TOSHIBA

E6582162④

Industrial Inverter

(For 3-phase motors)

Instruction Manual

Totally enclosed box type Inverter

TOSVERT™ VF-AS3

3-phase 480V class 0.4 to 75kW

Toshiba Industrial Products and Systems Corporation

Note

1. Make sure that this instruction manual is delivered to the end user of the inverter unit.
2. This manual gives supplementary information of some items referred in "VF-AS3 instruction manual" (E6582062). Read this manual and E6582062 before installing or operating the inverter unit, and store them in a safe place for reference.
3. All information contained in this manual will be changed without notice. Please visit our website for the latest information.

I Safety precautions

The items described in the instruction manual and on the inverter itself are very important so that you can use safely the inverter, 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 below and then continue to read "VF-AS3 instruction manual" (E6582062) and this manual. Make sure that you observe all warnings given.

Explanation of markings

Marking	Meaning of marking
⚠ WARNING	Indicates a hazardous situation that, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates information considered important but not hazard-related. It is used to address practices not related to physical injury.

Meanings of symbols

Symbol	Meaning of symbol
⃠	Indicates a prohibition (Do not do it). Detailed information on the prohibition is described in illustration and text in or near the symbol.
●	Indicates a mandatory action that must be followed. Detailed information on the mandatory action is described in illustration and text in or near the symbol.
△	Indicates a warning or caution. Detailed information on the warning or caution is described in illustration and text in or near the symbol.

■ Limits in purpose

Our inverters are designed to control the speeds of three-phase induction motors, interior permanent magnet synchronous motors (IPMSMs) and the surface permanent magnet synchronous motors (SPMSMs) for general industry.
Our inverters cannot drive a single-phase motor.

⚠ SAFETY PRECAUTIONS

- This product is an electronic component for general industrial uses in industrial application.
  It cannot be used for applications where may cause a significant public impact, such as power stations and railways, and for uses that will require special quality control or warranty.
  Neither is it applicable to equipment (for nuclear power, airplanes, aerospace, public transport, life support, surgeries and various safety and entertainment devices) to which the failure or malfunction of this product could pose a direct risk or threat to human life.
  If you wish to use the product for limited purposes and the product is understood to require no special quality control or warranty, please contact us before purchase to evaluate if the usage is applicable.
- Please ensure in advance that the product is appropriately placed and installed in your own device or system, fulfilling the intended purpose.
  The equipment designer or the customers who assembles the final product shall be held liable for the selection and application of the product. We are not responsible for how the product is incorporated into the final system design.
  When using the product, please systematically back up your data or safety devices so that any failure or malfunction of the product will not cause any significant accidents.
- Even if the product is found to be inapplicable for conditions above after purchasing or using the product, the product will remain inapplicable for such conditions.
- Do not use the product for any load other than with general industry three-phase induction motors, interior permanent magnet synchronous motors (IPMSMs) and the surface permanent magnet synchronous motors (SPMSMs).
- Please read the instruction manual carefully before installing or operating the product and use it properly.

■ Handling

⚠ WARNING

 Disassembly inhibited	• Never disassemble, modify or repair. This can result in electric shock, fire and other injury. Please call your Toshiba distributor for repairs.
 Prohibited	• Never remove the front cover when the power is on. The unit contains high voltage parts and contact with them will result in electric shock. • Do not stick your fingers into openings such as cable wiring holes and cooling fan covers. The unit contains high voltage parts and contact with them will result in electric shock or injury. • Do not place or insert any kind of object (electrical wire cuttings, rods, wires etc.) inside the inverter. This will cause a short circuit and result in electric shock or fire.

⚠ WARNING

 Mandatory action	• Turn the power on only after mounting the front cover. If you turn the power on without mounting the front cover, this will result in electric shock or other injury. • Immediately turn the power off if the inverter begins to emit smoke, an unusual odor, or unusual sounds. Continuous use of the inverter in such a state will cause fire. If the inverter is left to be turned on in that state, it can cause fire. Please call your Toshiba distributor for repairs. • Always turn the power off if the inverter is not used for a long time. The inverter will have failure due to leakage current caused by dust and other material. If the inverter's power is left to be turned on in that state, it can cause fire.

⚠ CAUTION

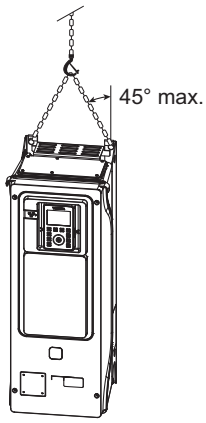
 Contact inhibited	• Do not touch heat radiating fins or discharge resistors. These devices get high temperature, and you will get burned if you touch them. • Do not touch the edge of metal parts. Touching the sharp edge will result in the injury.

■ Transportation & installation

⚠ WARNING

 Prohibited	• Do not install and operate the inverter if it is damaged or any of its components is missing. This will result in electric shock or fire. Please call your Toshiba distributor for repairs. • Do not place any inflammable object near the inverter. If flame is emitted due to failure in the inverter, this will lead to fire.
 Mandatory action	• Install proper short-circuit protection device (eg. ELCB or fuse) between the power supply and the inverter (primary side). If proper short-circuit protection device is not installed, short circuit current cannot be shut down by inverter alone and it will result in fire. • An emergency stop device must be installed that is configured in accordance with the system specifications. If such an emergency stop device that can activate mechanical brake by shutting off power supply is not installed, operation cannot be stopped immediately by the inverter alone, thus resulting in an accident or injury. • Close the front cover correctly, mount operation panel of the unit and close Ethernet connector cover. A gap can allow dust and water penetration and result in damage, fire or electric shock. • In using a power distribution device and options for the inverter, they must be installed in a cabinet. When they are not installed in the cabinet, this will result in electric shock.

⚠ CAUTION

Prohibited	• For transporting or carrying the inverter, do not hold by the front cover. The cover will come off and the unit will drop, resulting in injury. • Do not install the inverter in any place with large vibration. The unit will fall due to the vibration, resulting in injury. • Do not touch the edge of metal parts. Touching the sharp edge will result in the injury.
Mandatory action	• Carry the inverter with the cover attached, and avoid holding or putting your hands in the wiring holes during the transportation. Otherwise you can have your hands pinched and injured. • Carry the inverter by two people or more when the inverter is the model mass 20kg or more (VFAS3-4110PCE - 4370PCE). If you carry the inverter alone, this will result in injury. • Transport a large-capacity inverter (VFAS3-4450PCE - 4750PCE) by a crane. If you transport a heavy load by hand, this will result in injury. Please take the utmost care for the operator's safety, and please handle the inverter carefully in order not to damage the product. For lifting the inverter, hang the inverter with wire ropes via hanging bolts (hanging holes) provided at upper part or lower part of the inverter as shown in right. Note 1) Make sure that the inverter is hung by two wire ropes in a balanced manner, and be careful that the inverter does not receive excessive force during the hanging operation. Note 2) Be sure to carry the product with the cover attached. Note 3) Do not put your hand in the wiring port during transportation.  • Mount the inverter on a metal plate. The rear panel will get high temperature. Do not mount the inverter on an inflammable object, this will result in fire. • Install the inverter at a place which can support the unit's mass. If you install the inverter at a place which does not support the unit's mass, the unit will fall, resulting in injury. • Install a mechanical brake when it is necessary to hold a motor shaft. The brake function of the inverter cannot perform mechanical hold, and it will result in injury. • When using an input filter (ex. harmonics reduction), make sure the inverter behavior with your equipment before use. Otherwise it can cause an accident by inverter instability due to resonance between the inverter and the input filter.

NOTICE

Mandatory action	• Transport or install under the environmental conditions prescribed in the instruction manual. Transporting or installing under any other conditions will result in failure. • All options to be used must be those specified by Toshiba. The use of options other than those specified by Toshiba will result in an accident. • Transport the operation panel in accordance with law. Please transport the operation panel by airplane or ship in accordance with law as a lithium battery is used in the operation panel.

II Introduction

Thank you for purchasing Toshiba's totally enclosed box type inverter, "TOSVERT VF-AS3".
To handle TOSVERT VF-AS3 correctly, this instruction manual explains how to install the enclosed box type inverter, refer to the inverter manual E6582062 for how to wire the inverter, operation procedure, how to run the motor, measures for protective functions (when an alarm/trip occurs) and etc.
Please be informed that the specifications described in the instruction manuals, technical data may be changed without notice.

■ Trademarks in this manual

II

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Contents

1 Read first

This chapter explains check items when you receive the inverter, names of parts of the inverter, and the flow of basic procedures before operation.

1. 1 Check product purchase

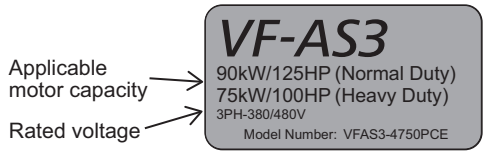
⚠ CAUTION

Mandatory action	• Use the inverter that conforms to specifications of the power supply and the three-phase motor to be operated. If you use the inappropriate inverter, not only will the three-phase motor not rotate correctly, but it will cause serious accidents such as overheating and burning out.

Before using the product you have purchased, check to make sure that it is exactly what you ordered. Check the contents of packing and accessories for damage.

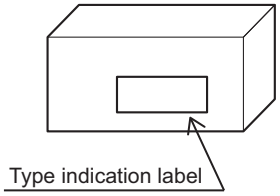
1

Rating label



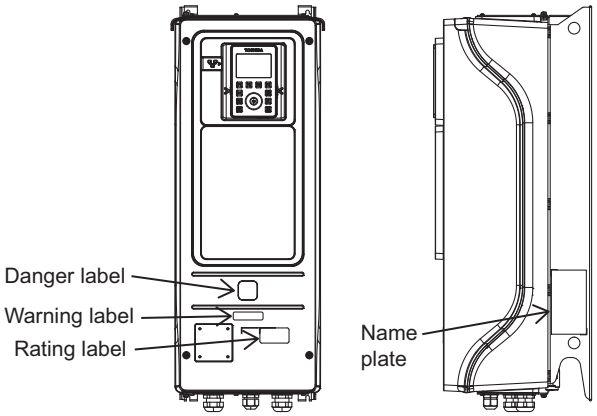
* Refer to [1.2] of E6582062 for (HD) and (ND).

Carton box

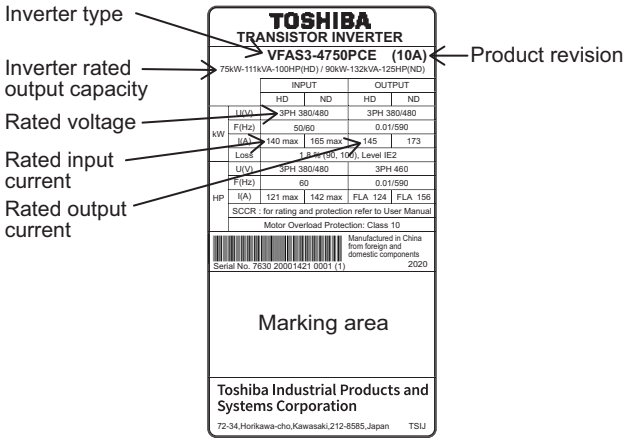


Danger/Warning label

Inverter main unit



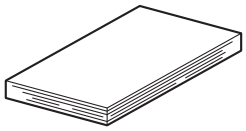
Name plate



Important	• Keep original "DANGER" or "WARNING" labels visibility on front cover for UL/CSA compliance.

Memo	• Product revision consists of numeric characters and an alphabet.

Quick start

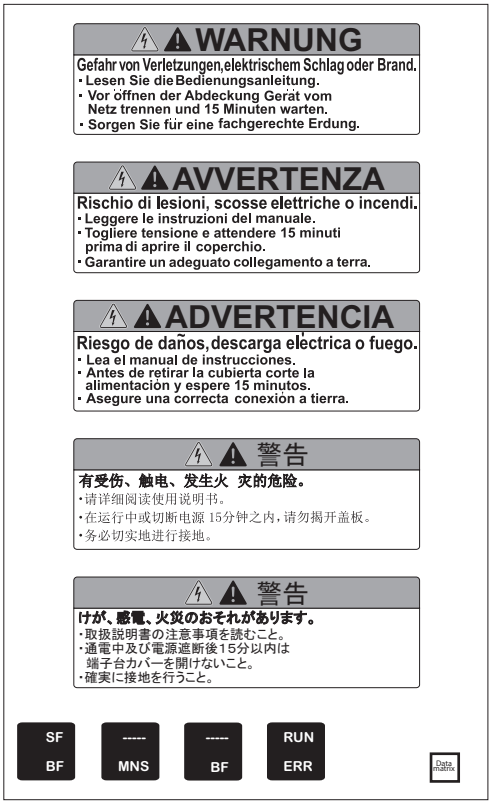


Top cover

* Top cover is not provided for UL type1 products (type-form with "E1" suffix)

Warning label kit

Warning labels in 5 languages for sticking .



Profinet DeviceNet Profibus CANopen

* The label for EtherCAT is accompanied with EtherCAT option product.

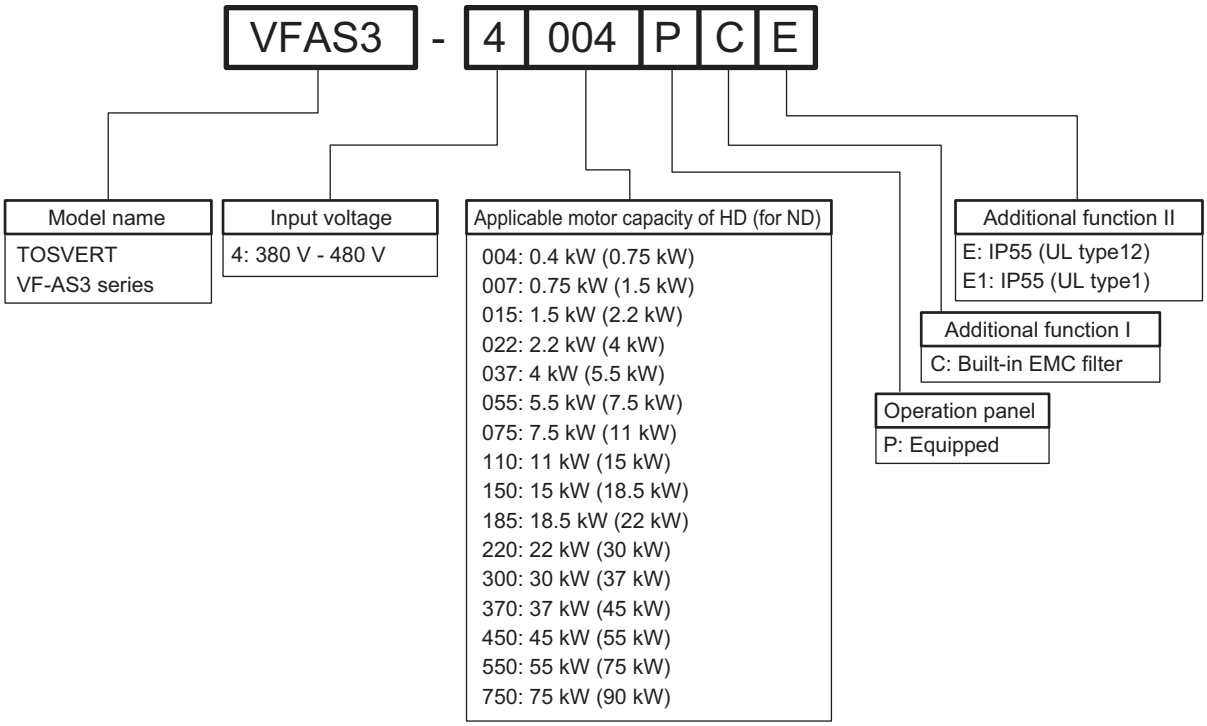
- German
- Italian
- Spanish
- Chinese
- Japanese

- Labels for communication option

  Affix to lower side of communication indicator.

