Inverter_Maintenance_Course_for_FR_800_ENG

Inverter
Maintenance Course for FR-800

This course is intended for the FR series inverter users. By taking this course, you will learn how to solve problems on your own at a fault occurrence and how to recover the system quickly.

L(NA)00181ENG

Introduction Purpose of the Course

This course is intended for the FR series inverter users who will build a system using the FR series inverter for the first time to learn about the maintenance of inverters.

This course requires you to operate the FR-A800 series inverter.
It is recommended that in advance you take the "Inverter Basics (Operation) course" and "Inverter Basics (Function) course" (both for the 800 series inverter).

* This course does not include description of the IPM motor.

Introduction Course Structure

The contents of this course are as follows.
We recommend that you start from Chapter 1.

Chapter 1 Mechanism of the Inverter

Learn the fundamental mechanism of the inverter to acquire knowledge required for maintenance.

Chapter 2 Maintenance Plan

Learn how to devise and carry out a maintenance plan.

Chapter 3 Maintenance and Check

Learn how to maintain and check the inverter system.

Chapter 4 Troubleshooting

Learn how to troubleshoot the cause of problems that might occur.

Chapter 5 Trace Function

Learn the outline of the trace function, which is useful to investigate the cause of trouble, and how to use it.

Final Test

6 questions (13 items)

Passing grade: 60% or higher

Introduction How to Use This e-Learning Tool

Go to the next page	▶I	Go to the next page.
Back to the previous page	I◀	Back to the previous page.
Move to the desired page	TOC	"Table of Contents" will be displayed, enabling you to navigate to the desired page.
Exit the learning program	X	Exit the learning program. The learning program window will be closed.

Introduction Precaution for Use

Safety precaution

When you use actual products for learning, please carefully read the safety precautions in the corresponding manuals.

Chapter 1 Mechanism of the Inverter

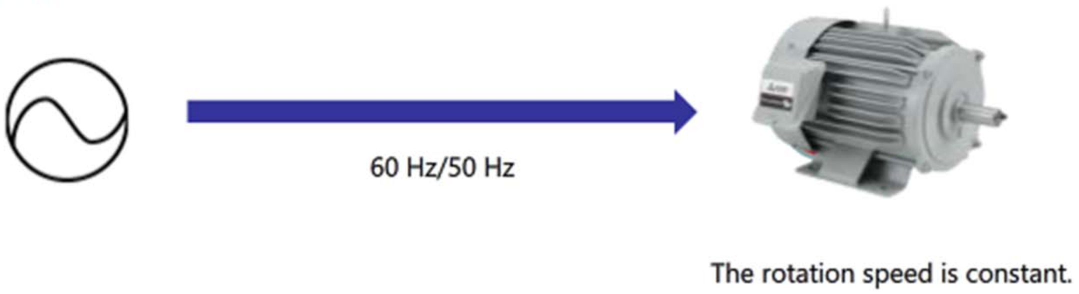
This chapter explains the fundamental mechanism of the inverter to acquire knowledge required for maintenance.
It is recommended for those who have already learned the fundamentals to review the contents of this chapter again.

1.1 Purpose for Using the Inverter
1.2 Internal Structure of the Inverter
1.3 Converter Circuit
1.4 Smoothing Capacitor
1.5 Inverter Circuit
1.6 Control Circuit
1.7 Summary of This Chapter

1.1 Purpose for Using the Inverter

Since the frequency of the AC power supplied from an electric power utility company is fixed (60 Hz/50 Hz), a motor connected directly to the power source runs at a constant speed.
An inverter allows the frequency and voltage to be flexibly changed, allowing the motor speed to be changed.
For example, an air conditioner uses a motor for temperature adjustment. An inverter air conditioner allows you to set temperatures freely by controlling the motor speed.

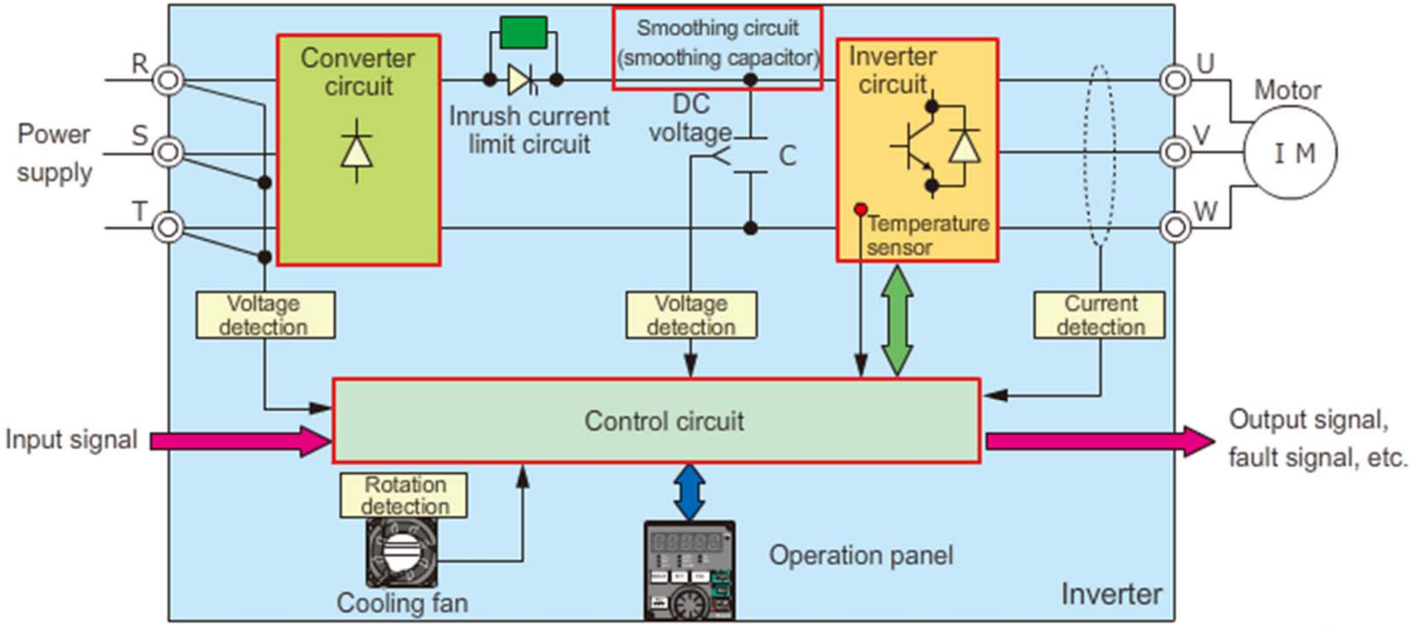
■ Without inverter



■ With inverter

1.2 Internal Structure of the Inverter

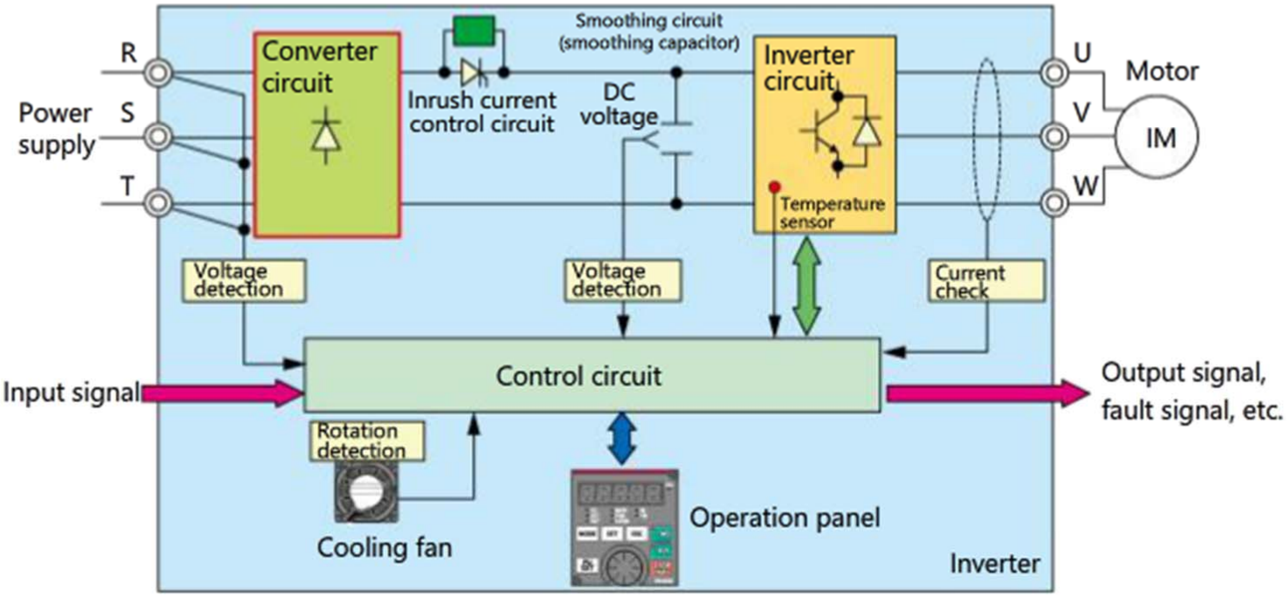
This section explains the internal structure of the inverter.
The following shows a block diagram of the internal circuit of the inverter and the function of each circuit.



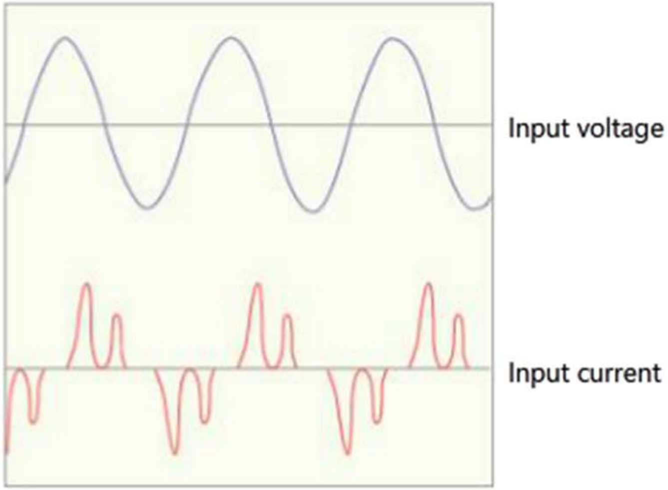
Circuit name	Role
Converter circuit	Converts AC to DC.
Smoothing capacitor	Smooths the DC voltage converted in the converter circuit.
Inverter circuit	Inverts DC converted in the control circuit to AC at a specified frequency.
Control circuit	Receives a command from an input signal and sends it to the inverter circuit. Outputs the inverter circuit status.

1.3 Converter Circuit

The converter circuit converts the input commercial AC power to DC.

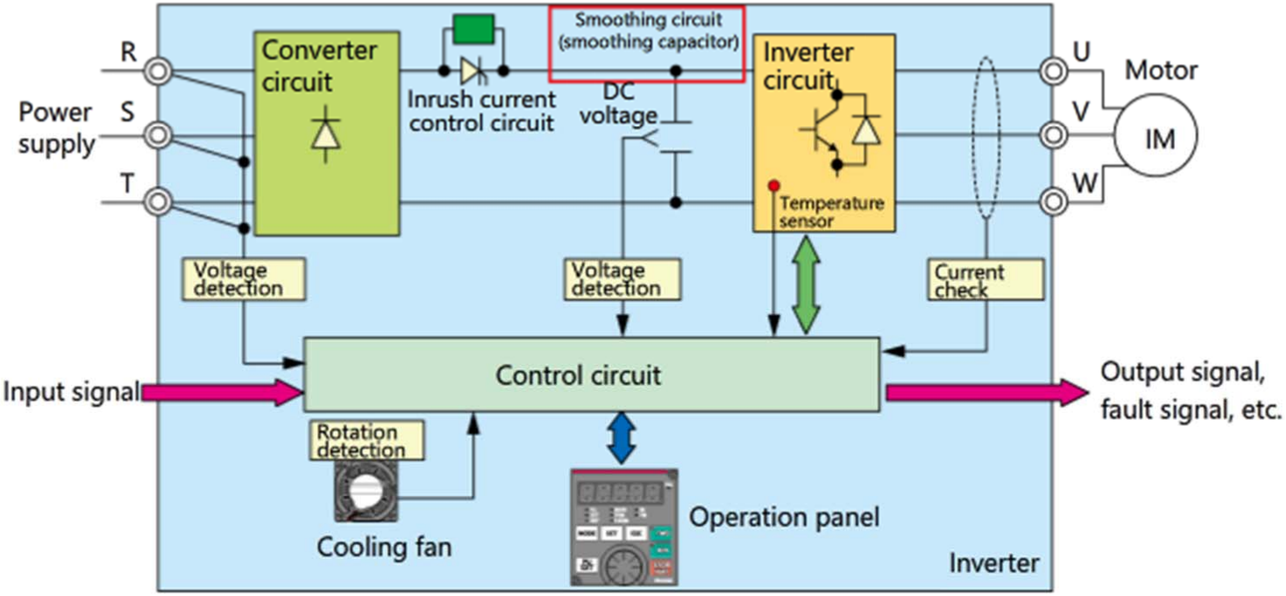


The following shows the waveform of input voltage/current.



1.4 Smoothing Capacitor

The smoothing capacitor smooths the DC voltage converted in the converter circuit.



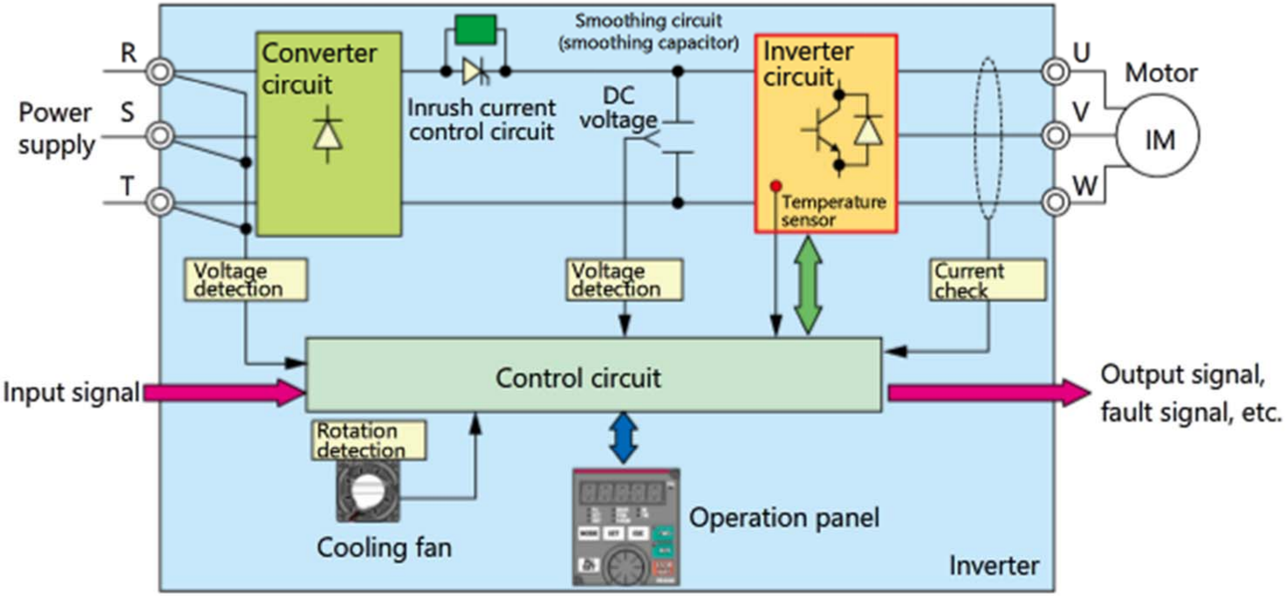
The following shows the waveforms of DC voltages before and after smoothing.

Voltage waveform before smoothing

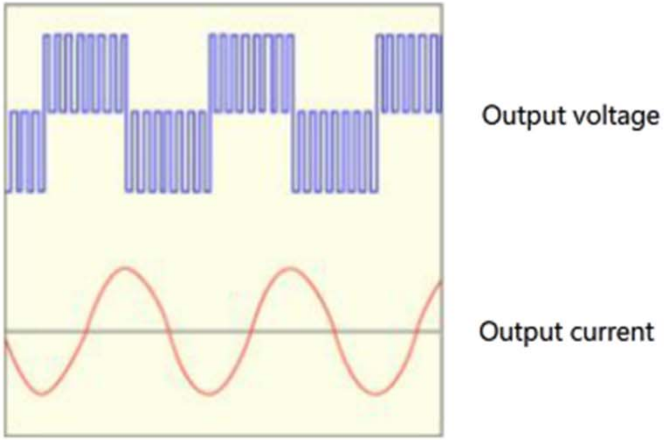
Voltage waveform after smoothing

1.5 Inverter Circuit

The invert circuit converts a voltage from DC to AC and outputs it to the motor.
When converting to AC, the circuit changes the frequency according to the command from the control circuit.

