TOSHIBA

Transistor Inverter

High-performance Inverter TOSVERT™

VF-AS1
Flexible for you

I need the most suitable inverter for my application, which has low noise, low harmonics, minimal parameter setting, high torque and control.

We meet all your requirements with VF-AS1. It has outstanding Performance, including high torque, fast response, high accuracy and excellent environmental compatibility with easy operation. The VF-AS1 is an advanced inverter evolved to satisfy all your needs in one comprehensive product.

High-performance Inverter TOSVERT™
VF-AS1

• Built-in thermal protection function which complies with NEC® 2005
• Comply with SEMI F47 (Semiconductor Equipment and Materials International)

For your Commercial facilities, offices and factories
• Feature: Reduce high-frequency noise*1, Reduce harmonics*1
• Applications: Washing machines, Treadmill, Showcase refrigerators, Medical equipment, stage equipment

For machinery that requires simple function
• Feature: EASY key, 8 basic parameters
• Applications: Drilling machines, Handling machines, Conveyors, Semiconductor production Equipment, Cutting machines, Woodworking machinery

For machinery that requires high torque and a large capacity
• Feature: Starting torque of 0.3Hz-200%*2, Up to 500kw for a 400V class
• Applications: Cranes, Mining machinery, refrigerator, Presses, Compressors, Crushing machine

For system devices that requires flexibility
• Feature: My function, High-precision and high-speed torque control with or without sensors
• Applications: Process lines, Printing machines, Coilers/uncoilers

Renewal: "Power Removal" safety function*3
Built-in Power Removal safety function which complies with EN61508-1 category 3 and IEC/EN61508-1 SIL2. It saves the installation of a line side or motor side contactor.

Compatible with the World's Main Standards (CE marking, UL, CSA, C-tick)
* UL and CSA compliency conditions partially differ from the standard specifications. Consult us separately for details.

** ISO-9001 Certification Acquired**

** ISO-14001 Certification Acquired**

Compatible with the UL, CSA, EN (CE marking). The factories manufacturing the products are ISO-9001, ISO-14001, SEMI Advanced Management System, and TOSHIBA Standard Management System certified factories.

High Voltage Class

<table>
<thead>
<tr>
<th>Voltage Class</th>
<th>Applicable Motor Output (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3ø200V/3ø200V</td>
<td>0.4 0.75 1.5 2.2 2.7 3.7 5.5 7.5 11 15 18.5 22 30 37 45 55 75 90 110 132</td>
</tr>
<tr>
<td>3ø400V/3ø400V</td>
<td>0.4 0.75 1.5 2.2 2.7 3.7 5.5 7.5 11 15 18.5 22 30 37 45 55 75 90 110 132</td>
</tr>
</tbody>
</table>

For inverter users
• Built-in thermal protection function which complies with NEC® 2005
• Comply with SEMI F47 (Semiconductor Equipment and Materials International)

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For machinery that requires simple function P4
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For your commercial facilities, offices and factories

This makes the inverter ideal for your electronic applications such as washing machines treadmill, showcase refrigerators for stores, medical equipment, and stage equipment where attention must be paid to peripheral devices.

*1: Photos of machinery are for illustrative purposes only.

Harmonics Reduction, Power Factor Improvement

- A compact, space-saving new type of DC reactor is built into 200 V class 11 to 45 kW and 400 V 18.5 to 75 kW models. In addition to reducing harmonics, this reactor limits the input current to 110% of the rated output current, and it has been designed to be compatible with power supply systems containing transformers, molded-case circuit breakers, and power lines.
- Adding on the optional DC reactor enables compliance with IEC harmonics standards.

High-frequency Noise Reduction

- High-frequency noise is drastically reduced on models with built-in noise filters. Built-in noise filters are ideal for sites from commercial facilities and offices through to factories where attention must be paid to peripheral devices.
- Compared with filter not integrated models, space and wiring savings have been achieved by incorporating the filter in the panel. Also, models with built-in EMC noise filter comply with the European EMC Directive as individual inverter units.

For machinery that requires simple function

This makes the inverter ideal for drilling machines, handling machines, conveyors, semiconductor production equipment, cutting machines, and woodworking machinery that require simple function.

*1: Photos of machinery are for illustrative purposes only.

Simple Setup by EASY Key

- In the Quick mode, pressing the EASY key on the panel allows you to operate the inverter by eight basic parameters. When setting each of the functions, press the EASY key to move to the standard mode by one-touch operation. In this mode, you can access all parameters.
- You can customize the Quick mode display, maximum of 32 target parameters are displayed to suit your specific setup requirements.
- You can also use the EASY key as a panel/remote key to switch between panel and remote operation, and as a shortcut key to directly access any specific setup or display screen.

Easy Installation, Easy commissioning, and Easy maintenance

- Side-by-side installation of inverters is possible up to the inverter’s total capacity. This allows effective utilization of space inside control panels. Heat sink can be installed outside of the panel as an option.
- Removable control terminal board
  - A removable terminal board is used. This allows you to use the control wiring when replacing the inverter, which also makes maintenance easier.
- ON/OFF control of cooling fan
  - Temperature-based ON/OFF control reduces noise while the inverter is being stopped, saves energy and extends the cooling fan’s life.
- Monitoring of serviceable parts/alarm output
  - The expected replacement cycle of main circuit capacitors, capacitors on control board, and cooling fan is monitored, and an alarm is output when the cycle is reached.
For machinery that requires high torque and a large capacity

This makes it ideal for cranes, mining machinery, refrigerator, presses, compressors, crushing machine and other machinery that require a high torque and large capacity.

*1: Photos of machinery are for illustrative purposes only.

