SECTION 6
Troubleshooting and Maintenance

6-1 Troubleshooting

6-1-1 Safety Messages

Please read the following safety messages before troubleshooting or performing maintenance on the inverter and motor system.

⚠ **WARNING** Wait at least ten (10) minutes after turning OFF the input power supply before performing maintenance or an inspection. Otherwise, there is a danger of electric shock.

⚠ **WARNING** Make sure that only qualified personnel will perform maintenance, inspection, and part replacement. Before starting to work, remove any metallic objects from your person (wristwatch, bracelet, etc.). Be sure to use tools with insulated handles. Otherwise, there is a danger of electric shock and/or injury to personnel.

⚠ **WARNING** Never remove connectors by pulling on its wire leads (wires for cooling fan and logic P.C.board). Otherwise, there is a danger of fire due to wire breakage and/or injury to personnel.

6-1-2 General Precautions and Notes

- Always keep the unit clean so that dust or other foreign matter does not enter the inverter.
- Take special care in regard to breaking wires or making connection mistakes.
- Firmly connect terminals and connectors.
- Keep electronic equipment away from moisture and oil. Dust, steel filings and other foreign matter can damage insulation, causing unexpected accidents, so take special care.

6-1-3 Inspection Items

This chapter provides instructions or checklists for these inspection items:

- Daily inspection
- Periodical inspection (approximately once a year)
- Insulation resistance (Megger) test (approximately once two years)

6-1-4 Troubleshooting Tips

The table below lists typical symptoms and the corresponding solution(s).

1. Inverter does not power up.

Possible Cause(s)	Corrective Action
Power cable is incorrectly wired.	Check input wiring
Short bar or DCL between [P] and [PD] is disconnected.	Install short bar or DCL between [P] and [PD] terminal.
Power cable is broken.	Check input wiring.

2. Motor does not start.

Possible Cause(s)	Corrective Action
Incorrect RUN command source is selected.	Check RUN command source (A002) for correct source. Ex. Terminal (digital input) : 01 Operator (RUN key) : 02
Incorrect frequency source is selected.	Check frequency source (A001) for correct source. Ex. Terminal (analog input) : 01 Operator (F001) : 02
Frequency setting is 0 Hz.	If frequency source is terminal (A001=01), check analog voltage or current signal at [O] or [OI] terminals.
	If frequency source is operator (A001=02), set frequency in F001.
	Depending on frequency source, input proper frequency reference.
	If frequency source is multi-speed operation, set frequency in A020 to A035 and A220.
RUN command is not set to input terminal.	If RUN command source is terminal (A002=01), set "forward" (00:FW) or "reverse" (01:RV) to any input terminals. In case of 3-wire control, set "3-wire start" (20:STA), "3-wire stop" (21:STP) and "3-wire FW/RV" (22:F/R) to any input terminals.
"Multi-speed input(s) (02 to 05:CF1 to CF4)" is (are) set to input terminal(s) and active.	Deactivate the input(s), or check the frequency reference parameters associated (A021 to A035).
Both FWD and REV input are active.	If RUN command source is FWD/REV input, activate either FWD or REV input.
Rotation direction restriction (b035) is enabled.	Check b035.
Incorrect input wiring or short bar position	Wire inputs correctly and/or install short bar. (ON/OFF status of inputs are monitored in d005.)
Incorrect analog input or variable resistor wiring	Wire correctly. In case of analog voltage or variable resistor input, check voltage between [O] and [L] terminal. In case of analog current, check current between current source and [OI] terminal.
RUN command source is operator, but input terminal is set to "Force terminal" and active.	Deactivate the input.
RUN command source is terminal, but input terminal is set to "Force operator" and active.	Deactivate the input.
Inverter is in trip status. (With ALARM LED and "Exxx" indication)	Reset inverter by STOP/RESET key and check error code.
Safety function is enabled and either GS1 or GS2 input is inactive.	If safety function is used, activate both GS1 and GS2. If not, disable safety function by dip switch.

Possible Cause(s)	Corrective Action
" 18:RS", " 14:CS" or " 11:FRS" is set to input terminal and the input is active.	Deactivate the input.
"84:ROK" is set to input terminal and the input is active.	Activate the input.
Cable between inverter and motor or internal cable of motor is breaking.	Check the wiring.
Excess load.	Remove excess load.
Motor is locked.	Unlock the motor.

3. Motor does not accelerate to command speed.

Possible Cause(s)	Corrective Action
Bad connection of analog wiring.	Check the wiring. In case of analog voltage or variable resistor input, check voltage between [O] and [L] terminal. In case of analog current, check current between current source and [OI] terminal.
Overload restriction or OC suppression function works.	Check the function level.
Max. frequency (A004) or upper limit (A061/A261) is lower than as expected.	Check the value.
Acceleration time is excessive.	Change acceleration time (F002/A092/A292).
"Multi-speed input(s) (02 to 05:CF1 to CF4)" is (are) set to input terminal(s) and active.	Deactivate the input(s).
"06:JG" is set to input terminal and the input is active.	Deactivate the input.
Excess load.	Remove excess load.
Motor is locked.	Unlock the motor.

4. Inverter does not respond to changes in frequency setting from operator.

Possible Cause(s)	Corrective Action
Incorrect frequency source is selected.	Check frequency source (A001=02).
"51:F-TM" is set to input terminal and the input is active.	Deactivate the input.

5. A part of function codes is not displayed.

Possible Cause(s)	Corrective Action
"Function code display restriction" (b037) is enabled.	Set 00 (all display) to b037.
"86:DISP" is set to input terminal and the input is active.	Deactivate the input.