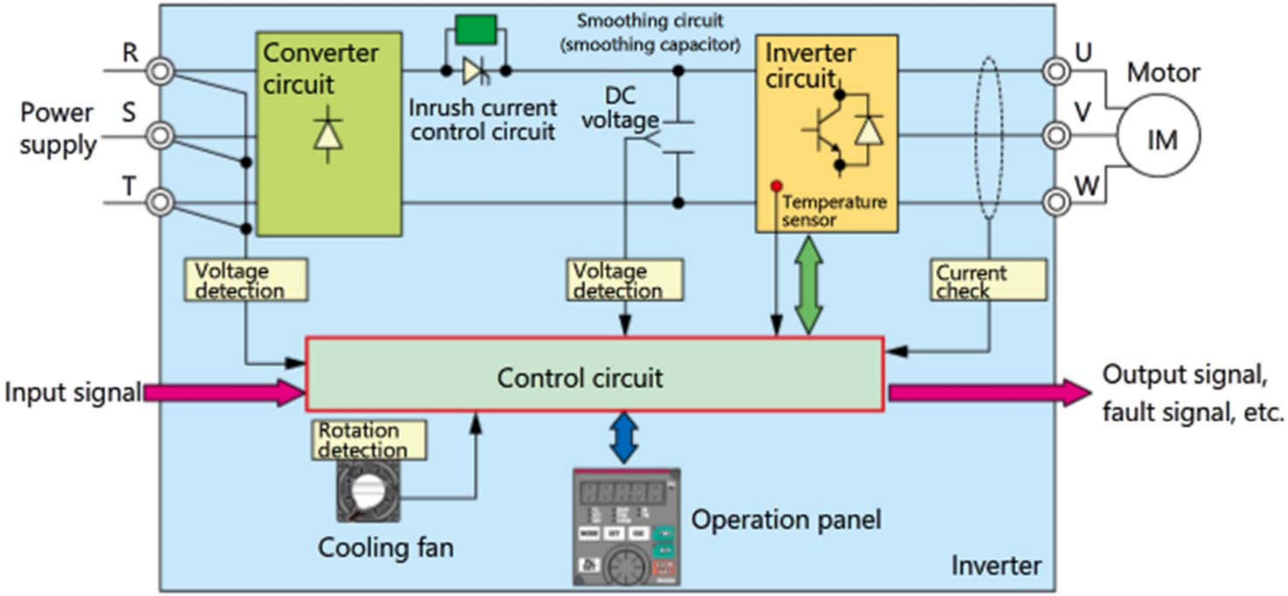


The following shows the waveform of output voltage/current.



1.6 Control Circuit

The control circuit is the brain of an inverter.
According to the commands from the operation panel on the inverter or an external input, the circuit starts and stops the motor, and changes the frequency by controlling the inverter circuit.



1.7 Summary of This Chapter

In this chapter, you have learned:

- Purpose for using the inverter
- Internal structure of the inverter
- Converter circuit
- Smoothing capacitor
- Inverter circuit
- Control circuit

Point

Mechanism of the inverter	The inverter changes the frequency of the commercial AC power (60 Hz/50 Hz) and controls the motor speed.
Internal structure of the inverter	The internal circuitry of an inverter consists of the converter circuit, smoothing capacitor, inverter circuit, and control circuit.
Converter circuit	The converter circuit converts the input commercial AC power to DC.
Smoothing circuit	The smoothing capacitor smooths the DC voltage converted in the converter circuit.
Inverter circuit	The invert circuit converts the voltage converted in the converter circuit from DC to AC and outputs it to the motor. When converting to AC, the circuit changes the frequency according to the command from the control circuit.
Control circuit	The control circuit is the brain of an inverter, which starts and stops the motor. According to the commands from the operation panel on the inverter or an external input, the circuit starts and stops the motor, and changes the frequency by controlling the inverter circuit.

Chapter 2 Maintenance Plan

This chapter explains how to devise and carry out a maintenance plan.

2.1 Life Cycle of the System

2.2 Planning

2.3 Designing

2.4 Starting up

2.5 Operation

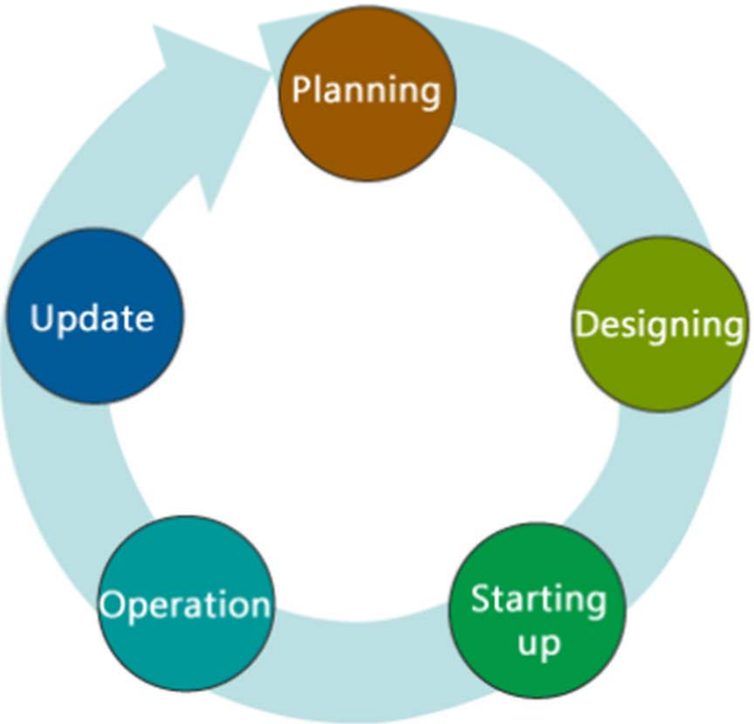
2.6 Update

2.7 Summary of This Chapter

2.1 Life Cycle of the System

It is important to devise and carry out a maintenance plan in accordance with the system life cycle stages.

■ Maintenance plan in accordance with the life cycle stages



Planning	Start to consider maintenance at the planning stage. Select appropriate products by clearly identifying the purposes and necessary functions of the system.
Designing	Determine an appropriate system design. Inappropriately-selected products, or improper installation, wiring, or arrangement may cause problems.
Starting up	Test and verify the system prior to full-scale operations reduce the number of problems that will occur during operation.
Operation	After identifying all problems, the stable operation of the system is achieved. However, it is important to be prepared for potential failures as the parts approach the end of their service life.
Update	When the entire system becomes outdated, consider updating the system using the products of new series.

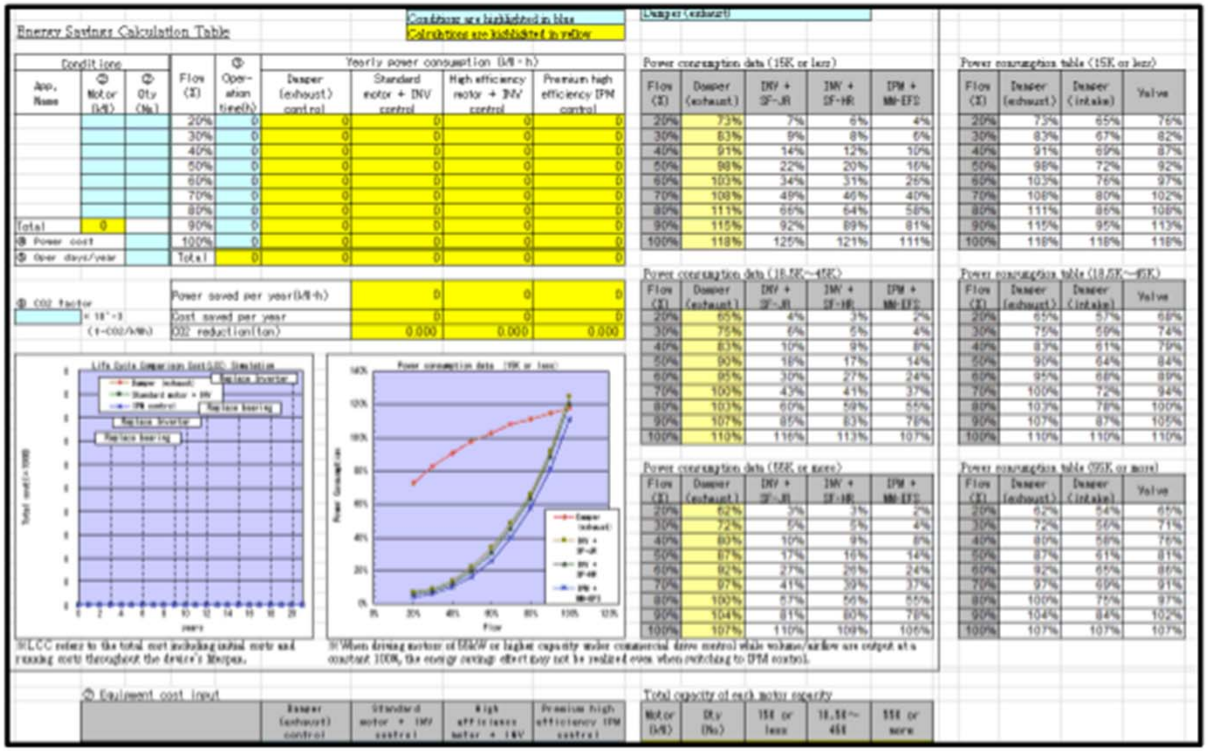
2.2 Planning

Introducing an inverter significantly saves the power compared to when the commercial power supply is used.
For selecting an inverter, the energy-saving effects is one of the important factors.

■ Energy savings calculation sheet

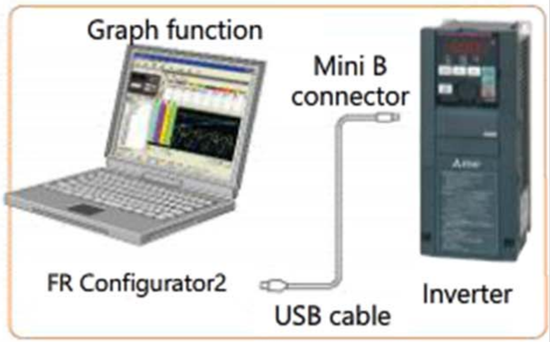
The energy savings calculation sheet can be downloaded for free at the Mitsubishi Electric FA Global Website. The energy saving effect achieved by replacing "commercial power supply" with "inverter control" can be calculated with the Excel sheet.

To calculate the energy saving effect, just enter the motor capacity, the number of motors, operating time, etc.



2.2 Planning

In selecting an inverter, please consider purchasing the following products.
The products are useful for maintenance, checks, and troubleshooting.

Product	Image	Description
LCD operation panel (FR-LU08)		• This LCD operation panel can be installed externally. • This LCD operation panel has the LCD monitor that can display textual information such as menus. • Parameters can be set and saved with this device.
FR Configurator2 (Setup software)		The wizard (interactive form) function of FR Configurator2 (setup software) helps to set up parameters. The high-speed sampling in the graph function is available during USB connection.
Measuring instrument	 Clamp meter Oscilloscope	These instruments are useful to measure current/voltage and obtain waveforms.

2.3 Designing

TOC

In designing an inverter system, installation and wiring that do not cause problems are important.

■ Earthing (grounding)

Without proper earthing (grounding), the inverter may cause noise affecting other devices.
Also, noise caused by other devices may disturb external input signals to the inverter, causing a malfunction.

A) Whenever possible, use the independent earthing (grounding) for the inverter.
If independent earthing (grounding) (I) is not available, use (II) common earthing (grounding) in the figure below where the inverter is connected with the other equipment at an earthing (grounding) point. Do not use the other equipment's earthing (grounding) cable to earth (ground) the inverter as shown in (III).
A leakage current containing many high frequency components flows into the earthing (grounding) cables of the inverter and peripheral devices. Because of this, the inverter must be earthed (grounded) separately from other devices.
This inverter must be earthed (grounded). Earthing (Grounding) must conform to the requirements of national and local safety regulations and electrical codes. (NEC section 250, IEC 536 class 1 and other applicable standards).
A neutral-point earthed (grounded) power supply for the 400 V class inverter in compliance with EN standard must be used.

B) Use the thickest possible earthing (grounding) cable.

C) The earth (ground) cable length should be as short as possible.

D) Run the earthing (grounding) cable as far away as possible from the I/O wiring of equipment sensitive to noises and run them in parallel in the minimum distance.

(I) Independent earthing (grounding)...Good

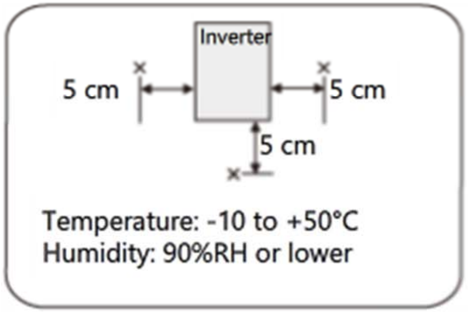
(II) Common earthing (grounding)...Good

(III) Common earthing (grounding) cable...Not allowed

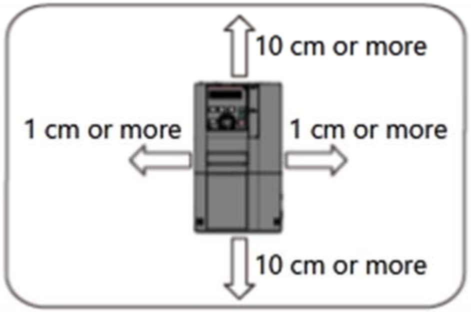
2.3 Designing

■ Installation environment

A sensitive device such as an inverter is vulnerable to heat and dust. Consider the installation environment.



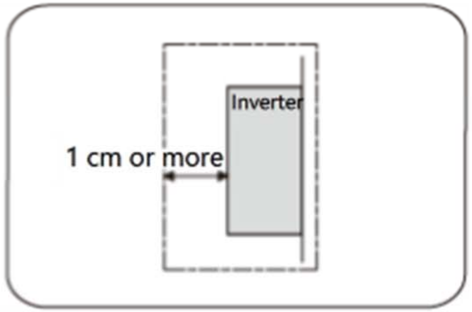
Leave enough clearances and take cooling measures.



* At a surrounding air temperature of 40°C or less, inverters can be installed without any clearance between them (0 cm clearance). (only 22K or lower)

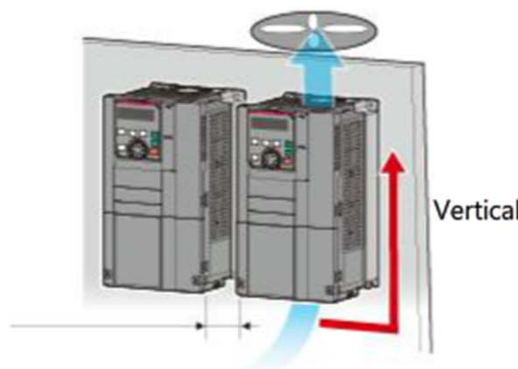
When the surrounding temperature exceeds 40°C, clearances between inverters should be 1 cm or more (5 cm or more for 5.5K or higher capacity inverters).

For 75K or higher capacity inverters, provide a clearance of at least 20 cm for both top and bottom and at least 10 cm for both right and left.

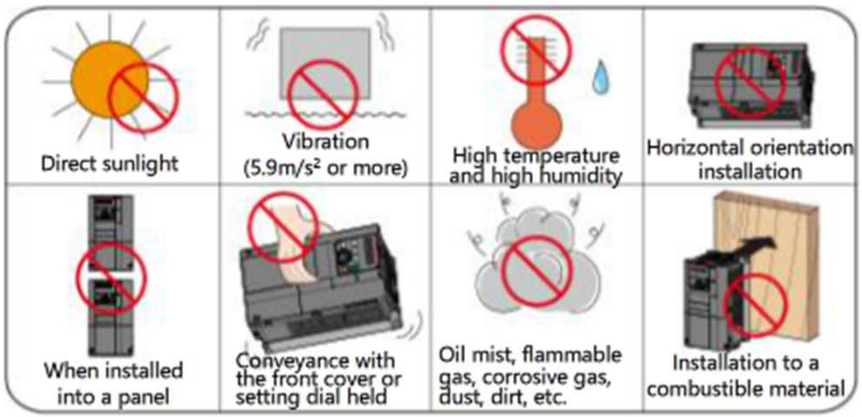


* Allow 5 cm or more clearances for 5.5K or more.

When encasing multiple inverters, install them in parallel as a cooling measure. Install the inverter vertically.



The inverter consists of precision machines and electronic parts. Never install or handle it in any of the following conditions as doing so may cause an operation fault or failure.



2.4 Starting up

It is dangerous to perform full-scale operations soon after the completion of inverter system setup (installation, wiring, and parameter settings).
Incorrect wiring or parameter settings may cause a trouble that leads to damage and accidents.
Therefore, carry out checks following the procedure below to make sure that operations can be properly performed before starting full-scale operations.

■ Checkup procedure

1. Wiring and installation environment check
Make sure that writing is correct and complete, and the installation environment is acceptable (heat, vibration, condensation (corrosion), corrosive gas).

↓

2. Parameter check
Make sure that parameter settings of the inverter are correct and complete.

↓

3. Test run only with the inverter
Turn on the power with a power supply and external I/O devices connected to make sure that the inverter is normally activated.

↓

4. Test run with the inverter + motor under no load
Connect a motor to the inverter and make sure that the motor runs following commands.

↓

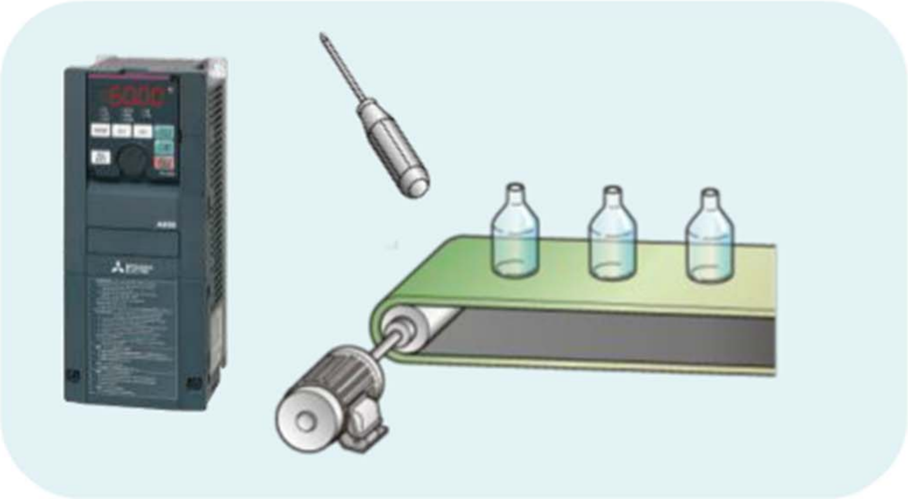
5. Test run under a load
Make sure that the motor runs following commands under a load.

