

Chapter 7 MAINTENANCE AND INSPECTION

Perform daily and periodic inspection to avoid trouble and keep reliable operation for a long time. Take care of the following items during work.

WARNING

- Before starting inspection and maintenance, first turn off the inverter and wait at least 5 minutes. This is because the electric charge in the DC link bus capacitor may remain even after the power is turned off and it may take time until the DC link bus voltage drops below a safe potential. After 5 minutes or more, remove the control circuit and main circuit terminal block covers. Make sure that the DC link bus voltage between the terminals P (+) and N (-) has dropped below the safe voltage level (+25 VDC), using a multimeter and then start the maintenance and inspection.

Electric shock may occur.

- Maintenance, inspection, and parts replacement should be made only by authorized persons.
- Take off the watch, rings and other metallic matter before starting work.
- Use insulated tools.
- Never modify the inverter.

Electric shock or injuries could occur.

7.1 Daily Inspection

Visually inspect errors in the state of operation from the outside without removing the covers while the inverter operates or while it is turned on.

- Check if the expected performance (satisfying the standard specification) is obtained.
- Check if the surrounding environment satisfies Chapter 2, Section 2.1 "Operating Environment."
- Check that the LED monitor displays normally.
- Check for abnormal noise, odor, or excessive vibration.
- Check for traces of overheat, discoloration and other defects.

7.2 Periodic Inspection

Perform periodic inspection by following the items of the list of periodic inspection in Table 7.1. Before performing periodic inspection, be sure to stop the motor, turn off the inverter, and shut down power supply. Then remove the covers of the control and main circuit terminal blocks.

Table 7.1 List of Periodic Inspections

Check part	Check item	How to inspect	Evaluation criteria	
Environment	1) Check the ambient temperature, humidity, vibration and atmosphere (dust, gas, oil mist, or water drops). 2) Check if tools or other foreign matter or dangerous objects are left around the equipment.	1) Check visually or measure using apparatus. 2) Visual inspection	1) The standard specification must be satisfied. 2) No foreign or dangerous objects are left.	
Voltage	Check if the voltages of the main and control circuit are correct.	Measure the voltages using a multimeter or the like.	The standard specification must be satisfied.	
Keypad	1) Check if the display is clear. 2) Check if there is missing parts in the characters.	1), 2) Visual inspection	1), 2) The display can be read and there is no fault.	
Structure such as frame and cover	1) Abnormal noise and excessive vibration 2) Loosen bolts (tightened parts) 3) Deformation and breakage 4) Discoloration and deformation caused by overheat 5) Check for foulness and dust.	1) Visual or hearing inspection 2) Retighten. 3), 4), 5) Visual inspection	1), 2), 3), 4), 5) No abnormalities	
Main circuit	Common	1) Check if bolts and screws are tight and not missing. 2) Check the devices and insulators for deformation, cracks, breakage and discoloration caused by overheat and deterioration. 3) Check for foulness and dust.	1) Retighten. 2), 3) Visual inspection	1), 2), 3) No abnormalities
	Conductor and wire	1) Check the conductor for discoloration and distortion caused by overheat. 2) Check the sheath of the cable for cracks and discoloration.	1), 2) Visual inspection	1), 2) No abnormalities
	Terminal block	Check that the terminals are not damaged.	Visual inspection	No abnormalities

Table 7.1 Continued

Check part		Check item	How to inspect	Evaluation criteria
Main circuit	Filtering capacitor (Note)	1) Check for electrolyte leakage, discoloration, cracks and swelling of the case. 2) Check if the safety valve does not protrude remarkably. 3) Measure the capacitance if necessary.	1),2) Visual inspection 3) Measure discharge time with capacitance probe.	1),2) No abnormalities 3) The discharge time is not shorter than time specified by the replacement manual.
	Braking resistor	1) Check for odor caused by overheat and cracked insulator. 2) Check for broken wire.	1) Smelling and visual inspection 2) Visual inspection or measurement with multimeter under disconnection of one lead	1) No abnormalities 2) Within $\pm 10\%$ of the specified resistance
	Transformer and reactor	Check for abnormal roaring noise and odor.	Hearing, visual and smelling inspection	No abnormalities
	Magnetic contactor and relay	1) Check for chatters during operation. 2) Check for rough contacts.	1) Hearing inspection 2) Visual inspection	1), 2) No abnormalities
Control circuit	Printed circuit board (Note)	1) Check for loose screws and connectors. 2) Check for odor and discoloration. 3) Check for cracks, breakage, deformation and remarkable rust. 4) Check the capacitors for electrolyte leaks and deformation.	1) Retighten. 2) Smelling and visual inspection 3), 4) Visual inspection	1), 2), 3), 4) No abnormalities
Cooling system	Cooling fan (Note)	1) Check for abnormal noise and excessive vibration. 2) Check for loose bolts. 3) Check for discoloration caused by overheat.	1) Hearing and visual inspection, or turn manually (be sure to turn the power off). 2) Retighten. 3) Visual inspection	1) Smooth rotation 2), 3) No abnormalities
	Ventilation path	Check the heat sink, intake and exhaust ports for clogging and foreign matter.	Visual inspection	No abnormalities

