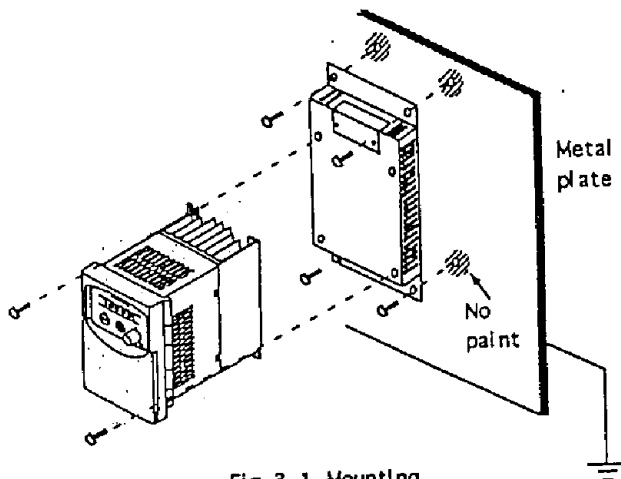


Fig. 3-1 Mounting

3.1.2 Ventilation

For cooling and handling purpose, be sure that the line filter and inverter must be mounted vertically to allow the free flow of air. In addition, be sure that it is separate from other components and walls for adequate ventilation. Minimum clearance is shown in Fig.3-2. If foreign matter is into the inside of line filter or inverter, this may cause damage to the equipment, so make sure that no foreign matter can enter it.

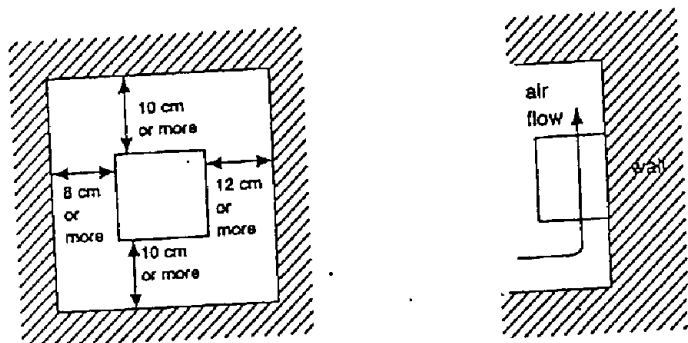



Fig. 3-2 Minimum clearance

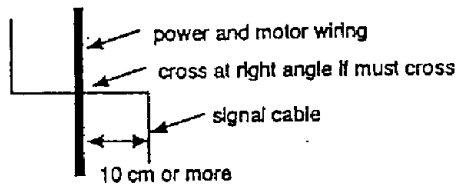
3.2 Electrical Installation

The following instruction provides the basic requirements of wiring for FFL100 line filter and L100 series inverter.

 WARNING
1. Observe all national standards and local standards for the wiring. 2. Wiring work shall be carried out by electrical experts. 3. Risk of electric shock. Disconnect incoming power supply and wait for 5 minutes.

The following considerations must be apply to all installation.

- 1) Use the wiring of correct size, the size of field wiring is shown Table 5-1.
- 2) Connection to the equipment terminal and field terminals must be reliably fixed having two independent means of support. Use the Insulated crimp terminals, and proper crimp tool.
- 3) Use the copper conductors only.
- 4) Separate the signal cable away from power wiring and motor wiring .



- 5) Do not remain unused wire, use the proper multi core cable.

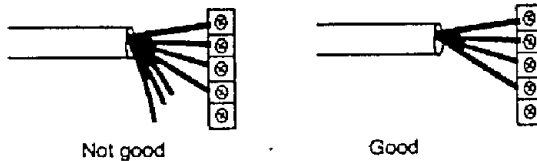


Fig. 3-3 Numbers of cable core

6) Use cable clamp of correct size for screened cable
 The main purpose of cable clamp on screened cable is to make good grounding. Loose clamping causes the noise interference. Use conductive foil or shielding foil such as the aluminum foil, if clamping seems to be loose.

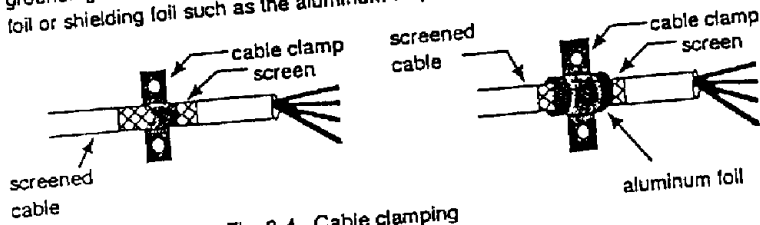


Fig. 3-4 Cable clamping

3.2.1 Power wiring

Be sure that the line filter and inverter are rigidly mounted, and no power is given before wiring.