6. Operator (keypad) does not respond.

Possible Cause(s)	Corrective Action
"86:DISP" is set to input terminal and the input is active.	Deactivate the input.

7. Parameter data does not change.

Possible Cause(s)	Corrective Action
Inverter is in RUN status.	Stop the inverter, make sure the motor stops and try again. If "RUN mode edit" is enabled, a part of function codes can be changed in RUN status.
Software lock function (b031) is enabled.	Disable software lock function.

8. Motor rotates reverse direction with forward command.

Possible Cause(s)	Corrective Action
Incorrect power wiring.	Exchange any two of U/T1, V/T2 or W/T3.
Incorrect logic of direction signal in 3-wire operation.	Check the logic of input set as "22:F/R".

9. Motor rotates reverse direction with RUN key of keypad.

Possible Cause(s)	Corrective Action
Keypad RUN key routing (F004) is incorrectly set.	Check F004.

10. Overcurrent trip (E03)

Possible Cause(s)	Corrective Action
Acceleration time is short.	Change acceleration time (F002/A092/A292).
	Enable "acceleration hold" function (A069, A070)
Excess load.	Remove excess load.
	Enable torque boost function.
	Set free V/f in V/F characteristic curve selection (A044/A244=02)
Overload restriction (b021) is disabled (00).	Enable overload restriction (b021=01/02/03).

Despite overload restriction is enabled, the inverter trips due to Overcurrent (E03).

Overload restriction level (b022/b025) is high.	Set overload restriction level (b022/b025) lower.
Deceleration rate at overload restriction (b023/b026) is too short.	Set deceleration rate at overload restriction (b023/b026) longer.

11. STOP/RESET key does not respond.

Possible Cause(s)	Corrective Action
STOP/RESET key disabled.	Check "STOP key enable" function. (b087)
Deceleration overvoltage suppression (b130) or controlled deceleration on power loss (b050) function is enabled.	Check b130 and b050.

12. Sound noise of motor or machine.

Possible Cause(s)	Corrective Action
Carrier frequency is low.	Set carrier frequency (b083) higher. (This could cause electric noise and leak current higher.)
Machine frequency and motor frequency are resonated.	Change output frequency slightly. If resonating in accel/deceleration, use jump frequency function (A063-68) to avoid machine frequency.
Over excitation	Set base frequency (A003/A203) and AVR voltage (A082/A282) according to motor rating. If not improved, reduce V/f gain (A045/A245) slightly or change V/f curve (A044/A244) as free V/f.

13. Overload trip (E05).

Possible Cause(s)	Corrective Action
Improper electronic thermal level	Check electronic thermal setting (b012/b013)
The application needs frequent strong accelerations with high peak currents.	Check if the application can accept softer acceleration rates to minimize peak currents F002/F202/A092/A292). Motor parameters are forcing too high unnecesary current to the motor (H020 to H034), depending in motor control method (A044/A244). If the inverter really can not deliver the current, change inverter to a higher power.

14. Over voltage trip (E07).

Possible Cause(s)	Corrective Action
Short deceleration time	Change deceleration time. (F003/F203/A093/A293)
Over voltage suppression during deceleration (b130) is disabled (00).	Enable over voltage suppression (b130=01/02).

In case the inverter trips due to over voltage, despite over voltage suppression is enabled.

Improper overvoltage suppression propotional gain (b134) or integral time (135).	Check overvoltage suppression propotional gain (b134) and integral time (b135).
Overvoltage suppression level (b131) is high.	Set Overvoltage suppression level (b131) lower. (lower limit of parameter b131 is

15. Thermistor error trip (E35).

Possible Cause(s)	Corrective Action
Thermistor is set to input [5] and DC24V is supplied.	Check setting of input terminal [5] (C005).

16. Unstable output frequency.

Possible Cause(s)	Corrective Action
Improper parameters	Set output frequency slightly smaller or bigger value than power source frequency.
	Change motor stabilization constant (H006/H203).
Load variation is excessive.	Change motor and inverter to one size bigger.
Power voltage variation is excessive.	Check power source.

17. Output torque is not sufficient.

Possible Cause(s)	Corrective Action
Improper parameters [Acceleration]	Increase torque boost (A042/A242-A043/A243)
	Reduce carrier frequency (A083).
	Change V/f curve (A044/A244) to SLV.
	Change torque boost select (A041/A241) to automatic.
Improper parameters [Deceleration]	Increase deceleration time (F003/F203/A093/A293).
	Disable AVR function (A081/A281).
	Install dynamic braking resistor or regenerative braking unit.

18. If cable to operator is disconnected, inveter will trip or stop.

Possible Cause(s)	Corrective Action
Improper setting of b165.	Set ex.operator com loss action (b165) to 02.

19. No response over Modbus communication.

Possible Cause(s)	Corrective Action
New parameter is not updated.	If C071, C074 or C075 is changed, cycle power or reset inverter by turning RS terminal ON and OFF.
Incorrect setting of RUN command source (A002/A202).	Set RUN command source (A002/A202) to 03.
Incorrect setting of Frequency source (A001/A201).	Set frequency source (A001/A201) to 03.
Incorrect setting of com. speed.	Check communication speed (A071).
Incorrect setting or duplication of Modbus address.	Check Modbus address (A072).
Incorrect setting of com. parity.	Check communication parity (A074).
Incorrect setting of com. stop bit.	Check communication stop bit (A075).
Incorrect wiring.	Check communication wiring at SP,SN terminals.

