# 24. TROUBLESHOOTING

If a fault occurs and the inverter fails to operate properly, locate the cause of the fault and take proper corrective action by referring to the troubleshooting below. If the corresponding information is not found in the table, the inverter has problem, or the component parts are damaged, contact the nearest service representative.

## 24.1 Inspection by the Display on the Parameter Unit

In response to the occurrence of a fault, the display unit of the inverter automatically displays the code of the detected fault.

| Display | Probable cause | Check | Corrective action |
|---|---|---|---|
| Err: Error | • Operation setting error<br>• Reset signal is ON.<br>• PU is not connected to the inverter correctly.<br>• High input voltage (approx. 260 VAC 520 VAC)<br>• Faulty internal circuit<br>• CPU run-away | • Review the operation method.<br>• Is wiring at the reset terminal correct?<br>• Is connector secured correctly?<br>• Is input voltage correct? | • Reset the inverter (page 48).<br>• Turn OFF the reset signal.<br>• Correct the connection.<br>• Use correct input voltage.<br>• Change the inverter. |
| OC1: Overcurrent during acceleration | Overcurrent | • Is acceleration too fast?<br>• Is output short-circuited or grounded? | • Extend acceleration time. |
| OC2: Overcurrent during constant speed operation | | • Was load changed suddenly?<br>• Is output short-circuited or grounded? | • Eliminate sudden load change. |
| OC3: Overcurrent during deceleration | | • Is deceleration too fast?<br>• Is output short-circuited or grounded?<br>• Is mechanical brake applied too early? | • Extend deceleration time.<br>• Check the brake application timing. |
| OV1: Overvoltage during acceleration | DC overvoltage in main circuit | • Is acceleration too fast? | • Extend acceleration time. |
| OV2: Overvoltage during constant speed operation | | • Is load changed suddenly? | • Eliminate sudden load change. |
| OV3: Overvoltage during deceleration | | • Is deceleration too fast? | • Extend deceleration time. (adjust deceleration time compensating for load $GD^2$) Reduce braking frequency. |

# 24. TROUBLESHOOTING

| Display | | Probable cause | Check | Corrective action |
|---|---|---|---|---|
| THT: | Overload warning | Thermal relay for inverter is tripped. | • Is motor used in the overloaded condition? | • Reduce the load. Increase the capacity of motor and inverter. |
| THM: | Overload warning | Termal relay for motor is tripped. | | |
| FAN: | Fan alarm | Cooling fan of the inverter has stopped. | • Is there foreign matter inside the fan assembly?<br>• Is there wiring error? | • Remove foreign matter.<br>• Check the wiring. |
| OLT: | Stall prevention | Operation of the stall prevention function or the current limit function for a long period. | • Is motor used in the overloaded condition? | • Reduce the load. Increase the capacity of motor and inverter. |
| BE: | Brake transistor alarm (*1) | Faulty brake transistor | • Is braking frequency correct? | • Reduce load ($GD^2$). Reduce braking frequency. |
| OHT: | External thermal relay tripped | An external thermal relay has been tripped. | • Is the motor overheated?<br>• Is an external relay in use? | • Reduce load ($GD^2$). Reduce braking frequency. Eliminate sending. |
| PE: | Parameter storing device error | Faulty EEPROM | • Is the number of<br>• parameter writing too many?<br>Is EEPROM worn out? | • Replace the inverter. |
| PUE: | PU disconnection detected | Connector of the parameter unit is disconnected. | • Is the parameter unit connection loose? | • Install and connect the parameter unit securely. |
| rET: | Retry count over | If operation cannot be resumed within the number of retry times set the inverter alarms and stop retry attempts. | • Check the cause of the error | |
| CPU: | CPU error | CPU run-away<br>The connection of the option and inverter is incorrect. | • Is the connector section loose? | • Replace the inverter. Securely connect. |
| GF: | Ground fault overcurrent (*2) | Occurrence of ground fault on output side | • Is there a ground fault in the motor or wire? | • Repair the ground fault section. |
| OPT: | Option alarm | Times of communication retries are over or check time intervals is over | • Check communication data and check time interval | • Correct communication data |
| 0: | Stop key function | PU stop key pressed while Pr.75 = 14 to 17. | • Pr.75 value | • Change setting. |