Points 5

Excellent Motor Control Performance

- Motor constants required for vector control can be easily set by auto-tuning to enable 1:120 speed control. Moreover, the VF-AS1 also features a robust structure that is unlikely to be influenced by motor temperature.
- On inverters provided with a sensor, high-torque operation of 200%*2 from zero velocity is possible, achieving a speed control range of 1:1000.
- High-speed response frequencies of 40 Hz without sensor and 50 Hz with sensor are achieved respectively, to maintain fixed speed in response to sudden changes in load.
- Modifying software enables high-frequency output up to 1000 Hz, which is ideal for spindle rotation of woodworking and metalworking machinery.

*2: When a TOSHIBA standard 3-phase, 0.4 to 3.7 kW 4-pole motor are driven.

Points 6

Dedicated Functions Ideal for Lifting Applications

Brake sequence/light-load, high-speed functions
- The inverter has two built-in functions, the brake sequence function and light-load, high-speed function, as standard. The brake sequence function measures the timing with braking by an external motor to achieve smooth operation at start and stop of braking operation. The light-load, high-speed function automatically increases the speed when operating light loads according to the lifting load to improve conveyance efficiency. A learning function for setting and storing to memory required parameters while performing actual operations is also provided to facilitate adjustments.

Built-in transistor for dynamic braking
- The VF-AS1 has a built-in transistor for dynamic braking up to 160 kW, which makes it ideal for lifting applications.

For system devices that require flexibility

This makes the inverter ideal for process lines, printing machines, coilers/uncoilers.

*1: Photos of machinery are for illustrative purposes only.

Points 7

Customizing by “My Function”

- With “My function”, you can create programs containing up to 28 steps. This achieves logic operations and internal data operations. Parameters can also be set according to analog input and minimum-peak hold of analog outputs. For example:
  - (Ex.1) Inverter is automatically switched to commercial operation without the external sequence when the inverter is tripped.
  - (Ex.2) A signal is output when torque reaches 120% and frequency is 5 Hz.
  - (Ex.3) “Forward rotation operation,” “preset-speed operation frequency 3” and “No.2 acceleration/deceleration” are simultaneously turned ON by input on a single terminal.
  - (Ex.4) The acceleration/deceleration time is changed dynamically by a voltage within the range 0 to 10 V.

Points 8

Communications and Network

- RS-485 communications
  - RS-485 communications is equipped as standard, and Modbus-RTU protocol is supported in addition to TOSHIBA protocol.

Network options
- Use of communication options enables support of DeviceNet*2, PROFINET and CC-Link*3 and other main fieldbuses.

Data tracing
- The PCM001Z communications software allows you to edit, monitor, and trace parameter data on a PC, enabling easier data management from inverter startup through to maintenance.

*2: DeviceNet is a registered trademark of ODVA (Open DeviceNet Vendor Association).
*3: CC-Link is a registered trademark of Mitsubishi Electric Corporation.
For machinery that requires expansion

Outstanding Lineup of Options

**LCD Extension Panel Option**

This panel is an 23-character x 8-line display, and can be used for simple setup and monitoring by selection of parameters using the jog dial. The display language can be switched between English and Japanese. (German, Italian, Spanish, and Chinese will be available soon.)

Type: RKP004Z

**LED Extension Panel Option**

Our customers require a “display that is easily visible from a long way away.” In response to this need, we developed this panel using 20 mm LEDs, the largest in its class in the market, to ensure outstanding visibility. It has also been designed to be fitted into panels for use as an extension panel or display. In addition, it can be used as a parameter copy and is capable of storing parameters for up to three models.

Type: RKP002Z

**Expanded Terminal Block Option**

This I/O terminal block can be added on to enhance your system for extra compatibility with a wide range of systems:

- Contact inputs (4)
- Contact outputs (2)
- Analog inputs (2)
- Analog outputs (2)
- PTC input (1)
- Relay output (1 circuit)
- Pulse train input (1)

Type: ETB003Z, ETB004Z

**Fieldbus Option**

Main fieldbuses are supported to enable connection to a host controller to achieve savings in space and centralized control of systems.

- DeviceNet*1
- PROFIBUS
- CC-Link*2

Type: DEV002Z, PDP002Z, CCL001Z

*1 DeviceNet is a registered trademark of ODVA (Open DeviceNet Vendor Association).
*2 CC-Link is a registered trademark of Mitsubishi Electric Corporation.

**Encoder Feedback Option**

Three encoder feedback options are provided to match output for support of vector control with a sensor.

- Line driver output (RS-422) Type: VEC007Z
- Open collector/complimentary output (12 V) Type: VEC004Z
- Open collector/complimentary output (15 V) Type: VEC005Z

**Wide Range of Applications**

**Safety Environmental Compatibility**

- Ambient temperature 60°C
  - The VF-AS1 can be used at a rating up to an ambient temperature of 50°C and in environments up to 60°C at a derating current.

- Eco Design
  - 88% of materials used on the VF-AS1 are recyclable, which design more than meets of the European WEEE (Waste Electrical and Electronic Equipment) Directive of 70%.

**Various Drive Performance**

- Permanent Magnet Motor (PM) Drive
  - The PM is driven efficiently by a TOSHIBA oriented control algorithm to achieve savings in energy and space.

- High-frequency 1000 Hz Output
  - Software modification increases output up to a high frequency of 1000 Hz, making it ideal for woodworking and metalworking machinery.

- New DC Braking
  - A newly developed DC braking function allows the stop time to a quarter of that on conventional models.

**A Further Enhanced of Functions**

**Multi-PID Control**

As well as process-type PID control (e.g. temperature, pressure, flow rate), the VF-AS1 incorporates speed-type PID control that is compatible with speed feedback, for example, in follow-up operation or winding, for line compatibility with line control.