↓

6. Parameter backup
If parameter settings are deleted by events such as an inverter failure and replacement, they can be restored.

2.5 Operation

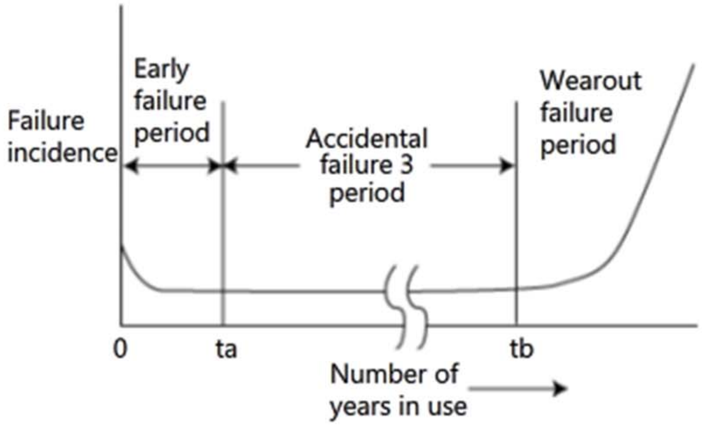
To prevent troubles, maintain and check the inverter system at regular intervals while it is in operation.
If a trouble occurs, precise troubleshooting reduces the recovery time.
(Details of maintenance and checks are given in Chapter 3.)



2.6 Update

If the inverter has been used exceeding its service life, it must be replaced.
Details of the replacement procedure are given in Chapter 3.

Figure 1. Relation between the number of years in use and failure incidence



■ Importance of parameter backup

When an inverter malfunctions, the parameter settings may be deleted.
Or, when the manufacturer is requested to repair an inverter, the manufacturer may delete the parameter settings.
Therefore, when starting the inverter or changing parameter settings, back up the settings.
Backing up the settings requires the operation panel, personal computer in which FR Configurator2 is installed, or a commercial USB memory device.
* Refer to "3.3 Replacing the Inverter" for details.

2.7 Summary of This Chapter

In this chapter, you have learned:

- Life Cycle of the System
- Planning
- Designing
- Starting up
- Operation
- Update

Point

Maintenance plan	It is important to devise a maintenance plan and carry out it in accordance with the inverter life cycle stages.
Planning	The energy-saving effects expected when an inverter is introduced can be calculated using an Excel sheet. The sheet can be downloaded for free at the Mitsubishi Electric FA Global Website.
Designing	It is important to carry out installation and wiring in consideration of heat dissipation and the countermeasures against noise and the entry of foreign substances.
Starting up	It is important to check wring and operations prior to full-scale operations.
Operation	To prevent troubles, it is important to maintain and check the inverter system at regular intervals while it is in operation.
Update	When an inverter fails or is needed to be replaced with a different model, the inverter needs to be replaced. It is important to back up parameter settings when starting up the inverter or changing the parameter settings.

Chapter 3 Maintenance and Check

This chapter explains how to maintain and check the inverter system.

3.1 Inspection Item

3.2 Lifespan and Replacement of Parts

3.3 Replacing the Inverter

3.4 Summary of This Chapter

3.1 Inspection Item

To prevent troubles, check for inverter system faults.
If some parts are worn out, replace them.
The inspection items and cleaning method are shown below.

■ Daily inspection

Check for the following faults during operation on a daily basis.

- Motor operation fault
- Improper installation environment
- Cooling system fault
- Abnormal vibration, abnormal noise
- Abnormal overheat, discoloration

■ Periodic inspection

Check the areas inaccessible during operation and requiring periodic inspection.

- Check the cooling system fault. (Clean the cooling fan.)
- Check the tightening and retighten.
- Check the conductors and insulating materials for corrosion and damage.
- Measure the insulation resistance.
- Check and change the cooling fan and relay.

■ Cleaning

Always run the inverter in a clean status.
When cleaning the inverter, gently wipe dirty areas with a soft cloth immersed in neutral detergent or ethanol.

3.2 Lifespan and Replacement of Parts

The inverter consists of many electronic parts such as semiconductor devices.
The following parts may deteriorate with age because of their structures or physical characteristics, leading to reduced performance or fault of the inverter.
For preventive maintenance, the parts must be replaced periodically.
Use the life check function (refer to Section 3.2.1) as a guidance of parts replacement.

Part name	Estimated lifespan*1	Description
Cooling fan	10 years	Replace (as required)
Main circuit smoothing capacitor	10 years*2	Replace (as required)
On-board smoothing capacitor	10 years*2	Replace (as required)
Relays	-	As required
Fuse (160K or higher)	10 years	Replace (as required)

*1 Estimated lifespan for when the yearly average surrounding air temperature is 40°C. (without corrosive gas, flammable gas, oil mist, dust and dirt etc.)
*2 Output current: 80% of the inverter rating

■ Precaution

The design life is a calculated value and is not a guaranteed product life.

3.2.1 Life Check Function

Set "1" in the parameter E704 (Pr.259) and then shut off the main circuit power to start automatic life check of the main circuit capacitor.
For the main circuit capacitor, control circuit capacitor, cooling fan, and inrush current limit circuit, a warning can be output as necessary, which gives an indication of replacement time.
Note that the life diagnosis of this function should be used as a guideline only, because with the exception of the main circuit capacitor and cooling fan, the life values are theoretical calculations.

■ Setting for measuring the life of inverter parts

Parameter No.	Name	Initial value	Setting range	Description
E704 (Pr.259)	Main circuit capacitor life measuring	0	0, 1	Setting "1" and turning the power supply OFF starts the measurement of the main circuit capacitor life. If the setting value of E704 (Pr.259) becomes "3" after turning the power supply ON again, it means that the measurement is completed. The deterioration degree is read to E703 (Pr.258).

■ Setting for inverter parts life display

Parameter No.	Name	Initial value	Setting range	Description
E700 (Pr.255)	Life alarm status display	0	0 to 15	Displays whether or not the parts of the control circuit capacitor, main circuit capacitor, cooling fan, and inrush current limit circuit have reached the life alarm output level.
E701 (Pr.256)	Inrush current limit circuit life display	100%	0 to 100%	Displays the deterioration degree of the inrush current limit circuit.
E702 (Pr.257)	Control circuit capacitor life display	100%	0 to 100%	Displays the deterioration degree of the control circuit capacitor.
E703 (Pr.258)	Main circuit capacitor life display	100%	0 to 100%	Displays the deterioration degree of the main circuit capacitor. The value measured by E704 (Pr.259) is displayed.

* Refer to the product's manual for details of each parameter.

3.3 Replacing the Inverter

When an inverter fails or is needed to be replaced with a different model, the inverter needs to be replaced.
Before replacement, parameters need to be backed up.
The parameter backup methods include the following four types.

■ Operation panel (FR-DU08)

- Back up the parameters to the operation panel on the inverter (removable).

■ LCD operation panel (FR-LU08)

- This optional LCD operation panel (removable) can store the setting values of up to three inverters.

■ FR Configurator2 (software)

- Connect a Windows® compatible personal computer in which FR Configurator2 is installed to the inverter using a USB cable to back up the parameters.

■ USB memory device

- Connect a commercial USB memory device to the inverter to back up the parameters.

3.3.1 Procedure for replacing the inverter

You need to know what to do before replacing the inverter.

■ Replacement procedure

1. Saving parameters
Save set parameters.

↓

2. Removing the existing inverter
Remove the wiring of the control circuit terminals and main circuit, and remove the inverter from the panel.

↓

3. Installing a new inverter
Install a new inverter into the panel and wire the control circuit terminals and main circuit.

↓

4. Restoring parameters
Restore the parameters to operate the inverter system.

* Some models can be replaced with the wiring of the control circuit terminals connected.

3.4 Summary of This Chapter

In this chapter, you have learned:

- Inspection item
- Lifespan and replacement of parts
- Replacing the inverter

Point

Inspection	Daily checks, periodic checks, and cleaning are important to prevent troubles.
Lifespan and replacement of parts	For preventive maintenance, replacement target parts need to be replaced at regular intervals. The life check function provides the indication of the timing for replacing parts.
Replacing the inverter	When an inverter fails or is needed to be replaced with a different model, the inverter needs to be replaced. Before replacement, parameters need to be backed up.
Backing up parameters	The parameter backup methods include the following four types. • Operation panel on the inverter • LCD operation panel (FR-LU08) • Personal computer in which FR Configurator2 is installed • Commercial USB memory device

Chapter 4 Troubleshooting

This chapter explains how to troubleshoot the cause of problems that might occur.

4.1 Troubleshooting Procedure

4.2 If an Error is Displayed

4.3 If No Error is Displayed

4.4 Summary of This Chapter

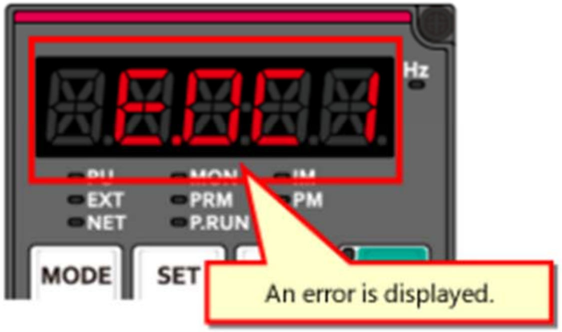
4.1 Troubleshooting Procedure

This section explains the procedure for eliminating troubles caused during an inverter system startup or operations.
The following shows the troubleshooting procedure.

1. Checking the error display
2. Checking the faults history
3. Eliminating the cause of the trouble
4. Resetting the protective function

4.1.1 Checking the error display

Check whether the operation panel monitor displays an error.



The error displays of the inverter include the following types.

Type of fault display	Description
Error message	A message regarding an operational fault and setting fault by the operation panel and parameter unit is displayed. The inverter does not trip.
Warning	The inverter does not trip even when a warning is displayed. However, failure to take appropriate measures will lead to a fault.
Alarm	The inverter does not trip. An alarm can also be output with a parameter setting.
Fault	When a protective function activates, the inverter trips and a fault signal is output.

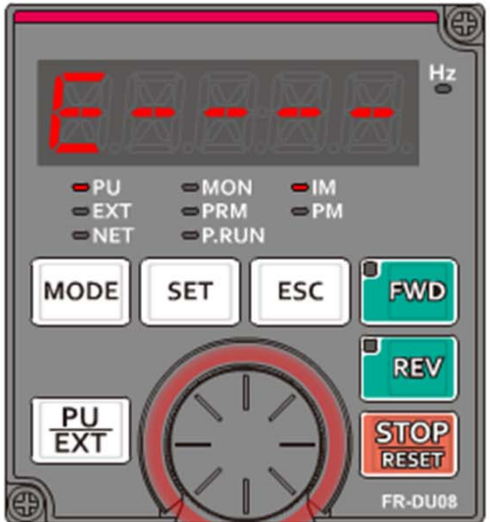
■ Precautions on how to read digital display

Note that some letters may appear in lowercase (b and d) and some numbers and letters may be difficult to read (for example, 5 and S). Be careful not to misread.

4.1.2 Checking the faults history

Using the faults history function, check how frequent errors occur and whether any other errors occur.
Make a note of detected errors.

Perform the faults history check using the operation panel simulator below.



Presently, the faults history mode is set.
Turn the setting dial to "E.0C1" and click ▶ .

4.1.3 Eliminating the cause of the trouble

Eliminate the cause of the trouble.
Take an appropriate corrective action according to the error display and the error details.

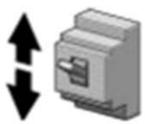
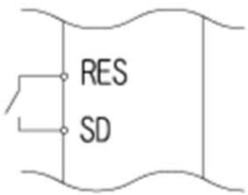
- If an error is displayed
  Check the details of the displayed error and corrective actions in a manual and others, and take the corrective action.
  Section 4.2 of this course explains how to detect and remedy errors in relation to the main protective functions (18 types).
- If no error is displayed
  Check the inverter and motor and take corrective actions.
  Section 4.3 of this course explains how to detect and remedy errors in relation to the main protective functions (7 types).

■ Precaution

1. Do not leave warnings and alarms, which do not trip inverters, unsolved.
   Otherwise, the inverter may trip or fail.
2. Do not reset the inverter before eliminating the cause of the trouble.
   Otherwise, unexpected operations may damage the system or cause accidents.

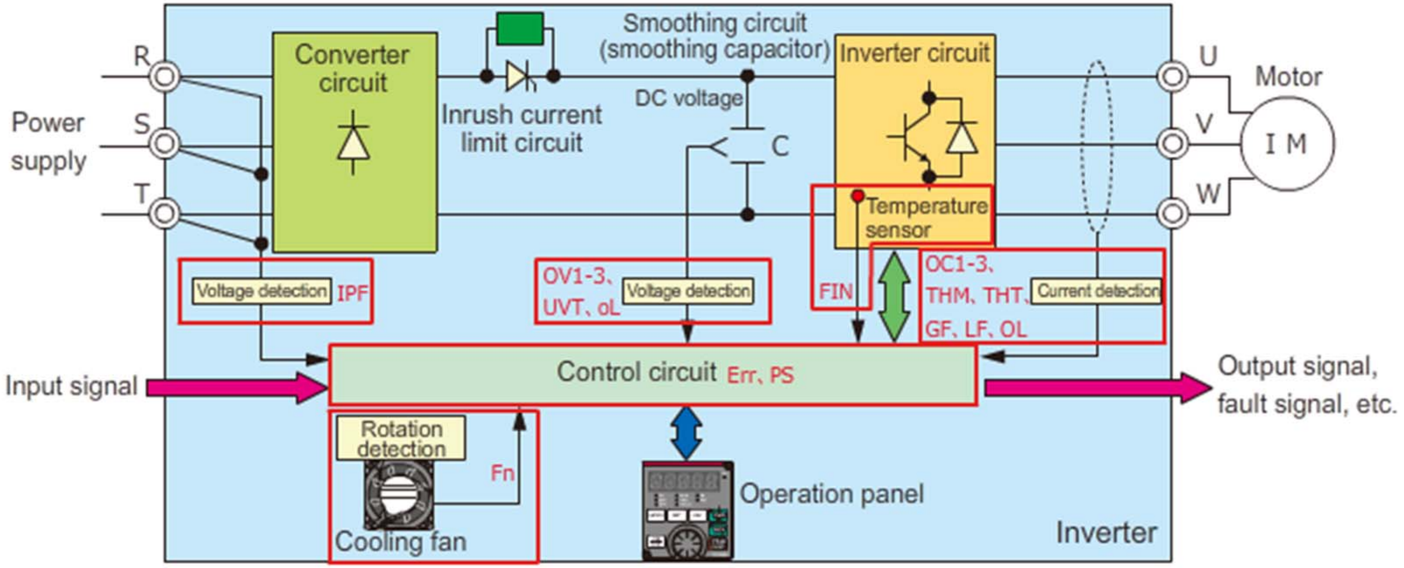
4.1.4 Resetting the protective function

After eliminating the cause of a trouble, reset the protective function to recover the system.
The following shows three types of resetting methods.

Reset type	Resetting method
Pressing the "STOP/RESET" key	Reset with the "STOP/RESET" key on the operation panel. Note that this may only be performed when a fault occurs and the inverter protective function is activated.   Also on the LCD operation panel FR-LU08, the inverter can be reset with the "STOP/RESET" key.
Cycling the power	Switch power OFF once, and then switch it ON again. 
Turning ON the RES (reset) signal	Keep the RES signal ON for 0.1 seconds or longer. (If the RES signal is kept ON, "Err" appears (flickers) to indicate that the inverter is in a reset status. Check the indication, and turn OFF the RES signal again.) * The reset state cannot be canceled if the RES signal is kept ON. 

4.2 If an Error is Displayed

If a protective function of the inverter detects an error, the operation panel displays the error on the monitor.
To eliminate the cause, the protective function must be understood and the proper corrective action must be taken according to the type of error.
This maintenance course explains how to detect and remedy errors in relation to the main protective functions (18 types).



Protection circuit	Description
Input voltage detection	Detects the input voltage from the power supply. Mainly used to detect an instantaneous power failure.
DC voltage detection	Detects the voltage (DC voltage) across the smoothing capacitor Mainly used to detect an overvoltage and voltage drop.
Output current detection	Detects the output current to the motor. Mainly used to detect an overcurrent, overload, ground fault, and output phase loss.
Cooling fan detection	Detects the rotations per minute of the cooling fan. Used to detect a cooling fan abnormality (failure).
FIN detection	Detects the heatsink temperature using the temperature sensor in the inverter circuit. Used to detect overheating of the heatsink.
Operation-related detection	Detected by the control circuit. Mainly used to detect an operation error and communication error.