**Notes:** 1. *1. For the inverter equipped with the optional brake resistor.
*2. Mounted on the 400 V class.
2. Error output is not given if input voltage is low or momentary power interruption occurs. In these cases, however, the inverter is protected so that the inverter will not be damaged. Depending on the operating status (magnitude of load, during acceleration/deceleration, etc.), the overcurrent protection function, etc. may be actuated when the input power is restored.

# 24. TROUBLESHOOTING

## 24.2 Troubles and Check Points

| Trouble | Check points |
|---|---|
| Motor does not start. | (1) Check the main circuit.<br>• Is power supplied? (Is the POWER indicating lamp lit?)<br>• Is the motor connected correctly?<br>(2) Check the input signals.<br>• Is the start signal input?<br>• Are both the forward and reverse rotation signals input?<br>• Is the frequency set signal zero?<br>• Is the circuit across terminals AU and SD closed (ON) when the frequency setting signal is in the range from 4 to 20mA?<br>• Is the output stop signal (across terminals MRS and SD) or the reset signal (across terminals RES and SD) ON?<br>(3) Check the values set for parameters.<br>• Is the reverse rotation prevention (Pr.78) function set?<br>• Is the setting for the reverse mode (Pr.79) correct?<br>• Are the setting for the bias and gain (Pr.902 to Pr.905) correct?<br>• Is the setting for the start frequency (Pr.13) larger than the operation frequency?<br>• Is the frequency setting for the operation functions (multiple-speed operation, etc.) correct?<br>• Is the setting for the upper limit frequency (Pr.1) zero?<br>(4) Check the load.<br>• Is the load too heavy?<br>• Is the motor start constrained?<br>(5) Others<br>• Has the emergency stop status been estableshed by pressing the parameter unit stop key? (Is "E 0" disprayed ?)<br>• Is the alarm indicating lamp (ALARM) lit? |
| Motor rotates in the opposite direction. | • Is the phase sequence (U, V, W) at the output terminals correct?<br>• Are the start signals (forward, reverse) connected correctly? |
| Actual motor speed differs from the set speed excessively. | • Is the frequency setting signal correct? (Measure the input signal level.)<br>• Are the values set for the following parameters correct? Pr.1 (upper limit frequency), Pr.38 (frequency at 5 VDC input), Pr.39 (frequency at 20mA input), Pr.902 to Pr.905 (bias and gain)<br>• Are the input signal lines influenced by external noise? (use shielded wires, if influenced.) |
| Motor acceleration or deceleration is not smooth. | • Is acceleration or deceleration time too short?<br>• Is the load too heavy?<br>• Is the stall prevention function activated due to excessively large value set for torque boost? |
| Motor speed varies during rotation. | • Is the load changing?<br>• Is the frequency setting signal stable? |
| Motor current is too large. | • Is the load too heavy?<br>• Is the value set for torque boost (manual) too large? |

# 24. TROUBLESHOOTING

| Trouble | Check points |
|---|---|
| Motor speed does not increase. | • Is the value set for upper limit frequency correct? Is it too small?<br>• Is the load too heavy?<br>• Is the stall prevention function activated due to excessively large value set for torque boost? |
| Motor speed fluctuates during motor operation. | (1) Check the load<br>• Is the load changing?<br>(2) Check the input signals.<br>• Is the frequency setting signal stable?<br>(3) Others<br>• In the general-purpose magnetic flux vector control mode, is the setting for applicable motor capacity (Pr.80) correct for the inverter capacity and motor capacity?<br>• In the general-purpose magnetic flux vector control mode, is the wiring length longer than 30m (98.46 feet)?<br>• In the V/F control mode, is the wiring length too long? |

