For inverter users

Application of this inverter
VF-FS1 is not applicable for apparatus which needs sudden deceleration and stop. Note) This inverter allows you to decrease the frequency up to 6,000Hz.

4) Measures against malfunction of external thermal relays:
(1) Separate the grounding line of the inverter from that of the affected electric and electronic systems.
(2) Install ground-fault relays with a high-frequency protective function (e.g., Toshiba CCR12 type of relays). When ELCBs are used, the PWM carrier frequency needs to be increased to 30kHz.
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. When a larger starting torque is necessary, select an inverter with a larger capacity and examine the possibility of increasing the motor capacity. If you need bigger starting torque, please consider both upgrading inverter rating and motor rating.

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 within the Total Harmonic Distortion (THD) of international standard IEC61000-3-12 without any external reactor. (Rm ≥120)

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

Note 1. 100% of torque refers to the amount of torque that the motor produces when it is running at a V/f-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.

### Acceleration/deceleration times

<table>
<thead>
<tr>
<th>Conditions</th>
<th>[ta = \frac{JM + JL}{9.56} \times \Delta N]</th>
</tr>
</thead>
<tbody>
<tr>
<td>JM</td>
<td>Moment of inertia of motor (kg·m²)</td>
</tr>
<tr>
<td>JL</td>
<td>Moment of inertia of load (kg·m²)</td>
</tr>
<tr>
<td>ΔN</td>
<td>Difference in rotating speed between before and after acc. or dce. (min⁻¹)</td>
</tr>
<tr>
<td>TL</td>
<td>Load torque (Nm)</td>
</tr>
<tr>
<td>TM</td>
<td>Motor rated torque x 1.1 (Nm) ... V/f control</td>
</tr>
<tr>
<td>TM/1.2 (Nm)</td>
<td>... Vector operation control</td>
</tr>
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