Remove the terminal cover of line filter and front cover of inverter (see Fig. 1-1 on page 1-2). Connect input power wiring to the terminal of line filter (L1, N and ground for the single phase, L1, L2, L3 and ground for three phase).

Twist the output wire of line filter and connect it (two wires on single phase filter, three wires on three phase filter) to input terminal of inverter through the wiring hole of center or left side.

Note: Some of inverters are needed to use ferrite core to input power wiring. See the section 4-3 for the detail.

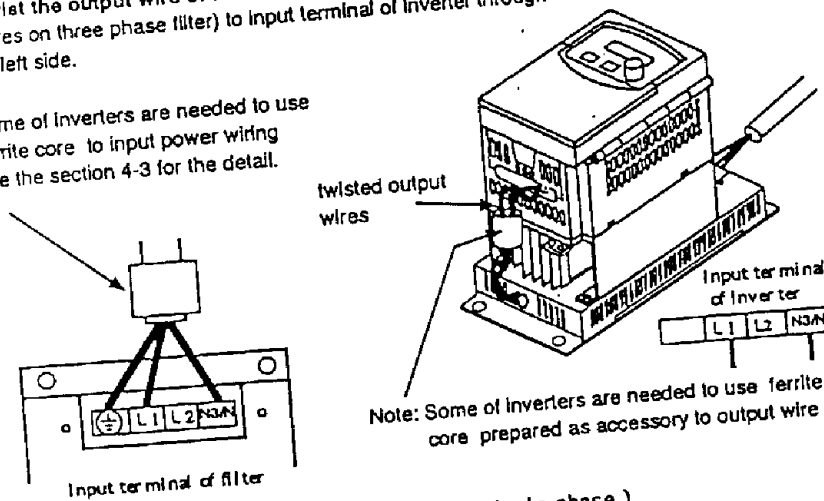


Fig. 3-5 Power wiring (ex. single phase)

3.2.2 Motor wiring

Prepare the screened cable, and connect it to the output terminal of inverter (U, V, W). Fix the screened cable at inverter side as close as possible with cable clamp to the well grounded metal plate.

Use the metal cable gland to the terminal box of motor.

Note: Some of Inverters are needed to use ferrite core as shown Fig. 3-10 to motor wiring as close as inverter. See the section 4-3 for the detail.

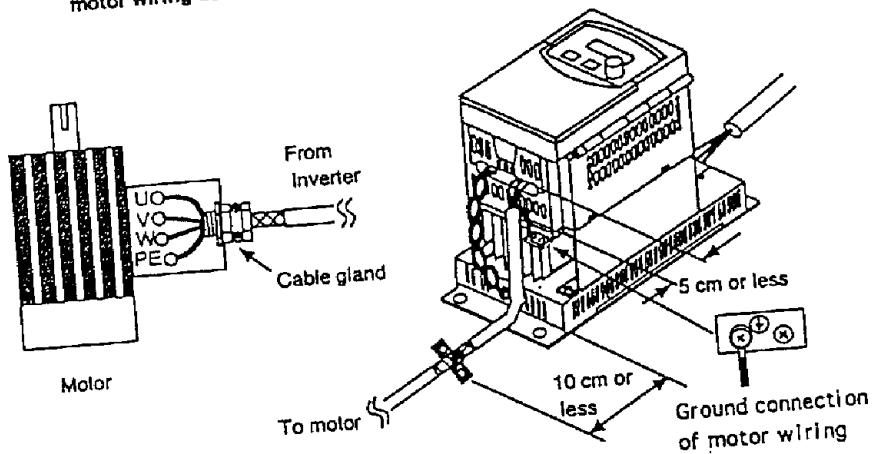


Fig. 3-6 Motor wiring

- 1) Motor terminal box must be made by metal, do not use a terminal box made by plastics.
- 2) Remove paint around wiring hole of the motor terminal box for good conduction.
- 3) Distance between the inverter and cable clamp must be 10 cm or less.
- 4) Length of unscreened part at the wiring hole must be 5 cm or less.
- 5) Maximum length of screened cable is 50 m.
- 6) Use the copper braid screened cable (CY). Cable screened with shielding foil often have higher coupling impedance than copper braid screened cable and is therefore unsuitable.

3.2.3 Earthing

The following instruction provides basic requirement of earthing for line filter, inverter and other equipment. The EMI(Electro Magnetic Interference) is influenced by the earthing condition, and failure of earthing makes an electrical shock hazard. Therefore special consideration is required.