- Traverse
- Power interruption synchronized control

**Drooping**

- Speed gain switching
- Zero speed lock
- Dwell

Drooping distributes the load of 2-shaft drive on conveyance machinery, for example. Speed gain switching enables adaptation to changes in inertia during operation. Zero speed is hold when the inverter is stopped. And dwell controls acceleration/deceleration, for example, when conveying heavy loads.
### Basic parameters

<table>
<thead>
<tr>
<th>Title</th>
<th>Function</th>
<th>Adjustment Range</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Parameter setting range function</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PB</td>
<td>Self-control model selection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AC</td>
<td>Maximum Frequency</td>
<td></td>
<td>400.0 Hz</td>
</tr>
<tr>
<td>RC</td>
<td>Motor overload protection level 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SS</td>
<td>Parameter display selection</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Quick mode (EASY)

To enter the Quick mode, press the EASY key on the panel. In this mode, you can set eight of the basic parameters.

### Standard mode

In this mode, you can set all parameters. For details of parameters, refer to the Instruction Manual.

### Extended parameters

About 500 extended parameters are available. For details on extended parameters, please visit our web site (http://www.inverter.co.jp/).

### Standard specifications (200 V class - 0.4 to 45 kW, 400 V class - 0.75 to 75 kW model)

#### 200 V class

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable Motor (kW)</td>
<td>0.4</td>
</tr>
<tr>
<td>Type</td>
<td>VFA51-1</td>
</tr>
<tr>
<td>Output Capacity (kW)</td>
<td>1.1</td>
</tr>
<tr>
<td>Output Current (A)</td>
<td>3.0</td>
</tr>
<tr>
<td>Note 2)</td>
<td></td>
</tr>
<tr>
<td>Note 3)</td>
<td></td>
</tr>
<tr>
<td>Output Voltage</td>
<td>3-phase, 200 to 240 V (The maximum output voltage is the same as the input voltage.)</td>
</tr>
<tr>
<td>Default Current Rating</td>
<td>150%–5 minute</td>
</tr>
</tbody>
</table>

#### Dynamic braking circuit

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Form</td>
<td>Built-in</td>
</tr>
</tbody>
</table>

#### NVFAS1–

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Note 4)</td>
<td>Inverters, 18.5kW or greater, do not have wiring port covers. They have large openings, but there is no space to bend the external cables inside the unit. If they are fitted external to the cabinet, please use an optional wiring port cover.</td>
</tr>
</tbody>
</table>

#### Cooling method

- Forced air cooling

#### Cooling fan noise (dBA)

- 43 | 43 | 55 | 55 | 56 | 58 | 60 | 64 | 64 | 64 | 64 | 64 |

#### Color

- EMI noise filter |

#### DC Reactor

- Built-in

### 400 V class

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable Motor (kW)</td>
<td>0.75</td>
</tr>
<tr>
<td>Type</td>
<td>VFA51-2</td>
</tr>
<tr>
<td>Output Capacity (kW)</td>
<td>1.8</td>
</tr>
<tr>
<td>Output Current (A)</td>
<td>2.3</td>
</tr>
<tr>
<td>Note 2)</td>
<td></td>
</tr>
<tr>
<td>Note 3)</td>
<td></td>
</tr>
<tr>
<td>Output Voltage</td>
<td>3-phase, 380 to 480 V (The maximum output voltage is the same as the input voltage.)</td>
</tr>
<tr>
<td>Default Current Rating</td>
<td>150%–5 minute</td>
</tr>
</tbody>
</table>

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<table>
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<tr>
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<th>Specification</th>
</tr>
</thead>
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<tr>
<td>Form</td>
<td>Built-in</td>
</tr>
</tbody>
</table>

#### Cooling method

- Forced air cooling

#### Cooling fan noise (dBA)

- 43 | 43 | 55 | 55 | 56 | 58 | 60 | 64 | 64 | 64 | 64 | 64 |

#### Color

- EMI noise filter |

#### DC Reactor

- Built-in

---

Note 1) Capacity is calculated at 200V for the 200V models and at 440V for the 400V models.

Note 2) Rated output current when the PWM carrier frequency (parameter F1) is 440 Hz or less.

The values between parentheses refer to rated output currents when set to 120 Hz.

Note 3) 15% when the inverter is used continuously (load of 100%).

Note 4) Inverters, 18.5kW or greater, do not have wiring port covers. They have large openings, but there is no space to bend the external cables inside the unit. If they are fitted external to the cabinet, please use an optional wiring port cover.

Note 5) Complies with the European EMC Directive.

Note 6) Not comply with the European EMC Directive.
<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applicable Motor (kW)</td>
<td>90 110 132 160 200 220 280 355 400 500</td>
</tr>
<tr>
<td>Type</td>
<td>4000P 4100P 4120P 4160P 4200P 4220P 4280P 4300P 4320P 4400P 4500P</td>
</tr>
<tr>
<td>Output Capacity (kW) now</td>
<td>130 141 173 209 230 255 284 325 419 511 578 717</td>
</tr>
<tr>
<td>Output Current (A) now</td>
<td>179 215 259 314 387 427 550 671 759 941</td>
</tr>
<tr>
<td>Voltage/frequency</td>
<td>3-phase, 380 to 480 V (The maximum output voltage is the same as the input voltage.)</td>
</tr>
<tr>
<td>Overload Current Rating</td>
<td>150% for 1 minute</td>
</tr>
<tr>
<td>Dynamic Braking</td>
<td>Built-in</td>
</tr>
<tr>
<td>Dynamic Braking Resistor</td>
<td>Compatible with external options</td>
</tr>
<tr>
<td>Voltage/frequency</td>
<td>3-phase, 380 to 480 V – 50/60 Hz</td>
</tr>
<tr>
<td>Output Voltage</td>
<td>3-phase, 380 to 480 V – 50/60 Hz</td>
</tr>
<tr>
<td>Overload Current Rating</td>
<td>3-phase, 200 to 240 V – 50/60 Hz</td>
</tr>
<tr>
<td>Dynamic Braking</td>
<td>Built-in</td>
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</tr>
<tr>
<td>Overload Current Rating</td>
<td>150% for 1 minute</td>
</tr>
</tbody>
</table>

Note 1) Capacity is calculated at 200V for the 200V models and at 440V for the 400V models.

