TOSHIBA

E6582439

■ Additional sheet

Compliance with Low Voltage Directive 2014/35/EU

Since 21 June 2023, EN61800-5-1 2007 / A1 (2017) / A11 (2021) has been harmonized standard listed on the Directive 2014/35/EU (Low Voltage). This additional sheet is very important to use VF-nC3M inverter safely, prevent injury to yourself and other people around you as well as to prevent damage to property in the area. Thoroughly familiarize yourself with the symbols and indications shown in the VF-nC3M instruction manual (E6581694/E6581695) and then continue to read this additional manual.

See web page https://www.inverter.co.jp/ for EU Declaration of Conformity and VF-nC3M instruction manual (E6581695)

VF-nC3M instruction manual (E6581694) is accompanied with product.

⚠ WARNING

Mandatory action

- Install proper short-circuit protective device between the power supply and the inverter (primary side).
  If proper short-circuit protective device is not installed, short circuit current cannot be shut down by inverter alone and it will result in fire.
  Integral solid state short circuit protection in the inverter does not provide branch circuit protection.
  Branch circuit protection must be provided in accordance with any local codes
- Take into account the minimum required prospective short-circuit current of short-circuit protective device.
  If short circuit protective device does not work properly due to lower level short-circuit current, it will result in electric shock or fire.
- Install the inverter into enclosure based on this manual, and install short-circuit protective device or power distribution devices based on the manufacturer manual.
  When they are installed with improper coordination, this will result in electric shock or fire.
- The grounding wire must be connected securely.
  If the grounding wire is not securely connected, when the inverter has failure or earth leakage, this will result in electric shock or fire.

PKR86019-00

This additional manual includes the correction and additional information to comply with Low Voltage Directive 2014/35/EU under the condition below.

- Applicable standard: EN 61800-5-1 :2007 / A1:2017 / A11:2021 (IEC61800-5-1 Ed.2.1)
- Pollution degree: 2
- Overvoltage category: 3
- The electronic power output short-circuit protection circuitry meets the requirements of IEC 60364-4-41:2005/AMD1 — Clause 411

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 grounding wiring to the grounding terminal on the EMC plate. Or install the EMC plate (option) and another cable connect to grounding terminal on the EMC plate. Ground each inverter directly when grounding multiple inverters Refer to the table in Table 3 for details about earth cable sizes.

(3) Install the inverter into the enclosure with proper short circuit protective device (SCPD) in accordance with the table of prospective short-circuit current (Isc) rating shown in Table 4-5.
Semiconductor fuses (gR) are mandatory in case of using DC bus and/or braking ports, to comply with IEC61800-5-1 Ed.2.1.

Compliance with EMC Directive 2014/30/EU

This additional manual includes the additional information for [9.1.1] of E6581815 to comply with EMC Directive 2014/30/EU.

These products cannot satisfy EMI requirement alone, but they can comply with the requirement by installing with the filter option shown in the table below

Reference *1	Career frequency (kHz)	EMC Filter	Conducted noise IEC61800-3 Category C1	Conducted noise IEC61800-3 Category C2
			Length of motor cable (m)	Length of motor cable (m)
VFNC3M-2002P	4 to 12	EMFS11-2007AZ	1	5
VFNC3M-2004P	4 to 12	EMFS11-2007AZ	1	5
VFNC3M-2007P	4 to 12	EMFS11-2007AZ	1	5
VFNC3M-2015P	4 to 12	EMFS11-4015BZ	1	5
VFNC3M-2022P	4 to 12	EMFS11-4015BZ	1	5

*1: Reference may be followed by any characters.