WARNING

1. The motor, line filter and inverter must be connected to appropriate safety earth. Failure to observe this precaution could result in electrical shock.
2. Do not use a plug-in connection for protective connection.

3.2.4 Control signal wiring

The following instruction provides basic requirement of control signal wiring of L100 series inverter.

Prepare the screened cable, and connect it to the control terminal of the logic control board through the wiring hole of left side or center.

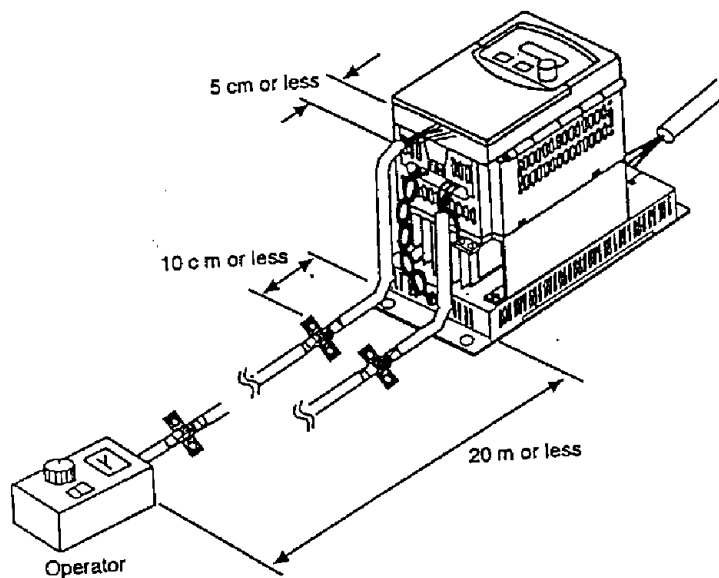


Fig. 3-7 Control signal wiring

- 1) Use the copper braid screened cable (CY).
- 2) Maximum length of screened cable is 20m.
- 3) Distance between the inverter and cable clamp must be 10 cm or less, between operator and cable clamp must be 10 cm or less.
- 4) Length of unscreened part at the wiring hole must be 5 cm or less.

Note: Some of inverters are needed to use ferrite core as shown Fig. 3-10 to control signal wiring as close as Inverter. See the section 4-3 for the detail.

3.2.5 Options

L100 series inverter is available some options, but it is required the special consideration to use those options. Table 3-1 shows applicable options, and the note when using options is described in this section.

Table 3-1 List of option for L100 series inverter

Inverter model name	Applicable option		
	operator box	DC choke coil	Braking unit
L100-002N	OPE-4MJ2	DCL - L - 0.2	BRD-E2
L100-004N	OPE-4MJ2	DCL - L - 0.4	BRD-E2
L100-005N	OPE-4MJ2	DCL - L - 0.7	BRD-E2
L100-007N	OPE-4MJ2	DCL - L - 0.7	BRD-E2
L100-011N	OPE-4MJ2	DCL - L - 1.5	BRD-E2
L100-015N	OPE-4MJ2	DCL - L - 1.5	BRD-E2
L100-022N	OPE-4MJ2	DCL - L - 2.2	BRD-E2
L100-037L	OPE-4MJ2	DCL - L - 3.7	BRD-E2
L100-004H	OPE-4MJ2	DCL - H - 1.5	BRD-E22
L100-007H	OPE-4MJ2	DCL - H - 1.5	BRD-E22
L100-015H	OPE-4MJ2	DCL - H - 1.5	BRD-E22
L100-022H	OPE-4MJ2	DCL - H - 2.2	BRD-E22
L100-030H	OPE-4MJ2	DCL - H - 3.7	BRD-E22
L100-040H	OPE-4MJ2	DCL - H - 3.7	BRD-E22

3.2.5.1 Operator box

Use screened cable as I/O signal cable. Maximum cable length must be 20m. Screened cable must be rigidly fixed to well grounded metal plate with conductive cable clamp at least two points inverter side and operator box side.

Note: Some of inverters are needed to use ferrite core as shown Fig. 3-10 to control signal wiring as close as inverter. See the section 4-3 for the detail.

3.2.5.2 DC choke coil

Use the twisted cable and length is maximum 50 cm as connection cable between inverter and DC choke coil. Ferrite core on cable is required and must be two turns. The specification of the ferrite core is shown in 3.2.5.4.