Note 2) Indicates the value when the PWM carrier frequency (parameter E11) is 2.5 kHz or less.

Note 3) Loading is required at 18.5kW or more, use an inverter of capacity one rank higher than the motor capacity.

Note 4) When inverters are used in applications where the ambient temperature will rise above 50°C, ensure the required space for air flow and quench heat radiation is provided.

Note 5) This function protects inverters from overcurrent due to output circuit ground fault.
External dimensions

- 200 V class - 0.4 to 55 kW, 400 V class -0.75 to 90 kW model

### Table: Input Voltage, Applicable Motor (kW), Inverter Type, Dimensions (mm), External Dimensions (mm), Approx. Weight (kg)

<table>
<thead>
<tr>
<th>Input Voltage Class</th>
<th>Applicable Motor (kW)</th>
<th>Inverter Type</th>
<th>Dimensions (mm) W</th>
<th>Dimensions (mm) H</th>
<th>Dimensions (mm) D</th>
<th>Dimensions (mm) WT</th>
<th>Dimensions (mm) HT</th>
<th>Dimensions (mm) External Dimensions W</th>
<th>Dimensions (mm) External Dimensions H</th>
<th>Dimensions (mm) External Dimensions D</th>
<th>Dimensions (mm) External Dimensions WT</th>
<th>Dimensions (mm) External Dimensions HT</th>
<th>Approx. Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200V</td>
<td>0.4</td>
<td>VFAS1-505P4</td>
<td>160</td>
<td>250</td>
<td>152</td>
<td>114</td>
<td>220</td>
<td>92</td>
<td>186</td>
<td>140</td>
<td>100</td>
<td>40</td>
<td>A</td>
</tr>
<tr>
<td></td>
<td>0.7</td>
<td>VFAS1-507P4</td>
<td>160</td>
<td>250</td>
<td>152</td>
<td>114</td>
<td>220</td>
<td>92</td>
<td>186</td>
<td>140</td>
<td>100</td>
<td>40</td>
<td>B</td>
</tr>
<tr>
<td></td>
<td>1.1</td>
<td>VFAS1-510P4</td>
<td>180</td>
<td>260</td>
<td>164</td>
<td>138</td>
<td>240</td>
<td>101</td>
<td>213</td>
<td>159</td>
<td>115</td>
<td>47</td>
<td>C</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>VFAS1-515P4</td>
<td>180</td>
<td>260</td>
<td>164</td>
<td>138</td>
<td>240</td>
<td>101</td>
<td>213</td>
<td>159</td>
<td>115</td>
<td>47</td>
<td>D</td>
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<tr>
<td></td>
<td>1.5</td>
<td>VFAS1-516P4</td>
<td>180</td>
<td>260</td>
<td>164</td>
<td>138</td>
<td>240</td>
<td>101</td>
<td>213</td>
<td>159</td>
<td>115</td>
<td>47</td>
<td>E</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>VFAS1-520P4</td>
<td>210</td>
<td>295</td>
<td>191</td>
<td>150</td>
<td>285</td>
<td>112</td>
<td>265</td>
<td>170</td>
<td>130</td>
<td>56</td>
<td>F</td>
</tr>
<tr>
<td></td>
<td>2.2</td>
<td>VFAS1-525P4</td>
<td>210</td>
<td>295</td>
<td>191</td>
<td>150</td>
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</tr>
</tbody>
</table>

Note: *Value in * includes attached DC reactor.
External dimensions

- 200 V class - 75 kW, 400 V class - 110 to 500 kW model

<table>
<thead>
<tr>
<th>Input Voltage Class</th>
<th>Applicable Motor (kW)</th>
<th>Inverter Type</th>
<th>Dimensions (mm)</th>
<th>External Dimensions Drawing</th>
<th>Approx. Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200V</td>
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<td>VFAS1-4206KPC</td>
<td>1150</td>
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</tbody>
</table>

Note: ) Value in ( ) includes attached DC reactor.
**Standard connection diagrams**

- **Standard connection diagram**: Sink logic (common: CC)
  - Main circuit power supply
    - 200V class: 0.4~75kW
      - 3-phase, 200 to 240V/50Hz/60Hz
    - 400V class: 0.75 to 90kW
      - 3-phase, 380 to 400V/50Hz/60Hz
    - 110 to 500kW
      - 3-phase, 380 to 400V/50Hz/60Hz
    - 3-phase, 480 to 500V/60Hz

- **Standard connection diagram**: Source logic (common: P24)
  - Main circuit power supply
    - 200V class: 0.4~75kW
      - 3-phase, 200 to 240V/50Hz/60Hz
    - 400V class: 0.75 to 90kW
      - 3-phase, 380 to 400V/50Hz/60Hz
    - 110 to 500kW
      - 3-phase, 380 to 400V/50Hz/60Hz

- **Terminal functions**
  - **Terminal Symbol**: Terminal Function
    - R1, S1, T1: Three-phase 380~400V/50Hz
    - 0.4~75kW
      - 3-phase, 200 to 240V/50Hz/60Hz
    - 400V class: 0.75 to 90kW
      - Three-phase 380~400V/50Hz/60Hz
    - 110 to 500kW
      - Three-phase 380~400V/50Hz/60Hz
    - 0.37~250kW
      - Three-phase 380~400V/50Hz/60Hz