(Note) The judgement level of part replacement period with Menu #5 "Maintenance information" should be used as a guide. Determine the replacement period on the basis of the standard replacement years. (See Section 7.5 "List of Periodical Replacement Parts.")

If the inverter is stained, wipe it off with a chemically neutral cloth to remove dust, use a vacuum cleaner.

■ Judgement of service life using maintenance information

Menu #5 "Maintenance information" in Programming mode can be used to display data for the judgement of replacement of "DC link bus capacitor," "electrolytic capacitor on the printed circuit board," and "cooling fan" as a guide.

If the replacement data is out of the judgement level for early warning, an early warning signal is output to an external device through terminal [Y1] (function code E20). (When any replacement data is out of the judgement level, terminal [Y1] outputs ON signal.)

Table 7.2 Parts Replacement Judgement with Menu #5 "Maintenance Information"

Parts to be replaced	Judgement level
DC link bus capacitor	85% or lower of the capacitance than that of the factory setting
Electrolytic capacitor on the printed circuit board	61,000 hours or longer as accumulated run time
Cooling fan (Nominal applied motor: 2 to 5 HP)	61,000 hours or longer as accumulated run time (Assumed life of cooling fan at ambient inverter temperature of 40°C(104°F))

(1) DC link bus capacitor

Measure the capacitance of the DC link bus capacitor as follows:

The capacitance is displayed in the reduction ratio (%) of the initial value written in the inverter memory before shipment.

----- Capacitance measurement procedure -----

- 1) Remove the RS-485 communications card (option) from the inverter if it is mounted. Disconnect the DC link bus to other inverters from terminals P (+) and N (-) of the main circuit if any. A DC reactor (option) and braking resistor (option) may not be disconnected. Keep the ambient temperature at $25 \pm 10^{\circ}\text{C}$ ($77 \pm 18^{\circ}\text{F}$).
- 2) Turn off the digital inputs (FWD, REV, and X1 to X3) at the control terminals.
 - If an external potentiometer is connected, to terminal [13], remove it.
 - Set the data of function codes E20 and E27 as the transistor output [Y1] or relay output [30A, B, C] does not come on while the inverter power is turned off. E.g., recommended settings are to assign normal logic signal **RUN** and **ALM** to terminals [Y1] and [30A, B, C] respectively.
- 3) Turn the inverter power on.
- 4) Check that the cooling fan rotates and the inverter is on halt.
- 5) Turn the main power supply off. Start measuring the capacitance of the DC link bus capacitor.
- 6) After the LED monitor is unlit completely, turn the main power supply on again.
- 7) Select Menu #5 "Maintenance information" in Programming mode, and check the reduction ratio (%) of the capacitance of the DC link bus capacitor.

(2) Electrolytic capacitor on the printed circuit board

The inverter keeps an accumulative total of the number of hours that power has been applied to the control circuit and displays it on the LED monitor. Use this to determine when the capacitor should be replaced. The display is in units of 1000 hours.

(3) Cooling fan

The inverter accumulates hours for which the cooling fan has run. The display is in units of 1000 hours.

The accumulated time should be used just a guide since the actual service life will be significantly affected by the temperature and operation environment.

7.3 Measurement of Electrical Amounts in Main Circuit

Because the voltage and current of the power supply (input, primary circuit) of the main circuit of the inverter and those of the motor (output, secondary circuit) include harmonic components, the readings may vary with the type of the meter. Use meters indicated in Table 7.3 when measuring with meters for commercial frequencies.

The power factor cannot be measured by a commercially available power-factor meter that measures the phase difference between the voltage and current. To obtain the power factor, measure the power, voltage and current on each of the input and output sides and calculate in the following formula.

