TOSHIBA

E6582384①

# ■ Additional sheet

## ■ VF-S15 : UL standard and CSA standard

VF-S15 that comply with UL/CSA Standard have the cULus mark on the nameplate.
This additional manual is the correction and additional information to comply with UL61800-5-1.

To comply with UL61800-5-1, please apply them in accordance with this additional manual description.

Confirm the safety precautions, the symbols and the indications described in the instruction manual E6582175 or E6581987 together.

cULus Mark on the nameplate


## 1. General

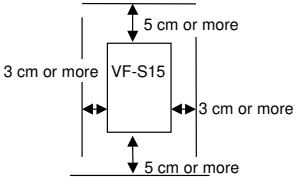
| ⚠ WARNING / AVERTISSEMENT | |
|---|---|
|  Electric shock | - RISK OF ELECTRIC SHOCK -<br>DANGEROUS VOLTAGE MAY EXIST FOR _15_MINUTES AFTER REMOVING POWER<br>- RISQUE DU CHOC ÉLECTRIQUE -<br>UNE TENSIONDANGEREUSE PEUT ÊTRE PRÉSENTÉE JUSQU'À _15_ MINUTES APRÈS AVOIR COUPÉL'ALIMENTATION |

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 (1000VDC 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

A UL certificate 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 the remark under Table 3 and Table 4

**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 | 1000 m or less |
| Ambient temperature | -10 to +40°C (50°C)<br>Maximum Surrounding Air Temperature<br>40 °C (with the protective label on the top of the inverter)<br>50 °C (without the protective label on the top of the inverter, except 0.75 kW or less in 200/240 V class) |
| 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 |
| Overvoltage category | III |

**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.

**[Single-phase 200/240V class]**

| Inverter model | Ambient temperature | Input voltage 200V to 240V PWM carrier frequency | |
|---|---|---|---|
| | | 2.0k to 4.0kHz | 4.1k to 12.0kHz |
| VFS15S-2004PL-CH | 40°C or less | 3.3 A | |
| VFS15S-2007PL-CH | 40°C or less | 4.8 A | |
| VFS15S-2015PL-CH | 40°C or less | 8.0 A | 7.9 A |
| | Above 40 to 50°C | 8.0 A | |
| VFS15S-2022PL-CH | 40°C or less | 11.0 A | 10.0 A |
| | Above 40 to 50°C | 11.0 A | |

Note ) For 0.75 kW or less in 200/240 V class, maintain the ambient temperature of 40°C or less and the PWM carrier frequency of 4kHz or less for the compliance with UL standard.

Note ) For "Above 40°C to 50°C" of the ambient temperature except 0.75 kW or less in 200/240 V class, remove the protective label on the top of the inverter for the compliance with UL standard.

**[Three-phase 400/500V class]**

| Inverter model | Ambient temperature | Input voltage 380V to 480V PWM carrier frequency | | Input voltage Above 480V to 500V PWM carrier frequency | |
|---|---|---|---|---|---|
| | | 2.0k to 4.0kHz | 4.1k to 12.0kHz | 2.0k to 4.0kHz | 4.1k to 12.0kHz |
| VFS15-4004PL1-CH | 40°C or less | 1.5 A | 1.5 A | | |
| | Above 40 to 50°C | 1.5 A | | | |
| VFS15-4007PL1-CH | 40°C or less | 2.3 A | 2.1 A | | |
| | Above 40 to 50°C | 2.3 A | | | |
| VFS15-4015PL1-CH | 40°C or less | 4.1 A | 3.7 A | | |
| | Above 40 to 50°C | 4.1 A | | | |
| VFS15-4022PL1-CH | 40°C or less | 5.5 A | 5.0 A | | |
| | Above 40 to 50°C | 5.5 A | | | |
| VFS15-4037PL1-CH | 40°C or less | 9.5 A | 8.6 A | | |
| | Above 40 to 50°C | 9.5 A | | | |
| VFS15-4055PL-CH | 40°C or less | 14.3 A | 13.0 A | | |
| | Above 40 to 50°C | 14.3 A | | | |
| VFS15-4075PL-CH | 40°C or less | 17.0 A | 17.0 A | | |
| | Above 40 to 50°C | 17.0 A | | | |
| VFS15-4110PL-CH | 40°C or less | 27.7 A | 25.0 A | | |
| | Above 40 to 50°C | 27.7 A | | | |
| VFS15-4150PL-CH | 40°C or less | 33.0 A | 30.0 A | | |
| | Above 40 to 50°C | 33.0 A | | | |

Note ) For "Above 40°C to 50°C" of the ambient temperature, remove the protective label on the top of the inverter for the compliance with UL standard.