**Note:** "Pr." is an abbreviation of "Parameter."

# 24. TROUBLESHOOTING

## 24.3 Protection Functions

The following protection functions are provided to protect the inverter. If any of the protection functions is activated, the inverter output is shut off, the error message is displayed, and at the same time the error signal is output. In this case, the drive output is halted and the motor is free to rotate. To restart operation, it is necessary to reset the inverter.

| Function Name | | Description | | Display (Parameter Unit) |
|---|---|---|---|---|
| Overcurrent shut-off | | If the inverter output current exceeds 200% of the rated current during acceleration/deceleration or constant speed operation, the protection circuit is actuated and inverter output is shut off. | During acceleration | E.OC1 (OC1) |
| | | | During constant speed operation | E.OC2 (OC2) |
| | | | During deceleration | E.OC3 (OC3) |
| Regenerative overvoltage shut-off | | If the DC voltage in the main circuit exceeds the specified value due to regenerative energy during braking, the protection circuit is activated and inverter output is shut off. | During acceleration | E.OU1 (OV1) |
| | | | During constant speed operation | E.OU2 (OV2) |
| | | | During deceleration | E.OU3 (OV3) |
| Overload shut-off (electronic thermal relay) (*1) | Motor | If overheating of the motor due to overload or lowered cooling performance during low speed operation is sensed by the electronic thermal relay built in the inverter, the inverter output is shut off. To operate a multiple-pole motor or more than one motor, provide a thermal relay on the output side of the inverter for each motor. | | E.THM (THM) |
| | Inverter | If the current exceeds 150% of the rated output current, but lower than 200% (overcurrent shut-off level), the electronic thermal relay is activated due to inverse time characteristics to shut off the inverter output, thereby protecting the output transistors. | | E.THT (THT) |
| External thermal relay input (*2) | | If the motor overheat protection thermal relay, installed externally, or the thermal relay built in the motor is activated (contact break), the inverter output is shut off. In this case, the inverter does not restart even if the relay contact closes automatically unless the inverter is reset. | | E.OHT (OHT) |
| Brake transistor error detection (*3) | | If an error of the brake transistor occurs due to excessively large regeneration energy (optional brake resistor connected), the function detects the error and shuts of the inverter output. | | E.bE (BE) |
| Parameter error | | The error signal is output and the inverter output is shut off. If an EEPROM error is detected. | | E.PE (PE) |
| Parameter unit disconnection | | If communications between the parameter unit and the inverter is suspended due to disconnection of the parameter unit from the inverter while the setting for Pr.75 is 2, 3, 16 or 17, the inverter output is shut off. | | E.PUE (PUE) |
| Retry count over | | If the operation cannot be Co-restarted within the preset number of retries, the inverter output is shut off. | | E.rET (RET) |