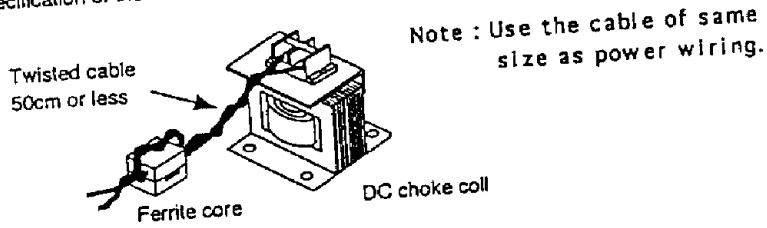


Fig. 3-8 DC choke coil

3.2.5.3 Braking unit

Use the twisted cable and length is maximum 50 cm as connection cable between inverter and braking unit. Mount the unit to the same metal plate that inverter is mounted. Ferrite core on cable is required and must be two turns. The specification of the ferrite core is shown in 3.2.5.4.

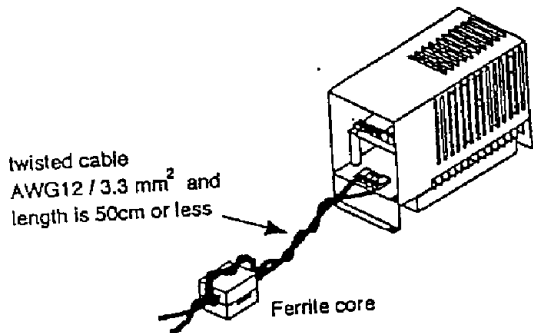


Fig. 3-9 Braking unit (BRD-E2,EZ2)

3.2.5.4 Specification of ferrite core to be used for options

The ferrite core which has following specification is needed when using the options.
The dimension is for reference

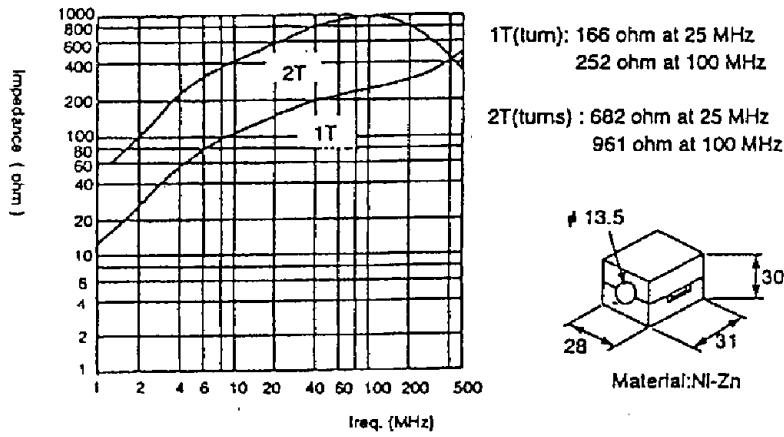


Fig. 3-10 Specification of ferrite core

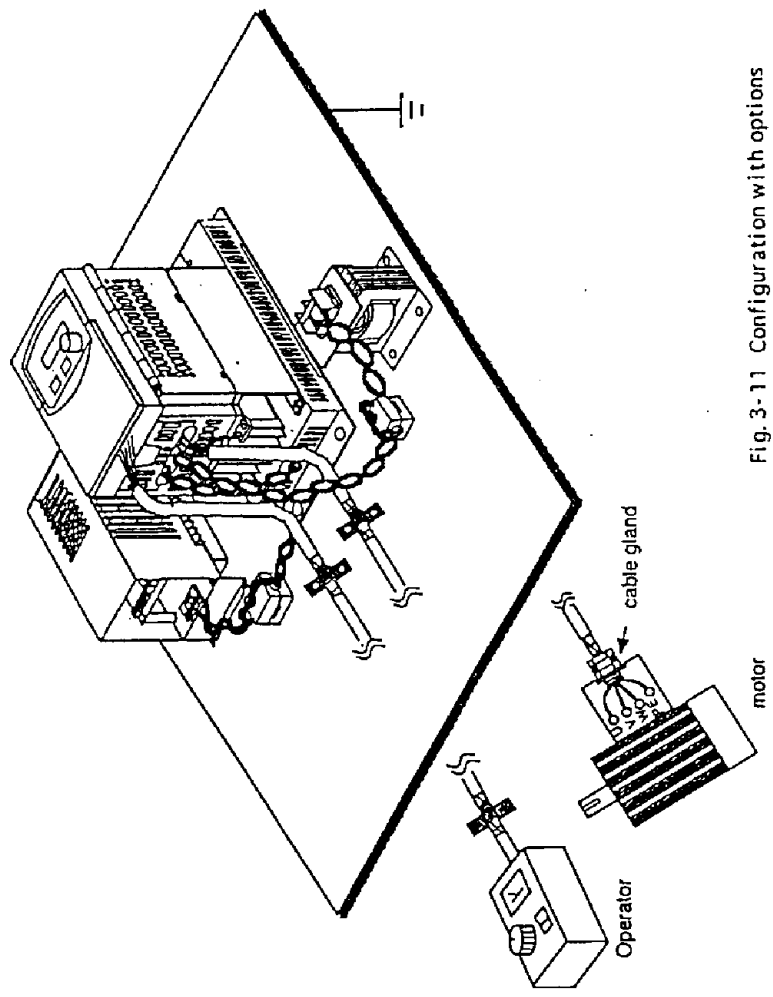
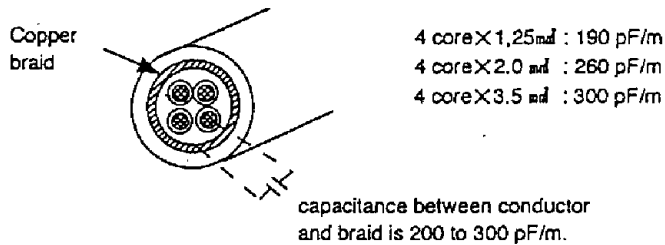