## 3. Compliance with Connection

**⚠ DANGER**

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.

(LE DÉCLENCHEMENT DU DISPOSITIF DE PROTECTION DU CIRCUIT DE DÉRIVATION PEUT ÊTRE DÛ À UNE COUPURE QUI RÉSULTE D'UN COURANT DE DÉFAUT. POUR LIMITER LE RISQUE D'INCENDIE OU DE CHOC ÉLECTRIQUE, EXAMINER LES PIÈCES PORTEUSES DE COURANT ET LES AUTRES ÉLÉMENTS DU CONTRÔLEUR ET LES REMPLACER S'ILS SONT ENDOMMAGÉS. EN CAS DE GRILLAGE DE L'ÉLÉMENT TRAVERSÉ PAR LE COURANT DANS UN RELAIS DE SURCHARGE, LE RELAIS TOUT ENTIER DOIT ÊTRE REMPLACÉ)

Use the UL conformed cables (Rating 75 °C or more, Use the copper conductors only.) to the main circuit terminals (R/L1, S/L2, T/L3, U/T1, V/T2, W/T3).

⇒ For recommended tightening torque, see Table 1.
⇒ Use the ring terminal for the earth cables, see Table 2.
⇒ For recommended electric wire sizes, see Table 3,4.
⇒ Use the electric wire of Class1 for the control circuits.

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, Part I. .

(LA PROTECTION INTÉGRÉE CONTRE LES COURTSCIRCUITS N'ASSURE PAS LA PROTECTION DE LA DÉRIVATION. LA PROTECTION DE LA DÉRIVATION DOIT ÊTRE EXÉCUTÉE CONFORMÉMENT AU CODE CANADIEN DE L'ÉLECTRICITÉ, PREMIÈRE PARTIE.)

Table 1 Tighten the screws to specified torque

| Recommended tightening torque for screws on the terminal board | | |
|---|---|---|
| | N·m | lb·in |
| M3.5 | 1.0 | 8.9 |
| M4 | 1.4 | 12.4 |
| M5 | 2.4 | 20.8 |
| M6 | 4.5 | 40.0 |
| M4 (grounding terminal) | 1.4 | 12.4 |
| M5 (grounding terminal) | 2.8 | 24.8 |

Table 2 Ring terminal sizes for earth cables

| Earth Cable Sizes | M4 (grounding terminal) | M5 (grounding terminal) |
|---|---|---|
| AWG14 | R2-4 [JIS standard] | R2-5 [JIS standard] |
| AWG12 | R5.5-4 [JIS standard] | R5.5-5 [JIS standard] |
| AWG10 | R5.5-4 [JIS standard] | R5.5-5 [JIS standard] |

## SCCR, Fuse and Wire sizes

Use the UL listed protective devices at connecting to power supply.
The VF-S15 short circuit current ratings have been obtained by shorting internal components. These ratings allow proper coordination of short circuit protection.

Suitable for use on a circuit capable of delivering not more than___**X**___rms symmetrical Amperes,___**Y**___Volts maximum, when protected by___**Z1**___with a maximum rating of___**Z2**___.
(CONVIENT AUX CIRCUITS NON SUSCEPTIBLES DE DÉLIVRER PLUS DE___**X**___AMPÉRES SYMÉTRIQUES EFFICACES, MAX. ___**Y**___V, AVEC PROTECTION PAR ___**Z1**___DE CALIBRE NOMINAL DE ___**Z2**___.)

Table 3 Standard SCCR condition of Fuses, Circuit breakers, line inductance and Wire sizes, with Enclosure