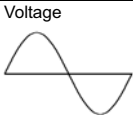
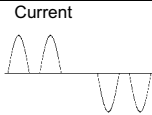
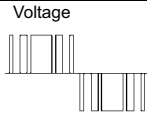
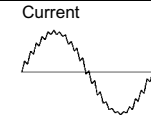
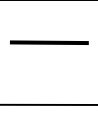



■ Three-phase input

■ Single-phase input

$$\text{Power factor} = \frac{\text{Electric power (W)}}{\sqrt{3} \times \text{Voltage (V)} \times \text{Current (A)}} \times 100 \%$$

$$\text{Power factor} = \frac{\text{Electric power (W)}}{\text{Voltage (V)} \times \text{Current (A)}} \times 100 \%$$

Table 7.3 Meters for Measurement of Main Circuit

Item	Input (primary) side			Output (secondary) side			DC link bus voltage (P (+)-N (-))
Waveform	Voltage 		Current 	Voltage 		Current 	
Name of meter	Ammeter AR, AS, AT	Voltmeter VR, VS, VT	Wattmeter WR, WT	Ammeter AU, AV, AW	Voltmeter VU, VV, VW	Wattmeter WU, WW	DC voltmeter V
Type of meter	Moving iron type	Rectifier or moving iron type	Digital AC power meter	Digital AC power meter	Digital AC power meter	Digital AC power meter	Moving coil type
Symbol of meter			—	—	—	—	



It is not recommended that meters other than a digital AC power meter be used for measuring the output voltage or output current since they may cause larger measurement errors or, in the worst case, they may be damaged.

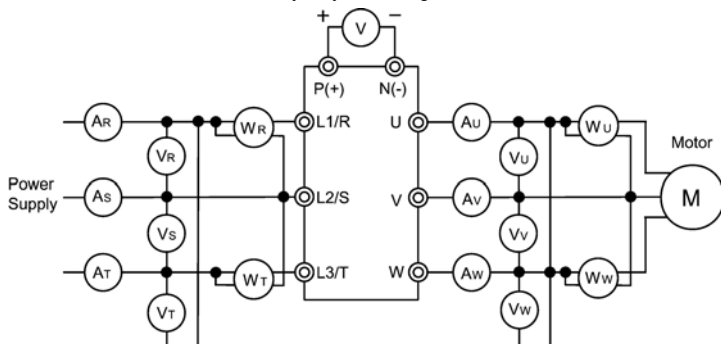


Figure 7.1 Connection of Meters

7.4 Insulation Test

Because an insulation test is made in the factory before shipment, avoid a Megger test.

If a Megger test is unavoidable, follow the procedure below. Because a wrong test procedure will cause breakage of the inverter, take sufficient care.

A dielectric strength test will cause breakage of the inverter similarly to the Megger test if the test procedure is wrong. When the dielectric strength test is necessary, contact your Fuji Electric representative.

(1) Megger test of main circuit

- 1) Use a 500 VDC Megger and shut off the main power supply without fail during measurement.
- 2) If the test voltage leaks to the control circuit due to the wiring, disconnect all the control wiring.
- 3) Connect the main circuit terminals with a common cable as shown in Figure 7.2.
- 4) The Megger test must be limited to across the common line of the main circuit and ground (\oplus).
- 5) 5 M Ω (1 M Ω for the EMC filter built-in type of inverters) or a larger value displayed at the Megger indicates a correct state. (The value is for a discrete inverter.)

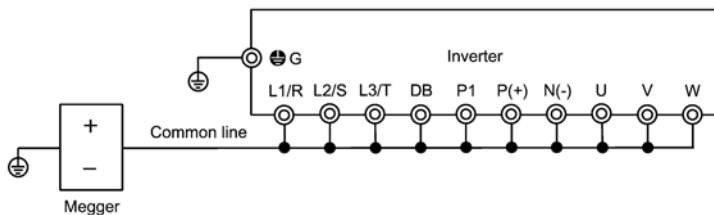


Figure 7.2 Megger Test

(2) Dielectric strength test of control circuit

Do not perform a Megger test or dielectric strength test for the control circuit. Prepare a high resistance range tester for the control circuit.

- 1) Disconnect all the external wiring from the control circuit terminals.
- 2) Perform a continuity test to the ground. 1 M Ω or a larger measurement indicates a correct state.

(3) Dielectric strength test of external main circuit and sequence control circuit

Disconnect all the inverter terminals so that the test voltage is not applied.

7.5 List of Periodical Replacement Parts

Each part of the product has its own service life that will vary according to the environmental and operating conditions. It is recommended that the following parts be replaced as specified below.

When the replacement is necessary, contact your Fuji Electric representative.

Table 7.4 Replacement Parts

Part name	Standard replacement intervals
Cooling fan	5 years
DC link bus capacitor	5 years
Electrolytic capacitor on the printed circuit board	7 years

7.6 Inquiries about Product and Guarantee

7.6.1 When making an inquiry

Upon breakage of the product, uncertainties, failure or inquiries, report the following information to your Fuji Electric representative.