- **Terminal circuit terminal**: Terminal Function
  - R1, S1, T1: Three-phase 380~400V/50Hz
    - 0.4~75kW
      - 3-phase, 200 to 240V/50Hz/60Hz
    - 400V class: 0.75 to 90kW
      - Three-phase 380~400V/50Hz/60Hz
    - 110 to 500kW
      - Three-phase 380~400V/50Hz/60Hz
    - 0.37~250kW
      - Three-phase 380~400V/50Hz/60Hz

- **Control circuit terminal**: Terminal Function
  - R1, S1, T1: Three-phase 380~400V/50Hz
    - 0.4~75kW
      - 3-phase, 200 to 240V/50Hz/60Hz
    - 400V class: 0.75 to 90kW
      - Three-phase 380~400V/50Hz/60Hz
    - 110 to 500kW
      - Three-phase 380~400V/50Hz/60Hz

- **Power supply**: Power supply (when SW1 is in any position other than PLC)
  - 24V internal output terminal
    - 24V 20mA

- **Multifunction programmable analog output**: 0~10Vdc input and 0~60Hz frequency

- **Digital signal equipotential (0V) terminal**
  - 0V side (if sink logic is selected), connect the reference potential-side (0V side) cable from the power supply to the CC terminal.
  - External power supply is used.

- **Inverter’s cooling power input terminals**: When using a DC power supply, connect three-phase power cables.

- **External power supply**: Use a power supply with a current rating of 1.1 or more.

---

2) Although the CC terminal and the CCA terminal are not insulated, they should be separated sufficiently, especially for an external power supply for the circuit and the logic for the analog circuit.

3) When SW1 is set to the same as the IVT (source/sink signal) input terminal provided for conventional models, use the ST function, assign it to a multifunction terminal or an optional control power supply backup.

Example: When assigning the ST function to the ST3 terminal.

Set SW1 to 3.

These settings put the motor into a standby state (S3 and CC are short-circuited, or coast and stop the motor if the circuit between S3 and CC is opened.)
For inverter users

When studying how to use our inverters

Notes

Leakage current

This inverter uses high-speed switching devices for PWM control. When a relatively long cable is used for power supply to an inverter, current may leak from the cable or the motor because of the inverter’s capacitance, adversely affecting peripheral equipment. The intensity of such a leakage current depends on the PWM carrier frequency, the length of the input and output cables, etc., of the inverter. To prevent current leakage, it is recommended to take the following measures.

[Effects of leakage current]

Leakage current, which increases when an inverter is used may pass through the following routes:

route (1) Leakage due to the capacitance between the ground and the noise filter
route (2) Leakage due to the capacitance between the ground and the inverter
route (3) Leakage due to the capacitance between the ground and the cable connecting the inverter and the motor.

route (4) Leakage due to the capacitance of the cable connecting the motor and an inverter in another power distribution line
route (5) Leakage through the grounding line common to motors
route (6) Leakage through the shielded cable to the capacitance of the grounding current which passes through the above routes may cause the following troubles:

Failure of a leakage circuit breaker in the same or another power distribution line
Malfunction of a ground relay installed in the same or another power distribution line
Noise produced at the output of an electronic device in another power distribution line
Activation of an external thermal relay installed between the inverter and the motor, at a current before the rate current

[Measures against effects of leakage current]

The measures against the effects of leakage current are as follows:

1) Measures to prevent the malfunction of leakage circuit breakers
   (1) Decrease the PWM carrier frequency of the inverter.
   (2) Use radio-frequency-interference-proof ELCBs as ground fault interrupters not only in the system into which the inverter is incorporated but also in other systems. When ELCBs are used, the PWM carrier frequency needs to be increased to operate the inverter.

2) When connecting multiple inverters to a single ELCB, use an ELCB with a high current sensitivity to reduce or make the number of inverters connected to the ELCB.

3) Measures against malfunction of ground-fault relay
   (1) Decrease the PWM carrier frequency of the inverter.
   (2) Install ground-fault relay with a high-frequency protection function, e.g., Toshiba CUX16 type of relay in both the same and other lines. When ELCBs are used, the PWM carrier frequency needs to be increased to operate the inverter.

4) Measures against noise produced by other electric and electronic systems
   (1) Separate the grounding line of the inverter from that of the affected electric and electronic systems.
   (2) Decrease the PWM carrier frequency of the inverter.

5) Measures against malfunction of external thermal relays
   (1) Remove the external thermal relay and use the electronic thermal function of the inverter instead of it. (Unapplicable to cases where a single inverter is used to drive more than one motor. Refer to the instruction manual for measures to be taken when thermal relays cannot be removed.)

6) When using an industrial inverter to drive a gear motor, inquire of the motor manufacturer about its continuous operation range, since low-speed operation of a gear motor may cause insufficient lubrication.

Power factor improvement capacitors

Do not install a power factor improvement capacitors on the input or output side of the inverter.

Installing a power factor improvement capacitors on the input or output side causes current containing harmonic components to flow into the inverter, adversely affecting the capacitor itself or causing the inverter to trip. To improve the power factor of an input AC reactor or a DC reactor (optional) on the primary side of the inverter.

Installation of input AC reactors

Such devices are used to improve the input power factor and suppress high harmonic currents and surges. Install an input AC reactor when using the inverter under the following conditions:

(1) When the power source capacity is 60kW or more, and when it is 10 times or more greater than the inverter capacity.

(2) When the inverter is connected to the same power distribution system as that of distorted wave-producing systems, such as fan motors and large-capacity inverters.