| Inverter model | Volt-age | Branch circuit protection | | | | | | | | (*4) | | Cable sizes | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | With Circuit breaker | | With GV□P | | | | (*1) With Fuse | | Line inductance | | Power circuit | Earth |
| | | (*2) Type-Form | SC CR | (*2)(*3) Type-Form | Voltage Rating | Power | SC CR | 600V Class J Rating | SCCR | Min. value | | | |
| | (V) | | (kA) | Type E | (V) | (HP) | (kA) | (A) | (kA) | mH | A | (AWG-) | (AWG-) |
| Marking | **Y** | **Z1, Z2** | **X** | **Z1, Z2** | | | **X** | **Z1, Z2** | **X** | - | - | - | - |
| VFS15S-2004PL-CH | 240 | HGL36015 | 5(*5) | GV2P10 | 240 | 0.5 | 5(*6) | 15 | 5(*6) | - | - | 14 | 14 |
| VFS15S-2007PL-CH | 240 | HGL36015 | 5(*5) | GV3P13 | 240 | 2 | 5(*6) | 25 | 5(*6) | - | - | 14 | 14 |
| VFS15S-2015PL-CH | 240 | HGL36030 | 5(*5) | GV3P25 | 240 | 3 | 5(*6) | 40 | 5(*6) | - | - | 10 | 12 |
| VFS15S-2022PL-CH | 240 | HGL36035 | 5(*5) | GV3P25 | 240 | 3 | 5(*6) | 45 | 5(*6) | - | - | 10 | 10 |
| VFS15-4004PL1-CH | 480 | HJL36015 | 5 | GV2P07 | 480Y/277 | 1 | 5 | 6 | 5 | - | - | 14 | 14 |
| VFS15-4007PL1-CH | 480 | HJL36015 | 5 | GV2P08 | 480Y/277 | 2 | 5 | 6 | 5 | - | - | 14 | 14 |
| VFS15-4015PL1-CH | 480 | HJL36015 | 5 | GV2P10 | 480Y/277 | 3 | 5 | 12 | 5 | - | - | 14 | 14 |
| VFS15-4022PL1-CH | 480 | HJL36015 | 5 | GV2P14 | 480Y/277 | 5 | 5 | 15 | 5 | - | - | 14 | 14 |
| VFS15-4037PL1-CH | 480 | HJL36015 | 5 | GV3P13 | 480Y/277 | 7.5 | 5 | 25 | 5 | - | - | 12 | 14 |
| VFS15-4055PL-CH | 480 | HJL36020 | 22 | GV3P18 | 480Y/277 | 7.5 | 22 | 40 | 22 | - | - | 10 | 10 |
| VFS15-4075PL-CH | 480 | HJL36030 | 22 | GV3P25 | 480Y/277 | 15 | 22 | 40 | 22 | - | - | 8 | 10 |
| VFS15-4110PL-CH | 480 | HJL36040 | 22 | GV3P32 | 480Y/277 | 20 | 22 | 60 | 22 | - | - | 8 | 10 |
| VFS15-4150PL-CH | 480 | HJL36050 | 22 | GV3P40 | 480Y/277 | 25 | 22 | 60 | 22 | - | - | 6 | 10 |

**For the enclosure volume, it must be minimum 53L(Liter).**
The enclosure mounting an inverter are a Type 1, 4(X) or 12 rated enclosure, only for the indoor usage.
Minimum enclosure volume allows for specified SCCR. Thermal requirements may require a larger enclosure.

The ampere rating of the short circuit protection devices in the table are maximum values.
Smaller ampere sizes can be used.

In case of using with a higher Short Circuit Current Ratings (SCCR) up to 100kA,
it is available by installing with the circuit breakers, GV□P or the fuses in the condition listed in Table 4.

Table 4 High SCCR condition of Fuses, Circuit breakers, line inductance and Wire sizes, with Enclosure

| Inverter model | Volt -age | Branch circuit protection | | | | | | | | (*4) | | Cable sizes | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | With Circuit breaker | | With GV□ P | | | | (*1) With Fuse | | Line inductance | | Power circuit | Earth |
| | | (*2) Type-Form | SC CR | (*2)(*3) Type-Form | Voltage Rating | Power | SC CR | 600V Class J Rating | SCCR | Min. | value | | |
| | (V) | | (kA) | Type E | (V) | (HP) | (kA) | (A) | (kA) | mH | A | (AWG-) | (AWG-) |
| Marking | **Y** | **Z1, Z2** | **X** | **Z1, Z2** | | | **X** | **Z1, Z2** | **X** | - | - | - | - |
| VFS15S-2004PL-CH | 240 | HGL36015 | 65 | GV2P10 | 240 | 0.5 | 65 | 15 | 100 | 2.5 | 5 | 14 | 14 |
| VFS15S-2007PL-CH | 240 | HGL36015 | 65 | GV3P13 | 240 | 2 | 65 | 25 | 100 | 2.5 | 7 | 14 | 14 |
| VFS15S-2015PL-CH | 240 | HGL36030 | 65 | GV3P25 | 240 | 3 | 65 | 40 | 100 | 1 | 13 | 10 | 12 |
| VFS15S-2022PL-CH | 240 | HGL36035 | 65 | GV3P25 | 240 | 3 | 65 | 45 | 100 | 1 | 18 | 10 | 10 |
| VFS15-4004PL1-CH | 480 | HJL36015 | 65 | GV2P07 | 480Y/277 | 1 | 65 | 6 | 100 | 12 | 1 | 14 | 14 |
| VFS15-4007PL1-CH | 480 | HJL36015 | 65 | GV2P08 | 480Y/277 | 2 | 65 | 6 | 100 | 12 | 1.7 | 14 | 14 |
| VFS15-4015PL1-CH | 480 | HJL36015 | 65 | GV2P10 | 480Y/277 | 3 | 65 | 12 | 100 | 6.8 | 3.2 | 14 | 14 |
| VFS15-4022PL1-CH | 480 | HJL36015 | 65 | GV2P14 | 480Y/277 | 5 | 65 | 15 | 100 | 5 | 4.7 | 14 | 14 |
| VFS15-4037PL1-CH | 480 | HJL36015 | 65 | GV3P13 | 480Y/277 | 7.5 | 65 | 25 | 100 | 3 | 8 | 12 | 14 |
| VFS15-4055PL-CH | 480 | HJL36020 | 65 | GV3P18 | 480Y/277 | 7.5 | 65 | 40 | 100 | 2.5 | 11 | 10 | 10 |
| VFS15-4075PL-CH | 480 | HJL36030 | 65 | GV3P25 | 480Y/277 | 15 | 65 | 40 | 100 | 1.5 | 15 | 8 | 10 |
| VFS15-4110PL-CH | 480 | HJL36040 | 65 | GV3P32 | 480Y/277 | 20 | 65 | 60 | 100 | 1.2 | 22 | 8 | 10 |
| VFS15-4150PL-CH | 480 | HJL36050 | 65 | GV3P40 | 480Y/277 | 25 | 65 | 60 | 100 | 0.8 | 29 | 6 | 10 |