1. General

⚠ WARNING

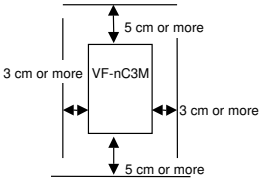
- RISK OF ELECTRIC SHOCK -
DANGEROUS VOLTAGE MAY EXIST FOR _15_MINUTES AFTER REMOVING POWER

The following steps must be performed before wiring and servicing.
(1)Turn off all input power.
(2)Wait at least fifteen minutes and check to make sure that the charge lamp is no longer lit.
(3)Use a tester that can measure DC voltage (400VDC or more), and check to make sure that the voltage to the DC main circuits (across PA/+ and PC/-) is 45V or less.
If these steps are not properly performed, the wiring will cause electric shock.

2. Compliance with Installation

Low Voltage directive was granted on the assumption that the inverter would be installed in an enclosure. Therefore, install the inverter in an enclosure and if necessary, take measures to maintain the inverter ambient temperature (temperature in the enclosure) within the specified temperature range.
Be sure to apply the minimum enclosure size shown in Table 4-5

■Standard installation



■Environments

Location of use	Indoors; not exposed to direct sunlight, corrosive gas, explosive gas, flammable gas, oil mist, or dust; and vibration of less than 5.9m/s^2 (10 to 55Hz).
Elevation	3000m or less for TN/TT/IT system. 2000m or less for Corner-earthed system. (Current reduction required over 1000 m) Note 1)
Ambient temperature	-10 to +60°C Note 2)
Storage temperature	-25 to +70°C (Temperature applicable for a short term.)
Relative humidity	5 to 95% (free from condensation and vapor).
Pollution degree	2

Note1: Current must be reduced by 1% for each 100 m over 1000 m. For example, 90% at 2000m and 80% at 3000m.
Note2: Above 40°C: Remove the protective seal from the top of inverter.
Above 50°C: Remove the seal from the top of the inverter and use the inverter with the output current reduced.
Side by side installation (with no space between inverters): Remove the seal from the top of each inverter. When installing the inverter where the ambient temperature will rise above 40°C, remove the seal from the top of the inverter and use the inverter with the output current reduced. (Refer to next page)

■Current reduction

According to the carrier frequency F300 setting, you may need to reduce the inverter's continuous output current. Reduction rates vary depending on the capacity of the inverter.

Inverter model	Ambient temperature	Input voltage three-phase 200V to 240V		
		PWM Carrier frequency		
		2.0 to 4.0 kHz	4.1 to 12.0 kHz	12.1 to 16.0 kHz
VFNC3M-2002P	50°C or less	1.4 A	1.4 A	1.4A
	Above 50 to 60°C	1.2 A	1.2 A	1.2A
VFNC3M-2004P	50°C or less	2.4 A	2.4 A	2.4A
	Above 50 to 60°C	2.1 A	2.1 A	2.1A
VFNC3M-2007P	40°C or less	4.2 A	3.6 A	3.0A
	Above 40 to 50°C	4.2A	3.2 A	2,8A
	Above 50 to 60°C	3.7A	3.2A	2.8A
VFNC3M-2015P	40°C or less	7.5 A	7.5 A	7.1A
	Above 40 to 60°C	7.5A	7.1 A	7.1A
VFNC3M-2022P	40°C or less	10.0 A	8.5 A	7.5A
	Above 40 to 60°C	10.0A	7.5 A	7.5A

*1: When ambient temperature is above 40°C, use after remove the caution label on the top of the inverter. The current value on the table is the value when the inverter is general installed and with top caution label for 40°C or less, without top caution label for above 40°C.

3. Compliance with Connection

⚠ WARNING

The opening of the branch circuit protective device may be an indication that a fault current has been interrupted. To reduce the risk of fire or electrical shock, current-carrying parts and other components of the controller should be examined and replaced if damaged.
If burnout of the current element of an overload relay occurs, the complete overload relay must be replaced.

Wiring

-> For recommended tightening torque for the main terminal, see Table 1.
-> Use the ring terminal for the earth cables, see Table 2.
-> For recommended wire size for the main terminal, see Table 3.

Integral solid state short circuit protection does not provide branch circuit protection.
Branch circuit protection must be provided in accordance with the any additional local codes.