When wiring the inverter

Wiring precautions

Installing a molded-case circuit breaker (MCCB)

(1) Install a molded-case circuit breaker (MCCB) on the inverter’s power supply input to protect the wiring.

(2) Avoid turning the molded-case circuit breaker on and off frequently to turn on/off the motor.

Installing a magnetic contactor [MC] (primary side)

(1) To prevent an automatic restart after the power interruption or overload relay has tripped, or actuation of the protective circuit, install an electric-magnetic contact in the power supply.

(2) The inverter is provided with a failure detection relay (FL), so that, if its contacts are connected to the operation circuit of the magnetic contactor on the primary side, the magnetic contactor will be opened when the protective circuit of the inverter is activated.

(3) The inverter can be used without a magnetic contactor. In this case, use an MCCB (equipped with a voltage tripping device) for opening the primary circuit when the inverter protective circuit is activated.

(4) Avoid turning the magnetic contactor on and off frequently to turn on/off the motor.

(5) Turn off the motor frequently, close the break the control terminals F (or FL)-CC.

Installing a magnetic contactor [MC] (secondary side)

(1) As a rule, if a magnetic contactor is installed between the inverter and the motor, do not turn on/off DQNDF while running. (If the secondary-side contactor is turned on DQNDF while running, a large current may flow in the inverter, causing inverter damage and failure.)

(2) A magnetic contactor may be installed to change the motor or change to the commercial power supply for a short time when the inverter is stopped. Always use an interlock with the magnetic contactor in this situation so that the commercial power supply is not applied to the inverter’s output terminals.

External signal

(1) Use a relay rated for low currents. Mount a surge suppressor on the excitation coil of the relay.

(2) When using the control circuit, use shielded wires or twisted pair cables.

(3) Before conduction the terminals except FLA, FLB and FLC are connected to electronic circuits, install signal terminals to prevent them from coming into contact with the main circuit.

Installing an overload relay

(1) The inverter has an electronic-thermal overload protective function.

(2) However, in the following cases, the thermal relay operation level must be adjusted or an overload relay matching the inverter’s characteristics must be installed between the inverter and the motor.

(a) When using a motor having a rated current value different from that of the inverter.

(b) When using several motors simultaneously.

(c) When the inverter to control the operation of a constant/torque motor (VF motor), change the protective characteristics of the electronic thermal relay according to the setting of the VF motor.

(2) In order to adequately protect a motor used for low-speed operation, we recommend the use of a motor equipped with an embedded thermal relay.

When changing the motor speed

Application to standard motors

Vibration

When a motor is operated with an industrial inverter, it experiences more vibrations than when it is operated by the commercial power supply. The vibration can be reduced to a negligible level by securing the motor and machine to the base firmly. However, a low vibration environment may increase at a light load due to resonance with the mechanical system.

Reduction gear, belt, chain

Note that the lubrication capability of a reducer or a converter used as the interface of the motor and the load machine may affect at low speeds.

When operating at a frequencies exceeding 60 Hz or higher, power transmission mechanisms such as reduction gear, belts and chains, may cause problems such as production of noise, a reduction in strength, or shortening of services life.

Frequency

Before setting the maximum frequency to 60 Hz or higher, confirm that this operating range is acceptable for the motor.

Application to special motors

Braking motor

When using a braking motor, if the braking circuit is directly connected to the inverter’s output terminals, the brake cannot be released because of the lowered starting voltage. Therefore, when using a braking motor, connect the braking circuit to the inverter’s power source side, as shown on the usually. Usually, braking motors produce larger noise in low speed ranges.

Toshiba Gold Motor (High-efficiency power-saving motor)

Inverter-driven operation of Toshiba Gold Motors is the best solution for saving energy. This is because these motors have improved efficiency, power factor, and noise/vibration reduction characteristics when compared to standard motors.

Pole-changing motor

Pole-changing motors can be driven by this inverter. Before changing poles, however, be sure to let the motor come to a complete stop.

High-pole-count motors

Note that high-pole-count motors (6 or more poles), which may be used for fan, etc., have higher rated current than 6-pole motors. The current ratings of multiple motors are relatively high. So, when selecting an inverter, you must pay special attention to its current rating so that the current rating of the motor is below that of the inverter. Single-phase motor

Because single-phase inverters are equipped with a centrifugal switch and capacitors for starting, they cannot be driven by an inverter. If only a single-phase, power supply is available in a 3-phase system, it can be driven by using a single-phase input inverter to convert it to a 3-phase 200V output. (A special inverter and a 3-phase motor are required.)
Peripheral devices

For inverter users

Selecting peripheral wiring sizes devices

<table>
<thead>
<tr>
<th>Voltage Class</th>
<th>Current Class</th>
<th>Inverter (A)</th>
<th>Emission (A)</th>
<th>Control Power Supply (A)</th>
<th>Motor (A)</th>
<th>Motor-End Surge Voltage Suppression Filter (400V type only)</th>
<th>Motor-End Surge Voltage Suppression Filter (400V type only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>200V Power Supply</td>
<td>160</td>
<td>75</td>
<td>150</td>
<td>95</td>
<td>50</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>400V Power Supply</td>
<td>190</td>
<td>180</td>
<td>160</td>
<td>132</td>
<td>100</td>
<td>70</td>
<td>30</td>
</tr>
</tbody>
</table>

Note 12) The number refers to a cable composition. For example, in the case of “150 mm² AWG 4/0”, the number 150 is the sum of the motor rated current multiplied by 1.05 to 1.1, and it is less than the inverter’s rated output power. For inverter users:

- Choose the wiring size according to the braking resistor value.
- Attach surge killers to the magnetic contactor and exciting coil of the relay.
- Choose the MCCB according to the power supply capacity.
- Selections for use of the Toshiba 4-pole standard motor with power supply voltage of 200V/400V-50Hz.