1. 2 Indication of product type

Explanation of the indication of the inverter type.



Important

- This inverter has multi-rating. The motor capacity is described based on HD rating. In the case of ND rating, it is described with parentheses like (ND: **kW).
  Note) HD: Heavy Duty, ND: Normal Duty

■ Type and frame size

This inverter has five types of units with frame size A1E to A5E according to the capacity. The following table shows the relationships between the types and the frame sizes.

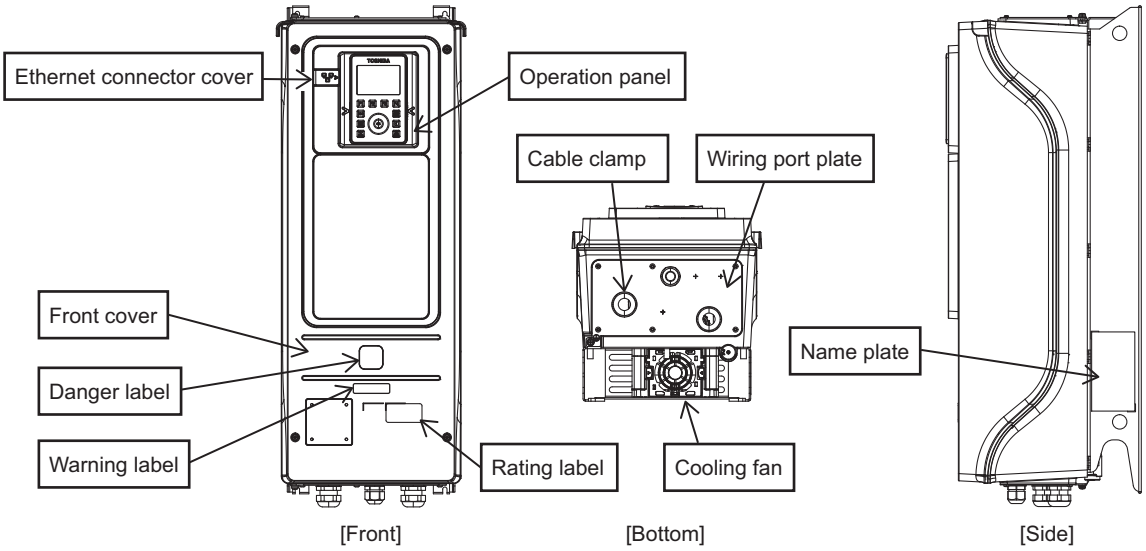
Type-Form	Frame size (Standard model: IP20)	Frame size (Totally enclosed box type: IP55)
VFAS3-4004PCE	A1	A1E
VFAS3-4007PCE		
VFAS3-4015PCE		
VFAS3-4022PCE		
VFAS3-4037PCE		
VFAS3-4055PCE	A2	A2E
VFAS3-4075PCE		
VFAS3-4110PCE	A3	A3E
VFAS3-4150PCE		
VFAS3-4185PCE		
VFAS3-4220PCE	A4	A4E
VFAS3-4300PCE		
VFAS3-4370PCE		
VFAS3-4450PCE	A5	A5E
VFAS3-4550PCE		
VFAS3-4750PCE		

1. 3 Structure of equipment

The following is brief explanation of the names and functions of parts that compose the inverter.

1. 3. 1 Outside view

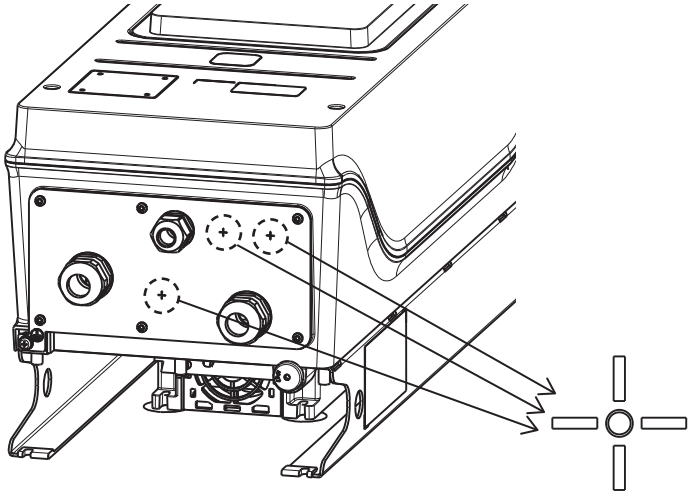
This inverter has five types of units with frame size A1E to A5E (made of resin or metal) according to the capacity. For details of outside dimensions, refer to [6. 2].



* Top cover is included in the package. To install it with the product, refer to [2.1.2] for details.

1. 3. 2 Wiring port plate

When you need additional holes for cables (braking resistor and/or additional control cable) to pass the wiring port plate, make the hole at the crossing marking on the wiring port plate.
Use the suitable cable gland for each hole in order to keep IP protection.



2 Installation and wiring

⚠ WARNING

 Prohibited	• Do not install and operate the inverter if it is damaged or any of its components is missing. This will result in electric shock or fire. Please call your Toshiba distributor for repairs. • Do not place or insert any kind of object (electrical wire cuttings, rods, wires etc.) inside the inverter. This will cause a short circuit and result in electric shock or fire. • Do not mount the inverter on an inflammable object. This will result in fire.
 Mandatory action	• Mount the inverter on a metal plate. The rear panel will get high temperature. • Install proper short-circuit protection device (eg. ELCB or fuse) between the power supply and the inverter (primary side). If proper short-circuit protection device is not installed, short circuit current cannot be shut down by inverter alone and it will result in fire. • An emergency stop device must be installed that is configured in accordance with the system specifications. If such an emergency stop device that can activate mechanical brake by shutting off power supply is not installed, operation cannot be stopped immediately by the inverter alone, thus resulting in an accident or injury.
 Be grounded	• 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.

⚠ CAUTION

 Prohibited	• For transporting or carrying the inverter, do not hold by the front cover. The cover will come off and the unit will drop, resulting in injury. • Do not touch the edge of metal parts. Touching the sharp edge will result in the injury. • Do not pull the cable connected to the terminal blocks. This can cause loose screw and can result in fire.
 Mandatory action	• Carry the inverter by two people or more when the inverter is the model mass 20kg or more (VFAS3-4110PCE - 4370PCE). If you carry the inverter alone, this will result in injury. • Transport a large-capacity inverter (VFAS3-4450PCE - 4750PCE) by a crane. If you transport a heavy load by hand, this will result in injury. • Install the inverter at a place which can support the unit's mass. If you install the inverter at a place which does not support the unit's mass, the unit will fall, resulting in injury.

NOTICE

Prohibited	• Do not connect an capacitor with DC input terminal [PA/+], [PC/-] (including DC link with another inverter) without installing proper pre-charge circuit. Excessive capacitor between DC terminals will cause the input overcurrent of inverter and will result in product damage or failure.

This chapter explains installation of the inverter, how to remove the covers, how to wire to the power supply and the motor, connection of the control circuit, and functions of terminals and connectors for communication.

2

2. 1 Installation

Take special care with the installation environment of inverter. Install the inverter in a location that secures space for ventilation and heat emitting, considering heat generation and occurrence of noise.

2. 1. 1 Installation environment

⚠ WARNING

Prohibited	• Do not place any inflammable object near the inverter. If flame is emitted due to failure in the inverter, this will lead to fire.

⚠ CAUTION

Prohibited	• Do not install the inverter in any place with large vibration. The unit will fall due to the vibration, resulting in injury.

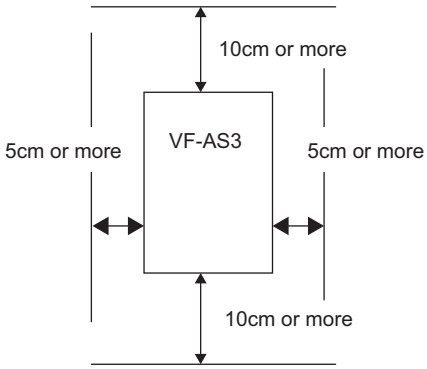
NOTICE

Mandatory action	• Transport or install under the environmental conditions prescribed in the instruction manual. Transporting or installing under any other conditions will result in failure.

This inverter is an electronic control instrument. Take full consideration to install it in the proper operating environment as follows.

■ Installation environment

- Operate in areas where ambient temperature ranges from –15°C to 50°C.
  Where ambient temperature will rise above 40°C, derating of rated current is needed. Refer to "Instruction Manual for Load Reduction" (E6582116) for details.
- Install the inverter in a well-ventilated place and mount it on a flat metal plate in portrait operation.
- Leave a space of 10cm or more on the upper and lower sides of the inverter, and a space of 5cm or more on each side.
- This inverter have a structure with IP55 conformity.
  IP55 is a structure that protects the contents from dust and harmful effects of water that drops from every direction.



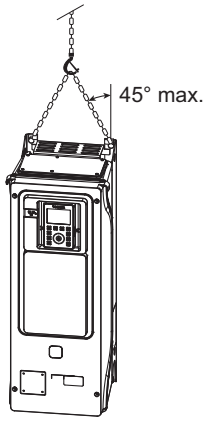
2. 1. 2 How to install

⚠ WARNING

Prohibited	• Do not place any inflammable object near the inverter. If flame is emitted due to failure in the inverter, this will lead to fire.
Mandatory action	• Mount the inverter on a metal plate. The rear panel will get high temperature. Do not mount the inverter on an inflammable object, this will result in fire. • Install proper short-circuit protection device (eg. ELCB or fuse) between the power supply and the inverter (primary side). If proper short-circuit protection device is not installed, short circuit current cannot be shut down by inverter alone and it will result in fire. • An emergency stop device must be installed that is configured in accordance with the system specifications. If such an emergency stop device that can activate mechanical brake by shutting off power supply is not installed, operation cannot be stopped immediately by the inverter alone, thus resulting in an accident or injury.

⚠ CAUTION

Prohibited	• For carrying the inverter, do not hold by the front cover. The cover will come off and the unit will drop, resulting in injury. • Do not install the inverter in any place with large vibration. The unit will fall due to the vibration, resulting in injury.
Mandatory action	• Carry the inverter with the cover attached, and avoid holding or putting your hands in the wiring holes. Otherwise you can have your hands pinched and injured. • Carry the inverter by two people or more when the inverter is the model mass 20kg or more (VFAS3-4110PCE - 4370PCE). If you carry the inverter alone, this will result in injury. • Transport a large-capacity inverter (VFAS3-4450PCE - 4750PCE) by a crane. If you transport a heavy load by hand, this will result in injury. Please take the utmost care for the operator's safety, and please handle the inverter carefully in order not to damage the product. For lifting the inverter, hang the inverter with wire ropes via hanging bolts (hanging holes) provided at upper part or lower part of the inverter as shown in right. Note 1) Make sure that the inverter is hung by two wire ropes in a balanced manner, and be careful that the inverter does not receive excessive force during the hanging operation. Note 2) Be sure to carry the product with the cover attached. Note 3) Do not put your hand in the wiring port during transportation. • Install the inverter at a place which can support the unit's mass. If you install the inverter at a place which does not support the unit's mass, the unit will fall, resulting in injury. • Install a mechanical brake when it is necessary to hold a motor shaft. The brake function of the inverter cannot perform mechanical hold, and it will result in injury. • When using an input filter (ex. harmonics reduction), make sure the inverter behavior with your equipment before use. Otherwise it can cause an accident by inverter instability due to resonance between the inverter and the input filter.



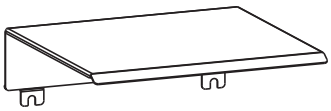
Select an indoor location with good ventilation, and then install the inverter upright on a flat metal plate. For the positions and sizes of the mounting holes, refer to [6. 2].

■ Top cover over view

Top cover is including in the package with the inverter.

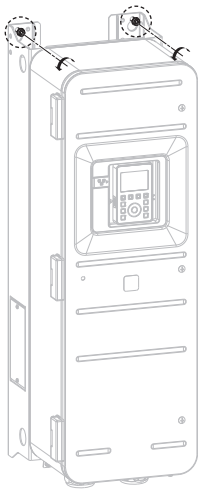
For frame size A1E, A2E, and A3E

For frame size A4E and A5E



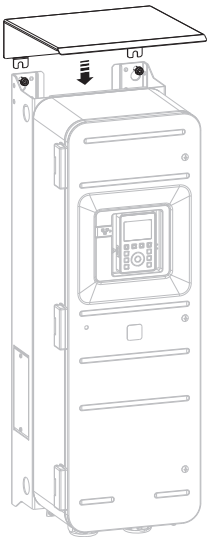
■ How to install the top cover

1) Top cover is installed before 2 mounting screws on top side are tightened with standard torque (the screws must be tightened with the torque to support the inverter weight).

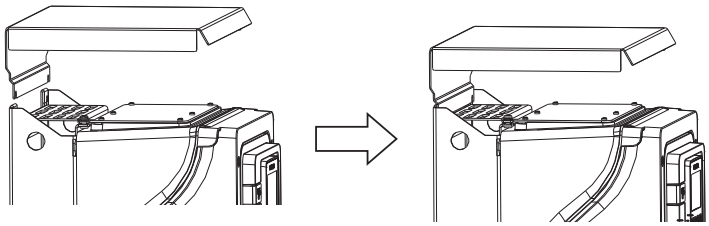


Important	• For UL type 12, top cover must be installed.

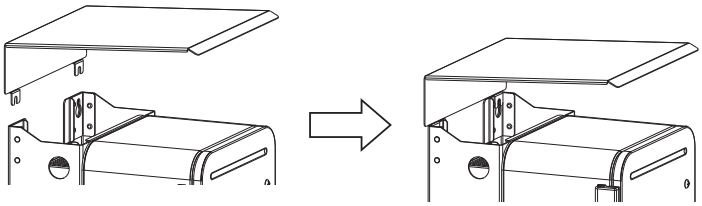
2) Set the top cover on the inverter, to fix it with 2 mounting screws for the inverter top side.



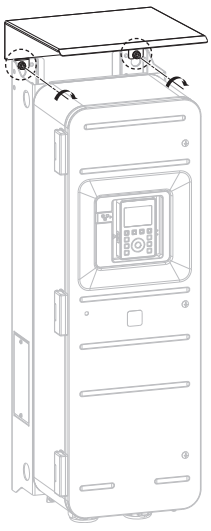
Frame size A1E, A2E, and A3E



Frame size A4E and A5E



3) Tighten 2 mounting screws on top with the standard torque.



2. 2 How to remove covers of inverter

⚠ WARNING

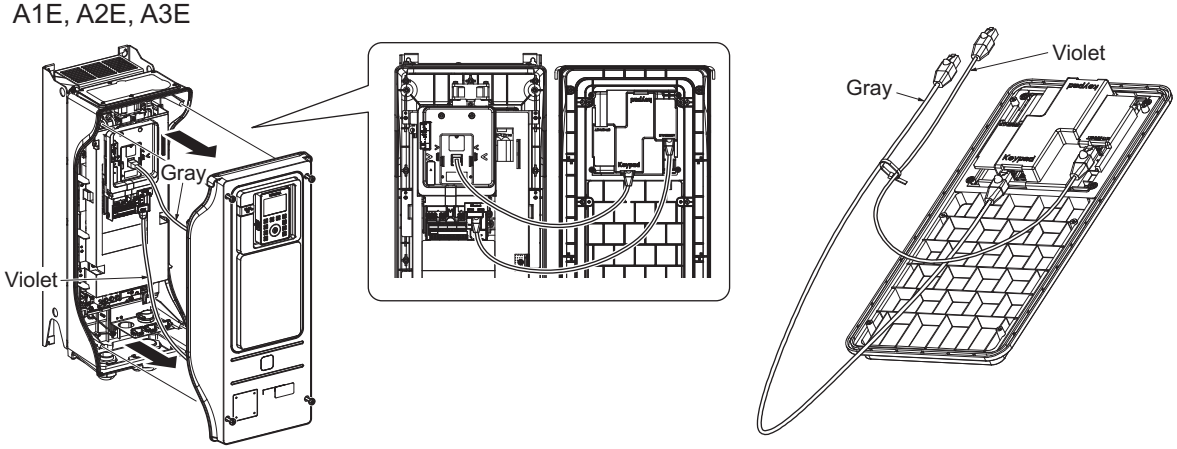
Prohibited	• Never open the front cover when the power is on. The unit contains high voltage parts and contact with them will result in electric shock.
Mandatory action	• Confirm the gasket is put into the groove of front cover before putting front cover. If the gasket is not put into the groove of front cover correctly, it can result in the electric shock or fire. • Turn the power off when removing the front cover. If the power is on, it can result in electric shock or injury. • After wiring is complete, be sure to replace the front cover and close Ethernet connector cover and cable cramp. Otherwise, it can result in electric shock or fire.