20. When inverter starts, ECB (Earth leakage Circuit Breaker) trips.

Possible Cause(s)	Corrective Action
Leak current of inverter is excessive.	Reduce carrier frequency (A083).
	Increase current sensor level of ECB or replace ECB with another one having higher current sensor level.

21. PM troubleshooting information.

Operation status	Symptom	Adjustment method	Adjustment item
Starting	Trouble is caused when reverse run.	Enable to the initial magnet position estimation function.	H123
	Generate out-of-step. Generate overcurrent trip.	Increase the starting current.	H117
		Increase the starting time.	H118
	Need for early starting.	Enable to the initial magnet position estimation function, and reduce the starting time.	H118, H123
Running under minimum frequency (H121)	Motor runs unsteadily.	Increase the starting current.	H117
Running around minimum frequency (H121)	Motor generates an impact. Generate overcurrent trip.	Adjust the speed response.	H116
		Adjust the minimum frequency when a load change.	H121
Runing over minimum frequency (H121)	Motor generate a hunting.	Adjust the speed response.	H116
		Reduce the stabilization constant. (When value is too small, you may not be able to obtain motor torque and motor will generate inpact or overcurrent trip near H121)	H119
		Increase the no-load current.	H122

6-2 Monitoring Trip Events, History, & Conditions

6-2-1 Fault Detection and Clearing

The microprocessor in the inverter detects a variety of fault conditions and captures the event, recording it in a history table. The inverter output turns OFF, or "trips" similar to the way a circuit breaker trips due to an over-current condition. Most faults occur when the motor is running (refer to the diagram to the right). However, the inverter could have an internal fault and trip in Stop Mode.

In either case, you can clear the fault by pressing the Stop/Reset key. Additionally, you can clear the inverter's cumulative trip history by performing the

procedure 6-3 *Restoring Factory Default Settings* on page 245 (setting b084=00 will clear the trip history but leave inverter settings intact).

6-2-2 Error Codes

An error code will appear on the display automatically when a fault causes the inverter to trip. The following table lists the cause associated with the error.

Erro Code	Name	Cause(s)
E01	Over-current event while at constant speed	The inverter output was short-circuited, or the motor shaft is locked or has a heavy load. These conditions cause excessive current for the inverter, so the inverter output is turned OFF. The dual-voltage motor is wired incorrectly.
E02	Over-current event during deceleration	
E03	Over-current event during acceleration	
E04	Over-current event during other conditions	
E05	Overload protection	When a motor overload is detected by the electronic thermal function, the inverter trips and turns OFF its output. Check if the application can accept softer acceleration rates to minimize peak currents F002/F202/A092/A292). Check if motor parameters are not correctly set (H020 to H034), depending in motor control method (A044/A244).
E06	Braking resistor overload protection	When the BRD operation rate exceeds the setting of "b090", this protective function shuts off the inverter output and displays the error code.
E07	Over-voltage protection	When the DC bus voltage exceeds a threshold, due to regenerative energy from the motor.
E08	EEPROM error	When the built-in EEPROM memory has problems due to noise or excessive temperature, the inverter trips and turns OFF its output to the motor.
E09	Under-voltage error	A decrease of internal DC bus voltage below a threshold results in a control circuit fault. This condition can also generate excessive motor heat or cause low torque. The inverter trips and turns OFF its output.
E10	Current detection error	If an error occurs in the internal current detection system, the inverter will shut off its output and display the error code.
E11	CPU error	A malfunction in the built-in CPU has occurred, so the inverter trips and turns OFF its output to the motor.
E12	External trip	A signal on an intelligent input terminal configured as EXT has occurred. The inverter trips and turns OFF the output to the motor.
E13	USP	When the Unattended Start Protection (USP) is enabled, an error occurred when power is applied while a Run signal is present. The inverter trips and does not go into Run Mode until the error is cleared.
E14	Ground fault	The inverter is protected by the detection of ground faults between the inverter output and the motor upon during powerup tests. This feature protects the inverter, and does not protect humans.
E15	Input over-voltage	The inverter tests for input over-voltage after the inverter has been in Stop Mode for 100 seconds. If an over-voltage condition exists, the inverter enters a fault state. After the fault is cleared, the inverter can enter Run Mode again.

Erro Code	Name	Cause(s)
E21	Inverter thermal trip	When the inverter internal temperature is above the threshold, the thermal sensor in the inverter module detects the excessive temperature of the power devices and trips, turning the inverter output OFF.
E22	CPU communication error	When communication between two CPU fails, inverter trips and displays the error code.
E25	Main circuit error (*3)	The inverter will trip if the power supply establishment is not recognized because of a malfunction due to noise or damage to the main circuit element.
E30	Driver error	An internal inverter error has occurred at the safety protection circuit between the CPU and main driver unit. Excessive electrical noise may be the cause. The inverter has turned OFF the IGBT module output.
E35	Thermistor	When a thermistor is connected to terminals [5] and [L] and the inverter has sensed the temperature is too high, the inverter trips and turns OFF the output.
E36	Braking error	When "01" has been specified for the Brake Control Enable (b120), the inverter will trip if it cannot receive the braking confirmation signal within the Brake Wait Time for Confirmation (b124) after the output of the brake release signal. Or when the output current doesn't reach the brake release current (b126) during the brake release time (b121)
E37	Safe Stop	Safe stop signal is given.
E38	Low-speed overload protection	If overload occurs during the motor operation at a very low speed, the inverter will detect the overload and shut off the inverter output.
E40	Operator connection	When the connection between inverter and operator keypad failed, inverter trips and displays the error code.
E41	Modbus communication error	When "trip" is selected (C076=00) as a behavior in case of communication error, inverter trips when timeout happens.
E43	EzSQ invalid instruction	The program stored in inverter memory has been destroyed, or the PRG terminal was turned on without a program downloaded to the inverter.
E44	EzSQ nesting count error	Subroutines, if-statement, or for-next loop are nested in more than eight layers
E45	EzSQ instruction error	Inverter found the command which cannot be executed.
E50 to E59	EzSQ user trip (0 to 9)	When user -defined trip happens, inverter trips and displays the error code.
E60 to E69	Option errors (error in connected option board, the meanings change upon the connected option).	These errors are reserved for the option board. Each option board can show the errors for a different meaning .. To check the specific meaning, please refer to the corresponding option board user manual and documentation.
E80	Encoder disconnection	If the encoder wiring is disconnected, an encoder connection error is detected, the encoder fails, or an encoder that does not support line driver output is used, the inverter will shut off its output and display the error code shown on the right.