Selecting the Capacity (model) of the Inverter

Harmonic current and influence to power supply

Harmonics are defined as sinusoidal waves that are multiple frequency of commercial power (base frequency 50Hz or 60Hz). Commercial power including harmonics has a distorted waveform. Some electrical and electronic devices produce distorted waves in their rectifying and smoothing circuits on the input side. Harmonics produced by a device influence other electrical equipment and facilities in some cases (for example, overheating of phase advancing capacitors and reactors).
Built-in options

Here are the internal devices optionally available. There are two types of optional devices: Add-on type and Plug-in type.

### Table of optional devices

<table>
<thead>
<tr>
<th>Option name</th>
<th>Function, purpose</th>
<th>Model</th>
<th>Type of Installation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expansion terminal/function</td>
<td>Expansion I/O card1</td>
<td>-</td>
<td>Add-on</td>
</tr>
<tr>
<td></td>
<td>Expansion I/O card2</td>
<td>-</td>
<td>Add-on</td>
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<tr>
<td></td>
<td>Expansion I/O card3</td>
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<td>Add-on</td>
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<tr>
<td>Communication function</td>
<td>OPC communication card</td>
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<td>Add-on</td>
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<td>DeviceNet communication card</td>
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<td>CANopen communication card</td>
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<td>Add-on</td>
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<tr>
<td></td>
<td>PG feedback</td>
<td>-</td>
<td>Plug-in</td>
</tr>
</tbody>
</table>

**External options**

1. **Add-on type devices and Plug-in type devices** can be installed at the same time. However, two identical optional devices and two identical communication devices cannot be connected and used.

**Up to two Add-on type devices and one Plug-in type device can be installed at the same time.**

**How to install**

Add-on type devices and insertion type devices are installed in different ways. Install them correctly, as shown in the figures below.

### Function of Expansion I/O card

- **Multifunction programmable output control**: Used for various uses such as open collector output, power output, etc.
- **Multifunction programmable open collector output**: Can be set to 0V or 24V.

### Function of PG feedback card

- **Sensor vector control**: Provides 12V output for driving motors.
- **PG feedback card**: Provides 24V output for driving motors.
- **PG supply power**: Provides 5V output for driving motors.

### Function of PG feedback card

- **PG method**: Provides 5V output for driving motors.
- **PG supply power**: Provides 5V output for driving motors.

### Dimension of depth that installed option

Depending on the capacity, the installation of an Add-on type device may increase the depth of the inverter.

### How to install

Add-on type devices and insertion type devices are installed in different ways. Install them correctly, as shown in the figures below.
For 200V class 11 to 45kW and 400V class 18.5 to 75kW, DC reactor is built in standard. Please use these external options when requiring the further improvement of the power factor and reducing harmonics.

External dimensions

For 400V class 300 to 500kW, be sure to connect the AC reactor in parallel.

Input AC reactor

Be sure to connect the DC reactor in parallel.

Model | Rated output | Inverter type | Terminals | Dimensional diagram | Terminal | Mass weight (kg)
<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>DCL-2007L6W</td>
<td>7A</td>
<td>VFAS1-2004PL, 2007PL</td>
<td>Terminal block M8, 1.2</td>
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<td>DCL-2022</td>
<td>14A</td>
<td>VFAS1-2015PL, 2022PL</td>
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<td>DCL-2032</td>
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<td>DCL-2055</td>
<td>38A</td>
<td>VFAS1-2055PL</td>
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<tr>
<td>DCL-2110</td>
<td>75A</td>
<td>VFAS1-2075PL, VFAS1-210PL</td>
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<td>DCL-2450</td>
<td>300A</td>
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<td>DCL-2950</td>
<td>316A</td>
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<td>DCL-2750</td>
<td>386A</td>
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<tr>
<td>DCL-2007L6W</td>
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<td>DCL-2022</td>
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<td>DCL-4110</td>
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<td>DCL-4220</td>
<td>75A</td>
<td>VFAS1-4220PL, 4220PL Note 1</td>
<td>Ring terminal M8, 1.0</td>
<td></td>
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<td></td>
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<tr>
<td>DCL-4450</td>
<td>150A</td>
<td>VFAS1-4450PL, 4450PM Note 1</td>
<td>Ring terminal M8, 1.0</td>
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<td></td>
<td></td>
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<tr>
<td>DCL-4750</td>
<td>225A</td>
<td>VFAS1-4750PM</td>
<td>Ring terminal M8, 1.0</td>
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<tr>
<td>DCL-4900</td>
<td>243A</td>
<td>VFAS1-4900PM Note 2</td>
<td>Refer to external dimension of inverter.</td>
<td></td>
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<tr>
<td>DCL-4110K</td>
<td>250A</td>
<td>VFAS1-4110KPM Note 2</td>
<td>Refer to external dimension of inverter.</td>
<td></td>
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<td></td>
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<tr>
<td>DCL-4132K</td>
<td>351A</td>
<td>VFAS1-4132KPM Note 2</td>
<td>Refer to external dimension of inverter.</td>
<td></td>
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<tr>
<td>DCL-4160K</td>
<td>486A</td>
<td>VFAS1-4160KPM Note 2</td>
<td>Refer to external dimension of inverter.</td>
<td></td>
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<td></td>
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<tr>
<td>DCL-4200K</td>
<td>575A</td>
<td>VFAS1-4200KPM Note 2</td>
<td>Refer to external dimension of inverter.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DCL-4260K</td>
<td>702A</td>
<td>VFAS1-4260KPM, 4260KPM Note 2</td>
<td>Refer to external dimension of inverter.</td>
<td></td>
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</tbody>
</table>

Note 1: Be sure to connect the AC reactor in parallel.