⚠ CAUTION

Mandatory action	• When opening and mounting the front cover or the power terminal block with a screwdriver, be sure not to scratch your hand as these results in injury.

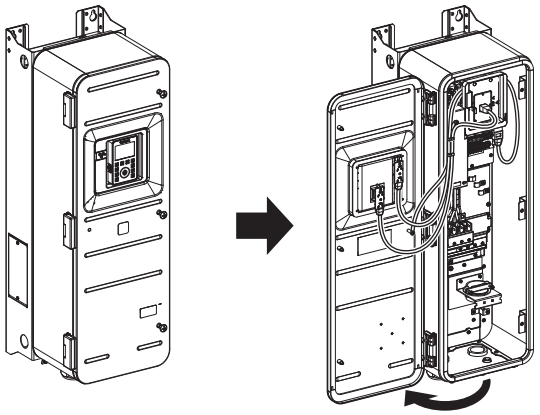
Before removing the front cover in order to wire for power terminals or control terminals, detach the cable for operation panel as shown below.

A1E, A2E, A3E



Important	• If a gasket is removed from the cover, put the gasket back into the groove of the cover.

A4E, A5E



2

After wiring, connect the cable for operation panel to its original location before closing front cover.

Important	• Attach the front cover correctly. Imperfect attachment can result in failure of IP55 compliance.

2. 3 Wiring

⚠ WARNING

Prohibited	• Do not stick your fingers into openings such as cable wiring holes and cooling fan covers. The unit contains high voltage parts and contact with them will result in electric shock or injury. • Do not place or insert any kind of object (electrical wire cuttings, rods, wires etc.) inside the inverter. This will cause a short circuit and result in electric shock or fire. • Never remove the front cover when the power is on. The unit contains high voltage parts and contact with them will result in electric shock. • Do not touch wires of equipment (e.g. ELCB) that is connected to the inverter power side at least 15 minutes after turning off the power. If an electric charge remains in a capacitor in the inverter, touching the wires before the indicated time will result in electric shock.
Mandatory action	• Electrical construction work must be done by a qualified expert. Erroneous connection of power supply by someone who does not have that expert knowledge will result in fire or electric shock. • Verify that 15 minutes have passed since the power is turned off then the charge lamp is off and DC bus voltage between [PA/+] and [PC/-] terminals is 45V or less, before starting wiring. If you perform wiring without this verification, it will result in electric shock. • In using a power distribution device and external options for the inverter, they must be installed in a cabinet. When they are not installed in the cabinet, this will result in electric shock.

2. 3. 1 Cautions for wiring

⚠ WARNING

 Mandatory action	• Mount the front cover after wiring. If you turn the power on without attaching the front cover, this will result in electric shock or other injury. • Wiring must be done after installation. If you perform wiring prior to installation, this will result in electric shock or other injury. • Tighten the screws on the terminal block to specified torque. If the screws are not tightened sufficiently to the specified torque, this will result in fire. • Verify that the power supply voltage is within +10% and -15% of the rated voltage written on the name plate. If you do not use the appropriate power supply voltage, this will result in failure or fire.
 Be grounded	• 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.

⚠ CAUTION

 Prohibited	• Do not touch the edge of metal parts. Touching the sharp edge will result in injury. • Do not pull the cable connected to the terminal blocks. This can cause loose screw and can result in fire.

NOTICE

 Prohibited	• Do not connect a capacitor with DC input terminal [PA/+], [PC/-] (including DC link with another inverter) without installing proper pre-charge circuit. Excessive capacitor between DC terminals will cause the input overcurrent of the inverter and will result in product damage or failure.
 Mandatory action	• Following type of screwdriver should be used; Frame size A1E : PH2 (phillips, bit type2), shaft diameter 5.0mm or less Frame size A2E : PH2 (phillips, bit type2), shaft diameter 5.8mm or less Improper screwdriver use will cause product damage.

Pay attention to the following when wiring.

■ **Measures for noise**

To prevent electrical interference due to high-frequency noise generated by the inverter, separately bundle wires to the power circuit's power side terminals ([R/L1], [S/L2], [T/L3]) and wires to the motor side terminals ([U/T1], [V/T2], [W/T3]).

■ Wiring

- For power terminals, use ferrules with insulation sleeve terminal and crimp-style terminal with insulation sleeve. Connect the terminals so that adjacent terminals do not touch each other.
- For the sizes of electric wires used in the power circuit, refer to the table in [4. 1].
- The length of each wire is assumed to be 30 m or less. If the wire length is over 30 m, the wire size (diameter) must be increased.
- For grounding terminal, use wires of the size that is equivalent to or larger than those given in table [4. 1] and always ground the inverter.
- Wire the grounding wire as close as possible to the inverter.
- To ground the inverter unit, connect it to an exclusive grounding terminal. Do not use screws of the case, chassis, etc.
- Tighten the screws of the power terminal block and the control terminal block to the recommended tightening torque shown in the table [2. 3. 3].

■ Control terminals

Refer to [2.3.5] of "VF-AS3 instruction manual" (E6582062).

2. 3. 2 Standard connection method

⚠ WARNING

 Prohibited	• Do not connect power supply to the output (motor side) terminals [U/T1], [V/T2] and [W/T3]. Connecting power supply to the output will damage the inverter and result in fire. • Do not insert a braking resistor between DC terminals [PA/+] and [PC/-]. This will result in fire. Please connect the braking resistor in accordance with the instruction manual. • Do not touch wires of equipment (e.g. ELCB) that is connected to the inverter power side at least 15 minutes after turning off the power. If an electric charge remains in a capacitor in the inverter, touching the wires before the indicated time will result in electric shock. • Do not touch output terminals [U/T1], [V/T2] and [W/T3] on the PM motor side while the PM motor is rotating even after turning off the power. While the PM motor is rotating even after the power is turned off, as a high voltage is generated in the output terminals [U/T1], [V/T2] and [W/T3] on the PM motor side, touching the output terminals will result in electric shock. Please perform wiring after verifying that the PM motor is stopped.
 Mandatory action	• Connect output terminals (motor side) correctly. If the phase sequence is incorrect, the motor will operate in reverse and that can result in injury. • In using a power distribution device and options for the inverter, they must be installed in a cabinet. When they are not installed in the cabinet, this will result in electric shock. • If using output filter between inverter and motor, read the filter manual and set correct parameters. Use of the filter under improper parameter setting will cause fire.
 Be grounded	• 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.

⚠ CAUTION

 Prohibited	• Do not install devices with built-in capacitors (such as noise reduction filters or surge absorbers) to the output terminals (motor side). Heat rises up and this can cause a fire.
 Mandatory action	• When using an input filter (ex. harmonics reduction), make sure the inverter behavior with your equipment before use. Otherwise it can cause an accident by inverter instability due to resonance between the inverter and the input filter.

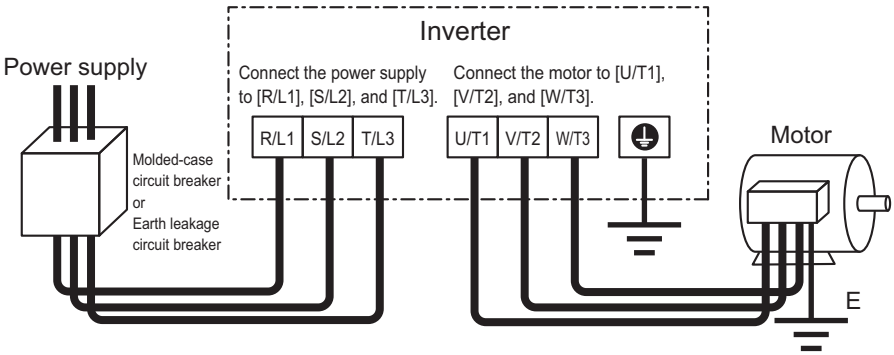
NOTICE

 Mandatory action	• All options to be used must be those specified by Toshiba. The use of options other than those specified by Toshiba will result in an accident.

The wiring of the power supply and motor is connected to the power terminal block and the wiring of external control equipment such as control signals to the control terminal block.

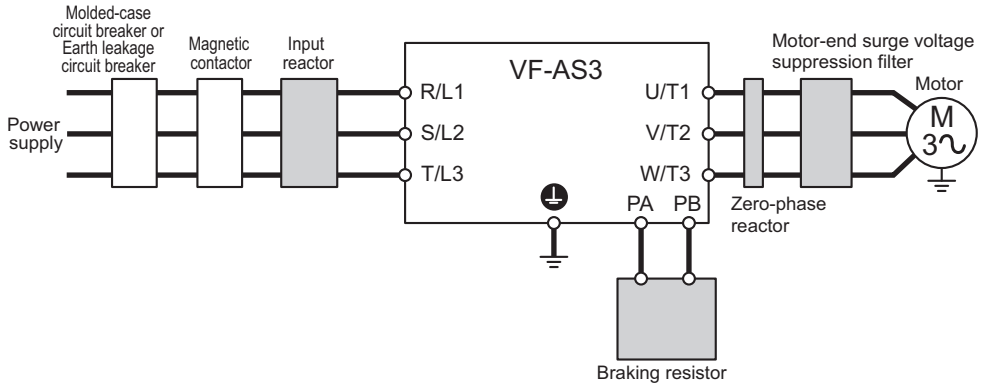
■ Connection to power supply and motor

This diagram shows a standard wiring of the power circuit.
Connection to the power supply and motor wiring is common to all the types.



■ Connection to peripheral devices

This diagram shows an example of connection to peripheral devices.

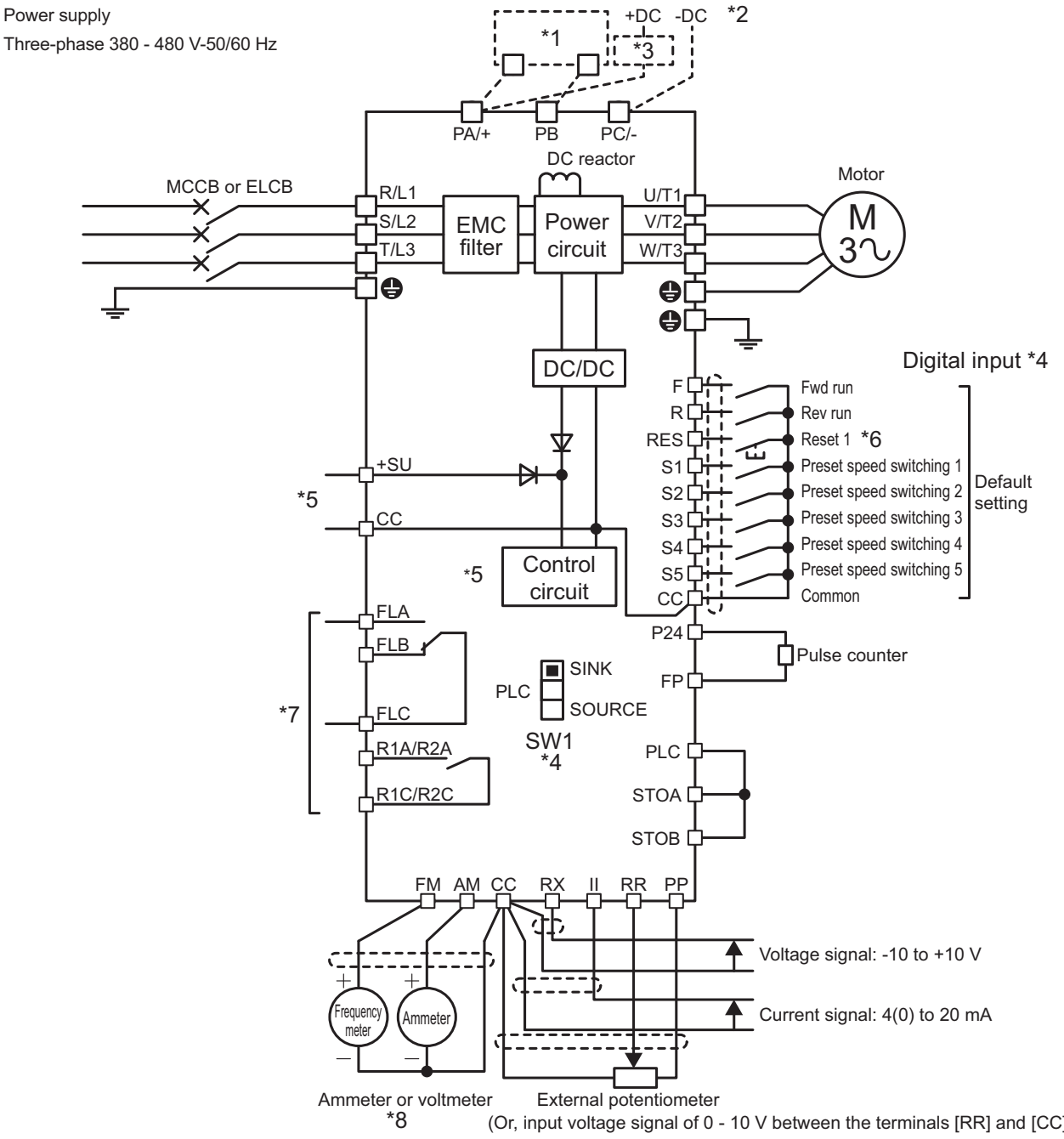


See [2.3.2] of E6582062 for detail instruction of wiring.

