TOSVERT™ inverter dedicated to fan and pump for HVAC

VF-FS1

Three-phase 200V class 0.4kW to 30kW
Three-phase 400V class 0.4kW to 30kW
DREAM INVERTER dedicated to fan and pump for HVAC

SPACE SAVING, ECO-FRIENDLY, NOISE-LESS and LONG LIFE
The VF-FS1 provides these features as standard

Applications:
- AHUS
- Ventilation fans
- Chillers
- Water pumps etc.

POINT 1
Half installation space and less wiring

POINT 2
Reactor-less harmonic reduction and high-frequency noise reduction

POINT 3
Long life and easy maintenance

POINT 4
Special softwares for fan and pump application are built-in

POINT 5
More energy saving and easier operation

POINT 6
Communications software and options

Totally enclosed box type for IP54

VF-FS1

TOSVERT™ inverter dedicated to fan and pump for HVAC

TOSVERT™ is a trademark of TOSHIBA Corporation.

Compatible with the World’s Main Standards (CE marking, UL, CSA, C-tick)

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- AHUs
- Ventilation fans
- Chillers
- Water pumps etc.

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Half installation space and less wiring

**Half installation space**

Reactor-less harmonic suppress technologies and built-in filter reduce 50% of installation space, save time and cost of wiring. And side-by-side installation realizes effective utilization of space in control panels.

**Reactor-less harmonics reduction and high-frequency noise reduction**

Harmonics reduction, Power factor improvement

Toshiba unique technologies suppress harmonics, particularly 5th and 7th harmonic current that affect power sources. And the power factor in all models has been improved. Harmonics are controlled to within the Total Harmonic Distortion (THD) of international standard IEC61000-3-12 without any external reactor. (Rsce ≥120)

High-frequency noise reduction

High-frequency noise is drastically reduced on models with built-in noise filters. Built-in noise filters are ideal for office, commercial facilities, and factories where special attention for peripheral devices are needed. Compared with existing model, less space and wiring are realized by incorporating filter in the panel. In addition, models with built-in EMC noise filter comply with the European EMC Directive as individual inverter units.

Long life and easy maintenance

**Long life and easy maintenance**

- 15 years life designed main capacitors
- An alarm warns when the main circuit capacitors, circuit boards capacitors, or cooling fan needs to be replaced.
- Cooling fan’s On/Off control extend its life
- Easy replacement of cooling fan by one touch
- The inverter unit can be replaced by removable terminal block without disconnecting cables.

Special softwares for fan and pump application are built-in

Ideal functions are built-in for fan and pump application.

- The local or remote operation can be selected by one touch.
- Bumpless function realize seamless operation between local and remote.
- Fire control enables forced operation in emergency. In case of emergency, forced control will run by specified frequency. The forced operation signal will be saved when the signal turns ON. Motor does not stop in the event of the occurrence of a soft fault.
- Speed reference can manage on/off operation. (sleep function)
- Low current detection can notice a broken belt or low load for pump application
- PTC thermistor input
- Built-in RS485 (TOSHIBA/Modbus protocol) communication as standard. Optional fieldbuses for LonWorks®, BACnet®, Metasys® N2 and APOGEE® FLN as built in option.

- Applications: Buildings, Airports, Theaters, Dome stadium, etc.
- Applications: Observation room, etc.
- Applications: AHU (Local)
- Applications: Smoke-extraction measure of Buildings, Smoke-extraction measure of warehouse, Smoke-extraction measure of Buildings etc.
More energy saving

The advanced energy-saving mode optimizes fan and pump efficiency even at normally inefficient in low speeds.

The effect can be monitored by operation panel or through serial communication data.

Effect of advanced energy-saving mode

![Graph showing output power vs. output frequency](image)

More energy saving

Communications software and options

Communications software

The PCM001Z communications software allows you to edit, monitor, and trace parameter data on a PC. It realizes easier data management for commissioning and maintenance.

Options

USB communications conversion unit

This is a unit which converts USB port signal to VF inverter serial port for data communication. Optional cables to USB and inverter unit are required. By using serial data communication, all parameters and monitoring data can be accessed for commissioning and maintenance.

Network

Built-in HVAC fieldbuses option are available to communicate with a host controller for centralized control.

- LoWorks®
- BACnet®
- Metasys® N2
- APOGEE® FLN

LED extension panel

The panel with 20 mm height LEDs displays frequency and parameters very clearly at sight. In addition, it can save and download up to three sets of individual parameters as a parameter writer.