# 24. TROUBLESHOOTING

| Function Name | | Description | Display (Parameter unit) |
|---|---|---|---|
| CPU error | | If the cycle of the CPU is not completed within the set time, the self-diagnostics interprets this as an error and shuts off inverter output. | E.CPU (CPU) |
| Current limit stall prevention | During acceleration | If current exceeding 150% (*4) of the rated inverter current flows in the motor, frequency ramp is halted until load current is reduced to prevent overcurrent shut-off the inverter. If the load current is reduced to 150%, the frequency will increase again. | Indicating lamp of the monitor mode blinks |
| | During constant speed operation | If current exceeding 150% (*4) of the rated inverter current flows in the motor, frequency ramp is halted until load current is reduced to prevent overcurrent shut-off of the inverter. If the load current is reduced to 150%, the frequency will increase again. | Indicating lamp of the monitor mode blinks After the stop, E.OLT (OLT) |
| | During deceleration | If the motor regeneration energy increases excessively and exceeds brake performance, this function stops decreasing of the frequency to prevent overvoltage shut-off. Deceleration continues after the regeneration energy has been reduced. If current exceeding 150% (*4) of the rated inverter current flows in the motor, frequency decrease is halted until load current is reduced to prevent overcurrent shut-off of the inverter. If the load current is reduced to 150%, the frequency will decrease again. | Indicating lamp of the monitor mode blinks. |
| Ground Fault | | If a ground fault current has flown due to a ground fault occurring in the output (load) side of the inverter, this function stops the inverter output. A ground fault occurring at low ground resistance may activate the overcurrent protection (OC1 to OC3). (Provided for the 400V type only.) | E. GF (GF) |
| Fan failure | | When the cooling fan of the inverter has stopped due to a foreign matter stuck in the fan or malfunction, the inverter output will be ceased. (1.5K to 3.7K 200V, 2.2K, 3.7K 400V) | E.FAn (FAN) |
| Option alarm | | Using computer communication, if times of communication retries are exceeded or check time interval is exceeded, the inverter output is shut off. | E.OPT (OPT) |

**Notes:** *1. If the inverter is reset, the accumulated internal thermal data of the electronic thermal relay is initialized. If "0" is set for Pr.9 (electronic thermal relay), the motor overload shut-off prevention function (THM) is invalid.

*2. This function is valid only when the "external thermal relay" is set.

*3. The function is valid only when the optional brake resistor is connected. (Brake resistor cannot be used for 0.1k and 0.2k. These drives have no brake transistor.)

*4. The stall prevention function activation current level can be set as required. Factory-setting is 150%.

- Retaining the error output signal..... If the power input to the inverter power supply side, is opened, when the protection function is activated, the inverter control power supply is lost and the error output signal cannot be retained. If the error output signal must be retained, the drive wiring must be designed to retain the error output signal externally. See the block diagram for information.
- Error display ..... If the protection function is activated, the alarm (ALARM) indicating lamp is lit. In response to the operation of the parameter unit, the display unit gives the indication shown above.
- Resetting procedure ..... If the protection function is activated, the inverter output shut-off state is retained. Continued operation is impossible unless the inverter is reset. The inverter reset procedure is indicated in page 48.

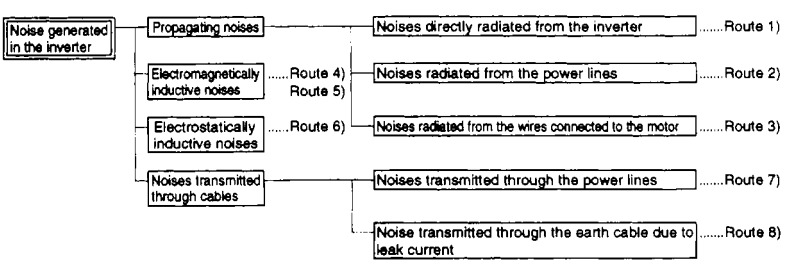
## 24.4 Noise

There are two types of noises-external noises which cause malfunctioning of the inverter and those radiated from the inverter to cause malfunctioning of a peripheral device. Although the inverters are designed not to be influenced by noises, the following general measures must be taken since the inverter is an electronic device which handles weak signals. In addition, since the inverter chops the output by high carrier frequency, the inverter itself is a source of noise generation. If peripheral equipment is affected by the noise generated by the inverter, noise suppressing measures must also be taken. The noise suppressing measures differ depending on noise propagation route.

(1) General measures
- Avoid running the power cable (input/output lines) and the signal lines in parallel or bundling them.
- Use shielded twisted-wire pair cable for the connecting line to the encoder and the control signal lines. The sheathing of the shielded cable must be connected to terminal SD.
- Grounding must be single-point grounding for the inverter and the motor.