**For the enclosure volume, it must be minimum 53L(Liter).**
The enclosure mounting an inverter are a Type 1, 4(X) or 12 rated enclosure, only for the indoor usage.
Minimum enclosure volume allows for specified SCCR. Thermal requirements may require a larger enclosure.

The ampere rating of the short circuit protection devices in the table are maximum values.
Smaller ampere sizes can be used.

(*1) Use Class CC or J fast acting or time delay with any manufacturer.

(*2) The manufacturer of the listed circuit breaker is "Schneider Electric".

(*3) For GV2P and GV3P use, 480 V ratings are for Wye connected electrical distribution systems.
GV2P self-protected manual combination starter must be used with GV2GH7 insulating barrier to meet Type E rating.
GV3P self-protected manual combination starter must be used with GV3G66 + GVAM11 insulating barrier and auxiliary contact to meet Type E rating. The GVAM11 provides a visual indication if the GV3P has tripped.
GV3P self-protected manual combination starter with connection by lugs that added the digit 6 to the end of reference must be used with LAD96570 (2 pieces) + GVAM11 to meet Type E rating.

UL61800-5-1 require publishing the standard Type E combination motor controller power rating since this is a basic identification marking of type E devices.
However, when applied as an input overcurrent protective device for a drive, the rated current of the Type E combination motor controller, not the rated power, is the key parameter for dimensioning.
GV□P Type E combination motor controllers are adjustable, their current range is shown on the adjustment dial and their selection is based on the input current and not the power rating of the drive.

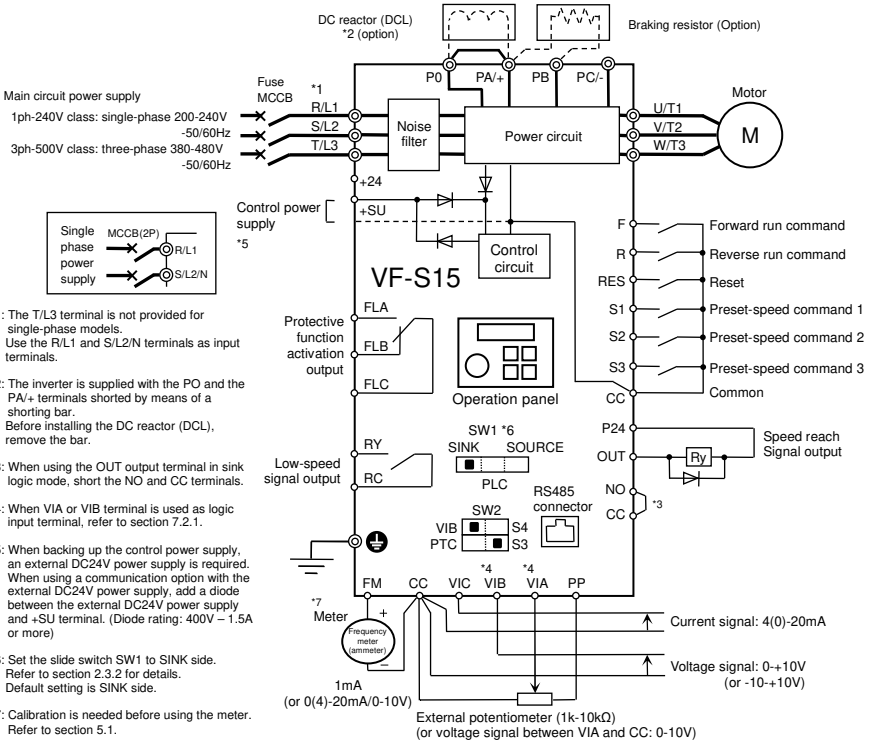
(*4) Reactor is RLW series of "MTE corporation" or from "Schneider Electric", do not substitute.
Reactor selection must be satisfied to the line inductance minimum values in the table.