External EMC directive compliant noise reduction filter

It can be compiled to the following directives by installing this filter.

- 400V class: IEC/EN61800-3, 1st Environment, C1 or IEC/EN61800-3, 1st Environment, C2
- 200V class: IEC/EN61800-3, 1st Environment, C2 or IEC/EN61800-3, 2nd Environment, C3
Note 1: Capacity is calculated at 220V for the 200V models, at 440V for the 400V models.

Note 2: hertz/second (Hz/s). Maintenance: is to reduce the inverter's internal temperature, then to cool the inverter. Use the inverter within the specified temperature range. When the inverter's internal temperature is more than 80°C, the inverter's output and operation will be stopped.

Note 3: Voltage +10%, -15% Note 4), frequency ±25%. AC drive. Power line filter. (1.1) is the number of the inverter's internal temperature. PFC control. 4-digit 7-segment LED. The motor is allowed to "slip" according to the load torque current.

Note 4: ±5%.
**Note 1:** To make it easier to grasp the dimensions of each inverter, dimensions common to all inverters in these figures are shown with numeric values but not with symbols.

Here are the meanings of the symbols used.
- **W:** Width
- **H:** Height
- **D:** Depth
- **W1:** Mounting dimension (horizontal)
- **H1:** Mounting dimension (vertical)
- **H2:** Height of EMC plate mounting area

**Note 2:** Here are the available EMC plates:
- **Fig. A:** EMP004Z (Approx. weight: 0.1kg)
- **Fig. B:** EMP005Z (Approx. weight: 0.3kg)
- **Fig. C:** EMP006Z (Approx. weight: 0.3kg)

**Note 3:** The models shown in Fig. A is fixed at two points: in the upper left and lower right corners.

<table>
<thead>
<tr>
<th>Voltage class</th>
<th>Applicable motor (kW)</th>
<th>Inverter type</th>
<th>Dimensions (mm)</th>
<th>Approx. weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-phase 200V</td>
<td>0.75</td>
<td>VFFS1-2007PM</td>
<td>W: 105 H: 130 D: 150</td>
<td>W1: 95 H1: 121.5 H2: 13</td>
</tr>
<tr>
<td></td>
<td>3.7</td>
<td>VFFS1-2037PM</td>
<td>W: 245 H: 310 D: 200</td>
<td>W1: 225 H1: 295 H2: 19.5</td>
</tr>
<tr>
<td></td>
<td>5.5</td>
<td>VFFS1-2055PM</td>
<td>W: 240 H: 420 D: 214</td>
<td>W1: 206 H1: 403 H2: 8.8</td>
</tr>
<tr>
<td></td>
<td>7.5</td>
<td>VFFS1-2075PM</td>
<td>W: 320 H: 630 D: 230</td>
<td>W1: 280 H1: 605 H2: 6.0</td>
</tr>
<tr>
<td>3-phase 400V</td>
<td>0.75</td>
<td>VFFS1-4007PM</td>
<td>W: 105 H: 130 D: 150</td>
<td>W1: 95 H1: 121.5 H2: 13</td>
</tr>
<tr>
<td></td>
<td>1.5</td>
<td>VFFS1-4015PM</td>
<td>W: 140 H: 170 D: 150</td>
<td>W1: 136 H1: 157 H2: 14</td>
</tr>
<tr>
<td></td>
<td>5.5</td>
<td>VFFS1-4055PM</td>
<td>W: 240 H: 420 D: 214</td>
<td>W1: 206 H1: 403 H2: 8.8</td>
</tr>
<tr>
<td></td>
<td>7.5</td>
<td>VFFS1-4075PM</td>
<td>W: 320 H: 630 D: 230</td>
<td>W1: 280 H1: 605 H2: 6.0</td>
</tr>
</tbody>
</table>

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- **Fig. C:** EMP006Z (Approx. weight: 0.3kg)

**Note 3:** The models shown in Fig. A is fixed at two points: in the upper left and lower right corners.
This standard diagram shows the wiring of the main circuit.