Table 1 Tighten the screws to specified torque

Screw size	tightening torque	
M3.5	1.0 N·m	8.9 lb·in
M4	1.4 N·m	12.4 lb·in
M5	3.0 N·m	26.6 lb·in

Table 2 Ring terminal size for earth cables

Earth Cable Sizes	M4 (grounding terminal)	M5 (grounding terminal)
AWG14	R2-4 [JIS standard]	R2-5 [JIS standard]

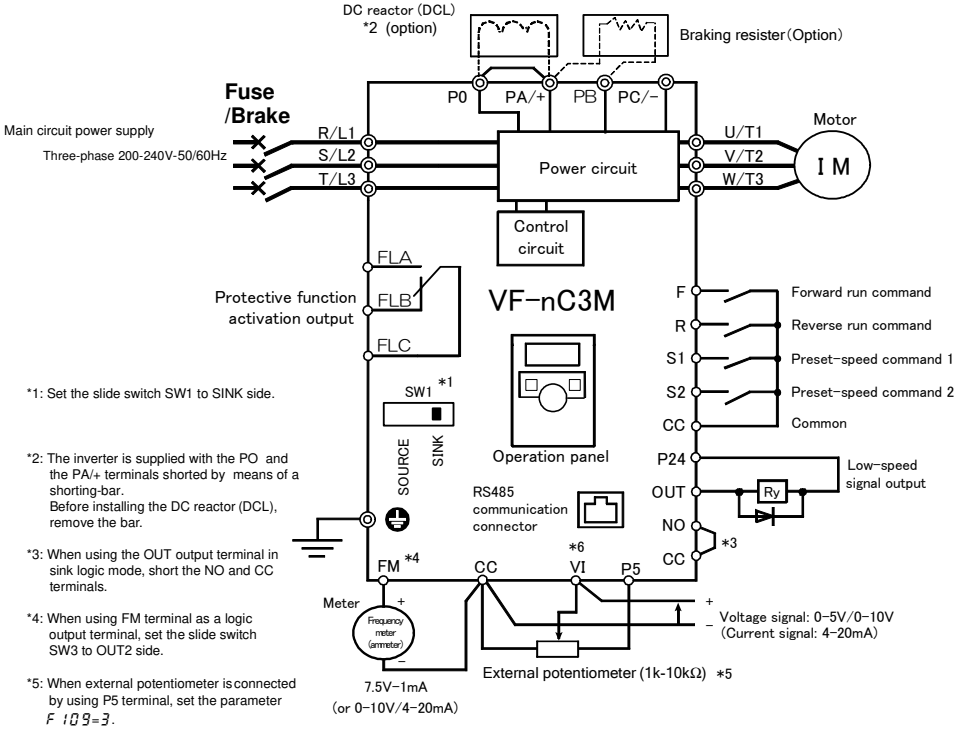
Table 3 Wire sizes

Inverter model	Wire sizes of power circuit	DC Reactor (Optional)	Braking resistor (optional)	Earth Cable
	mm^2	mm^2	mm^2	mm^2
VFNC3M-2002P	1.5	1.5	1.5	2.5
VFNC3M-2004P	1.5	1.5	1.5	2.5
VFNC3M-2007P	1.5	1.5	1.5	2.5
VFNC3M-2015P	1.5	1.5	1.5	2.5
VFNC3M-2022P	2.5	1.5	1.5	2.5

■Main and control circuit terminals

This diagram shows an example of wiring of the main and control circuit (in case of sink logic).

Standard connection diagram – SINK (Negative) (common:CC)



*1: Set the slide switch SW1 to SINK side.

*2: The inverter is supplied with the PO and the PA/+ terminals shorted by means of a shorting-bar.
Before installing the DC reactor (DCL), remove the bar.

*3: When using the OUT output terminal in sink logic mode, short the NO and CC terminals.

*4: When using FM terminal as a logic output terminal, set the slide switch SW3 to OUT2 side.

*5: When external potentiometer is connected by using P5 terminal, set the parameter F109=3.

