9. Measures to satisfy the standards

9.1 How to cope with the CE directive

In Europe, the EMC directive and the low-voltage directive, which took effect in 1996 and 1997, respectively, made it obligatory to put the CE mark on every applicable product to prove that it complies with the directives. Inverters do not work alone but are designed to be installed in a control panel and always used in combination with other machines or systems which control them, so they themselves are not considered to be subject to the EMC directive. However, the CE mark must be put on all inverters because they are subject to the low-voltage directive.

The CE mark must be put on all machines and systems with built-in inverters because such machines and systems are subject to the above directives. It is the responsibility of the manufacturers of such final products to put the CE mark on each one. If they are "final" products, they might also be subject to machine-related directives. It is the responsibility of the manufacturers of such final products to put the CE mark on each one. In order to make machines and systems with built-in inverters compliant with the EMC directive and the low-voltage directive, this section explains how to install inverters and what measures should be taken to satisfy the EMC directive.

We have tested representative models with them installed as described later in this manual to check for conformity with the EMC directive. However, we cannot check all inverters for conformity because whether or not they conform to the EMC direction depends on how they are installed and connected. In other words, the application of the EMC directive varies depending on the composition of the control panel with a built-in inverter(s), the relationship with other built-in electrical components, the wiring condition, the layout condition, and so on. Therefore, please verify yourself whether your machine or system conforms to the EMC directive.

9.1.1 About the EMC directive

The CE mark must be put on every final product that includes an inverter(s) and a motor(s). In the VF-nC3 series of inverters, the single-phase 200 V class is equipped with an EMI filter and complies with the EMC directive if wiring is carried out correctly.

■ EMC directive
2004/108/EC

The EMC standards are broadly divided into two categories; immunity- and emission-related standards, each of which is further categorized according to the operating environment of each individual machine. Since inverters are intended for use with industrial systems under industrial environments, they fall within the EMC categories listed in Table 1 below. The tests required for machines and systems as final products are almost the same as those required for inverters.

Table 1 EMC standards

Category	Subcategory	Product standards	Test standard
Emission	Radiation noise	IEC 61800-3	CISPR11(EN55011)
	Transmission noise		CISPR11(EN55011)
Immunity	Static discharge		IEC61000-4-2
	Radioactive radio-frequency magnetic contactor field		IEC61000-4-3
	First transient burst		IEC61000-4-4
	Lightning surge		IEC61000-4-5
	Radio-frequency induction/transmission interference		IEC61000-4-6
	Voltage dip/Interruption of power		IEC61000-4-11

9.1.2 Measures to satisfy the EMC directive

This subsection explains what measures must be taken to satisfy the EMC directive.

(1) The single-phase 240 V class is equipped with an EMI filter.

Table 2 Inverters and EMI filters

Single-phase 240 V class

Inverter and filter combinations		
Inverter type	Transmission noise IEC61800-3, category C1 applicable filters (motor wiring length of less than 5 m)	Transmission noise IEC61800-3, category C2 applicable filters (motor wiring length of less than 10 m)
VFNC3S-2001PL	Built-in filter	Built-in filter
VFNC3S-2002PL		
VFNC3S-2004PL		
VFNC3S-2007PL		
VFNC3S-2015PL		
VFNC3S-2022PL		

(2) Use shielded power cables, such as inverter output cables, and shielded control cables. Route the cables and wires so as to minimize their lengths. Keep a distance between the power cable and the control cable and between the input and output wires of the power cable. Do not route them in parallel or bind them together, instead cross at right angle.

(3) It is more effective in limiting the radiation noise to install the inverter in a sealed steel cabinet. Using wires as thick and short as possible, earth the metal plate and the control panel securely with a distance kept between the earth cable and the power cable.