Erro Code	Name	Cause(s)
E81	Excessive speed	If the motor speed rises to "maximum frequency (A004) x over-speed error detection level (P026)" or more, the inverter will shut off its output and display the error code shown on the right.
E83	Positioning range error	If current position exceeds the position range (P072-P073), the inverter will shut off its output and display the error code.

Error Code	Name	Descriptions
5555 Rotating	Reset	RS input is ON or STOP/RESET key is pressed.
----	Undervoltage	If input voltage is under the allowed level, inverter shuts off output and wait with this indication.
0000	Waiting to restart	This indication is displayed after tripping before restarting.
0000	Restricted operation command	Commanded RUN direction is restricted in b035.
L HC	Trip history initializing	Trip history is being initialized.
----	No data (Trip monitor)	No trip/waning data exists.
---- Blinking	Communication error	Communication between inverter and digital operator fails.
---0	Auto-tuning completed	Auto-tuning is completed properly.
---J	Auto-tuning error	Auto-tuning fails.

Note Reset is not allowed in 10 second after trip.

Note When error E08, E14 and E30 occur, reset operation by RS terminal or STOP/RESET key is not accepted. In this case, reset by cycling power. If still same error occurs, perform initialization.

6-2-3 Parameter Warning Codes

If set parameter is conflicted to other parameters, warning code is displayed as follows.

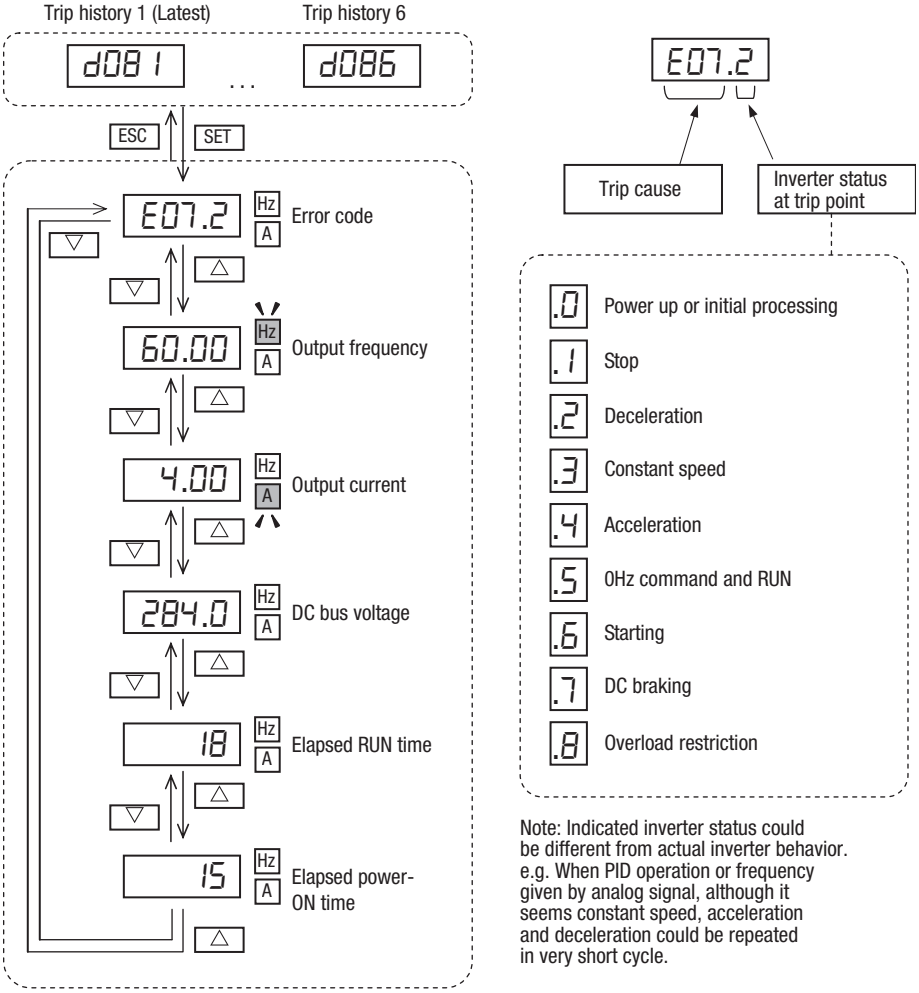
Warning code	Warning conditions		
H001	Frequency upper limit (A061)	>	Max. Frequency (A004)
H002	Frequency lower limit (A062)	>	Max. Frequency (A004)
H005	Output Frequency setting (F001) Multi-speed freq. 0 (A020)	>	Max. Frequency (A004)
H015	Output Frequency setting (F001) Multi-speed freq. 0 (A020)	>	Frequency upper limit (A061)
H025	Frequency lower limit (A062)	>	Output Frequency setting (F001) Multi-speed freq. 0 (A020)
H031	Start frequency (A082)	>	Frequency upper limit (A061)
H032	Start frequency (A082)	>	Frequency lower limit (A062)
H035	Start frequency (A082)	>	Output Frequency setting (F001) Multi-speed freq. 0 (A020)
H036	Start frequency (A082)	>	Multi-speed freq. 1-15 (A021-A035)
H037	Start frequency (A082)	>	Jogging frequency (A038)
H085	Output Frequency setting (F001) Multi-speed freq. 0 (A020)	=	Jump frequency (A063/A063/A063±A064/ A066/A068)
H086	Multi-speed freq. 1-15 (A021-A035)		