(*5) Although SCCR is 5 kA, the thermal design is for 1 kA. For applying SCCR up to 5 kA, reduce the load or install the input inductance not to exceed the rated input current.

## 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 with internal supply (Negative) (common: CC)




*1: The T/L3 terminal is not provided for single-phase models.
Use the R/L1 and S/L2/N terminals as input terminals.

*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 VIA or VIB terminal is used as logic input terminal, refer to section 7.2.1.

*5: When backing up the control power supply, an external DC24V power supply is required. When using a communication option with the external DC24V power supply, add a diode between the external DC24V power supply and +SU terminal. (Diode rating: 400V – 1.5A or more)

*6: Set the slide switch SW1 to SINK side.
Refer to section 2.3.2 for details.
Default setting is SINK side.

*7: Calibration is needed before using the meter.
Refer to section 5.1.

For sections,
refer to instruction manual E6581987 or E6582175
,

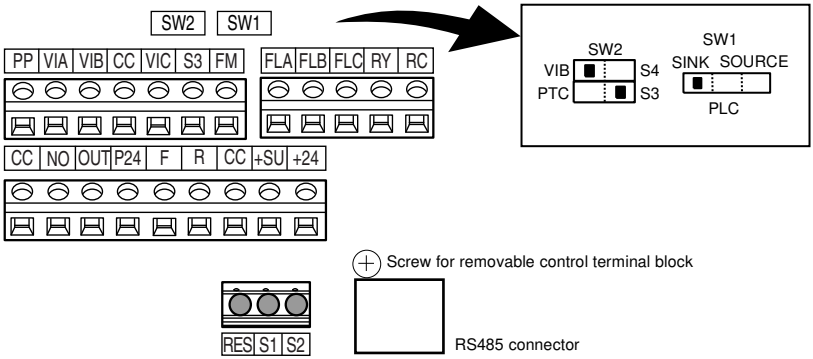
**Main circuit terminals**

| Terminal symbol | Terminal function |
|---|---|
| ⏚ | Grounding terminal for connecting inverter. There are 3 terminals in cooling fin or mounting part of EMC plate. |
| R/L1,S/L2,T/L3 | 200/240 V class Single-phase 200 to 240V-50/60Hz<br>400/500 V class : Three-phase 380 to 480V(UL)-50/60Hz<br>* Single-phase inputs are R/L1 and S/L2/N terminals. |
| U/T1,V/T2,W/T3 | Connect to three-phase motor. |
| PA/+, PB | Connect to braking resistors. |
| PA/+ | This is a positive potential terminal in the internal DC main circuit.<br>DC common power can be input between PA/+ terminal and PC/- terminal. |
| PC/- | This is a negative potential terminal in the internal DC main circuit.<br>DC common power can be input between PC/- terminal and PA/+ terminal. |
| 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. |

The arrangements of power circuit terminals are different from each range.

**Control circuit terminals**

The control circuit terminal block is common to all equipment.