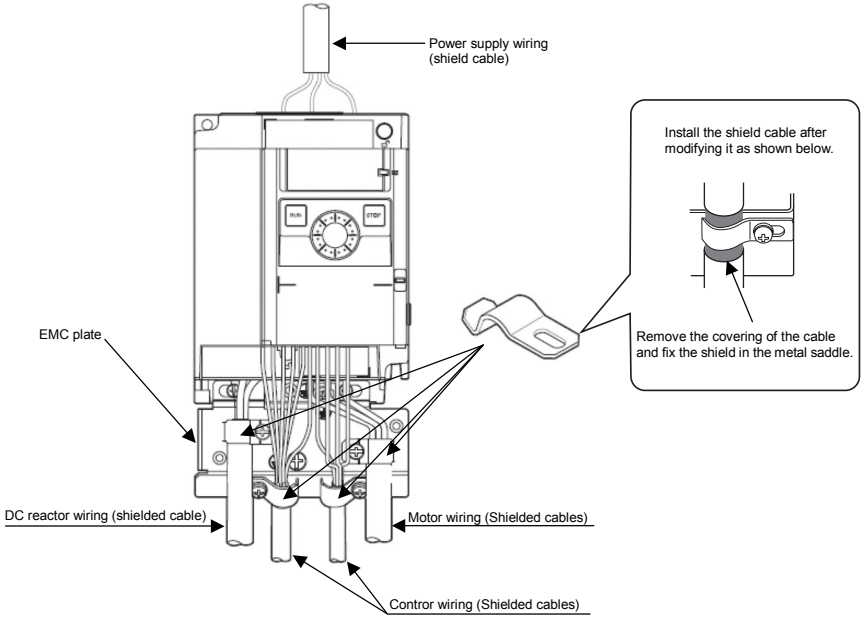
(4) Route the input and output wires apart from each other.

(5) To suppress radiation noise from cables, ground all shielded cables through a noise cut plate. It is effective to earth shielded cables in the vicinity of the inverter and cabinet (within a radius of 10cm from each of them). Inserting a ferrite core in a shielded cable is even more effective in limiting the radiation noise.

(6) To further limit the radiation noise, insert a zero-phase reactor in the inverter output line and insert ferrite cores in the earth cables of the metal plate and cabinet.

(7) Consult us about the three-phase 240 V and single-phase 120 V classes.

[Example of wiring]



9.1.3 About the low-voltage directive

The low-voltage directive provides for the safety of machines and systems. All Toshiba inverters are CE-marked in accordance with the standard EN 50178 specified by the low-voltage directive, and can therefore be installed in machines or systems and imported without problem to European countries.

Applicable standard: IEC61800-5-1
Pollution level: 2
Overvoltage category: 3

9.1.4 Measures to satisfy the low-voltage directive

When incorporating the inverter into a machine or system, it is necessary to take the following measures so that the inverter satisfies the low-voltage directive.

(1) Install the inverter in a cabinet and ground the inverter enclosure. When doing maintenance, be extremely careful not to put your fingers into the inverter through a wiring hole and touch a charged part, which may occur depending on the model and capacity of the inverter used.

(2) Connect earth wiring to the earth terminal on the EMC plate. Or install the EMC plate (attached as standard) and another cable connect to earth terminal on the EMC plate. Refer to the table 10.1 for earth cable sizes.

(3) Install a non-fuse circuit breaker or a fuse on the input side of the inverter. (See chapter 10.)

9.2 Compliance with UL Standard and CSA Standard

The VF-nC3 models, that conform to the UL Standard and CSA Standard have the UL/CSA mark on the nameplate.

9.2.1 Compliance with Installation

A UL certificate was granted on the assumption that the inverter would be installed in a cabinet. Therefore, install the inverter in a cabinet and if necessary, take measures to maintain the ambient temperature (temperature in the cabinet) within the specified temperature range. (See section 1.4.4)

9.2.2 Compliance with Connection

Use the UL conformed cables (Rating 75 °C or more, Use the copper conductors only.) to the main circuit terminals (3-phase models: R/L1, S/L2, T/L3, single-phase models: R/L1, S/L2/N).
For instruction in the United States, Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes.
For instruction in the Canada, Integral solid state short circuit protection does not provide branch circuit protection. Branch circuit protection must be provided in accordance with the Canadian Electrical Code and any additional local codes.