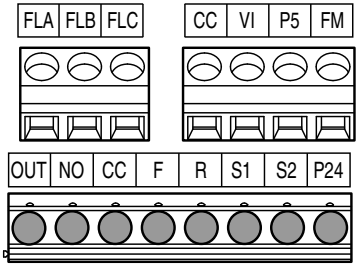
*6: When VI terminal is used as a logic input terminal, refer to section 7.2.1.

For sections and page, refer to instruction manual E6581694/ E6581695.

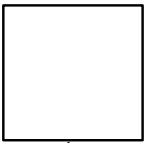
■Power circuit

Terminal symbol	Terminal function
⏚	Grounding terminal for connecting inverter. There are 3 terminals in total.
R/L1,S/L2,T/L3	200V/240V class: three-phase 200 to 240V-50/60Hz
U/T1,V/T2,W/T3	Connect to a (three-phase induction) motor.
PA/+, PB	Connect to braking resistors. Change parameters F304, F305, F308, F309 if necessary.
PC/-	This is a negative potential terminal in the internal DC main circuit.
PO, PA/+	Terminals for connecting a DC reactor (DCL: optional external device). Shorted by a shorting-bar when shipped from the factory. Before installing DCL, remove the shorting-bar.

■Control circuit terminals

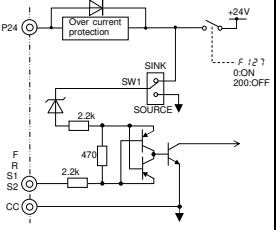


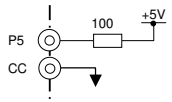
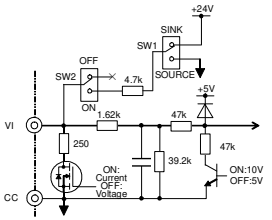
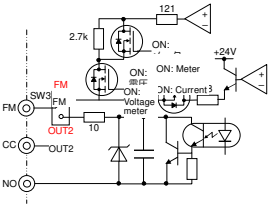
RS485 connector



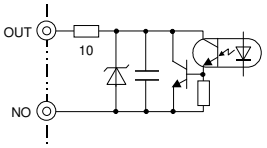
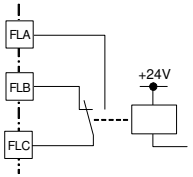
Screw size	Recommended tightening torque
M2.5 screw	0.5 N·m
	4.4 lb·in

Stripping length: 6 (mm)
Screwdriver: Small-sized flat-blade screwdriver
(Blade thickness: 0.5 mm, blade width: 3.5 mm)

Terminal symbol	Input / output	Function		Electrical specifications	Inverter internal circuits
F	Input	Multifunction programmable logic input	Shorting across F-CC causes forward rotation; open causes slow-down and stop. (When Standby ST is always ON) 3 different functions can be assigned.	No voltage logic input 24Vdc-5mA or less *Sink/Source selectable using slide switch SW1 (Default setting is SINK side)	
R	Input		Shorting across R-CC causes reverse rotation; open causes slow-down and stop. (When Standby ST is always ON) 3 different functions can be assigned.		
S1	Input		Shorting across S1-CC causes preset speed operation. 2 different functions can be assigned.		
S2	Input		Shorting across S2-CC causes preset speed operation. 2 different functions can be assigned.		
P24	Output	24Vdc power output (When F127=0)		24Vdc-100mA	
	Input	This terminal can be used as an external 24Vdc input for logic input terminal by changing parameter F127=200.		-	
CC	Common to Input / output	Control circuit's equipotential terminal (2 terminals)		-	