■ Standard connection diagram

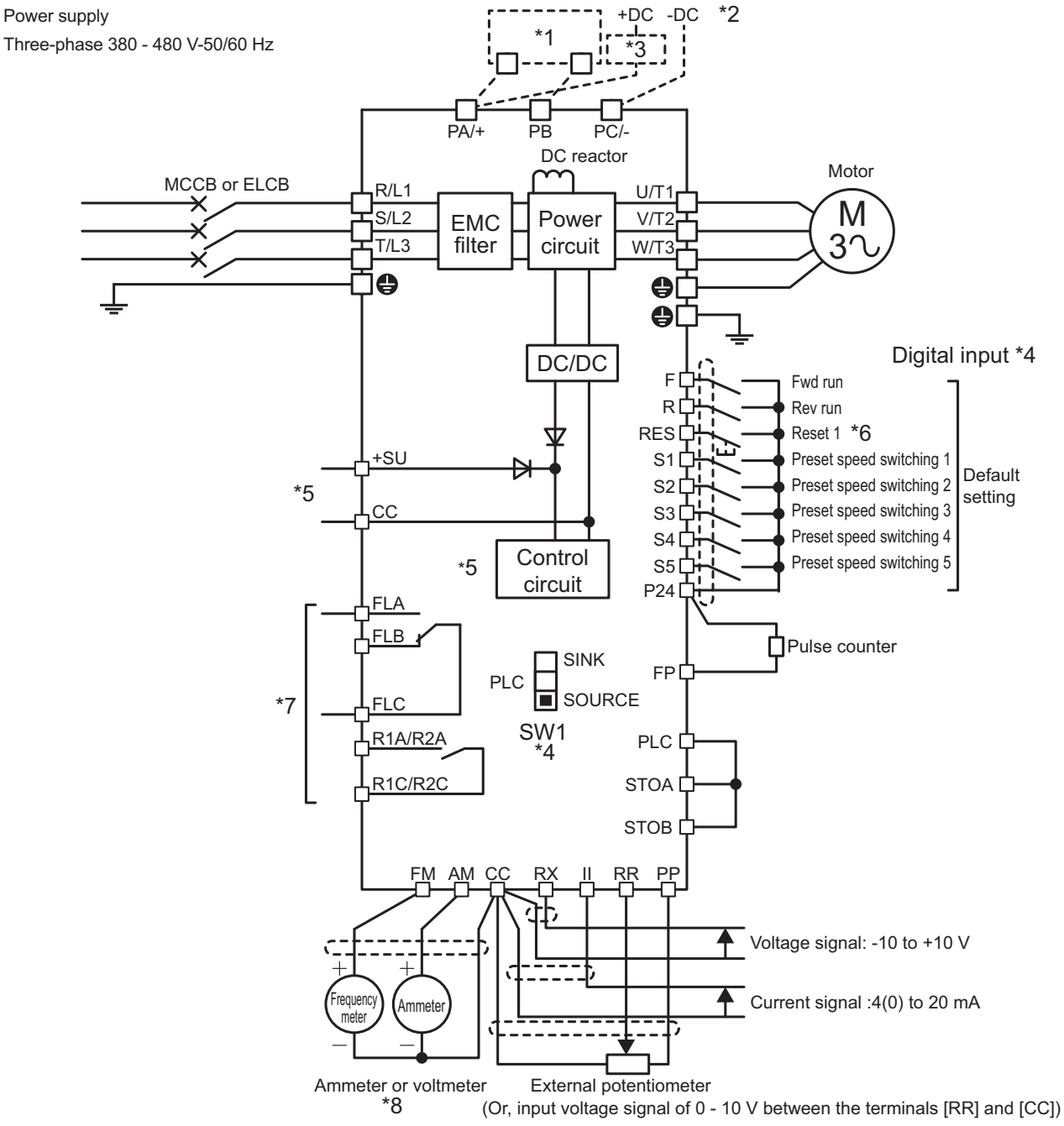
This diagram shows a standard wiring of the power circuit and control circuit.

[Standard connection diagram – sink logic with using internal supply]
This diagram shows an example of a standard connection.



*1 External braking resistor (option).
*2 To supply DC power, connect the inverter between the terminals [PA/+] and [PC/-].
*3 When using models of VFAS3-4220PCE to VFAS3-4750PCE with a DC power supply, a circuit to suppress an inrush current is required. For detail, refer to [10.5] of E6582062.
*4 This example shows "Sink" logic with using internal power supply. For use of external power supply, refer to [2. 3. 5] of E6582062.
*5 To supply control power from an external power supply for backing up the control power supplied from the inverter, an optional control power supply unit (CPS002Z) is required. In this case, it is used in conjunction with the inverter internal power supply.
Set <F647: Control power option failure detection> to back up the control power supply. For details, refer to [6. 30. 20] of E6582062.
*6 The reset signal is activated by ON→OFF trigger input.
*7 Connect to power to comply with OVCII (Over Voltage Category II). Isolation transformer is necessary when connecting to power supply (OVCIII).
*8 Calibration is required when connecting a meter. Refer to [5.2.6] of E6582062.

[Standard connection diagram – source logic with using internal supply]
This diagram shows an example of a standard connection.



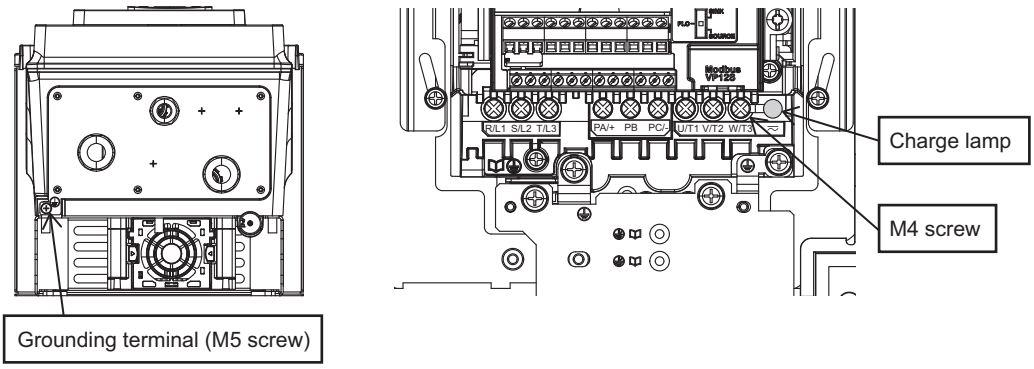
*1 External braking resistor (option).
*2 To supply DC power, connect the inverter between the terminals [PA/+] and [PC/-].
*3 When using models of VFAS3-4220PCE to VFAS3-4750PCE with a DC power supply, a circuit to suppress an inrush current is required. For detail, refer to [10.5] of E6582062.
*4 This example shows "Source" logic with using internal power supply. For use of external power supply, refer to [2.3.5] of E6582062.
*5 To supply control power from an external power supply for backing up the control power supplied from the inverter, an optional control power supply unit (CPS002Z) is required. In this case, it is used in conjunction with the inverter internal power supply.
Set <F647: Control power option failure detection> to back up the control power supply.
For details, refer to [6. 30. 20] of E6582062.
*6 The reset signal is activated by ON→OFF trigger input.
*7 Connect to power to comply with OVCII (Over Voltage Category II). Isolation transformer is necessary when connecting to power supply (OVCIII).
*8 Calibration is required when connecting a meter. Refer to [5.2.6] of E6582062.

2. 3. 3 Power terminals

Terminal symbol	Function	Applicable frame size
⏚	Grounding terminal for inverter case. There are multiple terminals in the product, they are also used to connect shield of input/motor cables.	All frame sizes
[R/L1] [S/L2] [T/L3]	Connected to an AC power supply. 480 V class: Three-phase 380 - 480 V-50/60 Hz	All frame sizes
[U/T1] [V/T2] [W/T3]	Connected to a three-phase motor.	All frame sizes
[PA/+] [PB]	Connected to a braking resistor. Set the parameters if necessary, refer to [6. 15. 4] of E6582062 for details.	All frame sizes
[PA/+] [PC/-]	DC bus terminals. When using DC power supply, refer to section [10.5] of E6582062.	All frame sizes

■ Arrangement of power terminals

1) Frame size A1E
VFAS3-4004PCE to 4037PCE

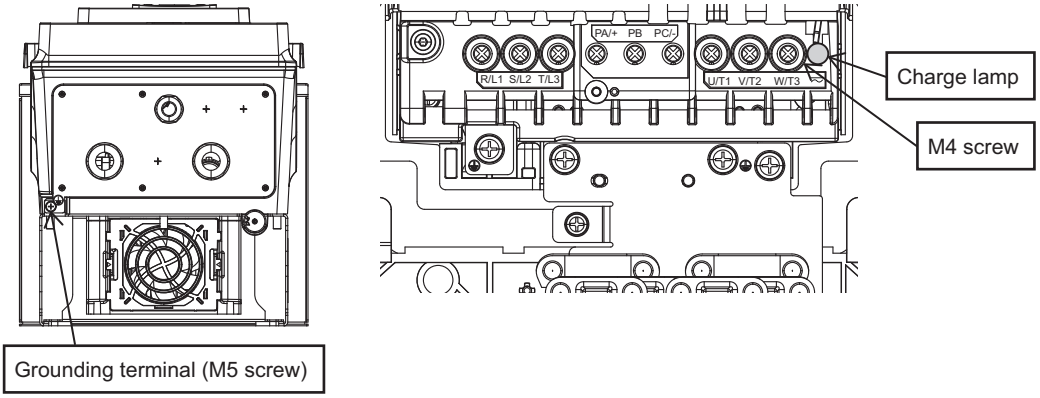


NOTICE

Mandatory action

- Following type of screwdriver should be used for M4 screw;
  PH2 (phillips, bit type2), shaft diameter 5.0 mm or less.
  Improper screwdriver use can cause product damage.

2) Frame size A2E
VFAS3-4055PCE, VFAS3-4075PCE

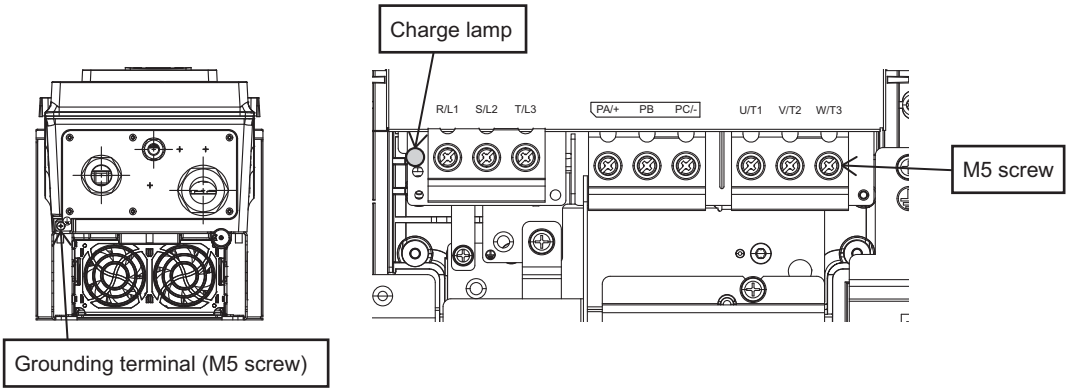


NOTICE

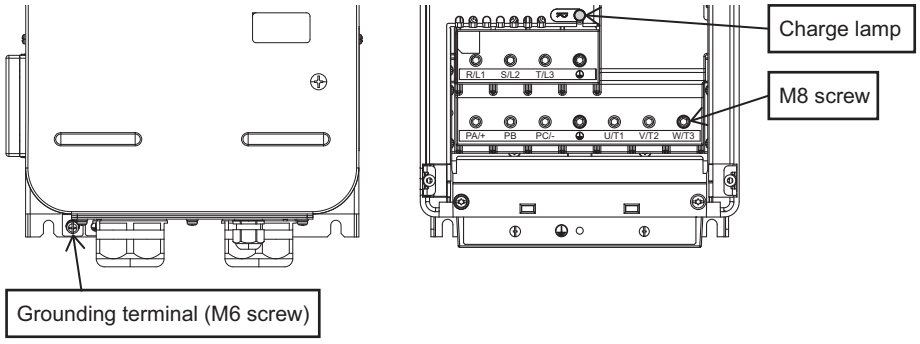
Mandatory action

- Following type of screwdriver should be used for M4 screw;
  PH2 (phillips, bit type2), shaft diameter 5.8 mm or less.
  Improper screwdriver use can cause product damage.

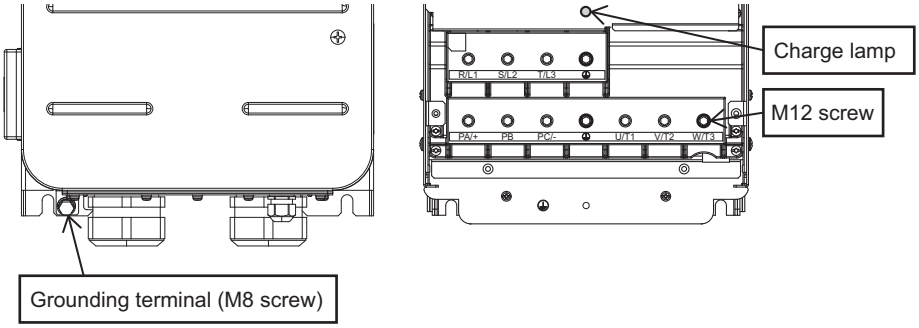
3) Frame size A3E
VFAS3-4110PCE, VFAS3-4150PCE, VFAS3-4185PCE



4) Frame size A4E
VFAS3-4220PCE, VFAS3-4300PCE, VFAS3-4370PCE



5) Frame size A5E
VFAS3-4450PCE, VFAS3-4550PCE, VFAS3-4750PCE



For tightening torque and wire strip length, refer to the table below.

Important

- After finishing the wiring installation, tighten all power terminal screws with proper torque again.

■ Power terminal torque and wire strip length

Frame size	Type-Form	Screw size	Torque*1		Strip length (mm)	Others
			(N • m)	(lb • in)		
A1E	VFAS3-4004PCE to 4037PCE	M4	1.3	11.5	10	-
A2E	VFAS3-4055PCE, 4075PCE	M4	1.5	13.3	10	-
A3E	VFAS3-4110PCE to 4185PCE	M5	2.6	23	18	-
A4E	VFAS3-4220PCE to 4370PCE	M8	5	44.3	28	for AWG2 or smaller cable
			10	88.5	28	for AWG1 or bigger cable
			12	106	28	Product revision "A" *2
A5E	VFAS3-4450PCE to 4750PCE	M12	10	88.5	35	for AWG1/0 or smaller cable
			18	159	35	for AWG2/0 or bigger cable
			25	221	35	Product revision "A" *2

■ **Grounding terminal (for inverter case) torque**

Frame size	Type-Form	Screw size	Torque*1		Strip length (mm)	Others
			(N • m)	(lb • in)		
A1E, A2E, A3E	VFAS3-4004PCE to 4185PCE	M5	2.6	23	-	-
A4E	VFAS3-4220PCE to 4370PCE	M6	4.4	38.9	-	-
A5E	VFAS3-4450PCE to 4750PCE	M8	11.8	104	-	-

*1 1(N • m) = 8.850(lb • in)

*2 Product revision is marked on Nameplate/Packaging label as "(number + alphabet)", refer to section [1.1].
Product revision A shows "(number + A)" on their labels, for example VFAS3-4370PC (8A)

2. 3. 4 Switching of grounding capacitor

⚠ WARNING

Mandatory action

- Disconnect the grounding capacitor, when using this inverter with the following power supply system.
  1) 480V power supply grounded in other than the neutral point (e.g. when the power supply has delta connection with single phase grounding)
  2) IT system (power supply isolated from ground or grounded through high impedance)
  Otherwise, it will result in failure or fire.
- Verify that 15 minutes have passed since the power is turned off then the charge lamp is off and DC bus voltage between [PA/+] and [PC/-] terminals is 45V or less, before switching the grounding capacitor.
  If you perform wiring without this verification, it will result in electric shock.

This inverter has a built-in EMC noise filter and the inverter input power supply is grounded via the capacitor.

Set the grounding capacitor switch connected/disconnected depends on your system.

■ **Connected (Default setting)**

- To comply with EMC directive
- To reduce emission noise from inverter

■ **Disconnected**

- To reduce leakage current
- To use inverter with IT system (power supply isolated from ground or grounded through high impedance)
- To use inverter with 480V power supply grounded in other than the neutral point (e.g. when the power supply has delta connection with single phase grounding)

Important

- Note that when the grounding capacitor is not grounded, the inverter unit no longer comply with the EMC directive.
- Be sure to set two screws to the same side.

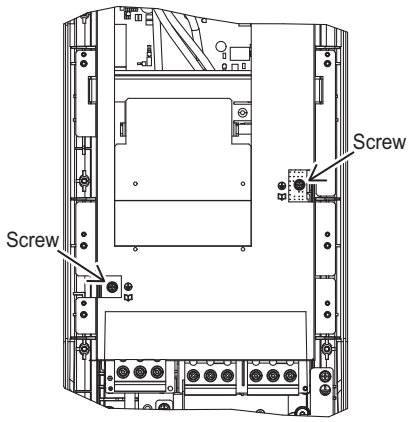
To switch the grounding capacitor for frame size A1E, A2E, A4E and A5E, refer to the description of frame size A1, A2, A4 and A5 respectively on [2.3.4] of E6582062. For frame size A3E see following instruction.