4.2 Explanation of the Operation

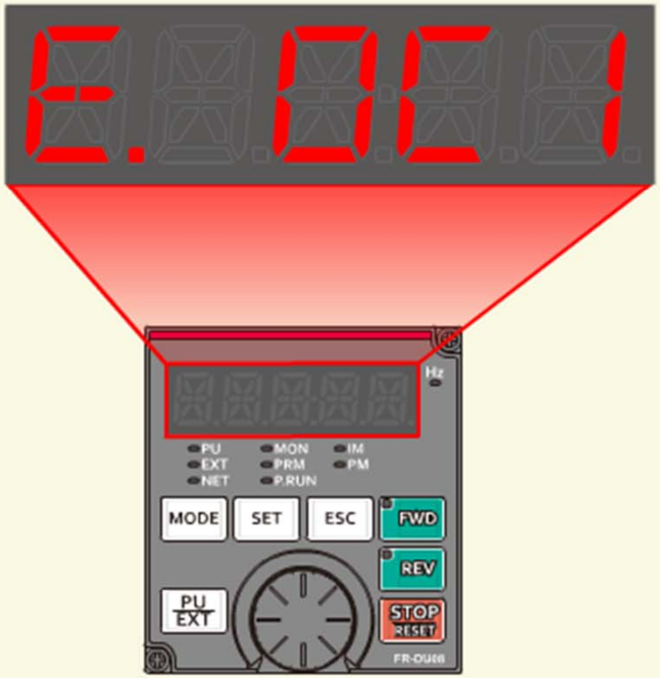
Operation panel indication: E.OC1

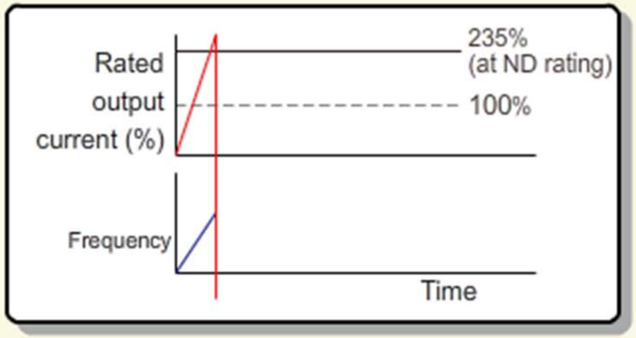
Fault | Output current detection

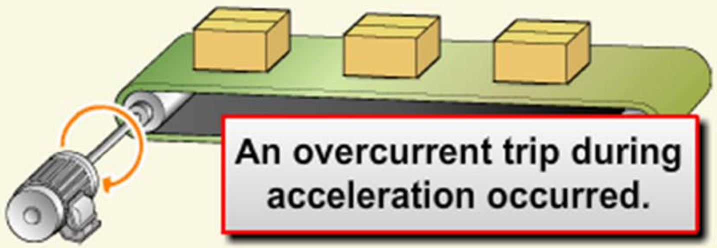
When the inverter's output current reaches or exceeds approximately 235% (at ND rating)* of its rated current during acceleration, the protective circuit is activated to trip the inverter.

* The percentage differs depending on the rating. Refer to the product's manual to be used for details.

Problem check | Location | Check point and remedy







4.2 Explanation of the Operation

This section describes how to check and fix the situation when a fault is displayed. The following marks are used in the subsequent sections.

Fault Warning Alarm Output stop depending on condition	Shows the types of fault displays.
Input voltage detection DC voltage detection Output voltage detection Cooling fan detection Heatsink detection Operation-related detection	Shows the protection circuit that has detected the error.

4.2.1 E. IPF: Instantaneous power failure

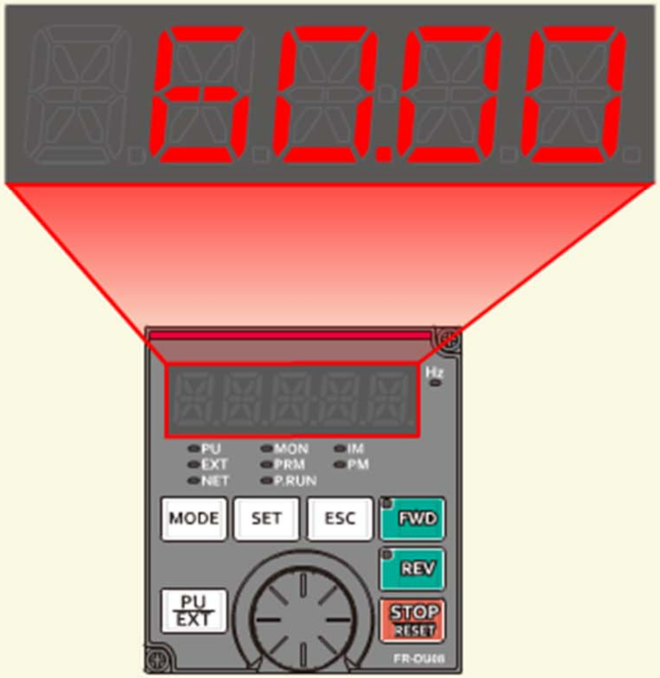
Operation panel indication	E.IPF

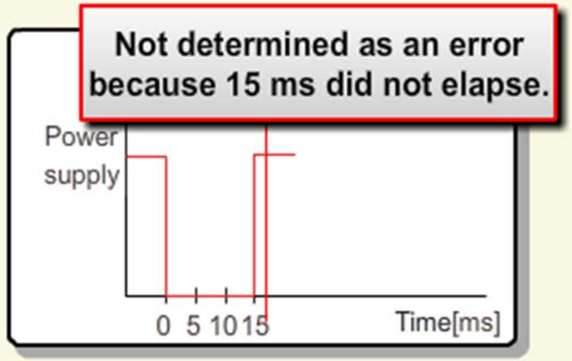
Fault

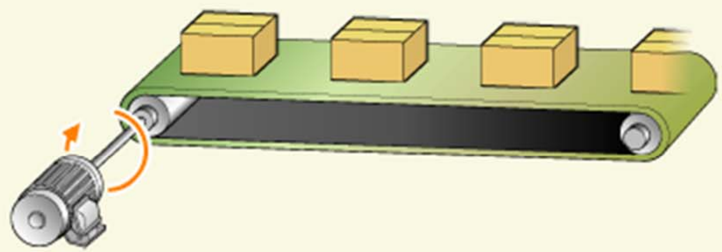
Input voltage detection

If a power failure occurs and lasts over 15 [ms], a warning is displayed and the inverter trips.

Problem check | Location | Check point and remedy







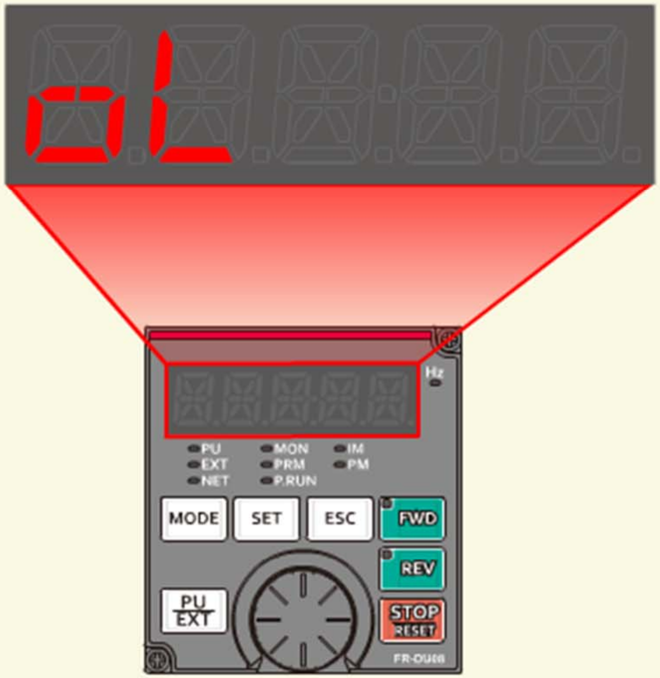
4.2.2 oL: Stall prevention (overvoltage)

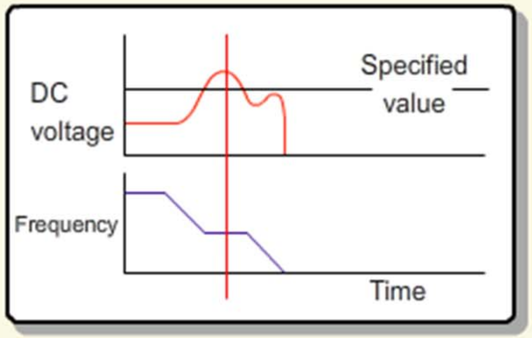
Operation panel indication	oL

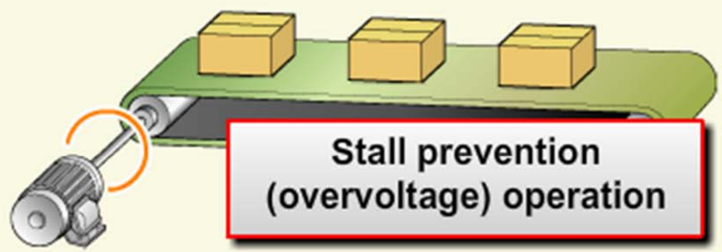
Warning | DC voltage detection

When the regenerative power of the motor becomes excessive and exceeds the regenerative power consumption capacity, the inverter outputs a warning.
At the same time, the inverter reduces the frequency to prevent an overvoltage trip.

Problem check | Location | Check point and remedy







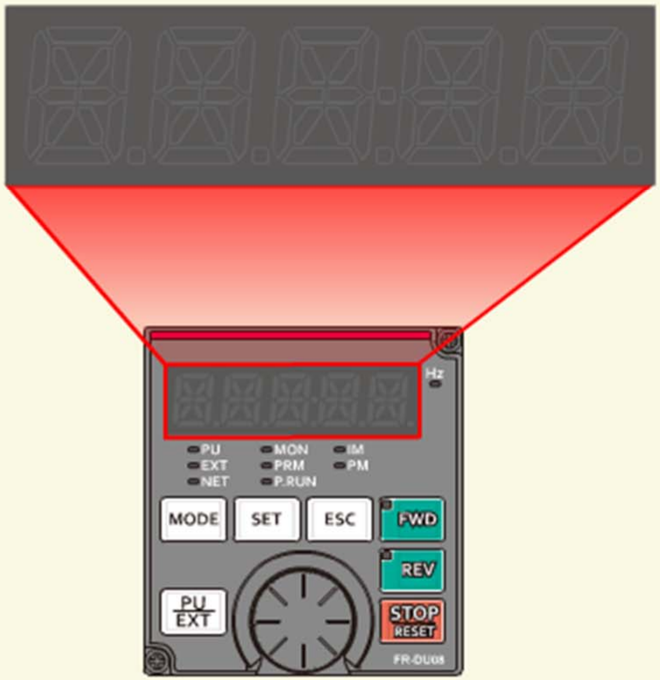
4.2.3 E. OV1: Regenerative overvoltage trip during acceleration

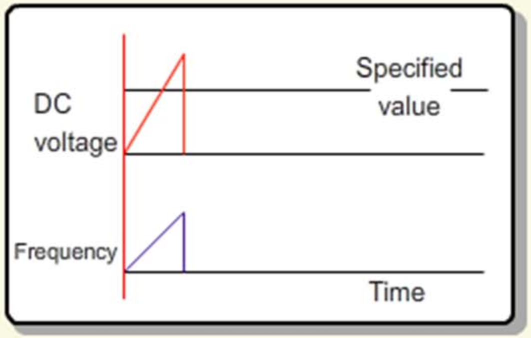
Operation panel indication | E.OV1

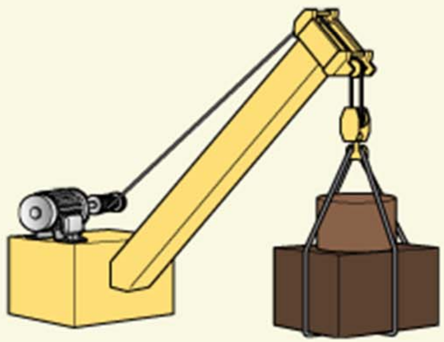
Fault | DC voltage detection

If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system.

Problem check | Location | Check point and remedy







4.2.4 E. OV2: Regenerative overvoltage trip during constant speed

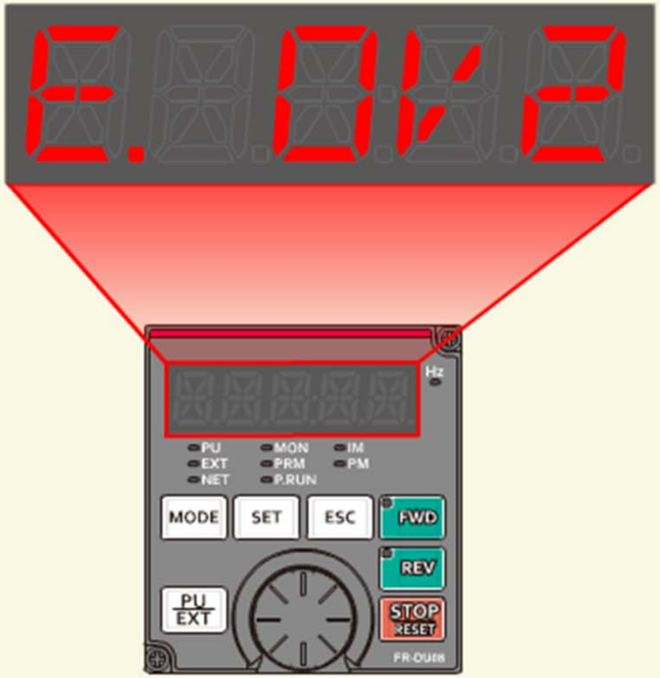
Operation panel indication	E.OV2

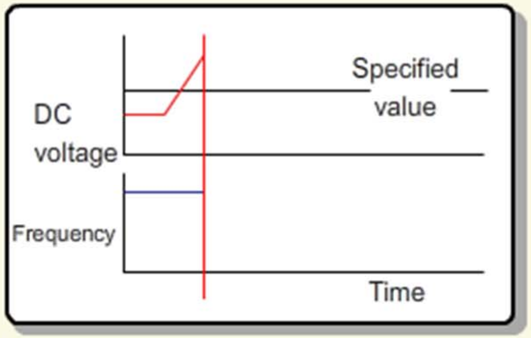
Fault

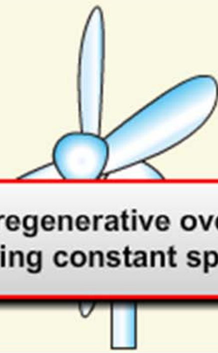
DC voltage detection

If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system.

Problem check | Location | Check point and remedy







A regenerative overvoltage trip during constant speed occurred.

4.2.5 E. OV3: Regenerative overvoltage trip during deceleration or stop

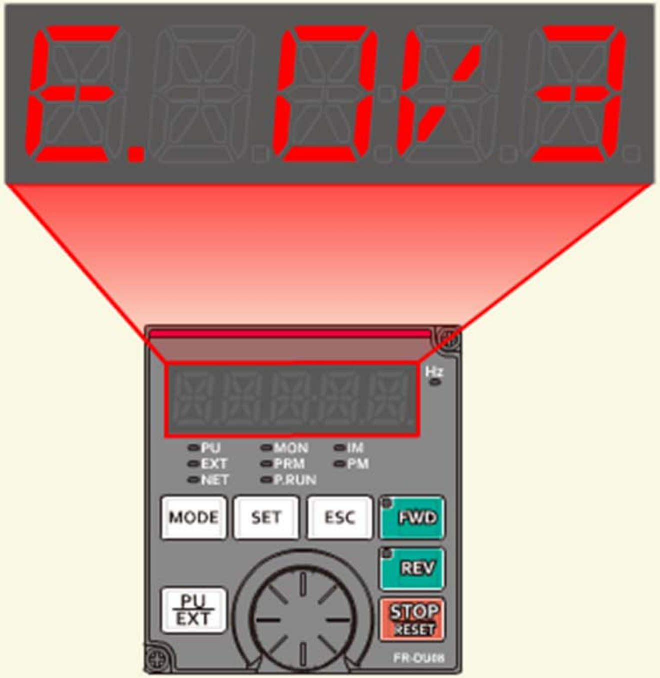
Operation panel indication	E.OV3

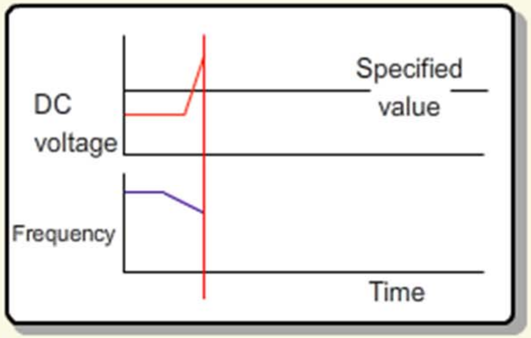
Fault

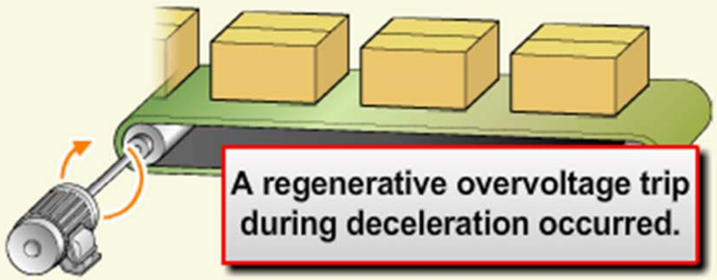
DC voltage detection

If regenerative energy causes the inverter's internal main circuit DC voltage to reach or exceed the specified value, the protective circuit is activated to stop the inverter output. The circuit may also be activated by a surge voltage produced in the power supply system.