(2) External noise can cause malfunctioning of the inverter
If noise generating equipment (magnetic contactor, electromagnetic brake, a number of relays, etc.) is installed near the inverter, and if the inverter could malfunction due to the noise generated by such equipment, it is necessary to take the measures indicated below.
- To install a surge suppressor in the equipment which generates noises to suppress noises.
- To install a data line filter in the signal lines.
- Ground the line connecting to the encoder and the shield of the control signal lines with the metallic cable clamp.

(3) Noise radiated from the inverter that causes malfunctioning of peripheral devices
Noise generated by an inverter are largely classified into the following types-noise radiated from the wires connected to the inverter and the inverter main circuit (input/output), noise induced electromagnetically or electrostatically in the signal lines which is run close to the power cables of the main circuit, and noise which is transmitted through the power supply.



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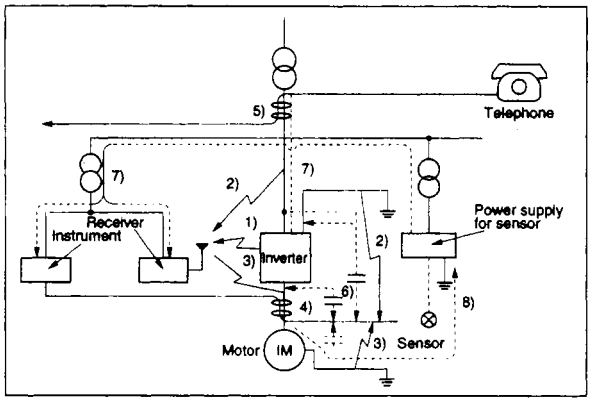


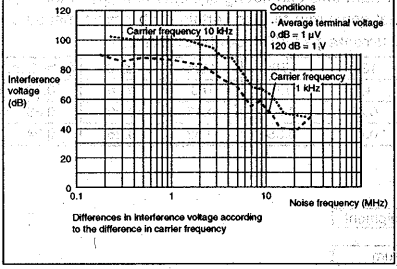

| Noise Propagation/ Transmission Route | Measures |
|---|---|
| 1) 2) 3) | Equipment or devices such as measuring instruments, receivers, and sensors, which are noise susceptible, or those in which the signal lines are run in the same enclosure or close to the signal lines of the inverter, the equipment or devices may malfunction due to noise propagation. In such a case, it is necessary to take the following measures:<br>(1) Install the equipment/devices which are easily influenced by noise away from the inverter.<br>(2) Run the signal lines which are easily influenced by noise as far from the inverter and its input/output lines as possible.<br>(3) Avoid running signal lines in parallel with the power lines (inverter input/output lines), also avoid bundling the signal lines with the power lines.<br>(4) If a line noise filter or radio noise filter is connected in the input/output lines, radiated noise from the power line can be suppressed.<br>(5) If shielded cables are used for signal lines and the power lines, or if the signal lines and the power lines are run in the individual metal conduits, the signal lines are effectively protected from propagated noises. |

| Noise Propagation/ Transmission Route | Measures |
|---|---|
| 4) 5) 6) | If the signal lines are run in parallel to the power lines or if the signal lines are bundled with the power lines, noise (electromagnetically induced noise, electrostatically induced noise) may propagate to the signal lines causing malfunctioning. In such cases, it is necessary to take the following measures:<br>(1) Install the equipment/devices which are easily influenced by noise away from the inverter.<br>(2) Run the signal lines which are easily influenced by noise as far from the inverter and its input/output lines as possible.<br>(3) Avoid running signal lines parallel with the power lines (inverter input/output lines), also avoid bundling the signal lines with the power lines.<br>(4) If shielded cables are used for signal lines and the power lines, or if the signal lines and the power lines are run in the individual metal conduits, the signal lines are effectively protected from propagation of noise. |
| 7) | If peripheral device is connected to the same power supply where the inverter is connected, noise generated by the inverter may be transmitted to the peripheral device through the power lines causing malfunctioning of the peripheral device. In such a case, it is necessary to take the following measures:<br>(1) Install a radio noise filter (FR-BIF(-H)) in the power line (input lines) of the inverter.<br>(2) Install a line noise filter (FR-BSF01) in the power line (input/output lines) of the inverter. |
| 8) | If a closed loop circuit is formed due to the wiring of a peripheral device to the inverter, leakage current may flow into the peripheral device through the grounding cable of the inverter and cause malfunctioning of the peripheral equipment. If this occurs, disconnect the grounding cable of the peripheral device. |