1 Remove the front cover.
For how to remove, refer to [2. 2].

2 Remove two screws for switching of grounding capacitor.
The grounding capacitor is disconnected.
Store removed screws in a safe place for recovery.

3 To recover the shipping state, mount the two screws for switching of grounding capacitor and tighten them.
The grounding capacitor is connected and grounded.

4 After switching, mount the front cover.
For how to mount, refer to [2. 2].



Important

- For models with two switching screws, be sure to set both screws to the same side.

3 Measures to satisfy standards

This chapter explains the measures to comply with EU directives, UL/CSA Standards, etc. by introducing examples.

3. 1 How to deal with CE marking

CE mark is put on all products of VF-AS3 to declare that they are in conformity with the requirements of Low Voltage Directive, EMC Directive and Machinery Directive as safety related component.

CE mark must be put on all machines and power drive systems with built-in inverter to conform to EU directives. It is the responsibility of the manufacturers of such final products to put the CE mark on each final product with built-in inverter. We recommend the installation method of inverters and measures described in this instruction manual to conform to these EU directives.

We have tested representative models with them installed under the environment described later in this manual to check for conformity with the EMC Directive. However, we cannot check the inverters under your operating environment. EMC 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, you need to verify yourself whether your machine and system conforms to the EMC Directive.

3. 1. 1 Compliance with EMC Directive

VF-AS3 series comply with EMC directive if the installation and wiring are carried out according to the guideline shown in this section.

The EMC standards are broadly divided into two categories; Emission and Immunity, each of which is further categorized according to the operating environment of each individual machine as shown in the table below. We consider that the tests required for machines and systems as final products are almost the same as those required for inverters.

Category	Subcategory	Product standards	Test standard
Emission	Radiated noise	IEC61800-3	CISPR11 (EN55011)
	Conducted noise		CISPR11 (EN55011)
Immunity	Electrostatic discharge		IEC61000-4-2
	Radio-frequency electromagnetic field		IEC61000-4-3
	Electrical fast transient/burst		IEC61000-4-4
	Surge		IEC61000-4-5
	Conducted radio-frequency common mode		IEC61000-4-6
	Voltage dips, short interruptions and voltage variations		IEC61000-4-11

(1) EMC Directive compliance of this inverter

The built-in EMC filter on the input side of this inverter reduces conducted noise and radiated noise from input cables. The compliance with the EMC Directive is as shown in the table below.

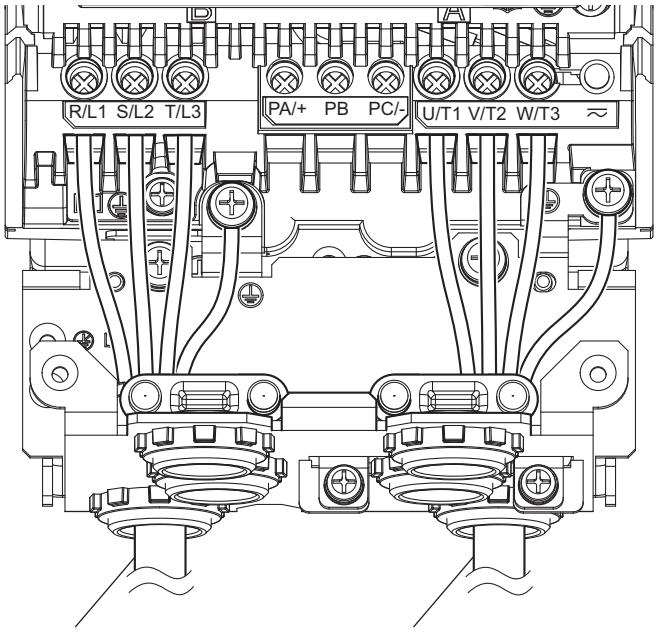
Inverter type	Carrier frequency <F300>	Conducted noise IEC61800-3 category C2 (EN55011 classA Group1)	Conducted noise IEC61800-3 category C3 (EN55011 classA Group2)
		Length of motor connecting cable	Length of motor connecting cable
	(kHz)	(m)	(m)
VFAS3-4004PCE	4	50	150
VFAS3-4007PCE	4	50	150
VFAS3-4015PCE	4	50	150
VFAS3-4022PCE	4	50	150
VFAS3-4037PCE	4	50	150
VFAS3-4055PCE	4	50	150
VFAS3-4075PCE	4	50	150
VFAS3-4110PCE	4	50	150
VFAS3-4150PCE	4	50	150
VFAS3-4185PCE	4	50	150
VFAS3-4220PCE	4	50	150
VFAS3-4300PCE	4	50	150
VFAS3-4370PCE	4	50	150
VFAS3-4450PCE	2.5	-	150
VFAS3-4550PCE	2.5	-	150
VFAS3-4750PCE	2.5	-	150

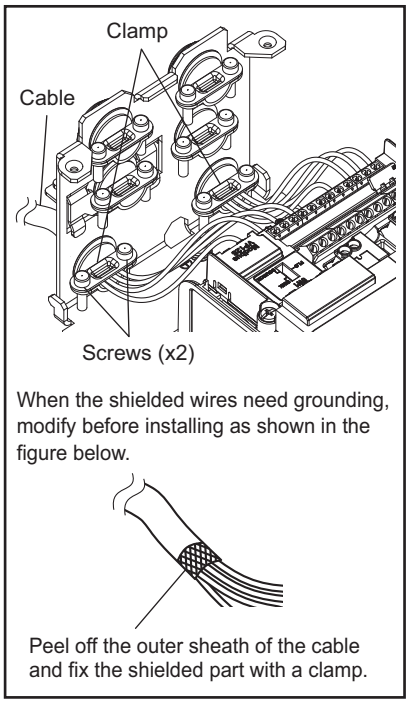
(2) Examples of measures to comply with EMC Directive

The following are measures to comply with EMC directive when installing VF-AS3 inverters in your systems.

- Examples of general measures
- When adding an EMC filter for further reduction of noise
- Measures for operation with external signals

The following are general EMC measures explained concretely.





Using shielded power wires and shielded control wires

- Use shielded power wires, such as inverter input/output wires, and shielded control wires.
- Route the wires and wires so as to minimize their lengths.
- Keep a distance between the power cable and the control wire and between the input and output wires of the power cable. Do not route them in parallel or bind them together. Instead, if necessary, cross at right angle.

Routing input and output wires apart

- Route the input and output wires apart as far as possible from each other.

Grounding of shielded wires

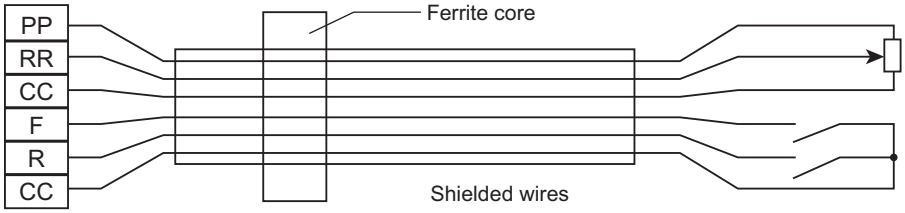
- To ground shielded wires through a metal conduit.
- To ground the shielded control wires by fixing the metal saddle of the body.
- Inserting a ferrite core in a shielded wire is even more effective in limiting the radiated noise.

Inserting zero-phase reactor and ferrite cores

- Insert a zero-phase reactor in the inverter output line.
- Insert ferrite cores in the grounding wires of the metal plate.

(3) Measures for operation with external signals

To operate with external signals, take measures as shown in the figure below (e.g.: using a potentiometer and Fwd/Rev terminals).



Memo

- Electromagnetic Compatibility Regulations for UKCA mark are also covered.

3

3. 1. 2 Compliance with Low Voltage Directive

⚠ 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 electric shock or 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 on the wall or 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.
Be grounded	• 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. • The product has a leakage current greater than 3.5 mA. A grounding wire (protective ground conductor) size must be at least 10mm^2 or two grounding wires with the size as same as original one must be used. Use of improper grounding wire will result in electric shock or fire. The grounding of drive system must be provided in accordance with the national electrical code and any additional local codes.
Electric shock	• Capacitive voltage above 50V may remain for 15 minutes after power is disconnected. Wiring or servicing must be performed under the capacitive voltage below 50V. Otherwise, it will result in electric shock.

⚠ CAUTION

Mandatory action

- This product can cause a DC current in the PE conductor. Where a residual current operated protective device (RCD) is used for protection against electric shock, only an RCD of Type B is allowed on the supply side of this product. All upstream RCD, up to the supply transformer, shall be of Type B.
  If proper device above is not used, it can result in electric shock.

Inverters are CE-marked in accordance with the requirement of Low Voltage Directive, and can therefore be installed in power drive system and exported without problem to EU countries.

- Applicable standard: EN61800-5-1 (IEC61800-5-1)
- Pollution degree: 2
- Overvoltage category: 3
- The electronic power output short-circuit protection circuitry meets the requirements of IEC60364-4-41:2005/AMD1 - Clause 411.

When incorporating the inverter into a power drive system, take the following measures to comply with Low Voltage Directive.

(1) Installation and upstream protection devices

- Install the inverter on a wall or into the enclosure with proper short circuit protective device (SCPD) in accordance with the table of prospective short-circuit current (Isc) rating shown in [9.1.2] of E6582062.

(2) Grounding

- Connect a dedicated wire to the grounding terminal on the inverter.
- Ground each inverter directly when grounding multiple inverters.
- Refer to the table in [4. 1] to select wire size.

  A grounding wire size must be at least 10mm^2. Also two grounding wires can be used with the size as same as that of [4. 1].
  The grounding of drive system must be provided in accordance with the national electrical code and any additional local codes.

(3) Overload protection

- For overload protection of inverter, refer to [5.2.5], [5.3.2] of E6582062.

(4) Motor overload protection and overtemperature protection

- For electronic motor thermal protection, refer to [5. 2. 5] of E6582062.
- For motor integrated PTC thermal protection, refer to [6. 30. 19] of E6582062.

Important

- Motor thermal protection should be used with <F607: Motor overload time> = 300 (default setting) or less.

Memo	• Electrical Equipment (Safety) Regulations for UKCA mark are also covered.

3. 1. 3 Compliance with safety standard

For detail, refer to "VF-AS3 Safety function manual" (E6582067).

3. 1. 4 Compliance with ATEX directive

For detail, refer to "VF-AS3 ATEX guide" (E6582068).

3. 1. 5 Declaration of Conformity

Declaration of Conformity is available via the internet at URL below.
https://www.toshiba-tips.co.jp/en/products/inverter/

3. 1. 6 Compliance of Ecodesign

VF-AS3 series inverter (variable speed drive) conform to Ecodesign requirements* by Commission Regulation (EU). For the detailed technical data, refer to its nameplate and technical data via the internet at URL below.
https://www.toshiba-tips.co.jp/en/products/inverter/

* Ecodesign requirements framework was established by Directive 2009/125/EC.

3. 2 Compliance with UL/CSA standards

The VF-AS3 models, that conform to the UL Standard and CSA Standard have the mark to prove the compliance on the nameplate.
This section shows the detail information for VF-AS3 UL/CSA compliance.

3. 2. 1 Compliance with Installation

⚠ WARNING / AVERTISSEMENT

Electric shock

- Capacitive voltage above 50V may remain for 15 minutes after power is disconnected. Wiring or servicing must be performed under the capacitive voltage below 50V.
  Otherwise, it will result in electric shock.
- Des tensions subsistent aux bornes des condensateurspendant 15 minutes apres l'ouverture de circuit d'enttee. Le câblage ou l'entretien doit être effectué sous une tension capacitive inférieure à 50 V.
  Sinon, cela entraînerait un choc électrique.

The following steps must be performed before wiring and servicing.

(1) Turn off all input power.
(2) Wait at least 15 minutes and check to make sure that the charge lamp is no longer lit.
(3) Use a measuring device that can measure DC voltage beyond 800Vdc and make sure that the voltage to the DC power circuits (across PA/+ and PC/-) is 45V or less.

UL certificate was granted under the short-circuit current rating (SCCR), branch circuit protection (BCP) and the enclosure shown in [3. 2. 3].
VF-AS3 series inverter should be mounted on a wall, under the condition shown in the table below.
Refer to [2. 1] for installation or [Chapter 6] for the specification not listed in the table.

Item	Specification
Maximum ambient temperature	40ºC
Over voltage category	OVC III The optional Relays ([FLA], [FLB], [FLC], [R1A], [R1C], [R2A] and [R2C] terminals) need to be supplied by an isolating device tapped from the mains. The Relay circuit is considered OVC II.
Pollution degree	PD 2
Altitude	2000m or less Current reduction is required above 1000m. For detail, refer to "instruction manual for load reduction" (E6582116)

Important

- Keep original "DANGER" / "WARNING" labels visibility on front cover for UL/CSA compliance.
- Install top cover for Type12 compliance.

3. 2. 2 Compliance with Connection

- Use the UL conformed cables (Rating 75°C or more for 45kW/VFAS3-4370PCE or smaller, Rating 90°C or more for 55kW/VFAS3-4450PCE or larger, Use the copper conductors only.) to the power circuit terminals ([R/L1], [S/L2], [T/L3], [U/T1], [V/T2], [W/T3]).
- Use the UL-certified electric wire for [FLA], [FLB], [FLC], [R1A], [R1C], [R2A] and [R2C] terminals.
- 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.)
- For recommended tightening torque, see [2. 3. 3]
- For recommended electric wire sizes, see [3. 2. 3]
- Use the electric wire of Class1 for the control circuits.

For details of wiring, terminals and the functions, refer to [2. 3. 2], [2. 3. 3], [2. 3. 4] and for control terminal refer to [2. 3. 5] of E6582062.

3. 2. 3 Cautions for peripheral devices

⚠ WARNING / AVERTISSEMENT

Mandatory action	• Damaged branch circuit protective device must be replaced. Continuous use of damaged branch circuit protective device can result in electric shock or fire. The opening of the branch-circuit protective device may be an indication that a fault current has been interrupted. 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 dispositif de protection du circuit de dérivation endommagé doit être remplacé. L'utilisation continue d'un dispositif de protection de circuit de dérivation endommagé peut entraîner un choc électrique ou un incendie. 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 traversè par le courant dans un relais de surcharge, le relais tout entier doit être remplacé.

For this inverter, a UL test has been performed under the condition of the power supply short-circuit currents shown as follows. These allow proper coordination of short circuit protection.

Suitable for use on a circuit capable of delivering not more than___X___rms symmetrical kilo Amperes, ___Y___Volts maximum, when protected by ___Z1___with a maximum rating of ___Z2___.
Where X, Y, Z1 and Z2 are indicated in following table.
(Convient aux circuits non susceptibles de délivrer plus de ___X___ampères symétriques efficaces, maximum ___Y___V, avec protection par ___Z1___de calibre nominal de ___Z2___.
Où X, Y, Z1 et Z2 sont indiqués dans le tableau suivant.)