Problem check | Location | Check point and remedy







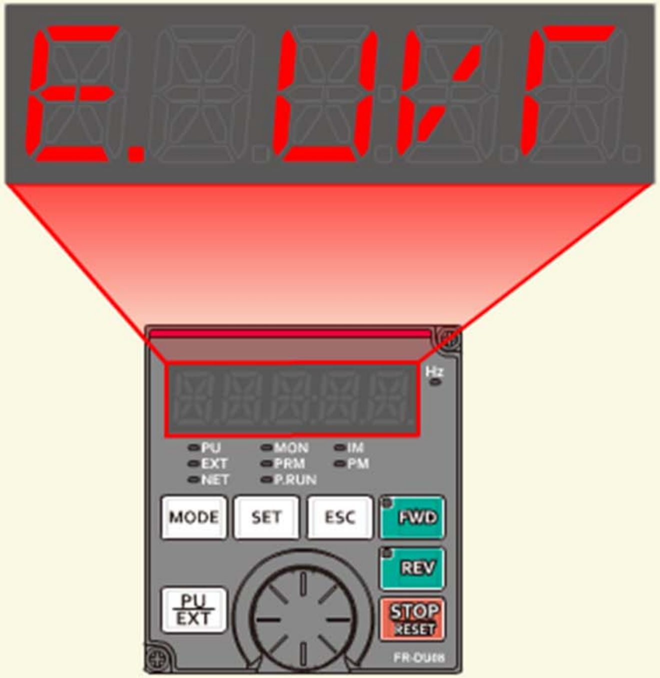
4.2.6 E. UVT: Undervoltage

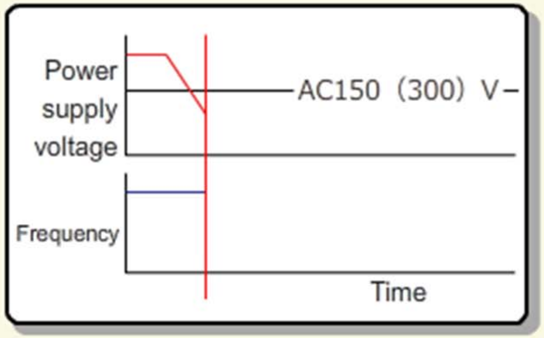
Operation panel indication | E.UVT

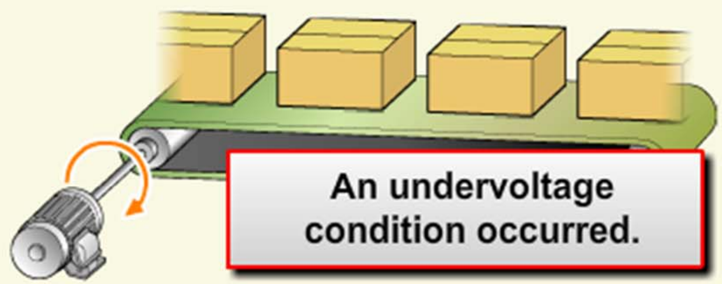
Fault | DC voltage detection

When the voltage drops to approximately 150V AC (approximately 300V AC with 400V class) or lower, a warning is displayed and the inverter trips.

Problem check | Location | Check point and remedy







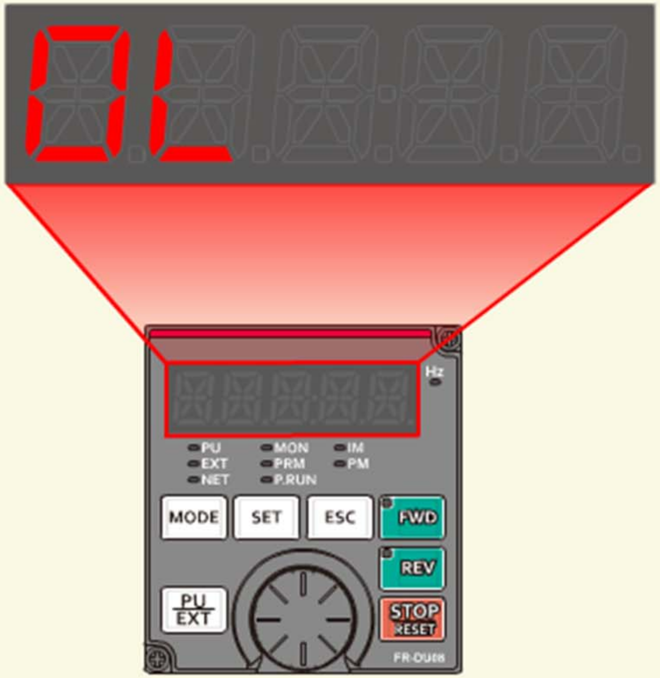
4.2.7 OL: Stall prevention (overcurrent)

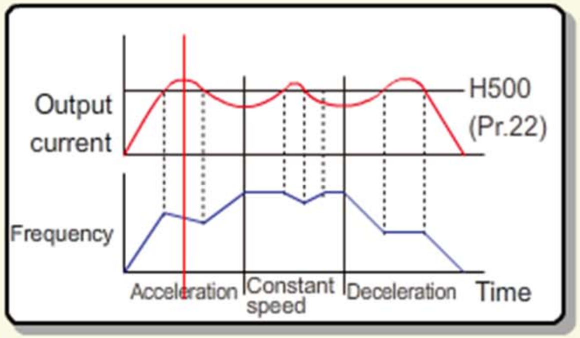
Operation panel indication	OL

Warning | Output voltage detection

When the output current exceeds the stall prevention operation level, a warning is displayed. At the same time, the inverter regulates the output frequency to prevent a trip due to an overcurrent.

Problem check | Location | Check point and remedy





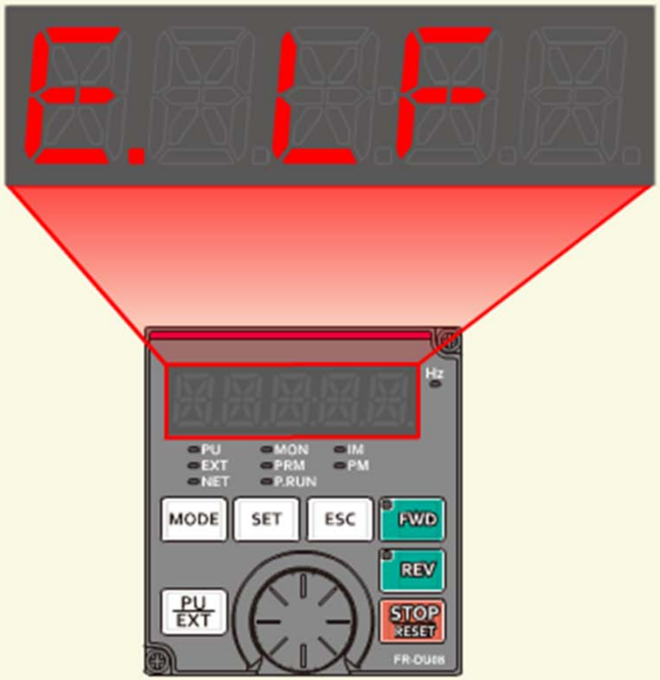
4.2.8 E. LF: Output phase loss

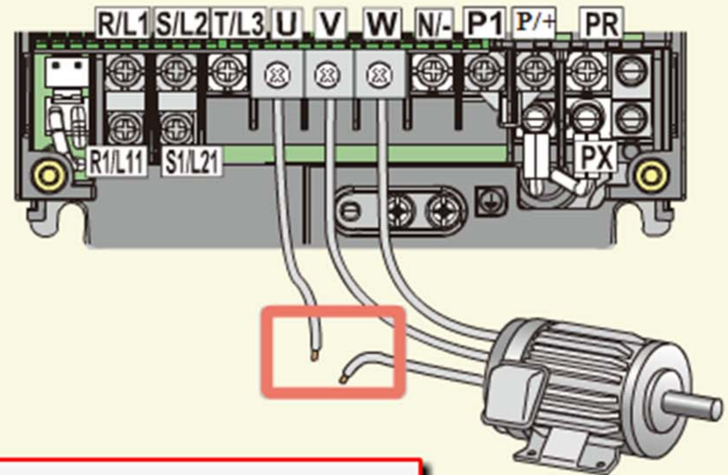
Operation panel indication	E.LF

Fault | Output voltage detection

When one of the three phases (U, V, W) of the inverter output is lost or the motor has the capacity smaller than the inverter (*1), a warning is displayed and the inverter trips. *1) A rough guide is an output current of approximately 25% or lower of the inverter rated current.

Problem check | Location | Check point and remedy





The wiring of the terminal U is broken.

4.2.9 E. OC1: Overcurrent trip during acceleration

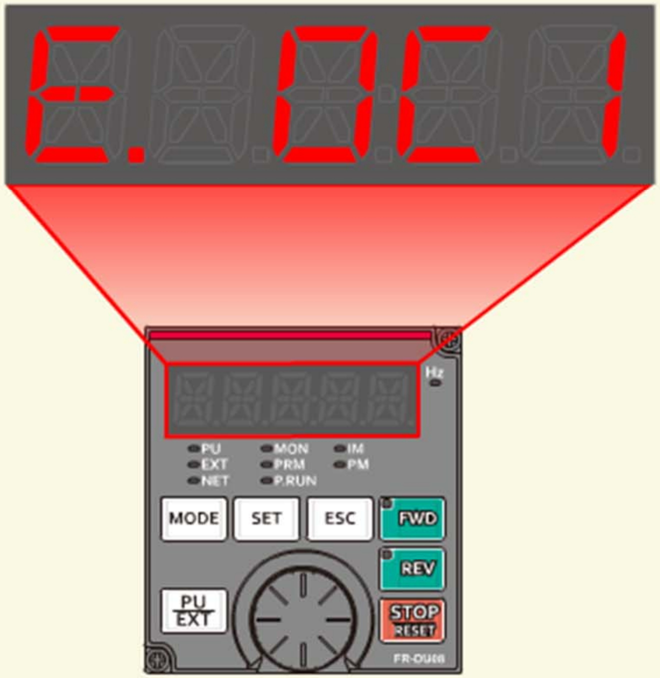
Operation panel indication | E.OC1

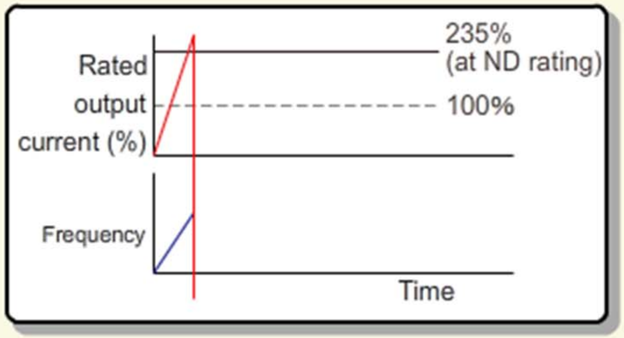
Fault | Output voltage detection

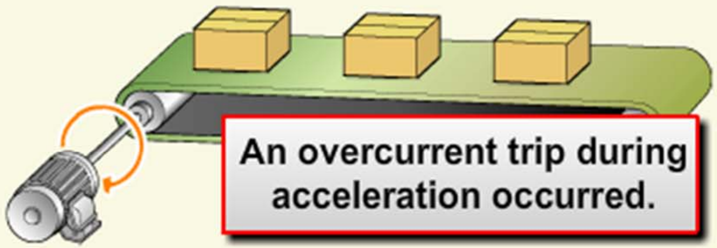
When the inverter's output current reaches or exceeds approximately 235% (at ND rating)* of its rated current during acceleration, the protective circuit is activated to trip the inverter.

* The percentage differs depending on the rating. Refer to the product's manual to be used for details.

Problem check | Location | Check point and remedy







4.2.10 E. OC2: Overcurrent trip during constant speed

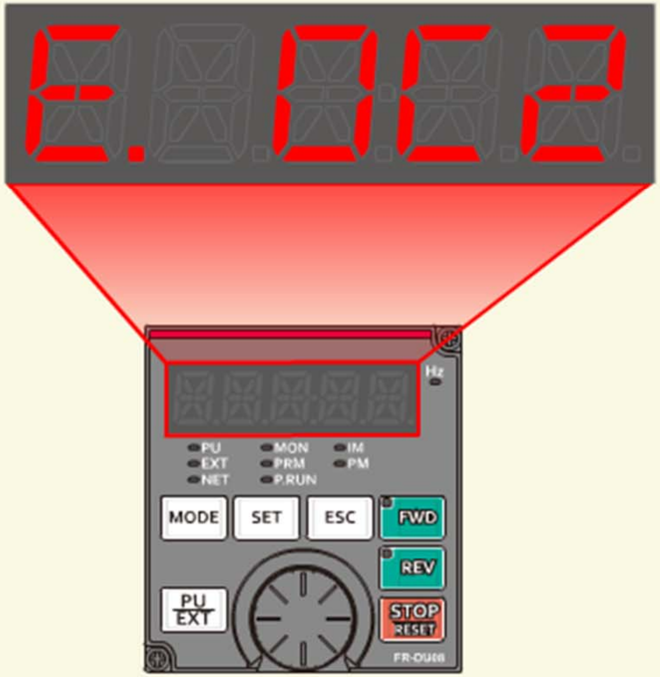
Operation panel indication	E.OC2

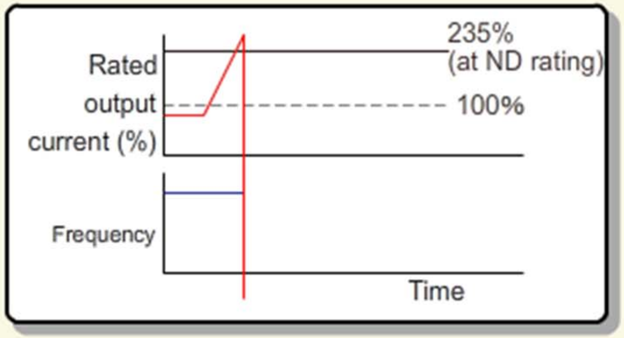
Fault | Output voltage detection

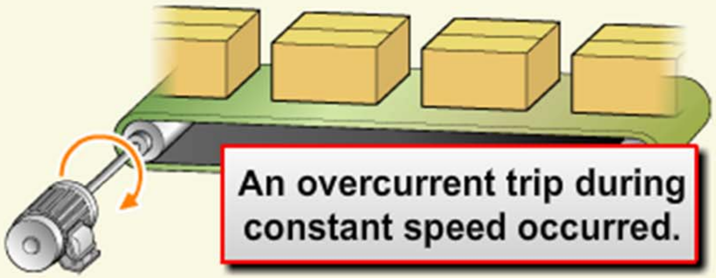
When the inverter's output current reaches or exceeds approximately 235% (at ND rating)* of its rated current during constant-speed operation, the protective circuit is activated to trip the inverter.

* The percentage differs depending on the rating. Refer to the product's manual to be used for details.

Problem check | Location | Check point and remedy







4.2.11 E. OC3: Overcurrent trip during deceleration or stop

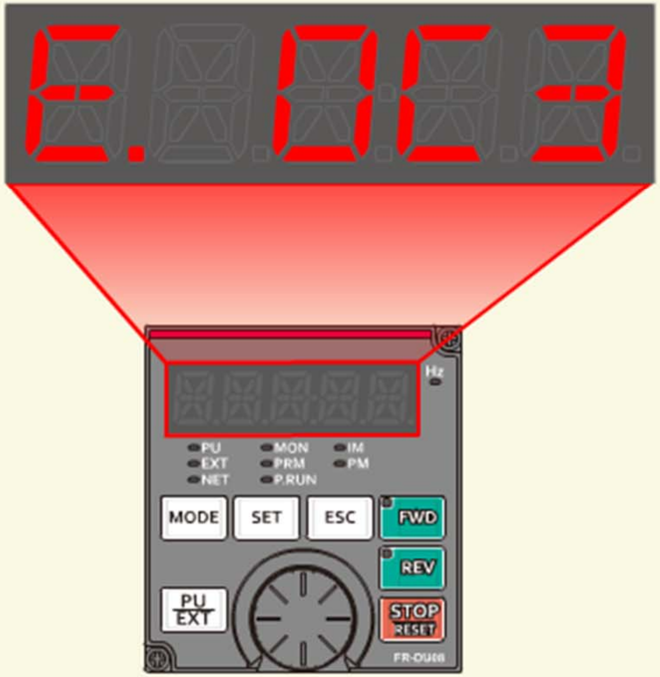
Operation panel indication	E.OC3

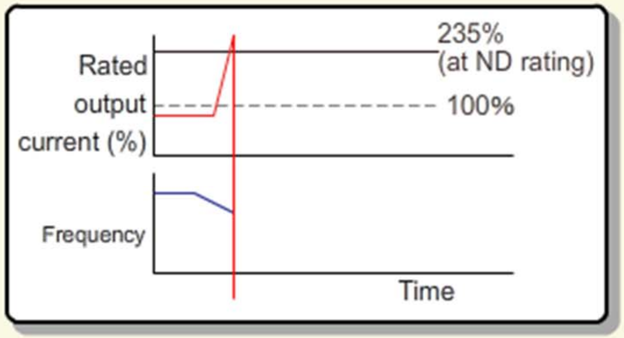
Fault | Output voltage detection

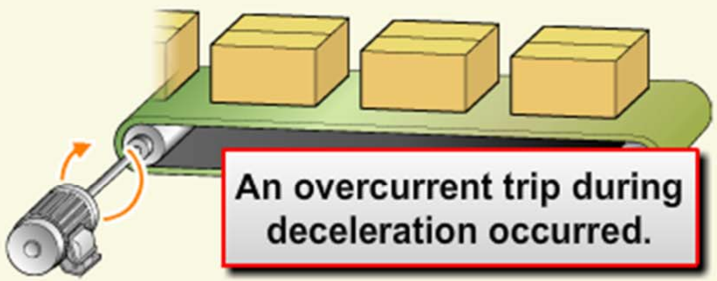
When the inverter's output current reaches or exceeds approximately 235% (at ND rating)* of its rated current during deceleration, the protective circuit is activated to trip the inverter.

* The percentage differs depending on the rating. Refer to the product's manual to be used for details.