Terminal symbol	Input / output	Function	Electrical specifications	Inverter internal circuits
P5	Output	Analog power supply output	5Vdc (permissible load current: 10mA)	
V I	Input	Multifunction programmable analog input. Factory default setting: 0-10Vdc (1/1000 resolution) and 0-60Hz (0-50Hz) frequency input. The function can be changed to 0-20mAdc (4-20mA) current input by parameter F109=1 setting. 0-5Vdc (1/1000 resolution) voltage input by parameter F109=3 setting. Switch to this setting when external potentiometer is connected by using P5 terminal. By changing parameter F109=2 setting, this terminal can also be used as a multifunction programmable logic input terminal. Sink/source logic is switched by slide switch SW1 and parameter F127. In that case, set the slide switch SW2 to ON side.	5V/10Vdc (internal impedance: 40kΩ) 4-20mA (internal impedance: 250Ω) Note 1)	
FM	Output	Multifunction programmable analog output. Standard default setting: output frequency. The function can be changed to 0-10Vdc voltage by parameter F681=2 setting or 0-20mAdc (4-20mA) current output by parameter F681=1 setting. By setting the slide switch SW3 to OUT2 side, these terminals can also be used as multifunction programmable open collector output terminals. (only sink logic)	1mAdc full-scale ammeter 0-20mA (4-20mA) DC ammeter Permissible load resistance: 750Ω or less 0-10V DC volt meter Permissible load resistance: 1kΩ or more Open collector output 25Vdc-50mA	

Note 1) Be careful, if 4-20mA is selected, when the inverter's power is ON, the internal impedance is 250Ω, but when the power is OFF, the internal impedance increases very much to approximately 40kΩ.

Terminal symbol	Input / output	Function	Electrical specifications	Inverter internal circuits
OUT NO Note 3)	Output	Multifunction programmable open collector output. Standard default setting detect and output low speed signal. Multifunction output terminals to which two different functions can be assigned. The NO terminal is an isoelectric output terminal. It is insulated from the CC terminal. By changing parameter settings, these terminals can also be used as multifunction programmable pulse train output terminals.	Open collector output 24Vdc-100mA To output pulse trains, a current of 10mA or more needs to be passed. Pulse frequency range: 25～1600pps	
FLA FLB FLC Note 2) Note 3)	Output	Multifunction programmable relay contact output. Detects the operation of the inverter's protection function. Contact across FLA-FLC is closed and FLB-FLC is opened during protection function operation.	Max. switching capacity 250Vac-2A 30Vdc-2A (cosϕ=1) : at resistive load 250Vac-1A (cosϕ=0.4) 30Vdc-1A (L/R=7ms) Min. permissible load 5Vdc-100mA 24Vdc-5mA	

Note 2) A chattering (momentary ON/OFF of contact) is generated by external factors of the vibration and the impact, etc. In particular, please set the filter of 10ms or more, or timer for measures when connecting it directly with input unit terminal of programmable controller. Please use the OUT terminal as much as possible when the programmable controller is connected.

Note 3) OVC II: Overvoltage category II

4. Compliance with short circuit protection

■ Co-ordination with upstream protection devices

Install the inverter into the enclosure with proper short circuit protective device (SCPD) in accordance with the table of prospective short-circuit current (Isc) rating shown in following pages.

Prospective short-circuit current (Isc) rating table

The rating of the short circuit protection devices in the table are maximum values. Smaller sizes can be used.
Use the wire with the size described in Table 3
Semiconductor fuses (gR) are mandatory in case of using DC output and/or braking ports to comply with IEC61800-5-1 Ed.2.1, refer to “Prospective short-circuit current rating table (Isc) with semiconductor fuse” in Table 5.

Table 4 Isc, Fuse/Braker with Enclosure

Reference *1	Maximum input voltage (V)	Applicable motor (kW)	Max. Isc (kA)	SCPD rating		Minimum line reactor (mH)	Minimum enclosure volume (L)
				Fuse gG *2 (A)	Circuit breaker *3		
VFNC3M-2002P	240	0.2	5	4	GV2L07	-	15.7
VFNC3M-2004P		0.4	5	8	GV2L08	-	15.7
VFNC3M-2007P		0.75	5	12	GV2L14	--	15.7
VFNC3M-2015P		1.5	5	20	GV2L16	-	15.7
VFNC3M-2022P		2.2	5	25	GV2L20	-	15.7

*1: Reference may be followed by any characters.
*2: Mersen is recommended supplier
*3: Tesys GV series from Schneider Electric are recommended.