■ Short-Circuit Current Rating (SCCR) and Wire size

Inverter model	Voltage class	Applicable motor		SCCR (kA)	Branch circuit protection with Fuses*1 *2		Power wire sizes	Grounding wire sizes *4
		(kW)	(HP)		Class	Rating (A)		
	Y	-	-	**X**	**Z1**	**Z2**	-	-
VFAS3-4004PCE	3-phase 480 V	0.75	1	100	Class J	3	AWG14*4	AWG14
VFAS3-4007PCE		1.5	2	100	Class J	6	AWG14*4	AWG14
VFAS3-4015PCE		2.2	3	100	Class J	10	AWG14*4	AWG14
VFAS3-4022PCE		4	5	100	Class J	15	AWG14*4	AWG14
VFAS3-4037PCE		5.5	7.5	100	Class J	15	AWG12*4	AWG12
VFAS3-4055PCE		7.5	10	100	Class J	20	AWG10*4	AWG10
VFAS3-4075PCE		11	15	100	Class J	30	AWG10*4	AWG10
VFAS3-4110PCE		15	20	100	Class J	40	AWG8*4	AWG8
VFAS3-4150PCE		18.5	25	100	Class J	50	AWG8*4	AWG8
VFAS3-4185PCE		22	30	100	Class J	60	AWG6*4	AWG6
VFAS3-4220PCE		30	40	100	Class J	80	AWG4*4	AWG4
VFAS3-4300PCE		37	50	100	Class J	90	AWG3*4	AWG4
VFAS3-4370PCE		45	60	100	Class J	100	AWG1*4	AWG4
VFAS3-4450PCE		55	75	100	Class J	150	AWG 1/0*3	AWG2
VFAS3-4550PCE		75	100	100	Class J	200	AWG 3/0*3	AWG 1/0
VFAS3-4750PCE		90	125	100	Class J	200	AWG 4/0*3	AWG 1/0

*1 The rating of fuses in the table are maximum values. Smaller rating fuses can be used for HD ratings. Branch circuit protection must be provided in accordance with the National Electrical Code and any additional local codes.

*2 Use fuses of Class CC or J, fast acting or time delay. Recommended supplier is Bussman or Mersen.

*3 The wire size is the one when 90°C is continuously allowed (ambient temperature of 40°C or less). The wire size of drive system must be provided in accordance with the National Electrical Code and any additional local codes.

*4 The wire size is the one when 75°C is continuously allowed (ambient temperature of 40°C or less). The wire size of drive system must be provided in accordance with the National Electrical Code and any additional local codes.

In case of using a circuit breaker as branch circuit protection, the inverter must be installed in an enclosure. Use standard type inverter and install it in Type12 rated enclosure in accordance with "VF-AS3 instruction manual", refer to section [9.2.3] of E6582062.

3. 2. 4 Overload protection

The overload protection levels are below,
HD rating: 150%-1minute, 180%-2s
ND rating: 120%-1minute, 135%-2s

Overload protection rated in percent of the rated current described on name plate. Refer to [5.2.5] of "VF-AS3 instruction manual" (E6582062)for details.

3. 2. 5 Motor thermal protection

NOTICE / AVIS

Mandatory action	• Set motor thermal protection according to motor rating. If motor thermal protection is not set, it can result in motor damage. • Réglez la protection thermique du moteur en fonction de sa puissance nominale. Si la protection thermique du moteur n'est pas réglée, cela peut entraîner des dommages au moteur.

To use the electronic thermal function of this inverter for motor thermal protection, set parameters according to the motor specifications applied. This electronic motor thermal function covers 10-100% of full-load current of inverter. When protection out of this range needed or multiple motors driven by one inverter, find an alternative source of thermal protection (ex. motor integrated thermal sensor or overload relay installation for each motor). For adjustment, refer to [5.2.5] of "VF-AS3 instruction manual" (E6582062).

Important	• Motor thermal protection should be used with <F607: Motor overload time> = 300 (default setting) or less.

3. 2. 6 Motor integrated PTC thermal protection

For details, refer to [6. 30. 19] of "VF-AS3 instruction manual" (E6582062).

4 Selection and installation of peripheral devices

In this chapter, the selection and installation methods of peripheral devices for this inverter are described.

⚠ WARNING

Mandatory action	• In using a power distribution device and external options for the inverter, they must be installed in a cabinet. When they are not installed in the cabinet, this will result in electric shock.
Be grounded	• 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.

NOTICE

Mandatory action	• All options to be used must be those specified by Toshiba. The use of options other than those specified by Toshiba will result in an accident.

4. 1 Selection of wire size

According to the voltage class and capacity of the inverter, perform wiring using appropriate wires as shown in the table below. When connecting peripheral devices to the inverter also, perform wiring according to the wire size for a wire location shown in the table below.

- The wire size is a value when using a 600 V PVC insulation copper wire with the maximum allowable temperature 70°C at the conductor for VFAS3-4370PCE or smaller, a 600V XLPE insulation copper wire with the maximum allowable temperature 90°C at conductor for VFAS3-4450PCE or larger with 40 °C ambient temperature and 30 m or less the length of each wire.
- For the wire of the control circuit, use a shielded wire with 0.75 mm^2 or more.

■**Wire size for HD rating**

Voltage class	Applicable motor (kW)	Inverter type-form		Wire size (mm^2)				
				Power circuit		DC wire	Braking resistor	Grounding wire
				Input	Output			
3-phase 480 V	0.4	VFAS3-	4004PCE	1.5	1.5	2.5	1.5	2.5
	0.75		4007PCE	1.5	1.5	2.5	1.5	2.5
	1.5		4015PCE	1.5	1.5	2.5	1.5	2.5
	2.2		4022PCE	1.5	1.5	2.5	1.5	2.5
	4.0		4037PCE	1.5	1.5	2.5	1.5	2.5
	5.5		4055PCE	1.5	2.5	2.5	1.5	2.5
	7.5		4075PCE	2.5	4	2.5	1.5	2.5
	11		4110PCE	4	6	4	1.5	4
	15		4150PCE	6	10	6	2.5	10
	18.5		4185PCE	10	10	10	2.5	10
	22		4220PCE	16	16	16	16	16
	30		4300PCE	25	25	16	16	16
	37		4370PCE	25	35	25	16	16
	45		4450PCE	35	35	35	35	16
	55		4550PCE	50	50	50	35	25
	75		4750PCE	95	95	70	35	50

■**Wire size for ND rating**

Voltage class	Applicable motor (kW)	Inverter type-form		Wire size (mm^2)				
				Power circuit		DC wire	Braking resistor	Grounding wire
				Input	Output			
3-phase 480 V	0.75	VFAS3-	4004PCE	1.5	1.5	2.5	1.5	2.5
	1.5		4007PCE	1.5	1.5	2.5	1.5	2.5
	2.2		4015PCE	1.5	1.5	2.5	1.5	2.5
	4.0		4022PCE	1.5	1.5	2.5	1.5	2.5
	5.5		4037PCE	1.5	2.5	2.5	1.5	2.5
	7.5		4055PCE	2.5	4	2.5	1.5	2.5
	11		4075PCE	4	6	4	1.5	4
	15		4110PCE	6	10	6	2.5	10
	18.5		4150PCE	10	10	10	2.5	10
	22		4185PCE	10	16	10	4	16
	30		4220PCE	16	25	16	16	16
	37		4300PCE	25	35	25	16	16
	45		4370PCE	35	35	35	16	16
	55		4450PCE	50	50	50	35	25
	75		4550PCE	70	95	70	35	50
	90		4750PCE	95	120	95	35	70

Memo

- The wire size of this chapter comply with IEC60364-5-52 (Grounding wire: IEC60364-5-54).
- Refer to [3. 2. 3] for UL standard compliance, [3. 1. 2] for Low voltage directive.
- The wire size must be selected in accordance with the national electrical code and any additional local codes.

4. 2 Selection of a wiring device

According to the table [4. 2. 1], select an appropriate wiring device depending on the voltage class and capacity of the inverter.

4. 2. 1 Selection table of a wiring device

Select a wiring device depending on the inverter type and input current in the table below.

■ Wiring devices for HD rating

Voltage class	Applicable motor (kW)	Inverter type-form		Input current (A)	Rated current (A)	
					Molded-case circuit breaker (MCCB) Earth leakage circuit breaker (ELCB)	Magnetic contactor (MC)
3-phase 480 V	0.4	VFAS3-	4004PCE	0.9	3	20
	0.75		4007PCE	1.8	3	20
	1.5		4015PCE	3.2	5	20
	2.2		4022PCE	4.9	10	20
	4.0		4037PCE	8.3	10	20
	5.5		4055PCE	10.9	15	20
	7.5		4075PCE	14.7	20	20
	11		4110PCE	21.4	30	32
	15		4150PCE	28.9	40	32
	18.5		4185PCE	35.4	50	50
	22		4220PCE	42.1	60	50
	30		4300PCE	57.1	75	60
	37		4370PCE	69.9	100	80
	45		4450PCE	84.8	125	100
	55		4550PCE	103.3	125	135
	75		4750PCE	139.8	175	200

- This is the selection when using a Toshiba standard 4-pole motor with an input of 380V-50Hz.
- Install a surge absorber on the exciting coil of a magnetic contactor (MC) and relays.
- When using an auxiliary contacts 2a type magnetic contactor (MC), use the 2a contacts in parallel to increase the liability of the contacts.
- The magnitude of the short-circuit current varies depending on the power supply capacity and wiring system conditions, so select the MCCB with the rated breaking current that matches the capacity. This table is selected assuming a general power supply capacity.
- For the influence of the leakage current, refer to [2. 4. 3] of instruction manual (E6582062).

■Wiring devices for ND rating

Voltage class	Applicable motor (kW)	Inverter type-form		Input current (A)	Rated current (A)	
					Molded-case circuit breaker (MCCB) Earth leakage circuit breaker (ELCB)	Magnetic contactor (MC)
3-phase 480 V	0.75	VFAS3-	4004PCE	1.6	3	20
	1.5		4007PCE	3.1	5	20
	2.2		4015PCE	4.5	10	20
	4.0		4022PCE	8.0	10	20
	5.5		4037PCE	10.8	15	20
	7.5		4055PCE	14.4	20	20
	11		4075PCE	20.8	30	32
	15		4110PCE	28.3	40	32
	18.5		4150PCE	34.9	50	50
	22		4185PCE	41.4	50	50
	30		4220PCE	55.9	75	60
	37		4300PCE	69.0	100	80
	45		4370PCE	83.4	125	100
	55		4450PCE	101.9	125	135
	75		4550PCE	138.0	175	200
	90		4750PCE	165.1	200	260

- This is the selection when using a Toshiba standard 4-pole motor with an input of 380V-50Hz.
- Install a surge absorber on the exciting coil of a magnetic contactor (MC) and relays.
- When using an auxiliary contacts 2a type magnetic contactor (MC), use the 2a contacts in parallel to increase the liability of the contacts.
- The magnitude of the short-circuit current varies depending on the power supply capacity and wiring system conditions, so select the MCCB with the rated breaking current that matches the capacity. This table is selected assuming a general power supply capacity.
- For the influence of the leakage current, refer to [2. 4. 3] of instruction manual (E6582062).

4. 2. 2 Installation of a molded-case circuit breaker (MCCB) and earth leakage circuit breaker (ELCB)

For protection of the wiring system, install a molded-case circuit breaker (MCCB) between the power supply and the inverter (primary side).
An earth leakage circuit breaker (ELCB) that is equipped with a function to shut off by detecting leakage current can be also installed. However, be cautious that an ELCB may operate improperly, because the leakage current becomes large due to the influence of a wiring method, a built-in noise filter, etc.
Because the short-circuit current is different with power supply capacity and wiring system conditions, select MCCB or ELCB depending on the inverter type and input current in the table [4. 2. 1].

Memo
- When complying with UL, CSA or Low Voltage Directive, refer to [Chapter 3].

4. 2. 3 Installation of a magnetic contactor (MC)

When installing a magnetic contactor (MC) on the primary or secondary side of the inverter, select them as follows.

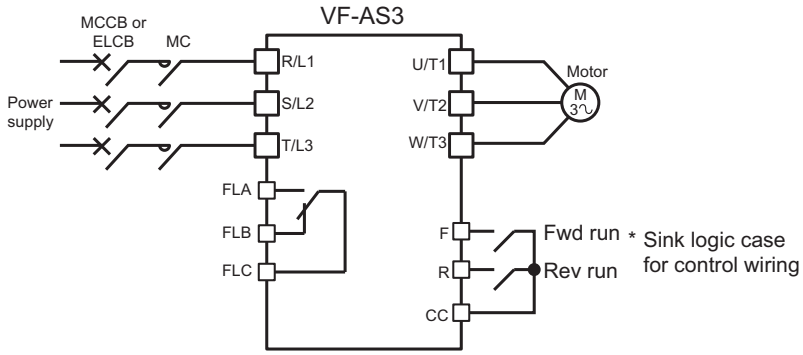
■ Installation on the primary side

When the power side and the inverter need to be detached in the following cases, install a magnetic contactor (MC) between the power supply and the inverter (primary side).
Select a magnetic contactor (MC) depending on the inverter type and input current in the table [4. 2. 1].

- Thermal relay on the motor is activated
- Fault detection relay (FL) inside the inverter is activated
- Not to automatically restart at restoration of power after power failure
- When using the braking resistor (option), the thermal relay of the braking resistor is activated

To open the power circuit (primary side) when the protective function detection relay inside the inverter is activated, the molded-case circuit breaker (MCCB) with a power cutoff device can be installed instead of magnetic contactors (MC). Make sure the molded-case circuit breaker (MCCB) trips at the contact of protection detection relay. If earth leakage detector is not installed, earth leakage circuit breaker (ELCB) should be installed instead of MCCB.

A connection example for installing the primary-side magnetic contactor (MC) is shown next.



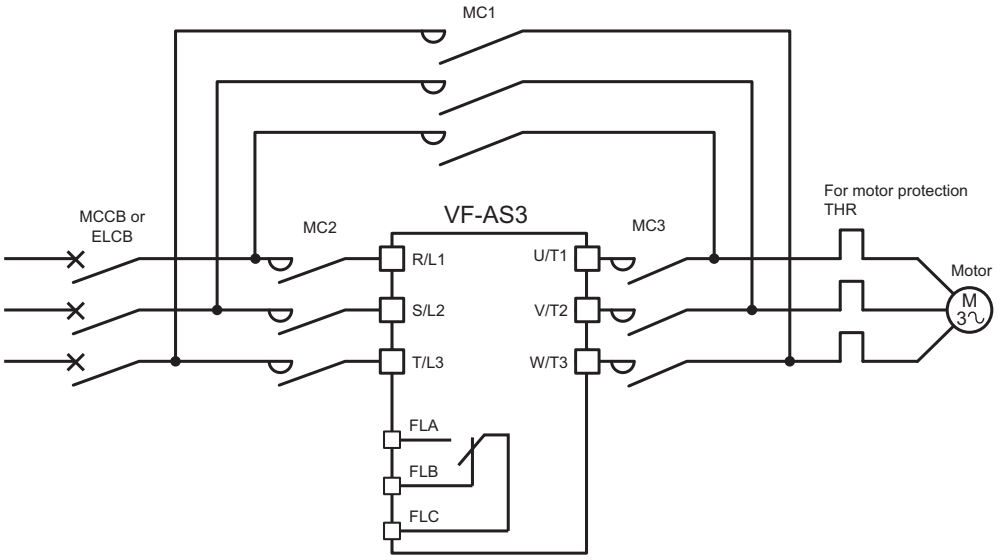
Important

- Do not run/stop the inverter by turning the magnetic contactor (MC) installed on the primary side ON/OFF. Avoid switching a magnetic contactor on the primary side more frequently than once every 1 hour. Instead, run/stop the inverter by using control terminal (ex. Digital input terminal [F] or [R]).
- Install a surge absorber on the exciting coil of a magnetic contactor (MC).

■ Installation on the secondary side

To switch the motor during the inverter is stopped, and change the motor power, a magnetic contactor (MC) can be installed between the inverter and motor (secondary side).
When operating the motor with commercial power supply by switching the circuit and not through the inverter, select a magnetic contactor (MC) with AC-3 Class and confirming to the motor rated current.

A connection example for installing the secondary-side magnetic contactor (MC) is shown next.



4

Important

- Be sure to have interlock for the commercial power supply is applied to the inverter output terminal.
- Do not turn the magnetic contactor (MC) in the secondary circuit ON/OFF during run. It can cause failure due to rush current flowing to the inverter.
- Install a surge absorber on the exciting coil of a magnetic contactor (MC).