Note 2: Be sure to connect the DC reactor in parallel to this 45kW or more and 400V KM45 or more inverter.
EMC Directive compliant noise reduction filter

For 300V class 0.4 to 7.5kW and 400V class 0.75 to 500kW, EMC noise filter is built-in standard. Please use these external options depended on the length of the cable between inverter and motor.

(1) Foot mount type EMC noise filter

- Foot mount installation
- Side mount installation

![Connection diagram](image)

Motor end surge voltage suppression filter (Only 400V class)

- Connection diagram
- Fig. A, Fig. B, Fig. C

EMC plate

- Exteral dimensions
- Motor end surge voltage suppression filter
- Countermeasure of motor end surge voltage

![Connection diagram](image)

Note 1) Be sure to connect the EMC noise filter in parallel.
Note 2) These values are referential ones of single piece of EMC noise filter. For 300V class, 200V-60Hz power source. For 400V class, 400V-50Hz power source.
This is used for the quick deceleration, the frequent deceleration stop or shortening the deceleration time at the large inertia load. This resistor consumes the regenerative energy when regenerative braking operation.

External dimensions

Note 3) The allowable continuous regenerative power differs on the resistor value or power tolerance. Please refer to the “Selection of braking resistor” in the next page.

Braking resistor (DGP600)

<table>
<thead>
<tr>
<th>Model</th>
<th>Standard w/ cover (mm)</th>
<th>Voltage (V)</th>
<th>Dimension (mm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DGP600DU-81</td>
<td>A1,A2,A3</td>
<td>1200-2000</td>
<td>L220xW200xH230</td>
<td>1.0</td>
</tr>
<tr>
<td>DGP600DU-82</td>
<td>A1,A2,A3</td>
<td>1200-2000</td>
<td>L220xW200xH230</td>
<td>1.0</td>
</tr>
<tr>
<td>DGP600DU-83</td>
<td>A1,A2,A3</td>
<td>1200-2000</td>
<td>L220xW200xH230</td>
<td>1.0</td>
</tr>
<tr>
<td>DGP600DU-84</td>
<td>A1,A2,A3</td>
<td>1200-2000</td>
<td>L220xW200xH230</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Braking unit

For 200V AC, please apply the 200V AC to the semiconductor inverter to operate the braking unit.
LCD Remote Keypad

- **External dimensions**
- **Installation on the unit**
- **Installation on the panel**
- **Palm top operation**

LED Remote Keypad

- **External dimensions**
- **Panel cutout dimensions**

Heatsink outer option

This option enables the heatsink parts of the backside of the inverter that generate much heat to be located at the outside of the panel. This is effective for the small sizing of the totally-enclosed box by reducing the heat values inside the box.

**Fig.A**

- **Panel cutout dimensions**

**Fig.B**

- **Panel cutout dimensions**

**Fig.C**

- **Panel cutout dimensions**
**Panel cutout dimensions**

<table>
<thead>
<tr>
<th>Model</th>
<th>Inverter type</th>
<th>External dimensions</th>
<th>Panel dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOT010Z</td>
<td>200Z</td>
<td>165</td>
<td>92</td>
</tr>
<tr>
<td>FOT011Z</td>
<td>200Z</td>
<td>150</td>
<td>96</td>
</tr>
<tr>
<td>FOT012Z</td>
<td>200Z</td>
<td>140</td>
<td>102</td>
</tr>
</tbody>
</table>

**Operation panel (Model: CBVR-7B1)**

- Color: - AS mark Gr(71) (Panel front side)
- Approx. weight: 0.7kg

**Connection diagram**

- Notes: The wire length should be 2m or less between the inverter and the operation panel.

**Frequency meter (QS-60T (80Hz-1mAdc))**

- Panel cutout dimension

**USB communications conversion unit**

- USB communications conversion unit
  - Model: VI8501Z
  - Inverter unit connection cable
    - Model: CA0001.1(1m)
    - CA0002.5(1.5m)
    - CA0003.0(3m)
  - USB cable (A/B connection type)
    - Use a commercially available USB cable.
    - (Compliant with USB1.1/1.2)

**Control power supply backup unit**

- Model: CP500G2Z
- KIP500G2Z can be used for both 200V and 400V class.

**Potentiometer (RV30YN-20S-B302)**

**Potentiometer panel**

**Potentiometer knob (K-3)**
To users of our inverters: Our inverters are designed to control the speeds of three-phase induction motors for general industry.

⚠️ Precautions

* Read the instruction manual before installing or operating the inverter unit and store it in a safe place for reference.
* When using our inverters for equipment such as nuclear power control, aviation and space flight control, traffic, and safety, and there is a risk that any failure or malfunction of the inverter could directly endanger human life or cause injury, please contact our headquarters, branch, or office printed on the front and back covers of this catalogue. Special precautions must be taken and such applications must be studied carefully.
* When using our inverters for critical equipment, even though the inverters are manufactured under strict quality control always fit your equipment with safety devices to prevent serious accident or loss should the inverter fail (such as issuing an inverter failure signal).
* Do not use our inverters for any load other than three-phase induction motors.
* None of Toshiba, its subsidiaries, affiliates or agents, shall be liable for any physical damages, including, without limitation, malfunction, anomaly, breakdown or any other problem that may occur to any apparatus in which the Toshiba inverter is incorporated or to any equipment that is used in combination with the Toshiba inverter. Nor shall Toshiba, its subsidiaries, affiliates or agents be liable for any compensatory damages resulting from such utilization, including compensation for special, indirect, incidental, consequential, punitive or exemplary damages, or for loss of profit, income or data, even if the user has been advised or apprised of the likelihood of the occurrence of such loss or damages.

For further information, please contact your nearest Toshiba Representative or International Operations-Producer Goods.
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