Problem check | Location | Check point and remedy







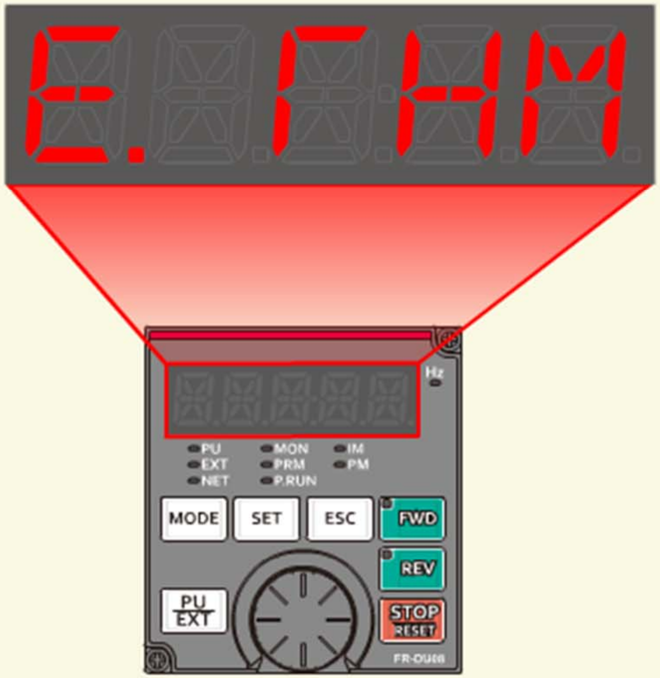
4.2.12 E. THM: Motor overload trip (electronic thermal relay function)

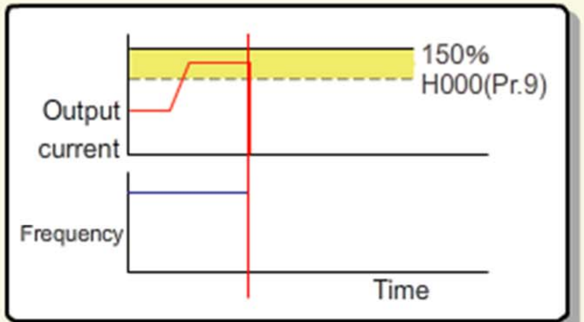
Operation panel indication	E.THM

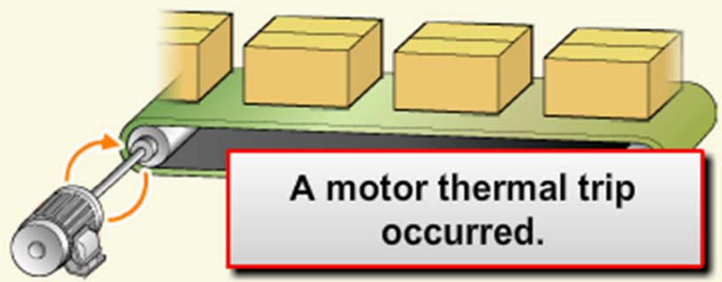
Fault | Output voltage detection

The electronic thermal O/L relay in the inverter detects overheating of the motor, and a warning is displayed and the inverter trips.

Problem check | Location | Check point and remedy







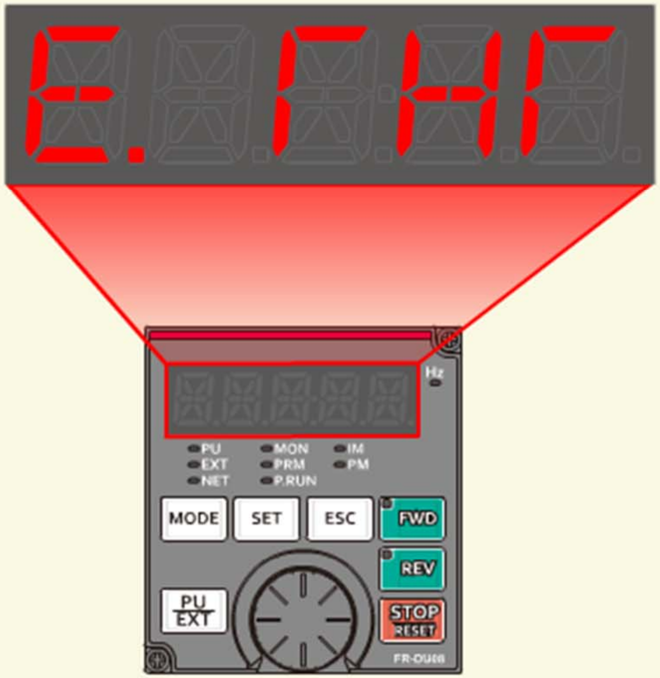
4.2.13 E. THT: Inverter overload trip

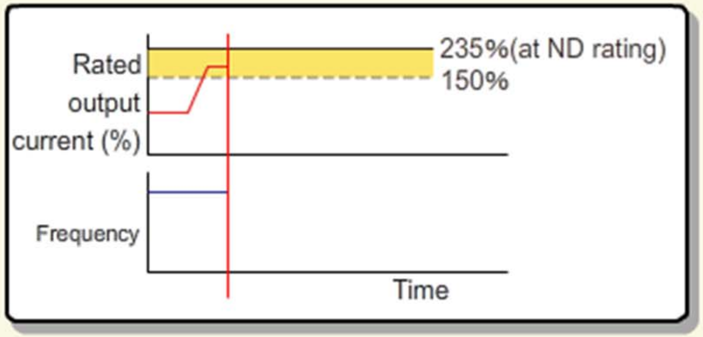
Operation panel indication	E.THT

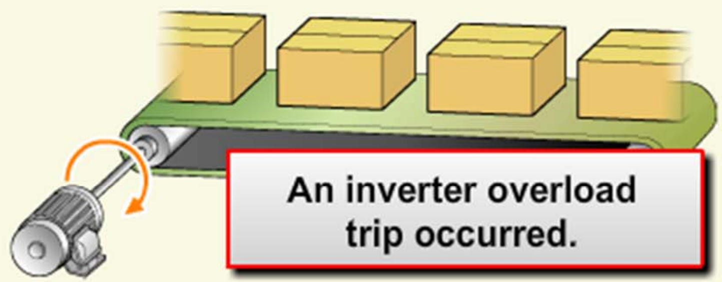
Fault | Output voltage detection

When the current flow becomes 150% or higher or lower than 235% (at ND rating)*, the electronic thermal O/L relay is activated to protect the output transistor. A warning is displayed and the inverter trips. * The percentage differs depending on the rating. Refer to the product's manual to be used for details.

Problem check | Location | Check point and remedy







4.2.14 E. GF: Output side earth (ground) fault overcurrent

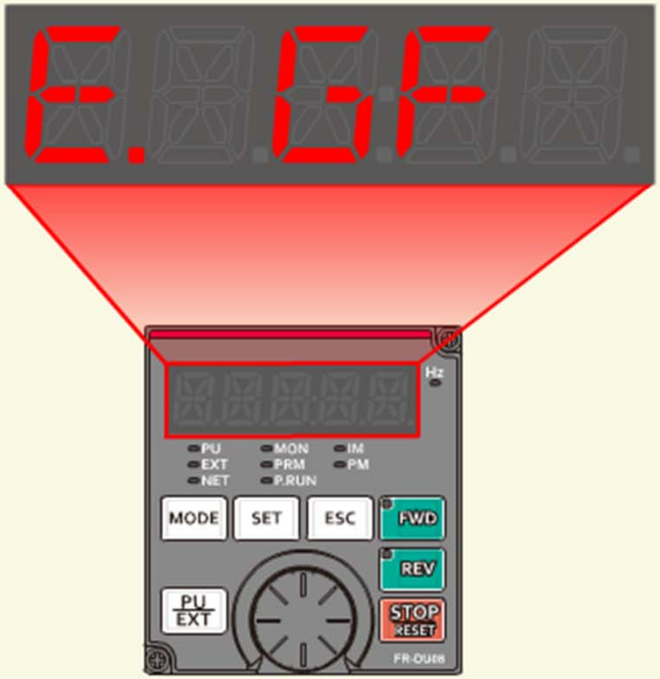
Operation panel indication	E.GF

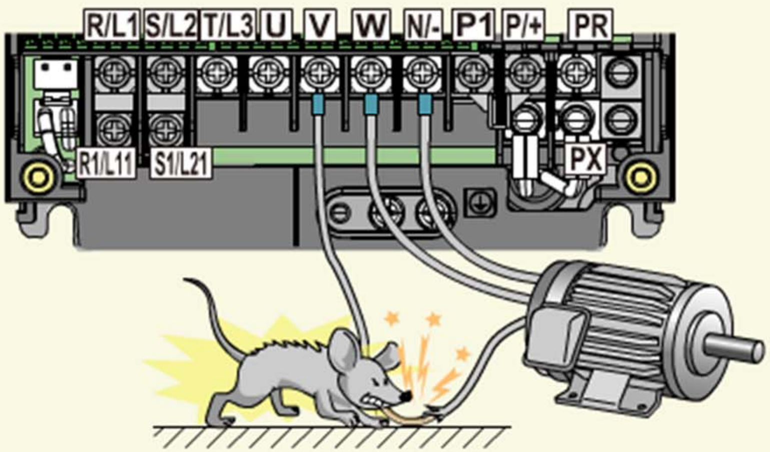
Fault

Output voltage detection

A warning is displayed and the inverter trips if a high earth (ground) fault current flows due to an earth (ground) fault that occurred on the inverter's output side (load side).

Problem check | Location | Check point and remedy





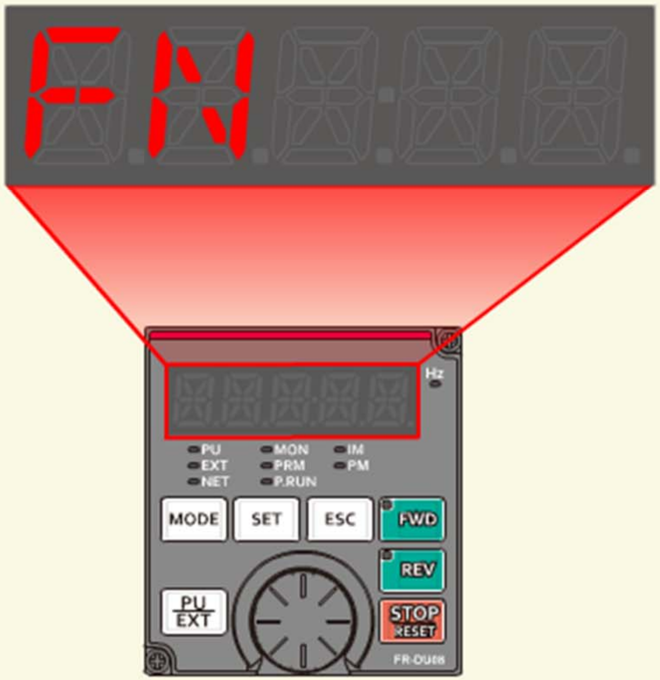
4.2.15 FN: Fan alarm

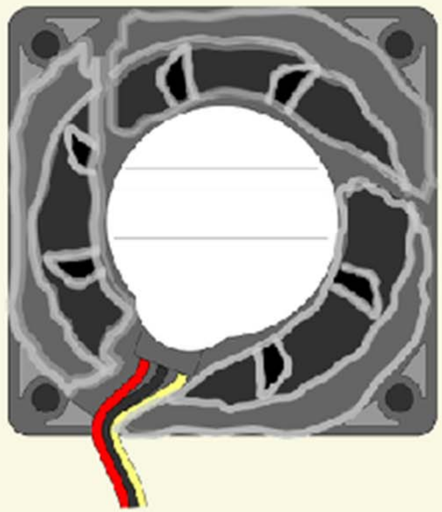
Operation panel indication	FN	

Alarm | Cooling fan detection

A warning is displayed in the following event: "The cooling fan stopped due to a failure", "The cooling fan operated differently from the setting of Cooling fan operation selection", or "The cooling fan rotated at rotations per minute at the specified value or lower". *Only for inverters with a built-in cooling fan

Problem check | Location | Check point and remedy





4.2.16 E. FIN: Heatsink overheat

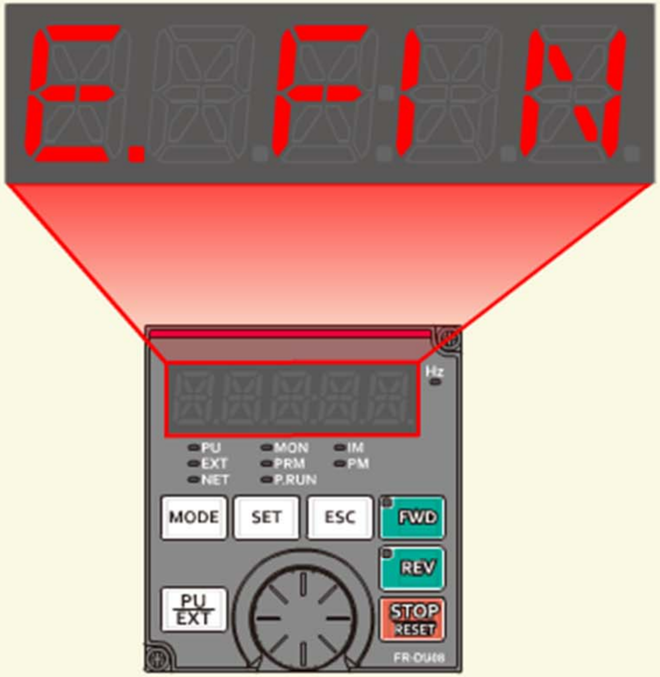
Operation panel indication	E.FIN

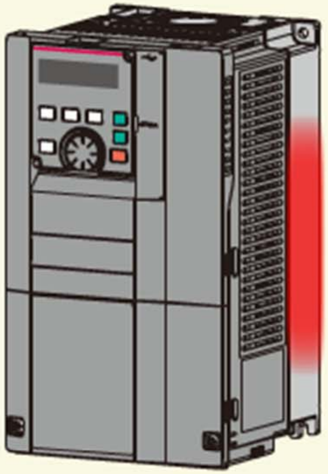
Fault

Heatsink detection

The heatsink in the inverter detects overheating.
A warning is displayed and the inverter trips.

Problem check | Location | Check point and remedy





4.2.17 PS: PU stop

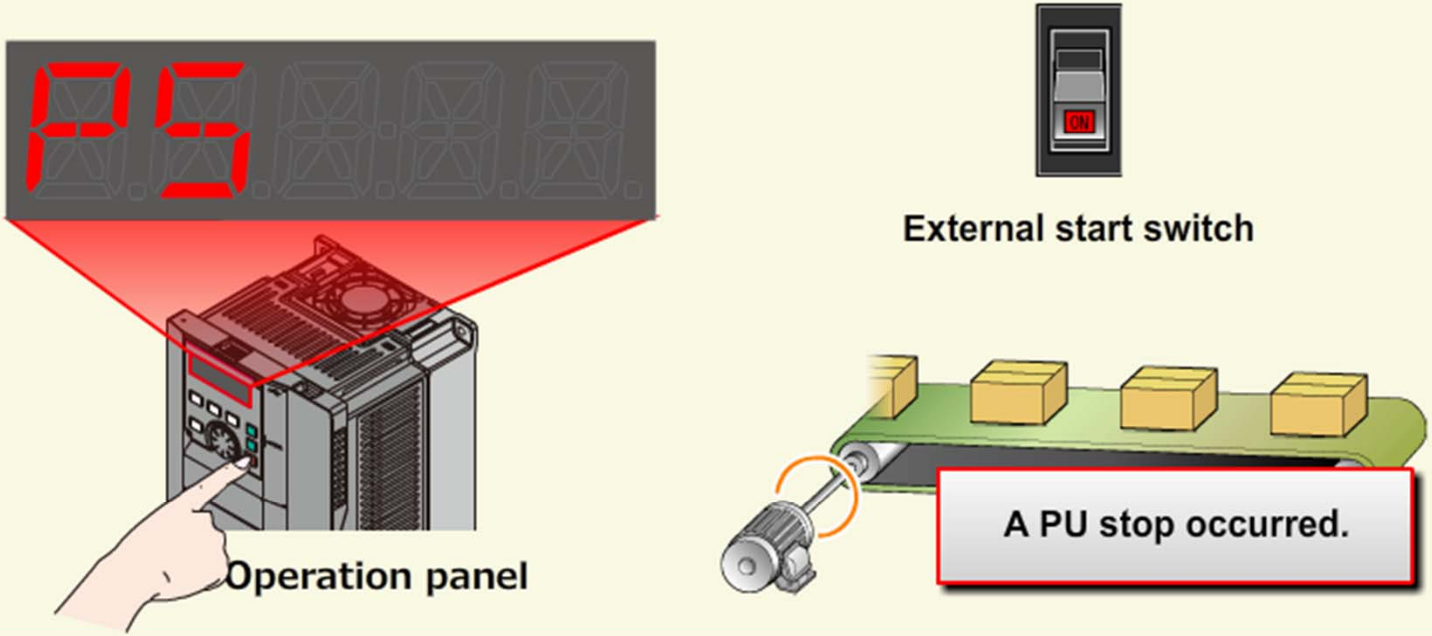
Operation panel indication	PS

Fault

Operation-related detection

When the STOP key on the operation panel is pressed during the External operation mode, a warning is displayed and the inverter decelerates to stop.

Problem check | Location | Check point and remedy



4.2.18 Err.: Error

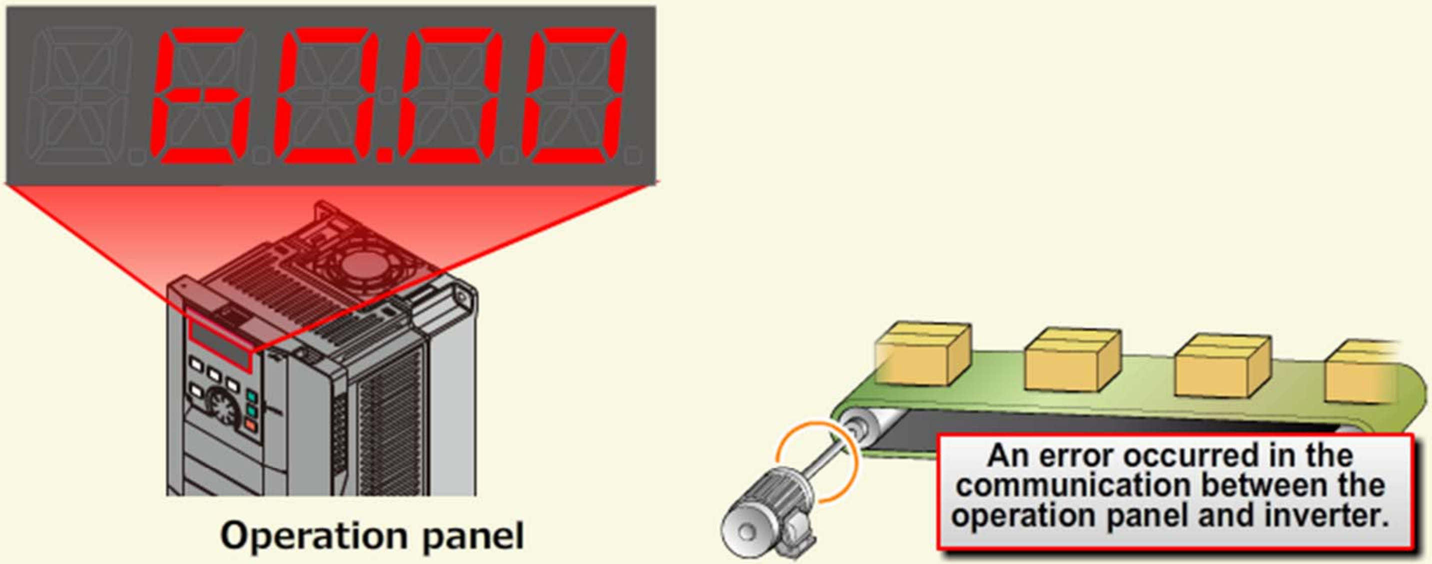
Operation panel indication	Err.