Fig. 3-11 Configuration with options

4. Further technical note

4.1 Influence of motor cable length

Copper braid screened cables as used the motor cable have a high cable capacity. A typical capacitance of screened cable is about 200 to 300 pF/m, and this figure is dependent on cable size. The leakage current from the cable is caused by this capacitance, this means that the longer the screened cable is, the higher the leakage current, and the greater the cable size is, the higher the leakage current. Since the long motor cable makes high leakage current, the followings must be considered.



- 1) Long motor cable and /or high leakage generate more line conducted noise. It cause less filtering effect due to saturation of the line filter.
- 2) The high leakage current may cause an over current trip of the inverter.
- 3) The high leakage current may cause a malfunction of a thermal relay or other device which is connected to motor cable.

4.2 Conformity to low voltage directive (LVD)

Protective structure of Installation must be considered to conform to low voltage directive. The filter and inverter can be conformed to LVD with mounting into a cabinet or with covers as follows.

Note : The inverter can be used as wall mounted type, it is not required any cabinet or cover to conform to LVD.

1) Cabinet

The filter and inverter must be installed into a cabinet which has the protection degree of IP4X ,or has any protection to prevent that small things comes into the filter and inverter.

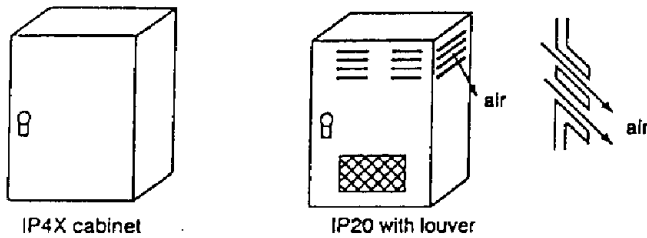


Fig 4-1 Inverter cabinet

2) Cover for wall mounting

Top cover and bottom covers are needed to mount on the wall.

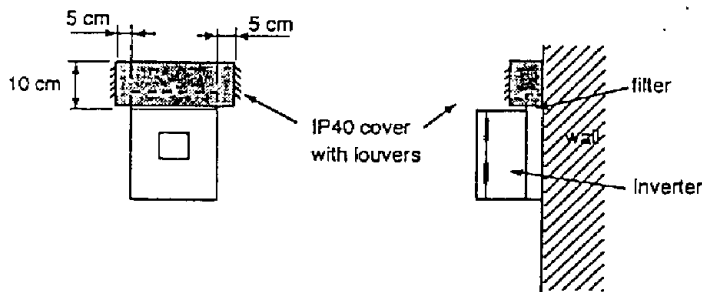


Fig. 4-2 Cover for wall mounting

4.3 Ferrite Core to wiring

To conform to EMC requirement to be used in public environment, ferrite core is needed to the wiring as shown in table 4-1. The ferrite core to be used is shown in section 3.2.5.4.

Table 4-1

Power source	Inverter model name	Power wiring	Motor wiring	OPE	DCL	BRD
single phase 200-240V	L100-002N		**		**	**
	L100-004N		**		**	**
	L100-005N	*			**	**
	L100-007N	*			**	**
	L100-011N	*			**	**
	L100-015N	*			**	**
	L100-022N	*			**	**
three phase 200-240V	L100-002N	*	**		**	**
	L100-004N	*	**		**	**
	L100-005N	*			**	**
	L100-007N	*			**	**
	L100-011N	*			**	**
	L100-015N	*			**	**
	L100-022N	*			**	**
three phase 380-480V	L100-004H	*			**	**
	L100-007H	*			**	**
	L100-015H	*			**	**
	L100-022H	*			**	**
	L100-030H	*		**	**	**
	L100-040H	*		**	**	**

- * : Required only for reduction of conducted emission noise to use in public environment.
- ** : Required only for reduction of radiated emission noise to use in public environment.