9.2.3 Compliance with Peripheral devices

Use the UL listed fuses at connecting to power supply.
Short circuit test is performed under the condition of the power supply short-circuit currents in below.
These interrupting capacities and fuse rating currents depend on the applicable motor capacities.

■ AIC, Fuse and Wire sizes

Voltage class	Capacity of applicable motor (kW)	Inverter model	AIC (A) (Interrupting capacity)	Fuse class and current (A)	Wire sizes of power circuit	Ground wire size AWG
Single-phase 100V class	0.1	VFNC3S-1001P	AIC 1000A	CC 8A max.	AWG 14	AWG 14
	0.2	VFNC3S-1002P	AIC 1000A	J 15A max.	AWG 14	AWG 14
	0.4	VFNC3S-1004P	AIC 1000A	J 25A max.	AWG 14	AWG 14
	0.75	VFNC3S-1007P	AIC 1000A	J 40A max.	AWG 10	AWG 12
Single-phase 200V class	0.1	VFNC3S-2001PL	AIC 1000A	CC 5A max.	AWG 14	AWG 14
	0.2	VFNC3S-2002PL	AIC 1000A	CC 7A max.	AWG 14	AWG 14
	0.4	VFNC3S-2004PL	AIC 1000A	J 15A max.	AWG 14	AWG 14
	0.75	VFNC3S-2007PL	AIC 1000A	J 25A max.	AWG 14	AWG 14
	1.5	VFNC3S-2015PL	AIC 1000A	J 40A max.	AWG 10	AWG 12
	2.2	VFNC3S-2022PL	AIC 1000A	J 45A max.	AWG 10	AWG 10
Three-phase 200V class	0.1	VFNC3-2001P	AIC 5000A	CC 3A max.	AWG 14	AWG 14
	0.2	VFNC3-2002P	AIC 5000A	CC 5A max.	AWG 14	AWG 14
	0.4	VFNC3-2004P	AIC 5000A	CC 7A max.	AWG 14	AWG 14
	0.75	VFNC3-2007P	AIC 5000A	J 15A max.	AWG 14	AWG 14
	1.5	VFNC3-2015P	AIC 5000A	J 25A max.	AWG 14	AWG 14
	2.2	VFNC3-2022P	AIC 5000A	J 25A max.	AWG 12	AWG 14
	3.7	VFNC3-2037P	AIC 5000A	J 45A max.	AWG 10	AWG 10

Input voltage	Drive motor	Power supply short-circuit and maximum input voltage
100V(1phase)	Up to 0.75kW	Suitable For Use On A Circuit Capable Of Delivering Not More Than 1,000A rms Symmetrical Amperes, 120 Volts Maximum When Protected by CC/J Class Fuses.
200V(1phase)	Up to 2.2kW	Suitable For Use On A Circuit Capable Of Delivering Not More Than 1,000A rms Symmetrical Amperes, 240 Volts Maximum When Protected by CC/J Class Fuses.
200V(3phase)	Up to 2.2kW	Suitable For Use On A Circuit Capable Of Delivering Not More Than 5,000A rms Symmetrical Amperes, 240 Volts Maximum When Protected by CC/J Class Fuses.
	3.7kW	Suitable For Use On A Circuit Capable Of Delivering Not More Than 5,000A rms Symmetrical Amperes, 240 Volts Maximum When Protected by J Class Fuses.

9.2.4 Motor thermal protection

Selects the electronic thermal protection characteristics that fit with the ratings and characteristics of the motor. (See 3.5.)

In case of multi motor operation with one inverter, thermal relay should be connected to each motor.