### Main circuit terminal

<table>
<thead>
<tr>
<th>Terminal symbol</th>
<th>Input/output</th>
<th>Function</th>
<th>Electrical specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>F</td>
<td>Input</td>
<td>No voltage contact input</td>
</tr>
<tr>
<td></td>
<td>R</td>
<td>Input</td>
<td>24Vdc-5mA or less</td>
</tr>
<tr>
<td></td>
<td>RES</td>
<td>Input</td>
<td>24Vdc (Insulation resistance: DC50Ω)</td>
</tr>
<tr>
<td></td>
<td>VIB</td>
<td>Input</td>
<td>0mA (0Vdc)</td>
</tr>
<tr>
<td></td>
<td>VIA</td>
<td>Input</td>
<td>5mA (0Vdc)</td>
</tr>
<tr>
<td></td>
<td>FM</td>
<td>Input</td>
<td>0.2mA (0Vdc)</td>
</tr>
<tr>
<td></td>
<td>PLA</td>
<td>Input</td>
<td>10Vdc (Internal impedance: 30kΩ)</td>
</tr>
<tr>
<td></td>
<td>FLA</td>
<td>Input</td>
<td>0Vdc (Internal impedance: 30kΩ)</td>
</tr>
<tr>
<td></td>
<td>FLB</td>
<td>Input</td>
<td>0Vdc (Internal impedance: 30kΩ)</td>
</tr>
<tr>
<td></td>
<td>PP</td>
<td>Output</td>
<td>Analog power supply output</td>
</tr>
<tr>
<td></td>
<td>PLA</td>
<td>Output</td>
<td>10Vdc (permisible load current: 10mA)</td>
</tr>
<tr>
<td></td>
<td>FLA</td>
<td>Output</td>
<td>24Vdc-0.5mA</td>
</tr>
<tr>
<td></td>
<td>FLB</td>
<td>Output</td>
<td>24Vdc-0.5mA</td>
</tr>
<tr>
<td></td>
<td>PLC</td>
<td>Output</td>
<td>24Vdc-0.5mA</td>
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<tr>
<td></td>
<td>FLA+</td>
<td>Output</td>
<td>24Vdc-0.5mA</td>
</tr>
<tr>
<td></td>
<td>FLB+</td>
<td>Output</td>
<td>24Vdc-0.5mA</td>
</tr>
<tr>
<td></td>
<td>PLC+</td>
<td>Output</td>
<td>24Vdc-0.5mA</td>
</tr>
</tbody>
</table>

### Control circuit terminal

<table>
<thead>
<tr>
<th>Terminal symbol</th>
<th>Input/output</th>
<th>Function</th>
<th>Electrical specifications</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tbody>
</table>

### Wiring devices

<table>
<thead>
<tr>
<th>Voltage class</th>
<th>Capacity of applicable motor (kW)</th>
<th>Input current (A)</th>
<th>Wire size (See Note 4)</th>
<th>Rated current (A)</th>
<th>Operational current (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Three-phase 380V class</td>
<td>0.4</td>
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<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

### Notes

1. This is a standard wiring diagram and is subject to change without notice. It is recommended to consult the catalog for more detailed specifications.
2. For more information, please refer to the catalog or contact customer service.
3. The diagram shows the main circuit and is subject to change without notice. It is recommended to consult the catalog for more detailed specifications.
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5. The diagram shows the main circuit and is subject to change without notice. It is recommended to consult the catalog for more detailed specifications.

---

**Standard connection diagram - SINK (Negative) (common: CC)**

1. Three-phase 200V class: three-phase 200-240V-50/60Hz
2. Three-phase 400V class: three-phase 380-480V-50/60Hz

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**Standard connection diagram - SOURCE (Positive) (common: P24)**

1. Three-phase 200V class: three-phase 200-240V-50/60Hz
2. Three-phase 400V class: three-phase 380-480V-50/60Hz

---

**Note 3:** For grounding, use a cable with a size equal to or larger than the above.

**Note 4:** Wire size (See Note 3) for main circuit (typical). (Note 4) for main circuit (typical).

**Note 5:** If there is a need to comply with UL standard, use correct size of UL wires.

---

**Main circuit terminal**

- **RL1, SL2, TL3**: 200V class: three-phase 200 to 240V-50/60Hz 400V class: three-phase 380 to 480V-50/60Hz
- **UVT, VT2, VT3**: Connect to a three-phase induction motor.
- **PA+, PCI+**: PA+ terminal: Positive potential terminal for the internal DC main circuit. PCI- terminal: Negative potential terminal for the internal DC main circuit. DC power can be supplied through the PA+ and PCI- terminals.