5. Technical Specifications

5.1 Filter specifications

Table 5-1 Standard specifications

Line filter type	Input power supply	Input current In (A)	Leakage current (mA / phase) at 60 Hz	
			worst case note 1	normal note 2
FFL100-SB3	single phase	2 × 6 A	—	<9 mA
FFL100-SB5	220-230V ± 10%	2 × 10 A	—	<9 mA
FFL100-SB11	240V + 5%	2 × 21 A	—	<9 mA
FFL100-LB3	50, 60Hz + 5%	2 × 21 A	—	<9 mA
FFL100-LB3	three phase	3 × 4 A	16 mA	<3.5 mA
FFL100-HB6	220-230V ± 10%	3 × 5.2 A	16 mA	<3.5 mA
FFL100-HB11	240V + 5%	3 × 11 A	16 mA	<3.5 mA
FFL100-HB17	50, 60Hz + 5%	3 × 22 A	16 mA	<3.5 mA
FFL100-HB6	three phase	3 × 5.2 A	30 mA	<3.5 mA
FFL100-HB11	380-460V ± 10%	3 × 11 A	30 mA	<3.5 mA
FFL100-HB17	480V + 5%	3 × 22 A	30 mA	<3.5 mA
FFL100-HB17	50, 60Hz + 5%	3 × 22 A	30 mA	<3.5 mA

Line filter type	Enclosure	Size of input terminal	Size of input wiring	Mass (kg)
FFL100-SB3	Aluminum IP20	M4	3 × AWG16 / 1.3 mm ²	0.43
FFL100-SB5	Aluminum IP20	M4	3 × AWG14 / 2.1 mm ²	0.6
FFL100-SB11	Aluminum IP20	M4	3 × AWG12-10 / 3.3-5.3 mm ²	0.88
FFL100-LB3	Aluminum IP20	M4	4 × AWG16 / 1.3 mm ²	0.56
FFL100-HB6	Aluminum IP20	M4	4 × AWG16 / 1.3 mm ²	0.72
FFL100-HB11	Aluminum IP20	M4	4 × AWG14 / 2.1 mm ²	1.2
FFL100-HB17	Aluminum IP20	M4	4 × AWG12 / 3.3 mm ²	1.3

Insulation resistance : 500 Vdc 1 min. 100MΩ or more

Overload capacity : 150% in 1 min. Operating temperature : -10 ~ +50°C

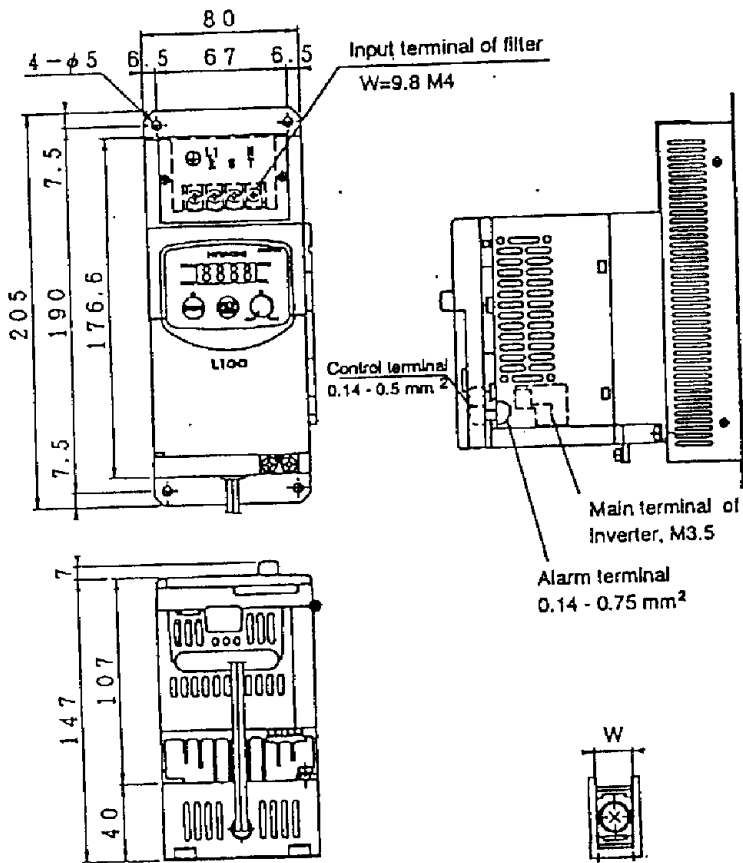
Storage temperature : -20 ~ +60°C Humidity : 20 ~ 90 % RH

Note 1) The meaning of worst case is that operating voltage is 460 V and one of the three phases is opened.