Warning code	Warning conditions		
H09 1	Free setting V/f frequency 7	>	Frequency upper limit (A06 1)
H092	Free setting V/f frequency 7	>	Frequency lower limit (A062)
H095	Free setting V/f frequency 7	>	Output Frequency setting (F001) Multi-speed freq. 0 (A020)
H201	Frequency upper limit (A261)	>	Max. Frequency (A204)
H202	Frequency lower limit (A262)	>	Max. Frequency (A204)
H205	Output Frequency setting (F001) Multi-speed freq. 0 (A220)	>	Max. Frequency (A204)
H215	Output Frequency setting (F001) Multi-speed freq. 0 (A220)	>	Frequency upper limit (A261)
H225	Frequency lower limit (A262)	>	Output Frequency setting (F001) Multi-speed freq. 0 (A220)
H231	Start frequency (A082)	>	Frequency upper limit (A261)
H232	Start frequency (A082)	>	Frequency lower limit (A262)
H235	Start frequency (A082)	>	Output Frequency setting (F001) Multi-speed freq. 0 (A220)
H285	Output Frequency setting (F001) Multi-speed freq. 0 (A220)	=	Jump frequency (A063/A063/ A063±A064/A066/A068)
H291	Free setting V/f frequency 7	>	Frequency upper limit (A261)
H292	Free setting V/f frequency 7	>	Frequency lower limit (A262)
H295	Free setting V/f frequency 7	>	Output Frequency setting (F001) Multi-speed freq. 0 (A220)

6-2-4 Trip History and Inverter Status

We recommend that you first find the cause of the fault before clearing it. When a fault occurs, the inverter stores important performance data at the moment of the fault. To access the data, use the monitor function (dxxx) and select d081 details about the present fault. The previous 5 faults are stored in d082 to d086. Each error shifts d081-d085 to d082-d086, and writes the new error to d081.

The following Monitor Menu map shows how to access the error codes. When fault(s) exist, you can review their details by first selecting the proper function: d081 is the most recent, and d086 is the oldest.



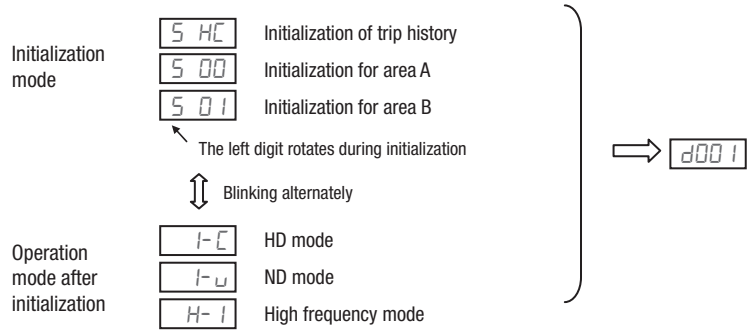
Note: Indicated inverter status could be different from actual inverter behavior. e.g. When PID operation or frequency given by analog signal, although it seems constant speed, acceleration and deceleration could be repeated in very short cycle.

6-3 Restoring Factory Default Settings

You can restore all inverter parameters to the original factory (default) settings according to area of use. After initializing the inverter, use the powerup test in Chapter 2 to get the motor running again. If operation mode (std. or high frequency) mode is changed, inverter must be initialized to activate new mode. To initialize the inverter, follow the steps below.

1. Select initialization mode in b084.
2. If b084=02, 03 or 04, select initialization target data in b094.
3. If b084=02, 03 or 04, select country code in b085.
4. Set 01 in b180.
5. The following display appears for a few seconds, and initialization is completed with d001 displayed.

Display during initialization



"B" Function		
Func. Code	**Name**	**Description**
b084	Initialization mode (parameters or trip history)	Select initialized data, five option codes: • 00 Initialization disabled • 01 Clears Trip history • 02 Initializes all Parameters • 03 Clears Trip history and initializes all parameters • 04 Clears Trip history and initializes all parameters and EzSQ program
b094	Initialization target data setting	Select initialized parameters, four option codes: • 00 All parameters • 01 All parameters except in/output terminals and communication. • 02 Only registered parameters in Uxxx. • 03 All parameters except registered parameters in Uxxx and b037.
b085	Initial data selection	Select initial data for initialization: • 00 (JPN/US) • 01 (EU)
b180	Initialization trigger	This is to perform initialization by parameter input with b084, b085 and b094. Two option codes: 00 Initialization disable 01 Perform initialization

Data of b084 is not saved in EEPROM to avoid unintentional initializing.