| Screw size | Recommended tightening torque |
|---|---|
| M3 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 |
|---|---|---|---|---|
| F | Input | Multifunction programmable logic input | Shorting across F-CC or P24-F causes forward rotation; open causes deceleration stop.<br>(When Standby ST is always ON)<br>3 different functions can be assigned. | No voltage logic input 24Vdc-5mA or less<br><br>Sink/Source and PLC selectable using slide switch SW1<br>(Default setting is Sink side)<br><br>Pulse train input (S2 terminal)<br>Pulse frequency range: 10pps~2kpps<br>Duty: 50±10%<br><br>PTC input (S3 terminal) |
| R | Input | | Shorting across R-CC or P24-R causes reverse rotation; open causes deceleration stop.<br>(When Standby ST is always ON)<br>3 different functions can be assigned. | |
| RES | Input | | This inverter protective function is reset if RES-CC or P24-RES is connected. Shorting RES-CC or P24-RES has no effect when the inverter is in a normal condition.<br>2 different functions can be assigned. | |
| S1 | Input | | Shorting across S1-CC or P24-S1 causes preset speed operation.<br>2 different functions can be assigned. | |
| S2 | Input | | Shorting across S2-CC or P24-S2 causes preset speed operation. By changing parameter F146 setting, this terminal can also be used as a pulse train input terminal. | |
| S3 | Input | | Shorting across S3-CC or P24-S3 causes preset speed operation. By changing slide switch SW2 and parameter F147 setting, this terminal can also be used as a PTC input terminal. | |
| CC | Common to Input / output | Control circuit's equipotential terminal (3 terminals) | | - |
| PP | Output | Analog power supply output | | 10Vdc (permissible load current: 10mAdc) |
| V I A<br><br>Note 1) | Input | Multifunction programmable analog input.<br>Default setting: 0-10Vdc (1/1000 resolution) and 0-60Hz (0-50Hz) frequency input.<br><br>By changing parameter F109, this terminal can also be used as a multifunction programmable logic input terminal. | | 10Vdc (internal impedance: 30kΩ) |
| V I B<br><br>Note 1) | Input | Multifunction programmable analog input.<br>Default setting: 0-10Vdc (1/1000 resolution) and 0-60Hz (0-50Hz) frequency input.<br><br>The function can be changed to -10-+10V input (1/2000 resolution) by parameterF107 =1 setting.<br><br>By switching slide switch SW2 and changing parameter F109 setting, this terminal can also be used as a multifunction programmable logic input terminal. | | 10Vdc (internal impedance: 30kΩ) |
| V I C | Input | Multifunction programmable analog input.<br>4-20mA (0-20mA) input. | | 4-20mA (internal impedance: 250Ω) |
| FM | Output | Multifunction programmable analog output. Default setting: output frequency.<br>The function can be changed to meter option (0-1mA), 0-10Vdc voltage or 0-20mAdc (4-20mA) current output by parameter F681 setting.<br>Resolution Max. 1/1000. | | 1mAdc full-scale ammeter.<br><br>0-20mA (4-20mA) DC ammeter<br>Permissible load resistance: 600Ω or less<br><br>0-10V DC volt meter<br>Permissible load resistance: 1kΩ or more |

| Terminal symbol | Input / output | Function | Electrical specifications |
|---|---|---|---|
| P24 | Output | 24Vdc power output, by changing SW1 to SINK or SOURCE side. | 24Vdc-100mA |
| | Input | This terminal can be used as a common terminal when an external power supply is used by changing SW1 to PLC side. | - |
| +24 | Output | 24Vdc power output | 24Vdc-100mA<br>Note 2) |
| +SU | Input | DC power input terminal for operating the control circuit. Connect a control power backup device (option or 24Vdc power supply) between +SU and CC. | Voltage:<br>24Vdc±10%<br>Current:<br>1A or more |
| OUT<br>NO | Output | Multifunction programmable open collector output. Default setting detect and output speed reach signal.<br>Multifunction output terminals to which two different functions can be assigned.<br>The NO terminal is an equipotential terminal. It is isolated from the CC terminal.<br><br>By changing parameter F669 settings, these terminals can also be used as multifunction programmable pulse train output terminals. | Open collector output<br>24Vdc-100mA<br><br>To output pulse trains,<br>a current of 10mA or more needs to be passed.<br><br>Pulse frequency range:<br>10~2kpps |
| FLA<br>FLB<br>FLC<br>Note 3)<br>Note 4) | Output | Multifunction programmable relay contact output.<br>Detects the operation of the inverter's protection function.<br>Contact across FLA-FLC is closed and FLB-FLC is opened during protection function operation. | Max. switching capacity<br>250Vac-2A,<br>30Vdc-2A<br>(cosϕ=1)<br>: at resistive load |
| RY<br>RC<br>Note 3)<br>Note 4) | Output | Multifunction programmable relay contact output.<br>Default settings detect and output low-speed signal output frequencies.<br>Multifunction output terminals to which two different functions can be assigned. | 250Vac-1A<br>(cosϕ=0.4)<br><br>30Vdc-1A<br>(L/R=7ms)<br><br>Min. permissible load<br>5Vdc-100mA<br>24Vdc-5mA |

Note 1) When VIA terminal is used as logic input terminal, be sure to connect a resistor between P24 and VIA in case of sink logic, between VIA and CC in case of source logic. (Recommended resistance: 4.7kΩ-1/2W)
It is not needed for VIB terminal.
Note 2) 100mA is the sum of P24 and +24.
Note 3) 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 4) OVC II: Overvoltage category II

## 4. Overload protection

VF-S15 has overload protection.
Over current rating: 150%-1min. 200%-0.5sec.
Refer to the nameplate for the rated current.

Refer to the instruction manual E6581987 or E6582175 for detailed information.

## 5. Motor thermal protection

# ⚠ CAUTION / ATTENTION

- 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 instructions can result in equipment damage.