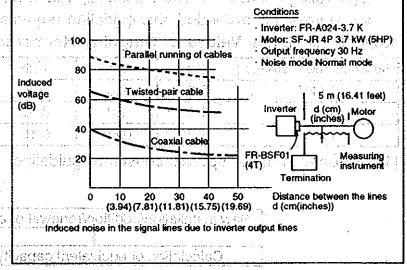
# 24. TROUBLESHOOTING

## • Examples and Results of Noise Protection

It is possible to lower the interference voltage(*) by lowering the carrier frequency. If motor noise does not pose a critical problem, lower the carrier frequency (1kHz) by changing the setting for Pr.72.

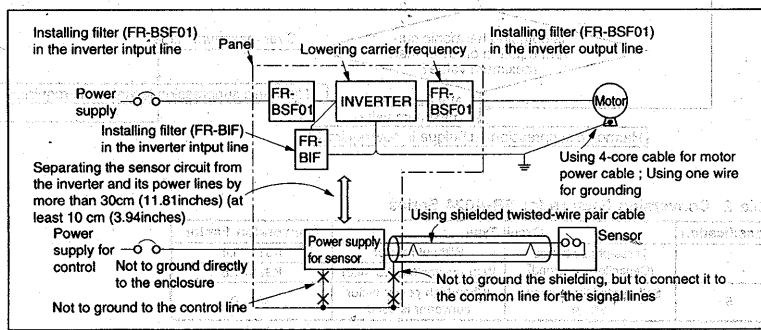



It is possible to reduce induced noises remarkably (1/10 to 1/100) by using shielded cable for the signal lines.
Running the signal line apart from inverter output line is also effective to reduce induced noise (reduction 1/2 to 1/3 by running the signal line 30cm apart from the inverter output line).




*Interference voltage: Represents amplitude of noise transmitted to the power supply from the inverter.

## • Noise protection measures



# 24. TROUBLESHOOTING

## 24.5 Power harmonic guidelines (Japan)

Harmonic currents generated by the inverter flow to a power receiving point via a power transformer. Since these outgoing harmonic currents affect other consumers, the power harmonic suppression guidelines were established.

1) "Household appliance and general-purpose product guideline"
   200V class inverters of 3.7kW and less are covered by this guideline. Install a power factor improving reactor to comply with this guideline.
2) "Specific consumer guideline"
   This guideline sets forth the maximum values of harmonic currents outgoing from a high-voltage or very high-voltage consumer who will install, add or renew harmonic generating equipment. If any of the maximum values is exceeded, this guideline requires that consumer to take certain suppression measures.

**Table 1 Maximum Values of Outgoing Harmonic Currents per 1kW Contract Power**

| Received Power Voltage | 5th | 7th | 11th | 13th | 17th | 19th | 23rd | Over 23rd |
|---|---|---|---|---|---|---|---|---|
| 6.6kV | 3.5 | 2.5 | 1.6 | 1.3 | 1.0 | 0.9 | 0.76 | 0.70 |
| 22kV | 1.8 | 1.3 | 0.82 | 0.69 | 0.53 | 0.47 | 0.39 | 0.36 |
| 33kV | 1.2 | 0.86 | 0.55 | 0.46 | 0.35 | 0.32 | 0.26 | 0.24 |