Prospective short-circuit current rating (Isc) table with semiconductor fuse

The rating of the short circuit protection devices in the table are maximum values. Smaller sizes can be used.
Use the wire with the size described in Table 3

Table 5 Isc, Fuse with Enclosure (semiconductor fuse IEC60269-4))

Reference *1	Maximum input voltage (V)	Applicable motor (kW)	Max. Isc (kA)	SCPD rating (semiconductor fuse: IEC60269-4 gR *2 690V		Minimum line reactor (mH)	Minimum enclosure volume (L)
				Rating (A)	Min. Size		
VFNC3M-2002P	240	0.2	5	4	10x38	-	15.7
VFNC3M-2004P		0.4	5	8	10x38	-	15.7
VFNC3M-2007P		0.75	5	12.5	10x38	-	15.7
VFNC3M-2015P		1.5	5	20	10x38	-	15.7
VFNC3M-2022P		2.2	5	25	10x38	-	15.7

*1: Reference may be followed by any characters.
*2: Mersen is recommended supplier

5. Overload protection

VF-nC3M has overload protection.
Over current rating: 150%-1min., 200%-0.5sec.
Refer to the nameplate for the rated current.

6. Motor thermal protection

⚠CAUTION

- Risk to damage the motor -
Motor thermal protection will not be provided by the drive if the motor's nominal current is 20% lower than that output of the drive.
In this case, find an alternative source of thermal protection.
Failure to follow these instruction can result in equipment damage.

The devices VF-nC3M are provided with integral overload and over-speed protection for the motor after activation of this function by setting.
Protection at 100% of the full load motor current. The motor thermal protection current (ɛHr) must be set to the rated current indicated on the motor nameplate.
The devices VF-nC3M are provided motor overload protection at 115% of rated current.

VF-nC3M has the motor thermal protection.
Select the electronic thermal protection characteristics that fit with the ratings and characteristics of the motor.
In case of multi motor operation with one inverter, thermal relay should be connected to each motor.

Setting the electronic thermal

- Function
  This parameter allows selection of the appropriate electronic thermal protection characteristics according to the particular rating and characteristics of the motor.

[Parameter setting]

Title	Function	Adjustment range				Default setting
EHr	Motor electronic-thermal protection level 1	10 – 100 (%) / (A)				100
OLN	Electronic-thermal protection characteristic selection	Setting value		Overload protection	Overload stall	0
		0	Standard motor	valid	invalid	
		1		valid	valid	
		2		invalid	invalid	
		3		invalid	valid	
		4	VF motor (special motor)	valid	invalid	
		5		valid	valid	
		6		invalid	invalid	
		7		invalid	valid	
F173	Motor electronic-thermal protection level 2	10 – 100 (%) / (A)				100
F607	Motor 150% overload detection time	10 – 2400 (s)				300
F632	Electronic-thermal memory	0: Disabled 1: Enabled				0

1) Setting the electronic thermal protection characteristics selection OLN and motor electronic thermal protection level 1 EHr, 2 F173

The electronic thermal protection characteristics selection OLN is used to enable or disable the motor overload trip function (OL2) and the overload stall function.
While the inverter overload trip (OL1) will be in constant detect operation, the motor overload trip (OL2) can be selected using the parameter OLN.

[Using standard motors (other than motors intended for use with inverters)]

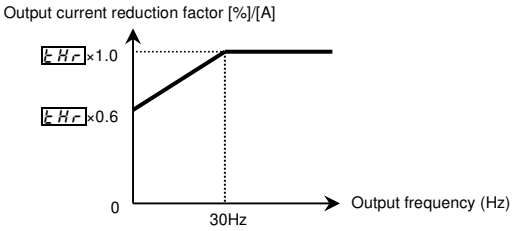
When a motor is used in the lower frequency range than the rated frequency, that will decrease the cooling effects for the motor. This speed up the start of overload detection operations when a standard motor is used in order to prevent overheating.