Output stop depending on condition

Operation-related detection

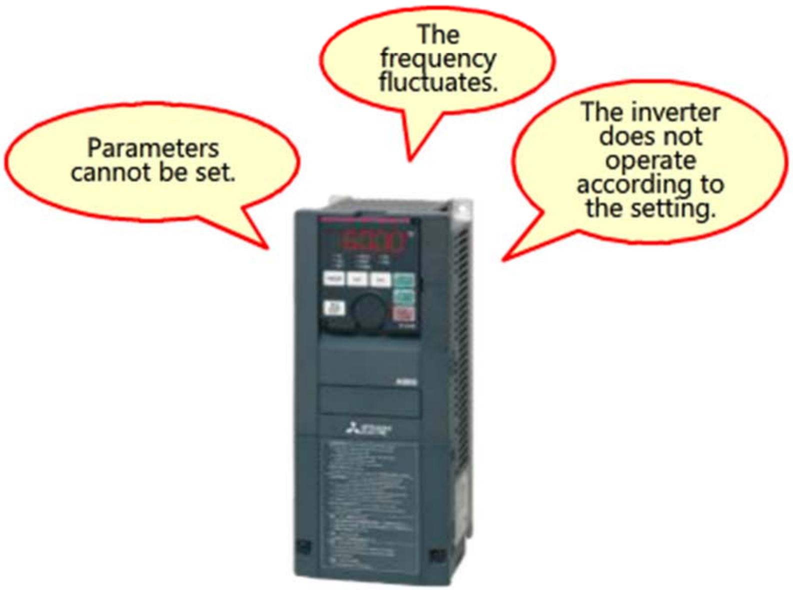
When a reset operation keeps the RES signal ON or the inverter cannot communicate with the operation panel because the panel is about to come off, a warning is displayed and the inverter trips. * When an error occurs in communication with the operation panel during the External operation mode, the inverter does not trip.

Problem check | Location | Check point and remedy



4.3 If No Error is Displayed

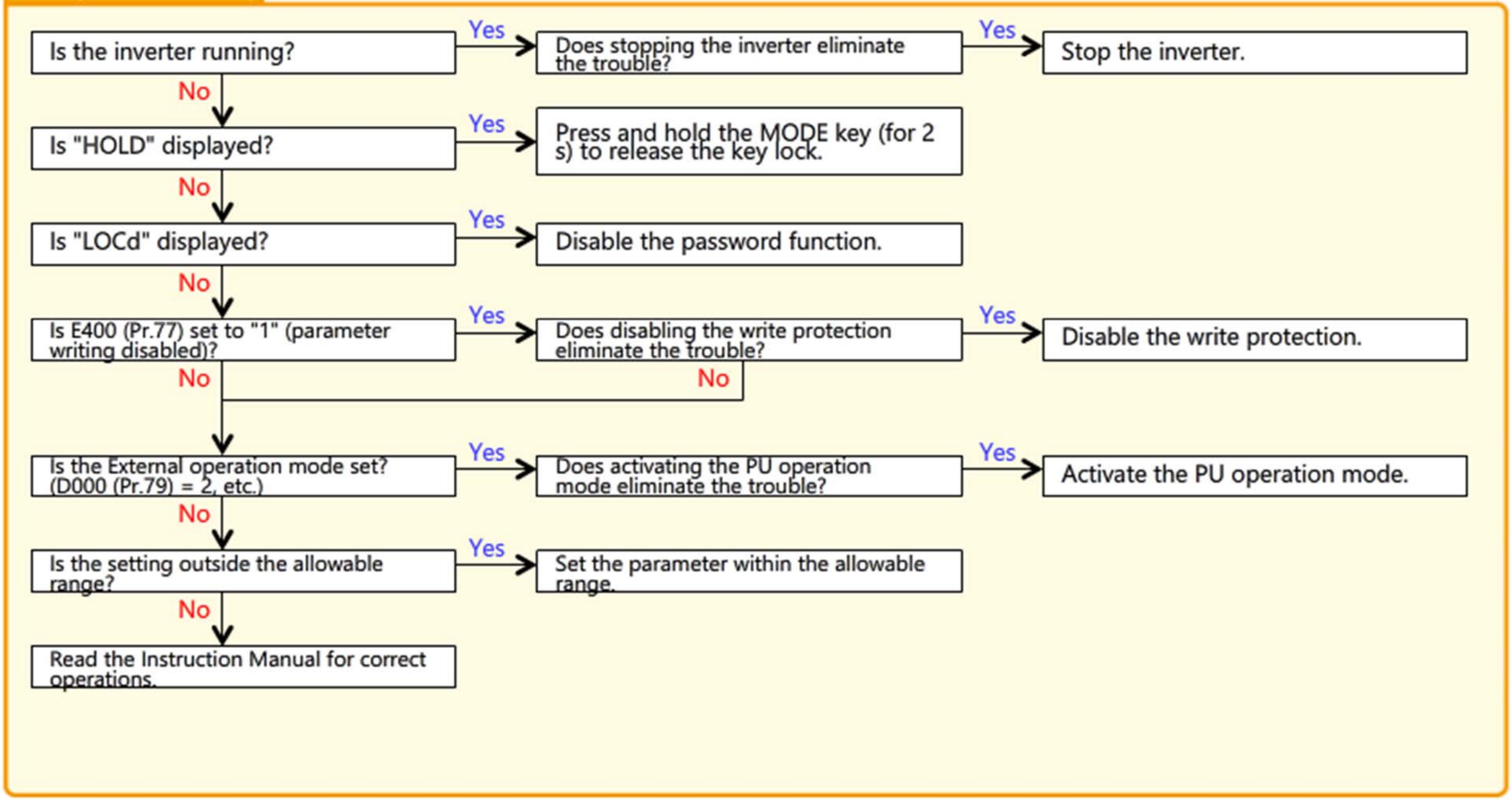
If a trouble occurs and no error is displayed, check the inverter and motor to determine the proper corrective action.
The subsequent flowcharts show frequent problems and solutions.



4.3.1 When parameters cannot be set

When parameters cannot be set, follow the flowchart below to track down the cause and take corrective actions.

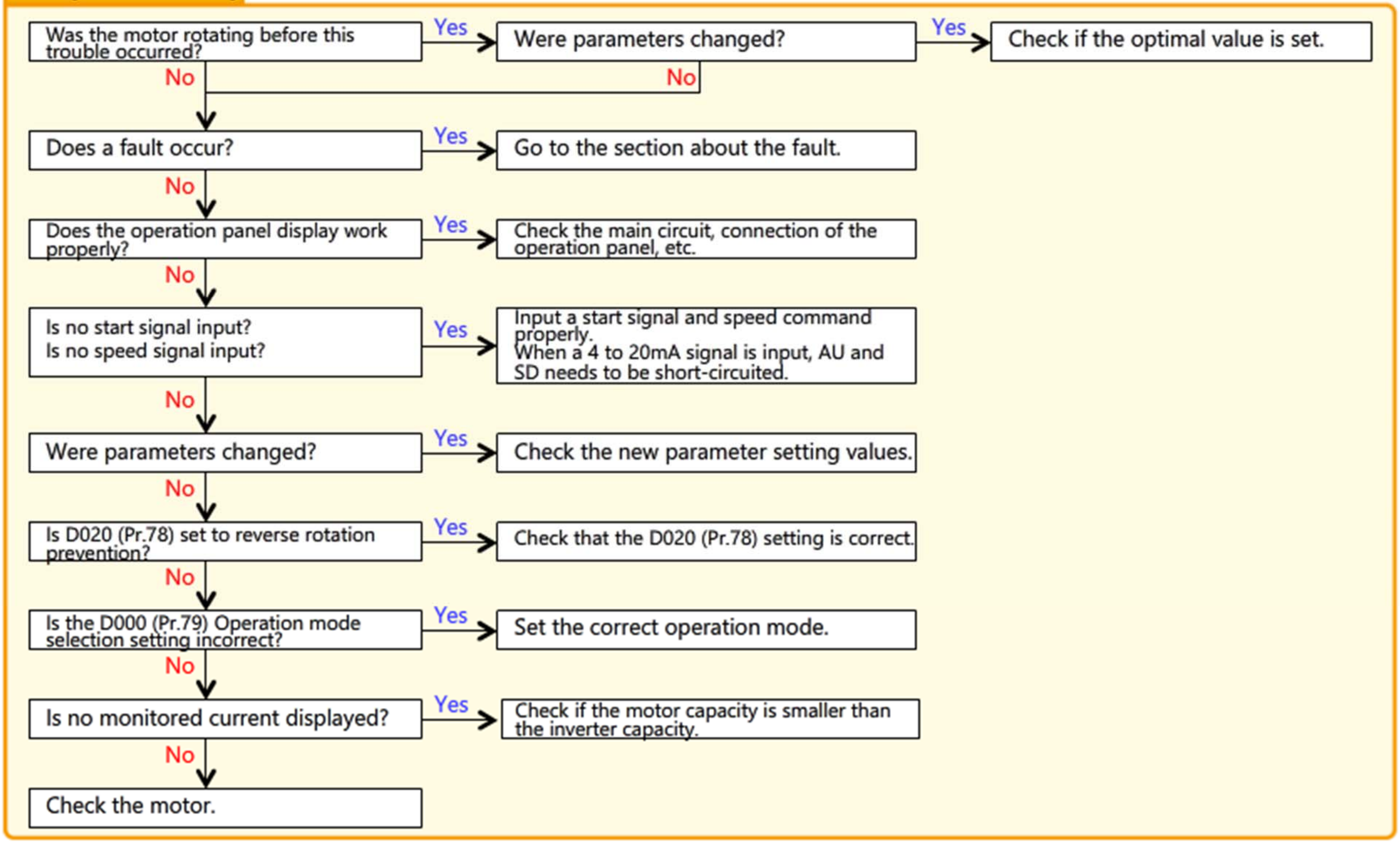
Check point and remedy



4.3.2 When the motor does not rotate

When the motor does not rotate, follow the flowchart below to track down the cause and take corrective actions.

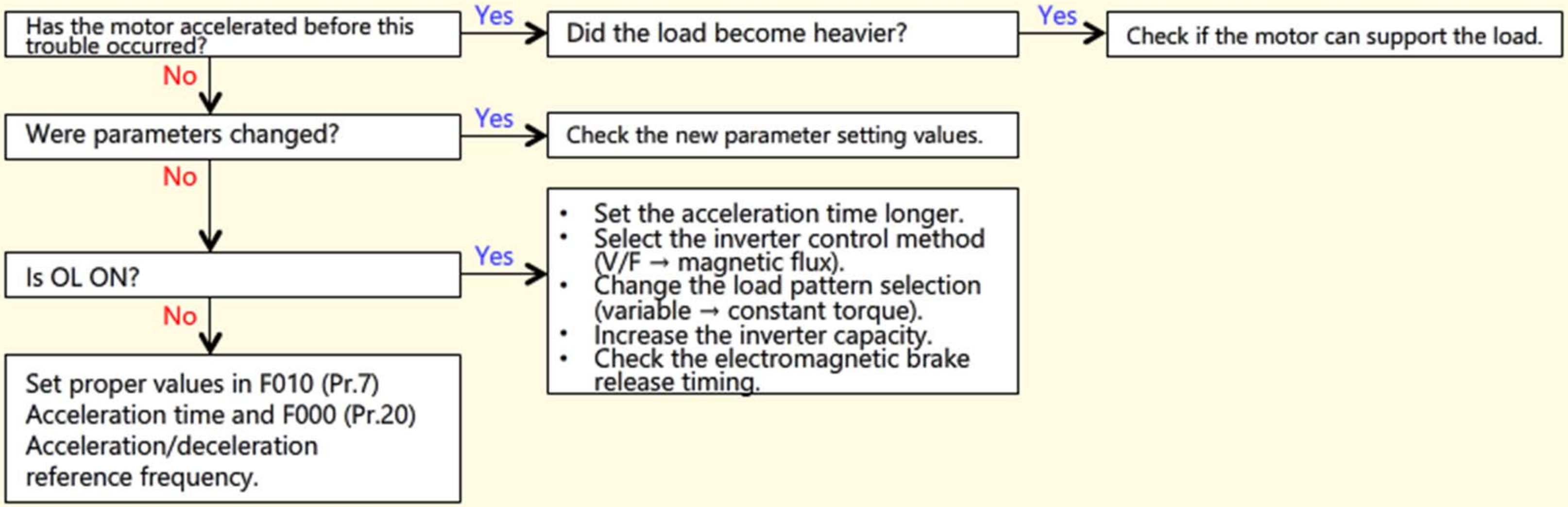
Check point and remedy



4.3.3 When the motor does not accelerate according to the set acceleration time

When the motor does not accelerate according to the set acceleration time, follow the flowchart below to track down the cause and take corrective actions.

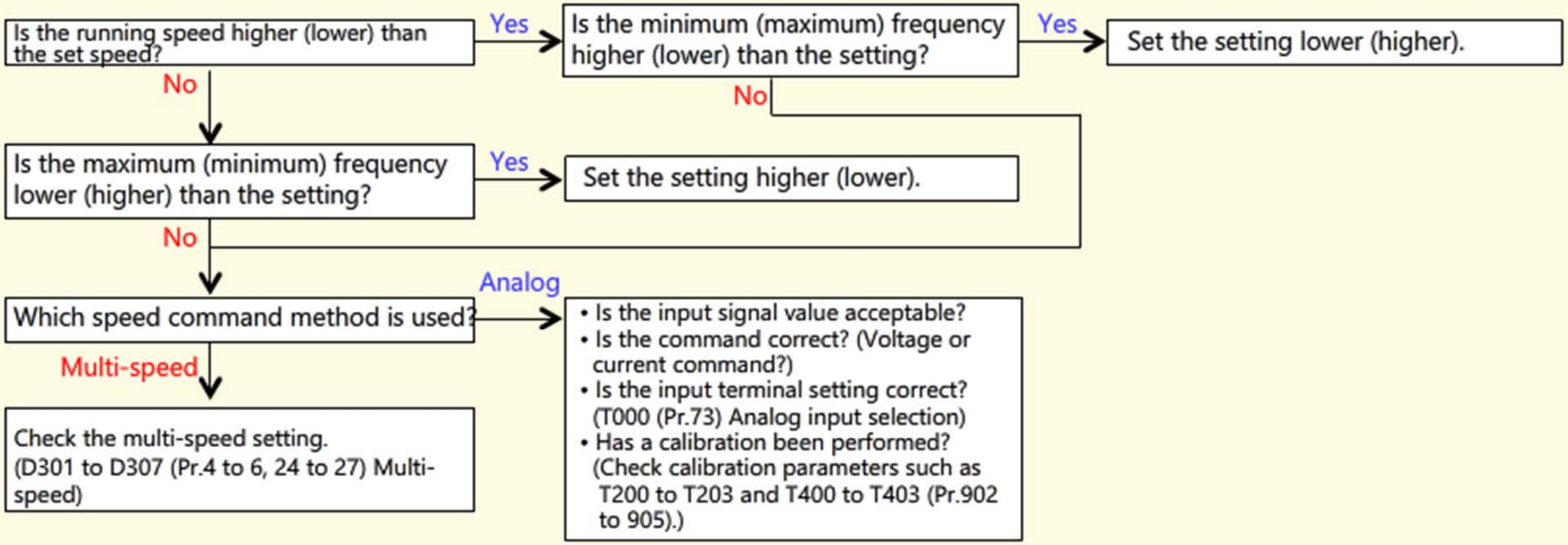
Check point and remedy



4.3.4 When constant-speed operation is not performed as commanded

When constant-speed operation is not performed as commanded, follow the flowchart below to track down the cause and take corrective actions.

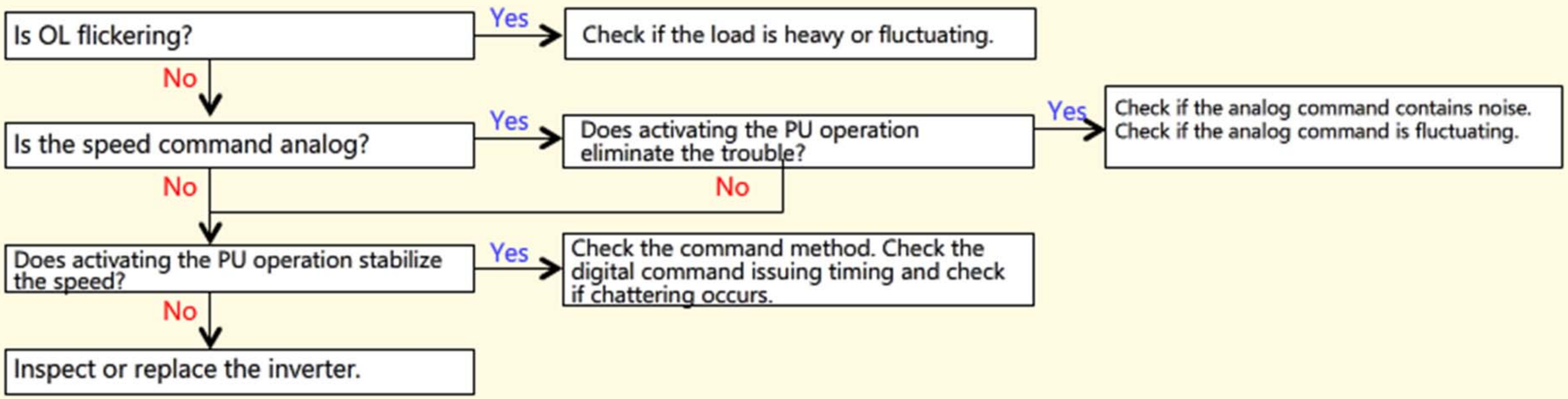
Check point and remedy



4.3.5 When the speed is unstable

When the speed is unstable, follow the flowchart below to track down the cause and take corrective actions.