**(- Risque d'endommagement du moteur -)**
**(La protection thermique du moteur ne sera pas assurée par le variateur si son courant nominal est inférieur de 20 % à celui de sortie du variateur.**
**Dans ce cas, recherchez une autre source de protection thermique.**
**Le non-respect de ces instructions peut entraîner des dommages matériels.)**

**The devices VF-S15 are provided with integral overload for the motor after activation of this function by setting. Protection at 100% of the full load motor current.**
**The motor thermal protection current (tHr ) must be set to the rated current indicated on the motor nameplate.**

VF-S15 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.

| | |
|---|---|
| tHr | : Motor electronic-thermal protection level 1 |
| OLM | : Electronic-thermal protection characteristic selection |
| F173 | : Motor electronic-thermal protection level 2 |
| F606 | : Motor overload reduction frequency threshold |
| F607 | : Motor 150% overload detection time |
| F631 | : Inverter overload detection method |
| F632 | : Electronic-thermal memory |
| F657 | : Overload alarm level |

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

[Parameter setting]

<table>
<tr><th>Title</th><th>Function</th><th colspan="4">Adjustment range</th><th>Default setting</th></tr>
<tr><td>tHr</td><td>Motor electronic-thermal protection level 1</td><td colspan="4">10 – 100 (%)</td><td>100</td></tr>
<tr><td rowspan="9">OLM</td><td rowspan="9">Electronic-thermal protection characteristic selection</td><td>Setting value</td><td></td><td>Overload protection</td><td>Overload stall</td><td rowspan="9">0</td></tr>
<tr><td>0</td><td rowspan="4">Standard motor</td><td>valid</td><td>invalid</td></tr>
<tr><td>1</td><td>valid</td><td>valid</td></tr>
<tr><td>2</td><td>invalid</td><td>invalid</td></tr>
<tr><td>3</td><td>invalid</td><td>valid</td></tr>
<tr><td>4</td><td rowspan="4">VF motor (special motor)</td><td>valid</td><td>invalid</td></tr>
<tr><td>5</td><td>valid</td><td>valid</td></tr>
<tr><td>6</td><td>invalid</td><td>invalid</td></tr>
<tr><td>7</td><td>invalid</td><td>valid</td></tr>
<tr><td>F173</td><td>Motor electronic-thermal protection level 2</td><td colspan="4">10 – 100 (%) / (A)</td><td>100</td></tr>
<tr><td>F606</td><td>Motor overload reduction frequency threshold</td><td colspan="4">0.0 – 60.0 (Hz)</td><td>6.0</td></tr>
<tr><td>F607</td><td>Motor 150% overload detection time</td><td colspan="4">10 – 2400 (s)</td><td>300</td></tr>
<tr><td>F631</td><td>Inverter overload detection method</td><td colspan="4">0: 150%-60s<br>1: Temperature estimation</td><td>0</td></tr>
<tr><td>F632</td><td>Electronic-thermal memory</td><td colspan="4">0: Disabled (tHr, F173)<br>1: Enabled (tHr, F173)<br>2: Disabled (tHr)<br>3: Enabled (tHr)</td><td>0</td></tr>
<tr><td>F657</td><td>Overload alarm level</td><td colspan="4">10-100</td><td>50</td></tr>
</table>

Note) AUL must be set to default setting (1: Constant torque characteristic) for the compliance with UL standard.
Note) F606 is available from CPU1 version 130 (Ver.130) or later. For Ver.128 or before, F606 doesn't exist and the threshold is fixed at 6Hz.

**1) Setting the electronic thermal protection characteristics selection OLM and motor electronic thermal protection level 1 tHr, 2 F173**

The electronic thermal protection characteristics selection (OLM) 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 constantly detective operation, the motor overload trip (OL2) can be selected using the parameter OLM

Explanation of terms
Overload stall: This is an optimum function for equipment such as fans, pumps and blowers with variable torque characteristics that the load current decreases as the operating speed decreases.
When the inverter detects an overload, this function automatically lowers the output frequency before the motor overload trip (OL2) is activated. With this function, operation can be continued, without tripping, by operating using a frequency balanced by load current.
Note: Do not use the overload stall function with loads having constant torque characteristics (such as conveyor belts in which load current is fixed with no relation to speed).

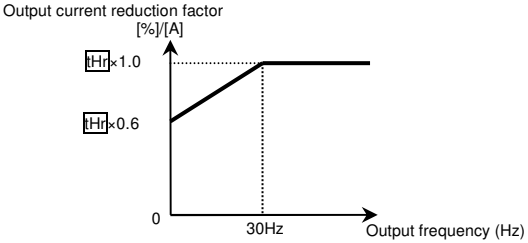
**[Using standard motors (other than motors intended for use with inverters)]**

When a motor is used in the lower frequency range than the rated frequency, that will decrease the cooling effects for the motor. This speeds 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 OLM

| 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 tHr (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 tHr for the motor in accordance with the motor's rated current.