---

**Control circuit terminal**

- **F**: Input
- **R**: Input
- **RES**: Input
- **VIA**: Input
- **VIB**: Input
- **PLC**: Input
- **FM**: Input
- **PLA**: Input
- **FLA**: Input
- **FLB**: Input
- **PP**: Output
- **PLA+**: Output
- **PLB+**: Output
- **PLC+**: Output

**Note 6:** Selections for use of the Toshiba 4-pole standard motor with power supply voltage of 200V/400V-50/60Hz.

**Note 7:** Choose the MCCB according to the power supply capacity.

**Note 8:** When using on the motor side during commercial-power supply operation, choose the MCCB with 2a-type auxiliary contacts.

**Note 9:** In the case the magnetic contactor (MC) with 2a-type auxiliary contacts is used for the control circuit, choose the MC with 2a-type auxiliary contacts.

**Note 10:** In the case the magnetic contactor (MC) with 2a-type auxiliary contacts is used for the control circuit, choose the MC with 2a-type auxiliary contacts.

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**Wiring devices**

- **Voltage class**: Three-phase 200V class
- **Capacity of applicable motor**: 30kW-1850kW
- **Input current (A)**: 1.5-10A
- **Wire size (See Note 4)**: 1.5-10mm²
- **Rated current (A)**: 0.5-10A
- **Operational current (A)**: 0.5-10A

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**Notes**

1. Note 3: For use of the Toshiba 4-pole standard motor with power supply voltage of 200V/400V-50/60Hz.
2. Note 4: For grounding, use a cable with a size equal to or larger than the above.
3. Note 5: If there is a need to comply with UL standard, use correct size of UL wires.
4. Note 6: Selections for use of the Toshiba 4-pole standard motor with power supply voltage of 200V/400V-50/60Hz.
5. Note 7: Choose the MCCB according to the power supply capacity.
6. Note 8: When using on the motor side during commercial-power supply operation, choose the MCCB with 2a-type auxiliary contacts.
7. Note 9: In the case the magnetic contactor (MC) with 2a-type auxiliary contacts is used for the control circuit, choose the MC with 2a-type auxiliary contacts.
8. Note 10: In the case the magnetic contactor (MC) with 2a-type auxiliary contacts is used for the control circuit, choose the MC with 2a-type auxiliary contacts.
### Basic functions

Each "setup item" that determines the control characteristics of the inverter is called a "parameter."
For example, to change the acceleration time, you choose the acceleration time parameter (labeled "AC").

#### wizard function

A wizard function enables the setup of the 10 most often used parameters quickly. It can be sequentially installed, such as installing the FC software.

<table>
<thead>
<tr>
<th>Title</th>
<th>Function</th>
<th>Adjustment range</th>
<th>Default setting</th>
</tr>
</thead>
<tbody>
<tr>
<td>FC</td>
<td>Operation frequency of operation panel</td>
<td>LL-LK</td>
<td>0.0</td>
</tr>
<tr>
<td>RU</td>
<td>Status function</td>
<td>Display parameters in groups of five in the reverse order to that in which they are switched (Possible to switch)</td>
<td>-</td>
</tr>
<tr>
<td>RU'</td>
<td>Automatic acceleration/deceleration</td>
<td>0: Standard 1. Automatic 2. Automatic (joy stick) 3. 5 times operation 4. External input/VDON command setting 5: 5 times input operation</td>
<td>0</td>
</tr>
<tr>
<td>LL</td>
<td>Lower limit frequency</td>
<td>0.0-50.0</td>
<td>Depends on capacity</td>
</tr>
<tr>
<td>UL</td>
<td>Upper limit frequency</td>
<td>200.0</td>
<td>Depends on capacity</td>
</tr>
<tr>
<td>LTR</td>
<td>Motor thermal protection</td>
<td>-</td>
<td>Depends on capacity</td>
</tr>
<tr>
<td>FL</td>
<td>Frequency set mode selection</td>
<td>1: V/F 2: 200.4 3: Operation panel 4: Serial communication</td>
<td>1</td>
</tr>
<tr>
<td>LF</td>
<td>Frequency adjustment</td>
<td>0.0-10.0 10.0-100.0</td>
<td>Depends on capacity</td>
</tr>
<tr>
<td>R1</td>
<td>Motor adjustment</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>π</td>
<td>Default setting</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>FTR</td>
<td>Forward/reverse selection</td>
<td>0: Forward run 1: Reverse run 2: Forward run (F/R switching possible)</td>
<td>0</td>
</tr>
<tr>
<td>FWC</td>
<td>Frequency wave selection</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>RDC</td>
<td>Acceleration time 1</td>
<td>0.0-50.0</td>
<td>Depends on capacity</td>
</tr>
<tr>
<td>RDE</td>
<td>Deceleration time 1</td>
<td>0.0-50.0</td>
<td>Depends on capacity</td>
</tr>
<tr>
<td>UL</td>
<td>Upper limit frequency</td>
<td>200.0</td>
<td>Depends on capacity</td>
</tr>
<tr>
<td>LL</td>
<td>Lower limit frequency</td>
<td>0.0-50.0</td>
<td>Depends on capacity</td>
</tr>
<tr>
<td>wU</td>
<td>Base frequency voltage 1</td>
<td>0.0-50.0</td>
<td>Depends on capacity</td>
</tr>
<tr>
<td>wU0</td>
<td>Base frequency voltage 2</td>
<td>0.0-50.0</td>
<td>Depends on capacity</td>
</tr>
<tr>
<td>RU0</td>
<td>Run-end electric protection level</td>
<td>0.0-10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>DUT</td>
<td>Electric protection level</td>
<td>0.0-10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>ST</td>
<td>Standard characteristic selection</td>
<td>1: Standard motor (Overload protection, DL standard) 2: 7.5kW motor (Overload protection, DL standard)</td>
<td>1</td>
</tr>
<tr>
<td>S1</td>
<td>1st speed operation frequency 1</td>
<td>0.0-10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>S2</td>
<td>2nd speed operation frequency 1</td>
<td>0.0-10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>S3</td>
<td>3rd speed operation frequency 3</td>
<td>0.0-10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>S4</td>
<td>4th speed operation frequency 4</td>
<td>0.0-10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>S5</td>
<td>5th speed operation frequency 5</td>
<td>0.0-10.0</td>
<td>10.0</td>
</tr>
<tr>
<td>S6</td>
<td>6th speed operation frequency 6</td>
<td>0.0-10.0</td>
<td>10.0</td>
</tr>
</tbody>
</table>