2) The meaning of normal is that all phases are connected correctly and line voltage is given 240V for single phase filter or 460 V for three phase filter.

5.2 Dimension

L100-002NFE/U with FFL100-SB3 L100-002NFE/U with FFL100-LB3
 L100-004NFE/U with FFL100-SB3 L100-004NFE/U with FFL100-LB3



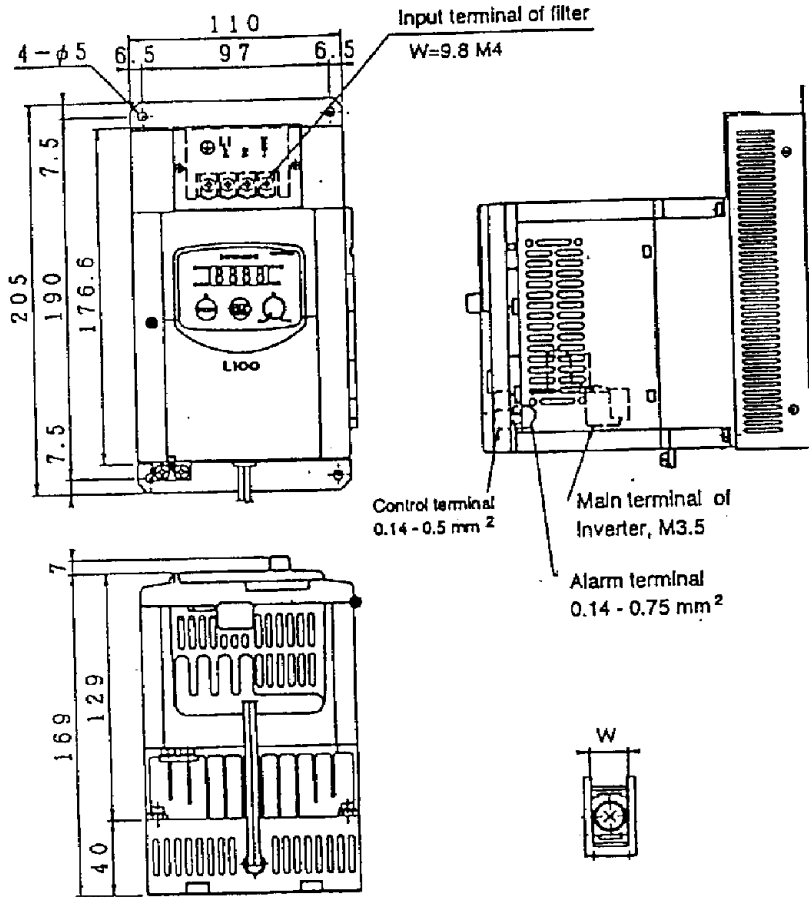
L100-005NFE with FFL100-SB5

L100-005NFE with FFL100-HB6

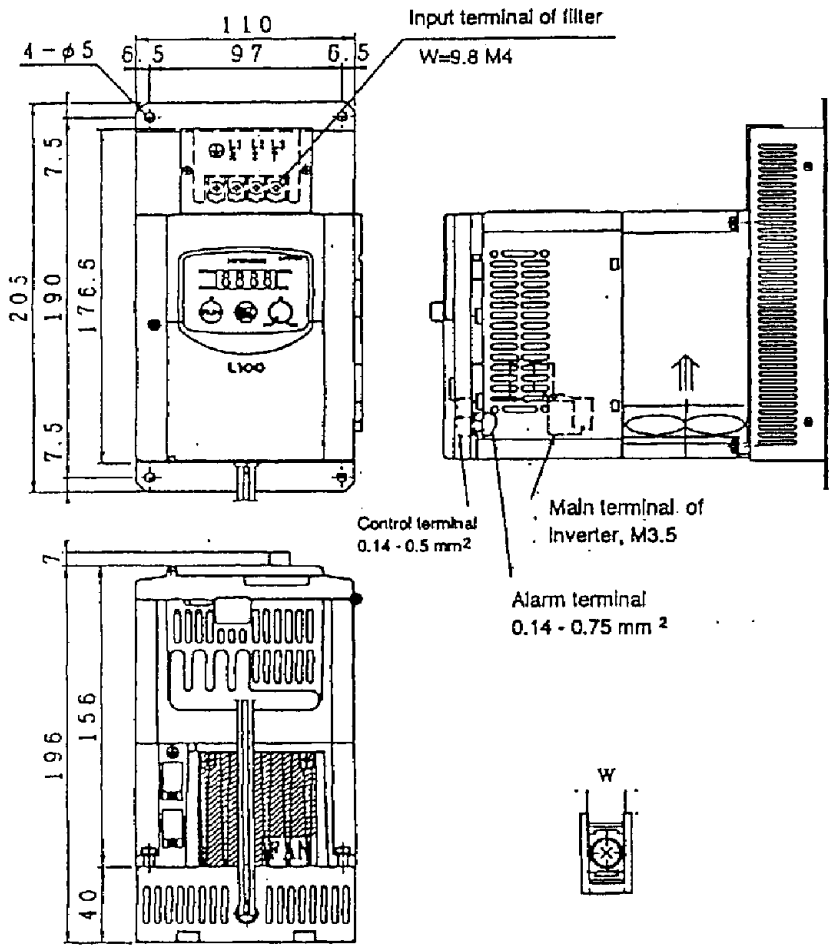
L100-007NFE/U with FFL100-SB5