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

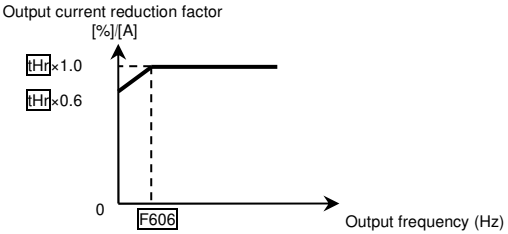
**[Using a VF motor (motor for use with inverter)]**

■ Setting of electronic thermal protection characteristics selection OLM

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

■ Setting of Motor overload reduction frequency threshold F606
VF motors (motors designed for use with inverters) can be used in frequency ranges lower than those for standard motors, but an extremely low speed will cause the cooling effect of the motor to decrease.
Set the value of F606 (Motor overload reduction frequency threshold) suited for the motor characteristic.
We recommend that it be set to around 6 Hz (default setting) (refer to the following figure).
Note) F606 is available from CPU1 version 130 (Ver.130) or later. For Ver.128 or before, F606 doesn't exist, and the threshold is fixed at 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.
* If the indications are in percentages (%), then 100% equals the inverter's rated output current (A).




**2) Motor 150%-overload detection time F607**
Done not change this parameter from default setting.

**3) Inverter overload detection method F631**

As this function is set to protect the inverter unit, this function cannot be turned off by parameter setting.
The inverter overload detection method can be selected using parameter f631 (Inverter overload detection method).
If the inverter overload trip function (OL1) is activated frequently, this can be improved by adjusting the stall operation level F601 downward or increasing the acceleration time ACC or deceleration time DEC.

- F631=0 (150%-60s)
  Protection is given uniformly regardless of temperature by the 150%-60 sec overload curve.
- F631=1 (Temperature estimation)
  This parameter adjusts automatically overload protection, predicting the inverter internal temperature rise.

**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.

**5) Overload alarm level F657**

When the motor overload level reaches to F657 setting value (%) of overload trip (OL2) level, "l" will be displayed on the left side digit and the "l" and output frequency monitor will be blinking alternately on overload alarm status.
Overload alarm signal can be output from output terminal.

## 6. Motor PTC thermal protection

Set a parameter F147 and lower slide switch of SW2 to PTC side, when S3 terminal is used as PTC input terminal.

F147: Logic input / PTC input selection (S3)
F645: PTC thermal selection
F646: Resistor value for PTC detection

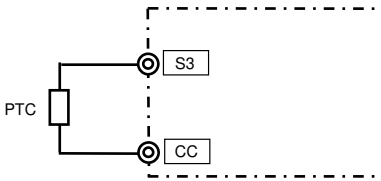
- Function
  This function is used to protect motor from overheating using the signal of PTC built-in motor.
  The trip display is "E-32".

[Parameter setting]

| Title | Function | Adjustment range | Default setting |
|---|---|---|---|
| F147 | Logic input / PTC input selection (S3) | 0: Logic input<br>1: PTC input | 0 |
| F645 | PTC thermal selection | 1: Tripping<br>2: Alarm only | 1 |
| F646 | PTC detection resistor value | 100-9999 (Ω) | 3000 |

Note : Protecting PTC thermal, set F147=1 (PTC input) and slide switch SW2 to PTC side.
- Tripping level is defined by F646 setting. Alarm level is defined by 60% of F646 setting.
- Connect the PTC between S3 and CC terminals. Detection temperature can be set by F646 setting.

**[Connection]**




- Output of PTC input alarm signal
  The PTC input alarm is assigned to the output terminal by setting the parameter of the output terminal selection function to 150 or 151.

## 7. Ground fault detection function

To comply UL61800-5-1, set ground fault detection selection (F614) to 1 “Enabled”.

## 8. Other

**⚠ WARNING / AVERTISSEMENT**

Operation of this equipment requires detailed installation and operation instructions provided in the hardware manual intended for use with this product.
This information is provided included in the container this device was packaged in.
This information should be retained with this device at all times.

(L'utilisation de cet équipement nécessite des instructions d'installation et d'utilisation détaillées, fournies dans le manuel du matériel destiné à être utilisé avec ce produit.
Ces informations sont fournies dans l'emballage de l'appareil.
Elles doivent être conservées avec cet appareil en permanence.)

If you need the hard copy (paper) of E6582175 (English), please contact to phone number: +86-21-6361-3300