4. 2. 4 Installation of a thermal relay (THR)

Use an electronic thermal protector of the inverter for motor overload protection. Set a motor overload protection level with a parameter according to the motor rating.
However, in the following cases, install a thermal relay (THR) between the inverter and motor (secondary side).

- Running multiple motors simultaneously with one inverter.
  In this case, install a thermal relay on each motor.
- Running a motor with smaller output than applicable motor output of the standard specification
  (When the motor capacity is too small to set with a parameter of the motor overload protection level).

For details on motor overload protection level, refer to [5.2.5] of E6582062.

To give sufficient protection for the motor running in a low-speed range, the use of a motor with motor winding embedded type thermal relay is recommended.

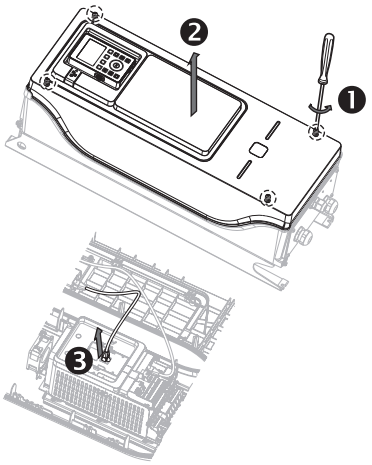
Important

- "Thermal overload relay" is recommended, install it for each motor to be protected. "Thermal relay with CT" is not available.

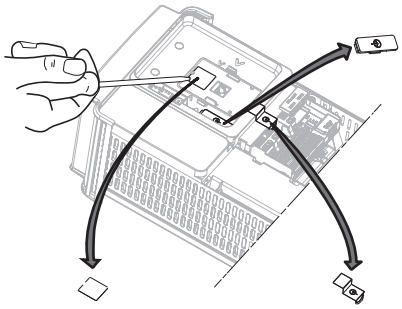
4. 3 External option and insert type option

Refer to E6582062 [10.3] and [10.4] except for mounting/removing Option adaptor shown in below.

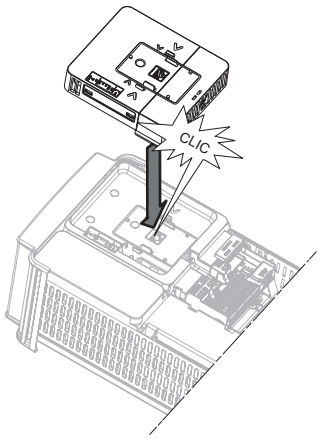
(1)



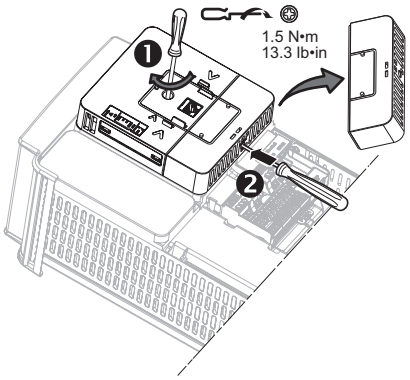
(2)



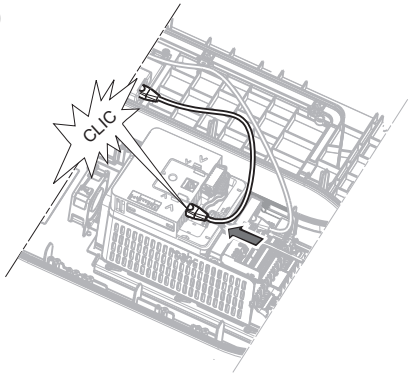
(3)



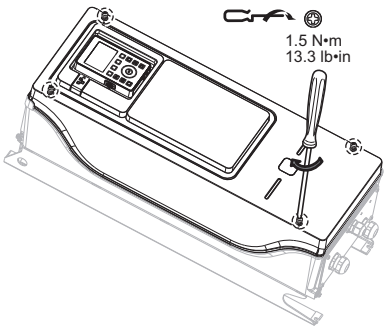
(4)



(5)



(6)



Note: Keep the parts to assemble if the Option adaptor is removed from the product

5 Table of parameters

For parameters, refer to the instruction manual E6582062 (chapter 11).
For standard default settings, refer to values in E6582062 [11.4], totally enclosed box type inverters have the same default setting as standard VF-AS3 inverters one.

6 Specifications

In this chapter, the inverter's model and type, standard specification, outside dimensions, and approx. mass are described.

6. 1 Model and main standard specification

■ Standard specification depending on model

< 480 V class: HD rating >

Item		Specification									
Voltage class		480 V class									
Frame size		A1E					A2E		A3E		
Applicable motor (kW)		0.4	0.75	1.5	2.2	4	5.5	7.5	11	15	18.5
Applicable motor (HP)		0.5	1	2	3	5	7.5	10	15	20	25
Rating	Type	VFAS3-									
	Form	4004PCE	4007PCE	4015PCE	4022PCE	4037PCE	4055PCE	4075PCE	4110PCE	4150PCE	4185PCE
	Output capacity (kVA) *1	1.1	1.7	3.0	4.3	7.1	9.7	12.6	17.9	24.2	29.9
	Output current (A) *2	1.5	2.2	4.0	5.6	9.3	12.7	16.5	23.5	31.7	39.2
	Output voltage	3-phase 380 V to 480 V (The maximum output voltage is equal to the input supply voltage)									
	Overload current rating	150%-1 minute, 180%-2 s									
Electrical braking	Dynamic braking circuit	Built-in									
	Dynamic braking resistor	External braking resistor (Optional)									
Power supply	Voltage-frequency	3-phase 380 V to 480 V - 50/60 Hz									
	Allowable fluctuation	Voltage 323V to 528V *3, Frequency ± 5%									
	Required power supply capacity (kVA) *4	0.7	1.4	2.6	3.7	6.6	8.5	11.4	16.6	22.3	27.3
Degree of protection (IEC60529)		IP55									
Enclosure rating (UL50)		Type 12 *5									
Cooling method		Forced air-cooled									
Cooling fan noise (dB) Reference value *6		58					54		60		
Color		RAL7016									
EMC filter (IEC61800-3)		Category C2 (motor cable length: 50m or less) / C3 (150m or less) *7									
DC reactor		Built-in									

*1. Capacity is calculated at 440 V for the 480 V class.
*2. Indicates rated output current setting when the PWM carrier frequency (parameter F300) is 4 kHz.
*3. When the input voltage is below rating, the output current may be restricted or increased depending on application.
*4. Required power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and wires).
*5. The top cover included in the package must be installed with inverter, it is Type1 without the top cover.
*6. These acoustic noise values are not guaranteed because they are just reference values.
*7. Under <F300> setting into 4kHz.

Item		Specification					
Voltage class		480 V class					
Frame size		A4E			A5E		
Applicable motor (kW)		22	30	37	45	55	75
Applicable motor (HP)		30	40	50	60	75	100
Rating	Type	VFAS3-					
	Form	4220PCE	4300PCE	4370PCE	4450PCE	4550PCE	4750PCE
	Output capacity (kVA) *1	35.3	46.9	56.8	67.1	80.8	111
	Output current (A) *2	46.3	61.5	74.5	88.0	106	145
	Output voltage	3-phase 380 V to 480 V (The maximum output voltage is equal to the input supply voltage)					
	Overload current rating	150%-1 minute, 180%-2 s					
Electrical braking	Dynamic braking circuit	Built-in					
	Dynamic braking resistor	External braking resistor (Optional)					
Power supply	Voltage-frequency	3-phase 380 V to 480 V - 50/60 Hz					
	Allowable fluctuation	Voltage 323 V to 528 V *3, Frequency ± 5%					
	Required power supply capacity (kVA) *4	32.7	44.3	53.9	65.6	79.5	108
Degree of protection (IEC60529)		IP55					
Enclosure rating (UL50)		Type 12 *5					
Cooling method		Forced air-cooled					
Cooling fan noise (dB) Reference value *6		64			63		
Color		RAL7016					
EMC filter (IEC61800-3)		Category C2 (motor cable length: 50m or less) / C3 (150m or less) *7			Category C3 (motor cable length: 150m or less) *7		
DC reactor		Built-in					

*1. Capacity is calculated at 440 V for the 480 V class.
*2. Indicates rated output current setting when the PWM carrier frequency (parameter F300) is 4 kHz.
*3. When the input voltage is below rating, the output current may be restricted or increased depending on application.
*4. Required power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and wires).
*5. The top cover included in the package must be installed with inverter, it is Type1 without the top cover.
*6. These acoustic noise values are not guaranteed because they are just reference values.
*7. Under <F300> setting into 4kHz for frame size A4E, or 2.5kHz for frame size A5E.

< 480V class: ND rating >

Item		Specification									
Voltage class		480V class									
Frame size		A1E					A2E		A3E		
Applicable motor (kW)		0.75	1.5	2.2	4	5.5	7.5	11	15	18.5	22
Applicable motor (HP)		1	2	3	5	7.5	10	15	20	25	30
Rating	Type	VFAS3-									
	Form	4004PCE	4007PCE	4015PCE	4022PCE	4037PCE	4055PCE	4075PCE	4110PCE	4150PCE	4185PCE
	Output capacity (kVA) *1	1.7	3.0	4.3	7.1	9.7	12.6	17.9	24.2	29.9	35.3
	Output current (A) *2	2.2	4	5.6	9.3	12.7	16.5	23.5	31.7	39.2	46.3
	Output voltage	3-phase 380 V to 480 V (The maximum output voltage is equal to the input supply voltage)									
	Overload current rating	120%-1 minute, 135%-2 s									
Electrical braking	Dynamic braking circuit	Built-in									
	Dynamic braking resistor	External braking resistor (Optional)									
Power supply	Voltage-frequency	3-phase 380 V to 480 V - 50/60 Hz									
	Allowable fluctuation	Voltage 323 V to 528 V *3, Frequency ± 5%									
	Required power supply capacity (kVA) *4	1.2	2.4	3.4	6.1	8.3	10.9	15.6	21.3	26.4	31.4
Degree of protection (IEC60529)		IP55									
Enclosure rating (UL50)		Type 12 *5									
Cooling method		Forced air-cooled									
Cooling fan noise (dB) Reference value *6		58					54		60		
Color		RAL7016									
EMC filter (IEC61800-3)		Category C2 (motor cable length: 50m or less) / C3 (150m or less) *7									
DC reactor		Built-in									

Item		Specification					
Voltage class		480 V class					
Frame size		A4E			A5E		
Applicable motor (kW)		30	37	45	55	75	90
Applicable motor (HP)		40	50	60	75	100	125
Rating	Type	VFAS3-					
	Form	4220PCE	4300PCE	4370PCE	4450PCE	4550PCE	4750PCE
	Output capacity (kVA) *1	46.9	56.8	67.1	80.8	111	132
	Output current (A) *2	61.5	74.5	88.0	106	145	173
	Output voltage	3-phase 380 V to 480 V (The maximum output voltage is equal to the input supply voltage)					
	Overload current rating	120%-1 minute, 135%-2 s					
Electrical braking	Dynamic braking circuit	Built-in					
	Dynamic braking resistor	External braking resistor (Optional)					
Power supply	Voltage-frequency	3-phase 380 V to 480 V - 50/60 Hz					
	Allowable fluctuation	Voltage 323 V to 528 V *3, Frequency ± 5%					
	Required power supply capacity (kVA) *4	42.0	52.4	63.2	77.0	103	125
Protective method (IEC60529)		IP55					
Enclosure rating (UL50)		Type 12 *5					
Cooling method		Forced air-cooled					
Cooling fan noise (dB) Reference value *6		64			63		
Color		RAL7016					
EMC filter (IEC61800-3)		Category C2 (motor cable length: 50m or less) / C3 (150m or less) *7			Category C3 (motor cable length: 150m or less) *7		
DC reactor		Built-in					

*1. Capacity is calculated at 440 V for the 480 V class.
*2. Indicates rated output current setting when the PWM carrier frequency (parameter F300) is 4 kHz.
*3. When the input voltage is below rating, the output current may be restricted or increased depending on application.
*4. Required power supply capacity varies with the value of the power supply side inverter impedance (including those of the input reactor and wires).
*5. The top cover included in the package must be installed with inverter, it is Type1 without the top cover.
*6. These acoustic noise values are not guaranteed because they are just reference values.
*7. Under <F300> setting into 4kHz for frame size A4E, or 2.5kHz for frame size A5E.

■ Common specification

Item		Specification
Control specification	Control system	Sinusoidal PWM control
	Output frequency range	Setting between 0.01 - 590 Hz. Default max. frequency is set to 0.01 - 80 Hz. Maximum frequency adjustment (30 to 590Hz)
	Minimum setting steps of frequency	0.01 Hz: operation panel input (60 Hz base), 0.03 Hz: analog input (60 Hz base, 11 bit/0 - 10 Vdc)
	Frequency accuracy	Analog input: ±0.2% of the maximum output frequency (at 25±10°C, bias gain fine-tunable) Digital input: ±0.01%±0.022 Hz of the output frequency
	Voltage/frequency characteristics	V/f constant, variable torque, automatic torque boost, vector control, base frequency adjustment 1, 2, 3, and 4 (15 - 590 Hz), V/f 5-point arbitrary setting, torque boost adjustment (0 - 30%), start frequency adjustment (0 - 10 Hz), stop frequency adjustment (0 - 30 Hz)
	Frequency setting signal	3 kΩ potentiometer (possible to connect to 1 - 10 kΩ-rated potentiometer) 0 - 10Vdc (input impedance Zin: 31.5 kΩ) -10 to +10 Vdc (Zin: 31.5 kΩ) 4 - 20 mAdc (Zin: 250 Ω)
	Terminal block frequency command	The characteristic can be set arbitrarily by two-point setting. Compliant with 7 types of input; analog input ([RR], [RX], [II], [AI4], [AI5]), and pulse input ([S4], [S5])
	Frequency jump	Three frequency can be set. Setting of jump frequency and width.
	Upper and lower limit frequencies	Upper limit frequency: 0 to max. frequency, lower limit frequency: 0 to upper limit frequency
	PWM carrier frequency	Frame size A1E to A4E: adjustable between 1.0 - 16 kHz Frame size A5E: adjustable between 1.0 - 8 kHz
	PID control	Adjustment of proportional gain, integral time, differential time and delay filter. Multi PID and external PID control.
	Torque control	Voltage command input specification: -10 - +10 Vdc
	Real time clock	Current time (Year, month, date, hour, minute), Timezone, Daylight saving time, 4 working days and 20 holidays can be set by parameters.
Operation specifications	Acceleration/deceleration time	0.01 - 6000 sec. Selectable from among acceleration/deceleration. times 1, 2, 3 and 4. Automatic acceleration/deceleration function. S-pattern acceleration/deceleration 1 and 2 pattern adjustable.
	DC braking	Adjustment of braking start frequency (0 - <FH>Hz), braking (0 - 100%) and braking time (0 - 25.5 sec.). With emergency off braking function and motor shaft fix control function.
	Forward run/reverse run	Forward run with ON of the terminal [F], Reverse run with ON of the terminal [R] (Default setting). Coast stop with OFF of the terminal assigned Stad-by function. Emergency off by panel operation or terminal.
	Jog run	Jog run, if selected, allows jog operation from the operation panel Jog run operation by terminal block is possible by setting the parameters.
	Preset speed operation	By changing the combination of the terminals [S1], [S2], [S3], [S4], [S5] set frequency + 31-speed operation. Selectable between acceleration/deceleration time, torque limit and V/f by set frequency.
	Retry	Capable of restarting after a check of the power circuit elements in case the protective function is activated. Max. 10 times selectable arbitrarily. Waiting time adjustment (0 - 10 sec.)
	Soft stall	Automatic load reduction control at overloading. (Default: OFF)
	Cooling fan ON/OFF management	The cooling fan will be stopped automatically to assure long life when unnecessary.
	Lockout key operation	Key lock selectable of RUN key, HAND/AUTO key , emergency stop/reset by STOP key or all keys on operation panel, with/without password.
	Regenerative power ride-through control	Possible to keep the motor running using its regenerative energy in case of a momentary power failure. (Default: OFF)
	Auto-restart	Possible to restart the motor in coasting in accordance with its speed and direction. (Default: OFF)
	Simplified pattern operation	Possible to select each 8 patterns in 2 groups from 15-speed operation frequency. Max. 16 types of operation possible. Terminal operation/repeat operation possible.
	Commercial power supply/Inverter switching	Possible to switch operation by commercial power supply or inverter
	Light-load high-speed operation	Improves the efficiency of the machine by increasing the motor speed when it is running under light load.
	Droop function	When two or more inverters are used to operate a single load, this function prevents load from concentrating on one inverter due to unbalance.
	Override function	External input signal adjustment is possible to the frequency command value.
Protective function	Protective function	Stall prevention, current limit, overcurrent, overvoltage, short circuit on the load side, ground fault on the load side [*1], undervoltage, momentary power failure (15 ms or more), non-stop control at momentary power failure, overload protection, arm short-circuit at starting, overcurrent on the load side at starting, overcurrent and overload at braking resistor, overheat, emergency off
	Electronic thermal characteristic	Switchable between standard motor/constant torque motor, adjustment of overload protection and stall prevention level.
	Reset	Reset by 1a contact closed (or 1b contact opened), or by operation panel. Or power supply OFF/ON. This function is also used to save and clear trip records.