6-4 Maintenance and Inspection

6-4-1 Daily and Yearly Inspection Chart

Item Inspected		Check for...	Inspection Cycle		Inspection Method	Criteria
			Daily	Year		
Overall	Ambient environment	Extreme temperatures & humidity	✓		Thermometer, hygrometer	Ambient temperature between -10 to 50°C, Humidity 90% or less non-condensing
	Major devices	Abnormal noise & vib.	✓		Visual and aural	Stable environment for electronic controls
	Power supply voltage	Voltage tolerance	✓		Digital volt meter, measure between inverter terminals [L1], [L2], [L3]	200 V class: 50/60 Hz 200 to 240 V (-15/+10%) 400 V class: 50/60 Hz 380 to 460 V (-15/+10%)
Main circuit	Ground Insulation	Adequate resistance		✓	Refer to P6-16	5 MΩ or greater
	Mounting	No loose screws		✓	Torque wrench	M3.5: 1.0 Nm M4: 1.4 Nm M5: 3.0 M6: 3.9 to 5.1 Nm M8: 5.9 to 8.8 Nm
	Components	Overheating		✓	Thermal trip events	No trip events
	IGBT	Resistance value		✓	Refer to P6-17	
	Terminal block	Secure connections		✓	Visual	No abnormalities
	Smoothing capacitors	Leaking, swelling	✓		Visual	No abnormalities
	Relay(s)	Chattering		✓	Aural	Single click when switching ON or OFF
	Resistors	Cracks or discoloring		✓	Visual	Check Ohms of optional braking res.
Control circuit	Function	Voltage balance between phases		✓	Measure voltage between U, V, W	Difference must be 2% or less.
		Protection circuit		✓	e.g. Input Ex.trip signal and check inverter behavior and alarm signal.	Functions properly.
	Overall	No odor, discoloring, corrosion		✓	Visual	No abnormalities
	Capacitor	Leaking, swelling	✓		Visual	Undistorted appearance
Cooling	Cooling fan	Noise	✓		Power down, manually rotate	Rotation must be smooth
		Dust	✓		Visual	Vacuum to clean
		Mounting	✓		Visual	Mounted firmly
	Heat sink	Dust	✓		Visual	Vacuum to clean
Display	LEDs	Legibility	✓		Visual	All LED segments work

Note 1 The life of a capacitor is affected by the ambient temperature. See page 252.

Note 2 Designed life of a cooling fan is.10 years. However, it is affected by the ambient temperature and other environmental conditions.

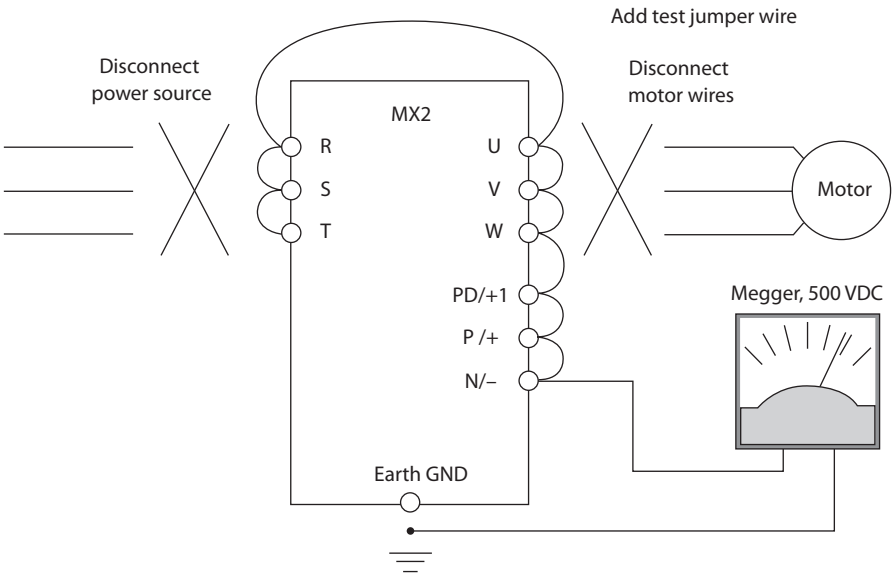
Note 3 The inverter must be cleaned periodically. If dust accumulates on the fan and heat sink, it can cause overheating of the inverter.

6-4-2 Megger test

The megger is a piece of test equipment that uses a high voltage to determine if an insulation degradation has occurred. For inverters, it is important that the power terminals be isolated from the Earth GND terminal via the proper amount of insulation.

The circuit diagram below shows the inverter wiring for performing the megger test. Just follow the steps to perform the test:

1. Remove power from the inverter and wait at least 5 minutes before proceeding.
2. Open the front housing panel to access the power wiring.
3. Remove all wires to terminals [R, S, T, PD/+1, P/+, N/-, U, V, and W]. Most importantly, the input power and motor wires will be disconnected from the inverter.
4. Use a bare wire and short terminals [R, S, T, PD/+1, P/+, N/-, U, V, and W] together as shown in the diagram.
5. Connect the megger to the inverter Earth GND and to the shorted power terminals as shown. Then perform the megger test at 500 VDC and verify 5 MΩ or greater resistance.



6. After completing the test, disconnect the megger from the inverter.
7. Reconnect the original wires to terminals [R, S, T, PD/+1, P/+, N/-, U, V, and W].

⚠ **Caution** Do not connect the megger to any control circuit terminals such as intelligent I/O, analog terminals, etc. Doing so could cause damage to the inverter.

⚠ **Caution** Never test the withstand voltage (HIPOT) on the inverter. The inverter has a surge protector between the main circuit terminals above and the chassis ground.

⚠ **Caution** Power terminal assignment is different compared to old models such as L100, L200 series, etc,. Pay attention when wiring the power cable.