### Extended parameters

About 170 extended parameters are available. For details on extended parameters, please visit our website. (http://www.inverter.co.jp/)

### Peripheral devices

- **Power supply**
- **Non-fuse breaker MCCB**
- **Magnetic contactor MC**
- **Input AC reactor (AC1)**
- **High-attenuation radio noise filter**
- **Zero-phase reactor for core-type noise reduction filter**
- **EMC noise filter**
- **Input AC reactor (AC2)**
- **Motor-end surge voltage suppression filter**
- **LED-FS1**
- **N.F**
- **N.F**
- **N.F**
- **N.F**
- **N.F**
- **N.F**
- **N.F**
- **N.F**

For details on parameters and functions, please refer to the operation manual. For specific functions, please visit our website. (http://www.inverter.co.jp/)

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**Caption:**
- "EMC noise reduction filter (Compliant with European standards)"
- "Magnetic contactor MC"
Wiring precautions

Installing a molded-case circuit breaker (MCCB) (1) Install a molded-case circuit breaker (MCCB) or 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. (3) To turn on/off the motor frequently, close/open the control terminals F (or R) - CC.

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 electromagnetic contactor 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 protective circuit of the inverter is activated. (4) Avoid turning the magnetic contactor on and off frequently to turn on/off the motor. (5) To turn on/off the motor frequently, close/open the control terminals F (or R) - 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 while running. (If the secondary-side contactor is turned ON/OFF 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 source 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 suppressor on the excitation coil of the relay. (2) When wiring the control circuit, use shielded or twisted-pair cables. (3) All control terminals, except FLA, FLB and FLC are electronic circuits. Therefore, input signals are transduced by power circuits.

Installing an overload relay (1) The V/F-1ST inverter has an electronic thermo-overload protective function. However, in the following cases, the thermal operation level must be adjusted or an overload relay matching the motor'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 driving several motors simultaneously. (c) When using the inverter to control the operation of a constant-torque motor (VF motor), change the protective characteristic of the electronic thermal relay according to the capacity of the VF motor. (d) If no overload relay is installed, the inverter cannot detect overload. (e) When no overload relay is installed, it is impossible to protect the motor from overloading.

Installing an input AC reactors These 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 200kW or more, and when it is 10 times or more greater than the current rating of the inverter. (2) When the inverter is connected to the same power distribution system as a transformer or a converter. (3) When the inverter is connected to the same power distribution system as that of a drive or a power supply system such as a variable speed pump, mixer or a large-capacity motor.