■Setting of electronic thermal protection characteristics selection OLN

Setting value	Overload protection	Overload stall
0	valid	invalid
1	valid	valid
2	invalid	invalid
3	invalid	valid

■Setting of motor electronic thermal protection level 1 EHr (Same as F173)

When the capacity of the motor in use is smaller than the capacity of the inverter, or the rated current of the motor is smaller than the rated current of the inverter, adjust thermal protection level 1 EHr for the motor in accordance with the motor's rated current.



Note: The motor overload protection start level is fixed at 30Hz.

[Using a VF motor (motor for use with inverter)]

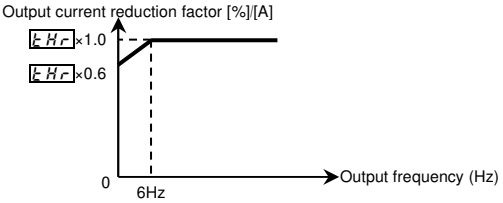
■Setting of electronic thermal protection characteristics selection OLn

Setting value	Overload protection	Overload stall
4	valid	invalid
5	valid	valid
6	invalid	invalid
7	invalid	valid

VF motors (motors designed for use with inverters) can be used in frequency ranges lower than those for standard motors, but their cooling efficiency decreases at frequencies below 6Hz.

■Setting of motor electronic thermal protection level 1 tHr (Same as F173)

If the capacity of the motor is smaller than the capacity of the inverter, or the rated current of the motor is smaller than the rated current of the inverter, adjust the electronic thermal protection level 1 tHr so that it fits the motor's rated current.



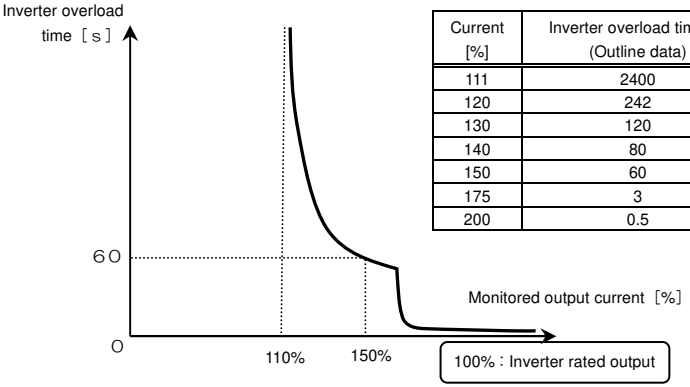
Note) The start level for motor overload reduction is fixed at 6 Hz.

2) Motor 150%-overload time F607

Parameter F607 is used to set the time elapsed before the motor trips under a load of 150% (overload trip OL2) within a range of 10 to 2400 seconds.

3) Inverter overload characteristics

Set to protect the inverter itself. The setting of this parameter cannot be turned to off.
When an inverter overload trip (OL1) operates, operation can be improved by lowering stall operating level F601, or increasing acceleration time ACC and deceleration time dEC.



Current [%]	Inverter overload time [s] (Outline data)
111	2400
120	242
130	120
140	80
150	60
175	3
200	0.5

Inverter overload protection characteristic

Note 1: At extremely low speeds of lower than 1 Hz, an overload trip (OL3) occurs in a short period of time to protect the inverter.
Note 2: At over 150%, an overload trip (OL1) occurs in a short period of time to protect the inverter.

4) Electronic thermal memory F632

When the power is OFF, it is possible to reset or maintain the overload totaling level.
This parameter's settings are applied both to the motor's electronic thermal memory and the electronic thermal memory for inverter protection.

[Parameters settings]

Title	Function	Adjustment range	Default setting
F632	Electronic thermal memory	0: Disabled 1: Enabled	0