6-4-3 IGBT Test Method

The following procedure will check the inverter transistors (IGBTs) and diodes:

1. Disconnect input power to terminals [R, S, and T] and motor terminals [U, V, and W].
2. Disconnect any wires from terminals [+] and [-] for regenerative braking.
3. Use a Digital Volt Meter (DVM) and set it for 1 Ω resistance range.
   You can check the status of the charging state of terminals [R, S, T, U, V, W, +, and –] of the inverter and the probe of the DVM by measuring the charging state.

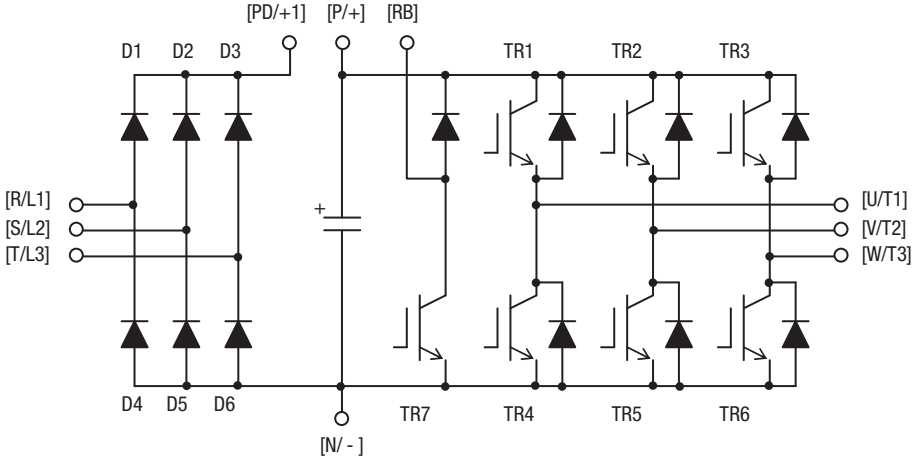


Table Legend

Almost infinite resistance: ≅∞Ω Almost zero resistance: ≅0Ω

Part	DVM		Measured Value
	–	+	
D1	[R]	[+1]	≅∞Ω
	[+1]	[R]	≅0Ω
D2	[S]	[+1]	≅∞Ω
	[+1]	[S]	≅0Ω
D3	[T]	[+1]	≅∞Ω
	[+1]	[T]	≅0Ω
D4	[R]	[–]	≅0Ω
	[–]	[R]	≅∞Ω
D5	[S]	[–]	≅0Ω
	[–]	[S]	≅∞Ω
D6	[T]	[–]	≅0Ω
	[–]	[T]	≅∞Ω
TR1	[U]	[+]	≅∞Ω
	[+]	[U]	≅0Ω
TR2	[V]	[+]	≅∞Ω
	[+]	[V]	≅0Ω
TR3	[W]	[+]	≅∞Ω
	[+]	[W]	≅0Ω
TR4	[U]	[–]	≅0Ω
	[–]	[U]	≅∞Ω
TR5	[V]	[–]	≅0Ω
	[–]	[V]	≅∞Ω
TR6	[W]	[–]	≅0Ω
	[–]	[W]	≅∞Ω
TR7	[RB]	[+]	≅∞Ω
	[+]	[RB]	≅0Ω
	[RB]	[–]	≅∞Ω
	[–]	[RB]	≅∞Ω

Note The resistance values for the diodes or the transistors will not be exactly the same, but they will be close. If you find a significance difference, a problem may exist.

Note Before measuring the voltage between [+] and [–] with the DC current range, confirm that the smoothing capacitor is discharged fully, then execute the tests.

6-4-4 General Inverter Electrical Measurements

The following table specifies how to measure key system electrical parameters. The diagrams on the next page show inverter-motor systems and the location of measurement points for these parameters.

Parameter	Circuit location of measurement	Measuring instrument	Notes	Reference Value
Supply voltage E_1	E_R – across L1 and L2 E_S – across L2 and L3 E_T – across L3 and L1	Moving-coil type voltmeter or rectifier type voltmeter	Fundamental wave effective value	Commercial supply voltage 200 V class: 200-240 V, 50/60 Hz 400 V class: 380-460 V, 50/60 Hz
Supply current I_1	I_r - L1 I_s - L2 I_t - L3		Total effective value	–
Supply power W_1	W_{11} – across L1 and L2 W_{12} – across L2 and L3		Total effective value	–
Supply power factor Pf_1	$Pf_1 = \frac{W1}{\sqrt{3} \times E_1 \times I_1} \times 100\%$			–
Output voltage E_O	E_U – across U and V E_V – across V and W E_W – across W and U	Rectifier type voltmeter	Total effective value	–
Output current I_O	I_U - U I_V - V I_W - W	Moving-coil type ammeter	Total effective value	–
Output power W_O	W_{O1} – across U and V W_{O2} – across V and W	Electronic type wattmeter	Total effective value	–
Output power factor Pf_O	Calculate the output power factor from the output voltage E, output current I, and output power W. $Pf_0 = \frac{W_1}{\sqrt{3} \times E_0 \times I_0} \times 100\%$			–

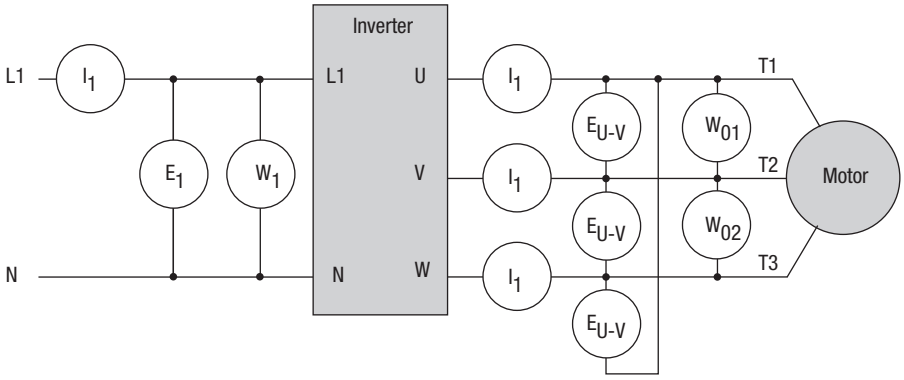
Note 1 Use a meter indicating a fundamental wave effective value for voltage, and meters indicating total effective values for current and power.