(1) Application of the specific consumer guideline

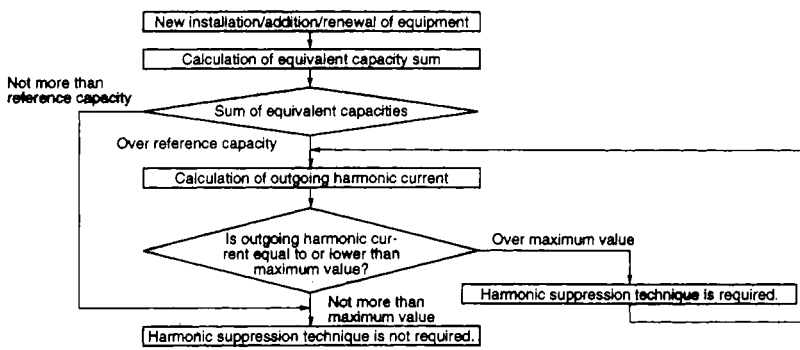



**Table 2 Conversion Factors for FR-A024 Series**

| Classification | Circuit Type | | Conversion Factor |
|---|---|---|---|
| 3 | Three-phase bridge (Capacitor smoothed) | Without reactor | K31 = 3.4 |
| | | With reactor (on AC side) | K32 = 1.8 |
| 5 | Self-excited three-phase bridge | When high power factor converter is used | K5 = 0 |

**Table 3 Equivalent Capacity Limits**

| Received Power Voltage | Reference Capacity |
|---|---|
| 6.6kV | 50kVA |
| 22/33kV | 300kVA |
| 66kV or more | 2000kVA |

**Table 4 Harmonic Content (Values at the fundamental current of 100%)**

| Reactor | 5th | 7th | 11th | 13th | 17th | 19th | 23rd | 25th |
|---|---|---|---|---|---|---|---|---|
| Not used | 65 | 41 | 8.5 | 7.7 | 4.3 | 3.1 | 2.6 | 1.8 |
| Used (AC side) | 38 | 14.5 | 7.4 | 3.4 | 3.2 | 1.9 | 1.7 | 1.3 |

# 24. TROUBLESHOOTING

1) Calculation of equivalent capacity P0 of harmonic generating equipment
The "equivalent capacity" is the capacity of a 6-pulse converter converted from the capacity of a consumer's harmonic generating equipment and is calculated with the following equation. If the sum of equivalent capacities is higher than the limit in Table 3, harmonics must be calculated with the following procedure:

$P0 = \Sigma (Ki \times Pi)$ [kVA]

Ki: Conversion factor (refer to Table 2)

Pi: Rated capacity of harmonic generating equipment* [kVA]

i: Number of indicating the conversion circuit type

Rated capacity: Determined by the capacity of the applied motor and found in Table 5. It should be noted that the rated capacity used here is used to calculate generated harmonic amount and is different from the power supply capacity required for actual inverter drive.

2) Calculation of outgoing harmonic current
Outgoing harmonic current=fundamental wave current (value converted from received power voltage) × operation ratio × harmonic content
- Operation ratio: Operation ratio = actual load factor × operation time ratio during 30 minutes
- Harmonic content: Found in Table 4.

**Table 5 Rated Capacities and Outgoing Harmonic Currents for Inverter Drive**

| Applied Motor (kW) | Rated Current [A] 200V | 400V | Fundamental Wave Current Converted from 6.6kV (mA) | Rated Capacity (kVA) | Fundamental Wave Current Converted from 6.6kV (No reactor, 100% operation ratio) 5th | 7th | 11th | 13th | 17th | 19th | 23rd | 25th |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.1 | Not Applied | — | — | — | — | — | — | — | — | — | — | — |
| 0.2 | | — | — | — | — | — | — | — | — | — | — | — |
| 0.4 | | 0.81 | 49 | 0.57 | 31.85 | 20.09 | 4.165 | 3.773 | 2.107 | 1.519 | 1.274 | 0.882 |
| 0.75 | | 1.37 | 83 | 0.97 | 53.95 | 34.03 | 7.055 | 6.391 | 3.569 | 2.573 | 2.158 | 1.494 |
| 1.5 | | 2.75 | 167 | 1.95 | 108.6 | 68.47 | 14.20 | 22.86 | 7.181 | 5.177 | 4.342 | 3.006 |
| 2.2 | | 3.96 | 240 | 2.81 | 156.0 | 98.40 | 20.40 | 18.48 | 10.32 | 7.440 | 6.240 | 4.320 |
| 3.7 | | 6.50 | 394 | 4.61 | 257.1 | 161.5 | 33.49 | 30.34 | 16.94 | 12.21 | 10.24 | 7.092 |