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

When studying how to use our inverters

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 by making appropriate wiring to the motor and machine to the basic frame. If the base is weak, however, the vibration may increase at a light load due to natural vibration of 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 be affected by these vibrations. 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 noises, a reduction in strength, or shortening of service 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

Gear motor

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

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

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

Pole-changing motor

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

Multipolar motors

Note that multipolar motors or more poles, which may be used for fans, etc., have higher rated current than 4-pole motors. The current ratings of multipolar motors are relatively high. So, when selecting a motor, you must pay special attention to its current rating and confirm that the current rating of the motor is below that of the inverter.

Single-phase motor

Because single-phase motors are equipped with a centrifugal switch and capacitors for starting, they cannot be driven by an inverter. If only a single-phase, power system is available a 3-phase motor can be driven by using a single-phase input inverter to convert it into a 3-phase 340V output. (A special inverter and a 3-phase motor are required.)

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 output voltage. When using a braking motor, if the braking circuit is directly connected to the inverter's power supply input side, as shown on the left. Usually, braking motors produce larger noise in low speed ranges.

Note: In the case of the circuit shown on the left, assign the function of detecting low speed signals to the RY and RC terminals. Make sure the parameters P135 is set to 4 in factory default setting.
Selecting the capacity (model) of the inverter

**Selection**

**Capacity**

Refer to the applicable motor capacities listed in the standard specifications. When driving a high-pole motor, special motor, or multiple motors in parallel, select such an inverter that the sum of the motor rated current multiplied by 1.05 to 1.1 is less than the inverter’s rated output current value.

**Acceleration/deceleration times**

The actual acceleration and deceleration times of a motor driven by an inverter are determined by the torque and moment of inertia of the load, and can be calculated by the following equations.

The acceleration and deceleration times of an inverter can be set individually. In any case, however, they should be set longer than their respective values determined by the following equations.

**Allowable torque characteristics**

When a standard motor is combined with an inverter to perform variable speed operation, the motor temperature rises slightly higher than it normally does during commercial power supply operation. This is because the inverter output voltage has a sinusoidal (approximate) PWM waveform. In addition, the cooling becomes less effective at low speed, so the torque must be reduced according to the frequency.

When constant-torque operation must be performed at low speeds, use a Toshiba VF motor designed specifically for use with inverters.

**Starting characteristics**

When a motor is driven by an inverter, its operation is restricted by the inverter’s overload current rating, so the starting characteristics is different from those obtained from commercial power supply operation.

Although the starting torque is smaller with an inverter than with the commercial power supply, a high starting torque can be produced at low speeds by adjusting the V/f pattern torque boost amount or by employing vector control.

If you need bigger starting torque, please consider both upgrading inverter rating and motor rating.

<table>
<thead>
<tr>
<th>Conditions</th>
<th>JM</th>
<th>JL</th>
<th>∆N</th>
<th>TL</th>
<th>TM</th>
<th>TB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor constant moment of inertia (kg·m²)</td>
<td>Load torque (Nm)</td>
<td>Motor rated torque x 1.1 (Nm)</td>
<td>Motor rated torque x 1.2 (Nm)</td>
<td>Motor rated torque x 0.05 (Nm)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
t_{a} = \frac{(JM + JL) \times \Delta N}{9.56 \times (TM - TL)} \]

\[
t_{d} = \frac{(JM + JL) \times \Delta N}{9.56 \times (TB + TL)} \]

**Harmonic current and influence to power supply**

Harmonics are defined as sinusoidal waves that is 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).

For this inverter Toshiba unique technologies suppress harmonics, particularly 5th and 7th harmonic current that affect power sources. And the power factor in all models has been improved. Harmonics are controlled to within the Total Harmonic Distortion (THD) of international standard IEC61000-3-12 without any external reactor. (Race:120)

Optional AC reactor enables to comply with Partial Weighted Harmonic Distortion (PWHD) of IEC:61000-3-12. (Race:120)

<table>
<thead>
<tr>
<th>Output frequency (Hz)</th>
<th>Maximum torque</th>
<th>Maximum allowable continuous torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>60</td>
<td>70</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Torque (%) (See Note 1)</th>
<th>100%</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>60</td>
</tr>
</tbody>
</table>

Note 1. 100% of torque refers to the amount of torque that the motor produces when it is running at a 60Hz-synchronized speed. The starting torque is smaller in this case than that required when power is supplied from a commercial power line. So, the characteristics of the machine to be operated need to be taken into consideration.

Note 2. The maximum allowable torque at 50Hz can be calculated approximately by multiplying the maximum allowable torque at a base frequency of 60Hz by 0.8.
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. The information in this brochure is subject to change without notice.