(Continued overleaf)

(Continued)

Item			Specification
Display function	Display	Alarms	Stall prevention during run, overvoltage limit, overload, undervoltage on power supply side, DC circuit undervoltage, setting error, in retry, upper limit, lower limit. (Control power supply option undervoltage), (Operation panel disconnection).
		Causes of Fault	Overcurrent, overvoltage, overheat, short circuit on the load side, ground fault on the load side, inverter overload, arm short-circuit at starting, overcurrent on the load side at starting, cooling fan fault, CPU fault, EEPROM fault, RAM fault, ROM fault, communication error, (braking resistor overcurrent/overload), (emergency off), (undervoltage), (undercurrent), (overtorque), (motor overload), (input phase lost), (output phase lost) The items in the parentheses are selectable.
		Monitoring function	Output frequency, frequency command, forward run/reverse run, output current, DC voltage, output voltage, compensated frequency, terminal input/output information, CPU version, past trip history, cumulative operation time, feedback frequency, torque, torque command, torque current, exiting current, PID feedback value, motor overload factor, inverter overload factor, PBR overload factor, PBR load factor, input power, output power, peak output current, peak DC voltage, RR input, II input, RX input, AI4 input, AI5 input, FM output, AM output, expansion I/O card option CPU version, integral input power, integral output power, communication option reception counter, communication option abnormal counter.
		Free unit display	Display of optional units other than output frequency (motor speed, line speed, etc.), current ampere/% switch, voltage volt/% switch
		Automatic edit function	Searches automatically parameters that are different from the default setting parameters. Easy to find changed parameters.
		User default setting	User parameter settings can be saved as default settings. Allows to restore the parameters to the user-defined parameter settings.
	LED	Charge lamp	Indicates power circuit capacitor charging.
Interface specification	Digital input		14 digital input terminals (of which 6 are optional) are programmable digital input, and the signal function are arbitrarily selected from 188 types including positive/negative logic selection. 3 function can be assigned for some terminals. The input level complies with IEC61131-2 logic type1.
	Digital output		3 digital output terminals (of which 2 are optional) are programmable digital output, and the signal function are arbitrarily selected from 260 types including positive/negative logic selection. 2 function can be assigned for some terminals. Output capacity is 24Vdc, 50mA.
	Sink/Source logic setting		Possible to select minus common (CC) or plus common (P24) for digital inputs by mechanical switch. (Default setting: external power supply)
	Pulse train frequency input		Possible to be assigned on digital input ([S4] and [S5]) terminals (Up to 30 kpps), can be used as PG input
	Pulse train frequency output		Possible to be assigned on digital output [FP] terminal (Up to 30 kpps, duty 50%)
	Relay output (Fault detection relay)		1c contact and five 1a contacts (of which 3 are optional) relays are programmable output, and the signal function are arbitrarily selected from 260 types. Output capacity is 250Vac-2A or 30Vdc-2A at maximum. (Fault detection output is assigned on 1c contact relay at default setting)
	Frequency command input		5 analog input terminals (of which 2 are optional) are frequency command input, The input level depends on each terminal (0-10V, +/-10V, 0-20/4-20mA or PTC).
	Output for frequency meter/ Output for ammeter		2 analog output terminals are programmable analog output, and the signal function are arbitrarily selected from 67 types. The output level are also programmable (1mA dc full-scale milli-ammeter, 0-20mA, 4-20mA or 0-10V).
	Control power supply		2 output: 10V-10mA and 24V-200mA with current limiter 1 input: control supply back up function (24Vdc-1A)
	Functional Safety		Safe Torque Off comply with IEC61800-5-2
	Communication function		Embedded Ethernet (dual port with switch): EtherNet/IP, Modbus-TCP, Webserver Embedded RS485 (2 channel): Toshiba inverter protocol, Modbus-RTU Optional: PROFINET, DeviceNet, PROFIBUS-DP, EtherCAT
Environments	Use environments		Indoor use. Place not exposed to direct sunlight and free of corrosive gas, flammable gas, explosive gas, oil mist, and large amount of non-conductive or conductive dust.
	Ambient temperature		-15 to +50°C (Derating of rated current is needed when ambient temperature will rise above 40°C)*2
	Storage temperature		-25 to +70°C (temperature applicable for a short term)
	Relative humidity		5 to 95% (free from condensation)
	Altitude		4800m or less for TN/TT system 3800m or less for IT system 2000m or less for corner-earthed system Current reduction necessary if above 1000m *3
	Vibration *4		5.9 m/s^2{0.6G} or less (10 - 55 Hz)

*1: This function protects inverters from overcurrent due to output circuit ground fault.
*2: For detail of current reduction, see "instruction manual for load reduction" (E6582116).
*3: Current must be reduced by 1% for each 100m over 1000m. (e.g. 90% at 2000m, 80% at 3000m.)
*4: Test condition: IEC60068-2-6, IEC60068-2-27

6. 2 Outlines and mass

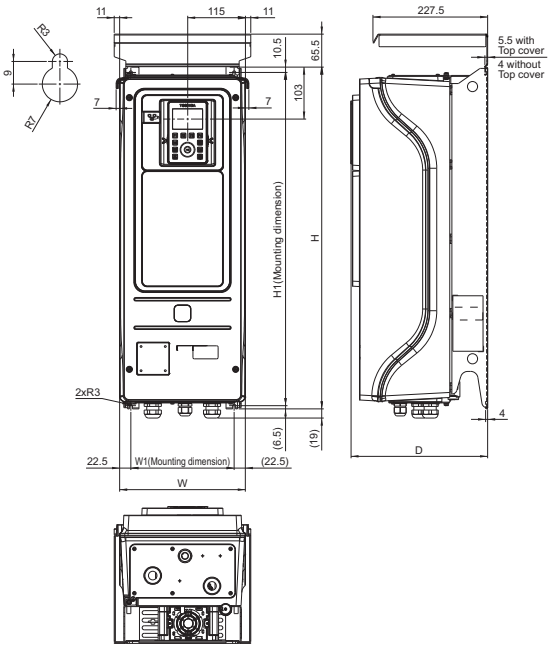
■ Dimensions and mass

Frame size	Type-Form	Dimensions (mm)					Approximate mass (kg)*1
		W*1	H*1	D	W1	H1	
A1E	VFAS3-4004PCE	272 (250)	743.5 (678)	271	205	661	13.2 (12.1)
	VFAS3-4007PCE						13.2 (12.1)
	VFAS3-4015PCE						13.4 (12.3)
	VFAS3-4022PCE						13.6 (12.5)
	VFAS3-4037PCE						13.7 (12.6)
A2E	VFAS3-4055PCE	272 (250)	743.5 (678)	301	205	661	17.1 (16.0)
	VFAS3-4075PCE						17.4 (16.3)
A3E	VFAS3-4110PCE	272 (250)	743.5 (678)	301	205	661	21.3 (20.2)
	VFAS3-4150PCE						21.8 (20.7)
	VFAS3-4185PCE						21.9 (20.8)
A4E	VFAS3-4220PCE	320 (290)	1015 (910)	340	250	888	51.5 (49.5)
	VFAS3-4300PCE						51.5 (49.5)
	VFAS3-4370PCE						52.5 (50.5)
A5E	VFAS3-4450PCE	375 (345)	1358 (1250)	375	293	1220	89 (87)
	VFAS3-4550PCE						91 (89)
	VFAS3-4750PCE						91 (89)

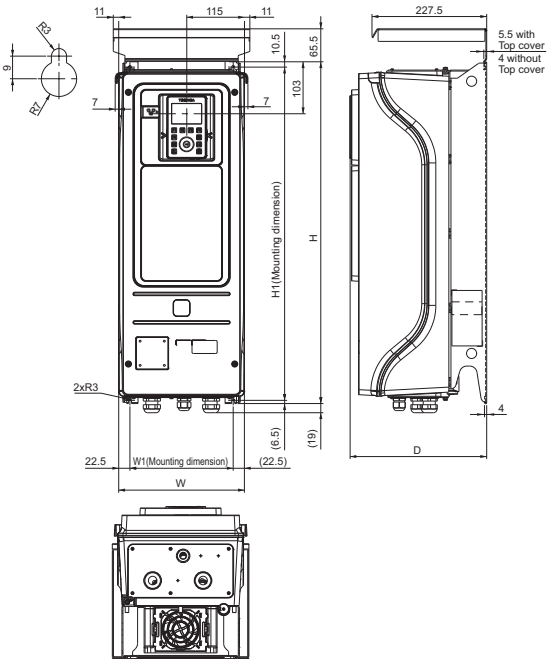
*1: Values in ( ) without attached top cover

■ Outline drawing

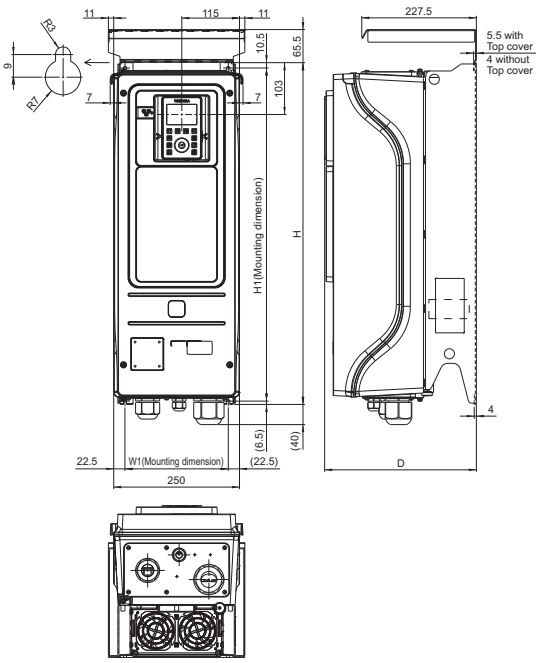
A1E



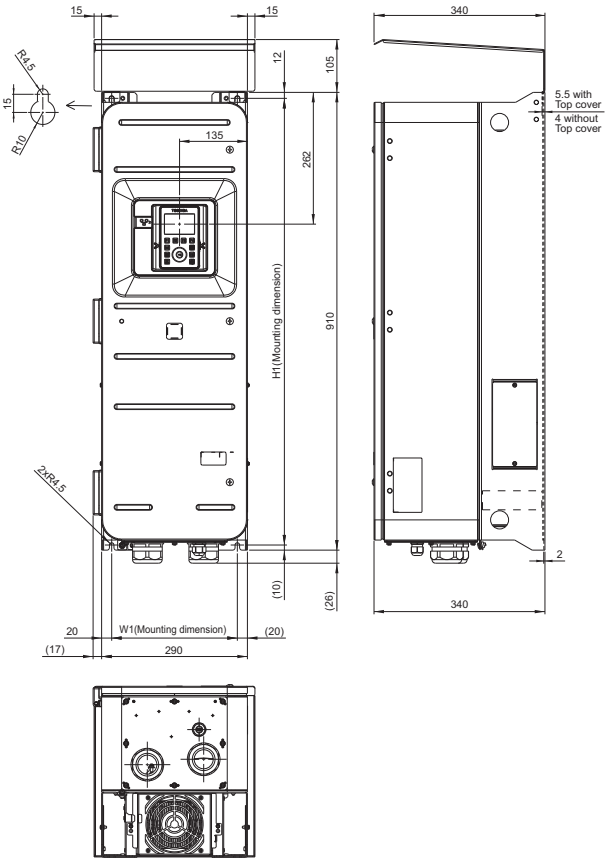
A2E



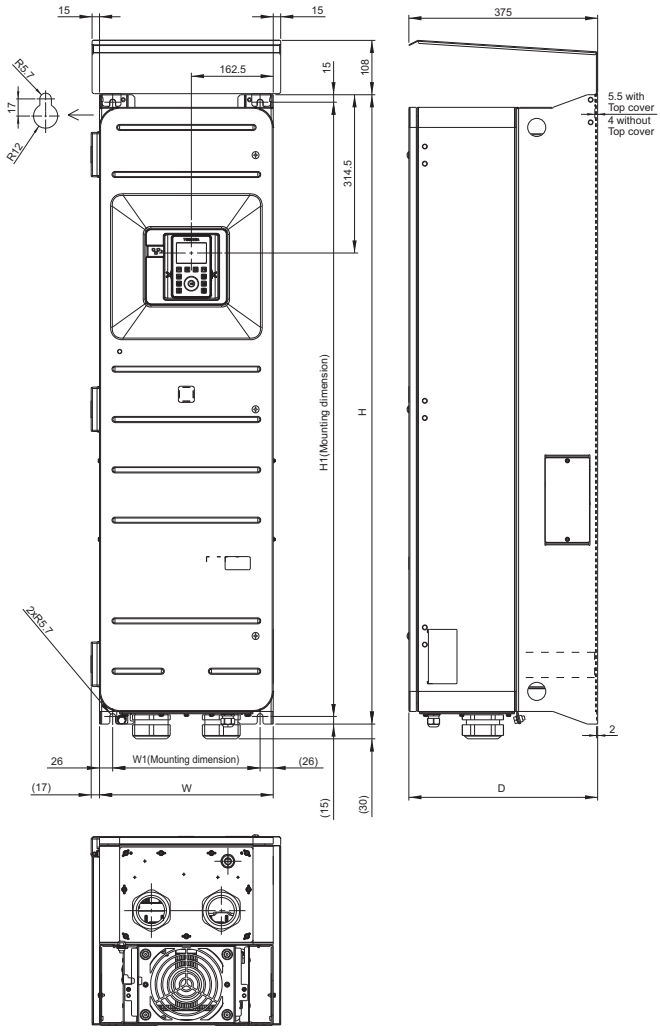
A3E


11
115
11
227.5
5.5 with Top cover
4 without Top cover
R3
R7
9
7
7
10.5
65.5
103
H1(Mounting dimension)
H
4
22.5
W1(Mounting dimension)
(22.5)
(6.5)
(40)
250
D

A4E


15
15
340
R4.5
R10
15
12
105
5.5 with Top cover
4 without Top cover
135
262
H1(Mounting dimension)
910
2xR4.5
2
(10)
(26)
340
20
W1(Mounting dimension)
(20)
(17)
290

A5E


15
15
375
R5.7
R12
17
162.5
15
108
5.5 with Top cover
4 without Top cover
314.5
H1(Mounting dimension)
H
2xR5.7
2
26
W1(Mounting dimension)
(26)
(17)
W
(15)
(30)
D

6