- 1) Inverter type
- 2) SER No. (serial number of equipment)
- 3) Function code data that you changed from the factory defaults
- 4) ROM version
- 5) Date of purchase
- 6) Inquiries (for example, point and extent of breakage, uncertainties, failure phenomena, and other circumstances)

7.6.2 Product warranty

To all our customers who purchase Fuji Electric FA Components & Systems' products:

Please take the following items into consideration when placing your order.

When requesting an estimate and placing your orders for the products included in these materials, please be aware that any items such as specifications which are not specifically mentioned in the contract, catalog, specifications or other materials will be as mentioned below.

In addition, the products included in these materials are limited in the use they are put to and the place where they can be used, etc., and may require periodic inspection. Please confirm these points with your sales representative or directly with this company.

Furthermore, regarding purchased products and delivered products, we request that you take adequate consideration of the necessity of rapid receiving inspections and of product management and maintenance even before receiving your products.

[1] Free of charge warranty period and warranty range

(1) Free of charge warranty period

- 1) The product warranty period is "1 year from the date of purchase" or 24 months from the manufacturing date imprinted on the name plate, whichever date is earlier.
- 2) However, in cases where the use environment, conditions of use, use frequency and times used, etc., have an effect on product life, this warranty period may not apply.
- 3) Furthermore, the warranty period for parts restored by Fuji Electric's Service Department is "6 months from the date that repairs are completed."

(2) Warranty range

- 1) In the event that breakdown occurs during the product's warranty period which is the responsibility of Fuji Electric, Fuji Electric will replace or repair the part of the product that has broken down free of charge at the place where the product was purchased or where it was delivered. However, if the following cases are applicable, the terms of this warranty may not apply.
 - ① The breakdown was caused by inappropriate conditions, environment, handling or use methods, etc. which are not specified in the catalog, operation manual, specifications or other relevant documents.
 - ② The breakdown was caused by the product other than the purchased or delivered Fuji's product.
 - ③ The breakdown was caused by the product other than Fuji's product, such as the customer's equipment or software design, etc.
 - ④ Concerning the Fuji's programmable products, the breakdown was caused by a program other than a program supplied by this company, or the results from using such a program.
 - ⑤ The breakdown was caused by modifications or repairs affected by a party other than Fuji Electric.
 - ⑥ The breakdown was caused by improper maintenance or replacement using consumables, etc. specified in the operation manual or catalog, etc.
 - ⑦ The breakdown was caused by a chemical or technical problem that was not foreseen when making practical application of the product at the time it was purchased or delivered.
 - ⑧ The product was not used in the manner the product was originally intended to be used.
 - ⑨ The breakdown was caused by a reason which is not this company's responsibility, such as lightning or other disaster.
- (2) Furthermore, the warranty specified herein shall be limited to the purchased or delivered product alone.
- (3) The upper limit for the warranty range shall be as specified in item (1) above and any damages (damage to or loss of machinery or equipment, or lost profits from the same, etc.) consequent to or resulting from breakdown of the purchased or delivered product shall be excluded from coverage by this warranty.

(3) Trouble diagnosis

As a rule, the customer is requested to carry out a preliminary trouble diagnosis. However, at the customer's request, this company or its service network can perform the trouble diagnosis on a chargeable basis. In this case, the customer is asked to assume the burden for charges levied in accordance with this company's fee schedule.

[2] Exclusion of liability for loss of opportunity, etc.

Regardless of whether a breakdown occurs during or after the free of charge warranty period, this company shall not be liable for any loss of opportunity, loss of profits, or damages arising from special circumstances, secondary damages, accident compensation to another company, or damages to products other than this company's products, whether foreseen or not by this company, which this company is not be responsible for causing.

[3] Repair period after production stop, spare parts supply period (holding period)

Concerning models (products) which have gone out of production, this company will perform repairs for a period of 7 years after production stop, counting from the month and year when the production stop occurs. In addition, we will continue to supply the spare parts required for repairs for a period of 7 years, counting from the month and year when the production stop occurs. However, if it is estimated that the life cycle of certain electronic and other parts is short and it will be difficult to procure or produce those parts, there may be cases where it is difficult to provide repairs or supply spare parts even within this 7-year period. For details, please confirm at our company's business office or our service office.

[4] Transfer rights

In the case of standard products which do not include settings or adjustments in an application program, the products shall be transported to and transferred to the customer and this company shall not be responsible for local adjustments or trial operation.

[5] Service contents

The cost of purchased and delivered products does not include the cost of dispatching engineers or service costs. Depending on the request, these can be discussed separately.

[6] Applicable scope of service

Above contents shall be assumed to apply to transactions and use of the country where you purchased the products.

Consult the local supplier or Fuji for the detail separately.