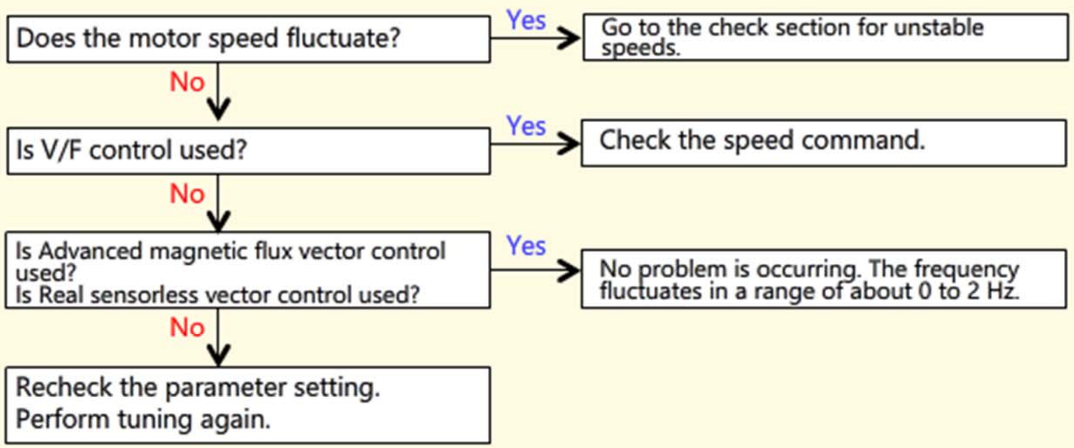
Check point and remedy



4.3.6 When the displayed frequency fluctuates

When the frequency displayed on the monitor fluctuates, follow the flowchart below to track down the cause and take corrective actions.

Check point and remedy



4.3.7 When the motor generates abnormal noise

When the motor generates abnormal noise, follow the flowchart below to track down the cause and take corrective actions.

Check point and remedy

Shut off the power supply or stop the inverter output during operation.

If the noise is quickly eliminated → Electrical factor

<Electrical factor>	<Countermeasure>
• Carrier frequency	• Increase the carrier frequency.
• Voltage unbalance	• Replace the inverter.
• Stall operation	• Remove the fast-response current limit.
• Resonance	• Increase the base frequency.
• Fluctuation in power supply voltage	• Set the base frequency voltage.

If the noise is still heard → Mechanical factor

<Mechanical factor>

- Bearing abnormality, wind noise from the fan motor, etc.

4.4 Summary of This Chapter

In this chapter, you have learned:

- Troubleshooting procedure
- If an error is displayed
- If no error is displayed

Point

Troubleshooting procedure	When a trouble has occurred, follow the procedure below. 1.Checking the error display 2.Checking the faults history 3.Troubleshooting 4.Resetting the protective function
Resetting the protective function	The methods for resetting the protective function include the following three types. • Press the STOP/RESET key on the operation panel. • Switch power OFF once, and switch it ON again. • Keep the RES (rest) signal ON for 0.1 seconds or longer.
Protective function	The protective function protects the internal circuit of the inverter from overcurrent, overvoltage, and heat. The protective function detects analog values, such as voltage and current, in circuits and stops the inverter output if the detected value exceeds the allowable range.
Trouble with error display	If a protective function of the inverter detects an error, the operation panel displays the error on the monitor. To eliminate the cause, the protective function must be understood and the proper corrective action must be taken according to the type of error.
Trouble with no error display	If a trouble occurs and no error is displayed, check the inverter and motor to determine the proper corrective action.

Chapter 5 Trace Function

This chapter explains the outline of the trace function, which is useful to investigate the cause of trouble, and how to use it.

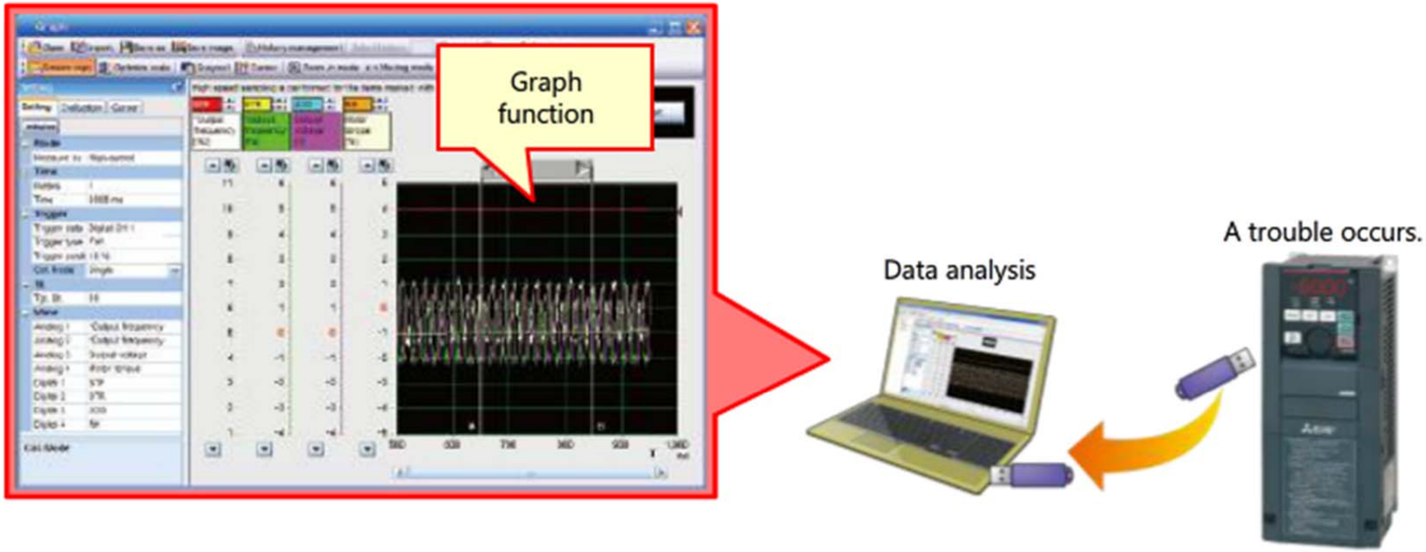
5.1 Outline of the Trace Function

5.2 How to Use the Trace Function

5.3 Summary of This Chapter

5.1 Outline of the Trace Function

The "trace function" logs the inverter's operating status, and you can analyze the cause by dating back to when the trouble occurred.
The traced data (log) can be saved in the commercial USB memory device for analysis in other places.



The following briefly explains the terms used for explanation of the trace function.

■ Sampling

Sampling is an operation to collect data of an inverter at fixed intervals. Any types of data can be selected (such as output frequency and output current). The collected data is not saved in the built-in RAM or a USB memory device until a trigger occurs.

■ Trigger

A trigger is an event that causes something to happen. If a trigger occurs, saving sampled data starts. Any trigger conditions can be set. For example, if the occurrence of a fault is set as a trigger, the collected data can be used to investigate causes of faults.

5.2 How to Use the Trace Function

This section explains the procedure from saving the trace data (using a fault occurrence as a trigger) to analyzing the data.

The procedure here uses the fault Motor overload trip (E.THM) as an example.
Motor overload trip occurs when the protective function to prevent the motor from overheating (electronic thermal O/L relay) is activated.
If the output current of the inverter remains at the same level as or higher than the rated motor current for a certain length of time, the function is activated.

The saved trace data can be analyzed using the graph function of FR Configurator2.

■ Parameter setting

1. Trace mode selection

Select the destination location of the acquired trace data.
Set the parameter to "Memory mode (automatic transfer)". When a trigger occurs, the trace data is saved in the USB memory device.

Parameter		Initial value	Description
A901 (Pr.1021)	Trace mode selection	0: Memory mode (The data is saved in the built-in RAM.)	1: Memory mode (automatic transfer)

2. Analog source selection

Select analog data to be sampled.
Set ch1 to "Output current" and ch2 to "Electronic thermal O/L relay load factor".
A fault occurs when the electronic thermal relay function load factor becomes 100%.

Parameter		Initial value	Description
A910 (Pr.1027)	Analog source selection (1ch)	201: Output frequency	2: Output current
A911 (Pr.1028)	Analog source selection (2ch)	202: U phase output current	10: Electronic thermal O/L relay load factor

(Continues to the next page.)

5.2 How to Use the Trace Function

(Continues from the previous page.)

3. Digital source selection

Select digital data to be sampled.
Assign the "STF signal", which is the initial value, to ch1 and the "ALM signal" to ch2.
The STF signal turns ON when forward operation starts. The ALM signal turns ON when a fault occurs.

Parameter		Initial value	Description
A930 (Pr.1038)	Digital source selection (1ch)	1: STF	Do not change.
A931 (Pr.1039)	Digital source selection (2ch)	2: STR	106: ABC1 terminal (ALM signal)

4. Trigger mode selection

Select the trigger condition.
Use the fault occurrence, which is the initial value, as the trigger condition.

Parameter		Initial value	Description
A905 (Pr.1025)	Trigger mode selection	0: Fault trigger	Do not change.

5. Trace operation selection

Setting this parameter starts/stops sampling.
Set "1" to start sampling.

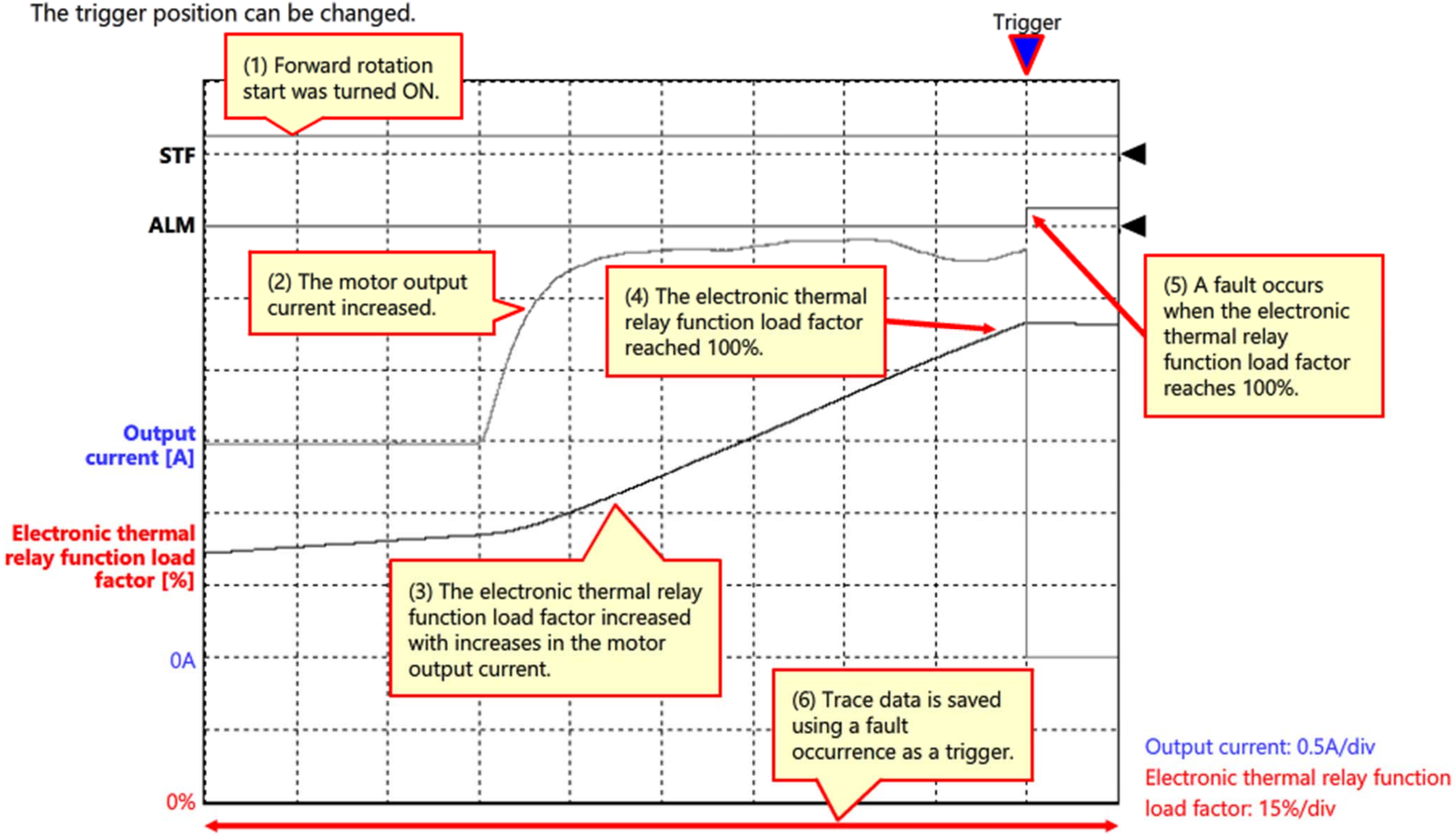
Parameter		Initial value	Description
A900 (Pr.1020)	Trace operation selection	0: Sampling standby	1: Sampling start

You have finished setting basic parameters.
When a fault occurs, trace data is automatically saved.

5.2 How to Use the Trace Function

■ Data analysis

The following shows an analysis example of acquired trace data.
When data saved in a USB memory device is opened with the graph function of FR Configurator2, the data is displayed as a graph.
Data before the trigger occurred is saved, and this will help investigate the cause of the fault.
The trigger position can be changed.



Refer to the product's manual to be used for more details of the trace function.

5.3 Summary of This Chapter

In this chapter, you have learned:

- Outline of the trace function
- How to use the trace function

Point

Outline of the trace function	The "trace function" logs the inverter's operating status, and you can analyze the cause by dating back to when the trouble occurred. As an advantage of this function, the traced data (log) can be saved in the commercial USB memory device for analysis in other places.
Graph function	The acquired trace data can be analyzed using the graph function of the inverter setup software (FR Configurator2).

Test Final Test

Now that you have completed all of the lessons of the Inverter Maintenance Course for FR-800, you are ready to take the final test. If you are unclear on any of the topics covered, please take this opportunity to review those topics.
There are a total of 6 questions (13 items) in this Final Test.
You can take the final test as many times as you like.

How to score the test

After selecting the answer, make sure to click the **Answer** button. Your answer will be lost if you proceed without clicking the Answer button. (Regarded as unanswered question.)

Score results

The number of correct answers, the number of questions, the percentage of correct answers, and the pass/fail result will appear on the score page.

Correct answers : 6

Total questions : 6

Percentage : 100%

To pass the test, you have to answer **60%** of the questions correct.

Proceed Review

- Click the **Proceed** button to exit the test.
- Click the **Review** button to review the test. (Correct answer check)
- Click the **Retry** button to retake the test again.

Test Final Test 1

The following explains the checks that should be carried out prior to starting up an inverter system. Fill in the blanks of the explanation.

First, check the --Select-- and the installation environment.

Next, check that the --Select-- settings are correct and complete.

After finishing the checks, perform a --Select-- with an inverter only and then with a --Select-- and the inverter.

If no problem has occurred, perform a --Select-- with the --Select-- under a load to make sure that the system operates as designed.

Last, make a --Select-- of the --Select-- .

Answer Back

Test Final Test 2

Select the correct explanation regarding the installation environment for an inverter. (Select one of the following.)

- To use the space efficiently, install the inverter without clearance around it.
- To release heat and let dirt escape, leave clearance as wide as possible around the inverter.

Answer Back

Test Final Test 3

Select a term that is not used as a type of fault display. (Select one of the following.)

- Alarm
- Failure
- Fault

Answer Back

Test Final Test 4

Select the correct explanation regarding troubleshooting. (Select one of the following.)

- A trouble that does not stop the inverter output may be ignored.
- Once a trouble has occurred, reset the inverter as soon as possible.
- Do not ignore a trouble even if it does not stop the inverter output. Eliminate the cause of the trouble.

Answer Back

Test Final Test 5

Select the incorrect explanation about when a trouble likely occurs. (Select one of the following.)

- Immediately after the inverter system is started
- When a load heavier than the capability of the inverter or motor is applied
- When the inverter has been used exceeding its service life

Answer Back

Test Final Test 6

Select the best explanation about trouble prevention. (Select one of the following.)

- Be familiar with troubleshooting.
- Determine the application purpose and needed functions, select products, and develop design well in advance.
- Troubles can occur at any time. It is meaningless to consider anything.

Answer Back

Test | Test Score

You have completed the Final Test. You results area as follows.
To end the Final Test, proceed to the next page.

Correct answers : 6

Total questions : 6

Percentage : 100%

Proceed   Review

Congratulations. You passed the test.

Inverter_Maintenance_Course_for_FR_800_ENG

TOC

You have completed the Inverter Maintenance Course for FR-800.

Thank you for taking this course.

We hope you enjoyed the lessons and the information you acquired in this course will be useful in the future.

You can review the course as many times as you want.

Review

Close