3) Harmonic suppression technique requirement
If the outgoing harmonic current is higher than the maximum value per 1kW contract power × contract power, a harmonic suppression technique is required.

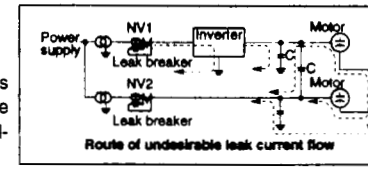
4) Harmonic suppression techniques

| No. | Item | Description |
|---|---|---|
| 1 | Reactor installation (ACL, DCL) | Install a reactor (ACL) in the AC side of the inverter or a reactor (DCL) in its DC side or both to suppress harmonic currents. |
| 2 | High power factor converter (FR-HC) | Designed to switch the converter circuit on-off to convert an input current waveform into a sine wave, the high power factor converter (FR-HC) suppresses harmonic current considerably. The FR-HC is used with the standard accessories. |
| 3 | Installation of power factor improving capacitor | When used with a series reactor, the power factor improving capacitor has an effect of absorbing harmonic currents. |
| 4 | Transformer multiphase operation | Use two transformers with a phase angle difference of 30 as in Y-△, △-△ combination to provide an effect corresponding to 12 pulses, reducing low-degree harmonic currents. |
| 5 | AC filter | A capacitor and a reactor are used together to reduce impedance at specific frequencies, producing a great effect of absorbing harmonic currents. |
| 6 | Active filter | This filter detects the current of a circuit generating a harmonic current and generates a harmonic current equivalent to a difference between that current and a fundamental wave current to suppress a harmonic current at a detection point, providing a great effect of absorbing harmonic currents. |

# 24. TROUBLESHOOTING

**Leakage Current**

Between the input/output lines of the inverter and in the motor, capacitance exists and due to this capacitance leakage current flows. Since amount of leakage current varies depending on the capacitance and carrier frequency, leakage current will increase if low-noise operation is attempted by higher carrier frequency setting. It is necessary to take the measures indicated below if such operation mode is required.



Route of undesirable leak current flow

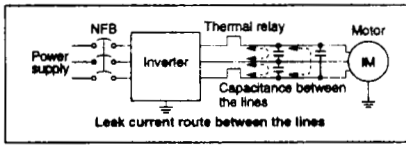
**(1) Leakage current to grounding**

Leakage current not only flows into the circuits of the inverter itself, but it also flows into the circuits of other systems through the grounding.

- **Measures**
  - Lower the carrier frequency (Pr.72). If the carrier frequency is lowered, motor noise is increased.
  - Use leakage breaker designed for higher harmonic and surge, New Super NV series of Mitsubishi for example. This allows low noise operation (at higher carrier frequency). For details of leak breaker selection, refer to page 128.

**(2) Leakage current between the lines**

There are cases that an external thermal relay is tripped unexpectedly due to higher harmonic component of the leakage current generated by the capacitance between the inverter output lines.



Leak current route between the lines

- **Measures**
  - Use an electronic thermal relay of the inverter.
  - Lower the carrier frequency. This causes increased motor noise.

    To protect the motor correctly without being affected by the leakage current between the lines, the method to directly detect the motor sensor using a temperature sensor is recommended.