L100-007NFE/U with FFL100-HB6

L100-004HFE/U with FFL100-HB6

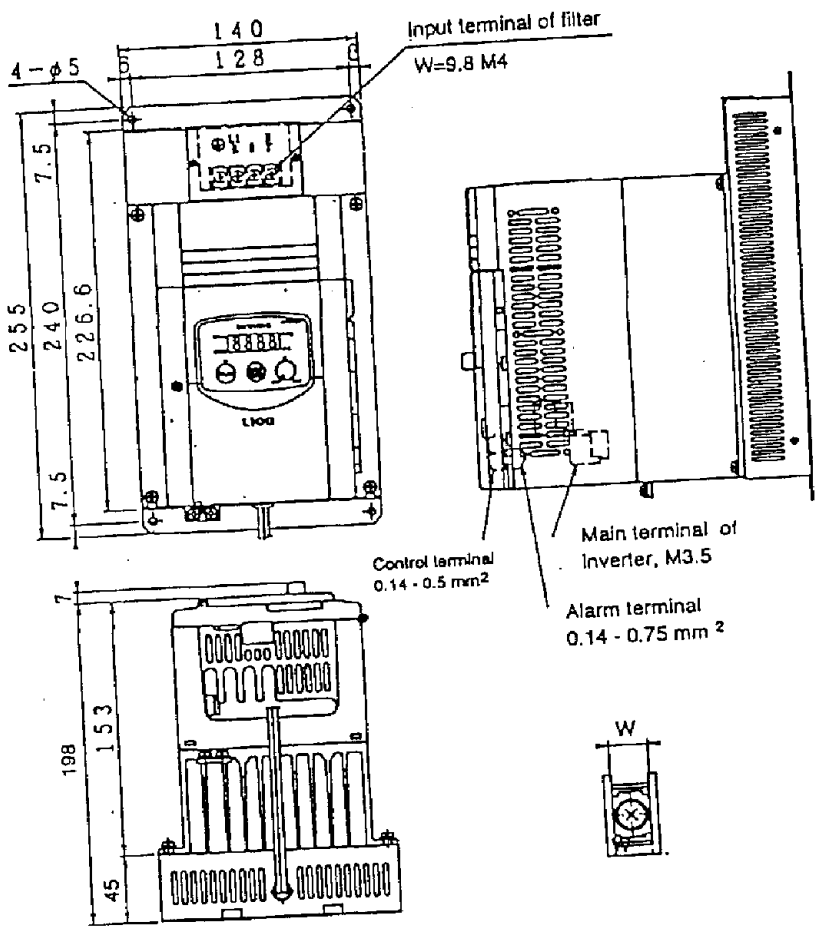


L100-007HFE/U with FFL100-HB6
 L100-015HFE/U with FFL100-HB6



L100-011NFE with FFL100-SB11
L100-015NFE/J with FFL100-SB11

L100-011NFE with FFL100-HB11
L100-015NFE/J with FFL100-HB11



L100-022NFE/U with FFL100-SB11 L100-022NFE/U with FFL100-HB11
 L100-022HFE/U with FFL100-HB11 L100-030HFE with FFL100-HB11
 L100-037LFU with FFL100-HB17 L100-040HFE/U with FFL100-HB11