Note 2 The inverter output has a distorted waveform, and low frequencies may cause erroneous readings. However, the measuring instruments and methods listed above provide comparably accurate results.

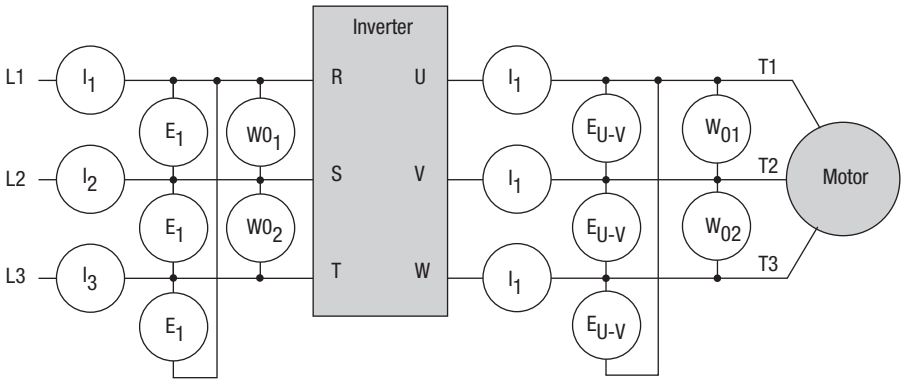
Note 3 A general-purpose digital volt meter (DVM) is not usually suitable to measure a distorted waveform (not pure sinusoid).

The figures below show measurement locations for voltage, current, and power measurements listed in the table on the previous page. The voltage to be measured is the fundamental wave effective voltage. The power to be measured is the total effective power.

Single-phase Measurement Diagram

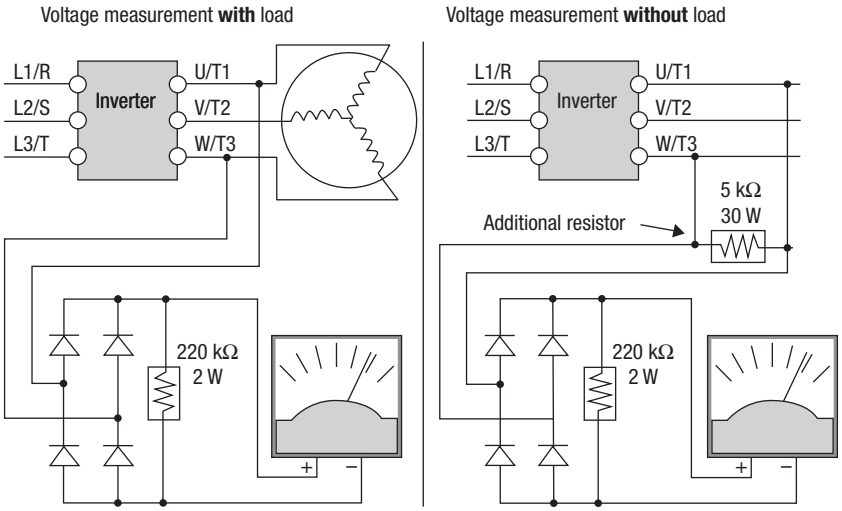


Three-phase Measurement Diagram



6-4-5 Inverter Output Voltage Measurement Techniques

Taking voltage measurements around drives equipment requires the right equipment and a safe approach. You are working with high voltages and high-frequency switching waveforms that are not pure sinusoids. Digital voltmeters will not usually produce reliable readings for these waveforms. And, it is usually risky to connect high voltage signals to oscilloscopes. The inverter output semiconductors have some leakage, and no-load measurements produce misleading results. So, we highly recommend using the following circuits to measure voltage for performing the equipment inspections.



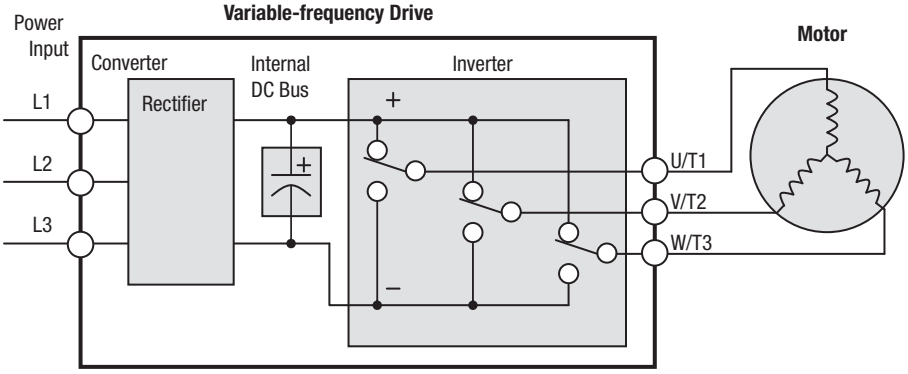
V Class	Diode Bridge	Voltmeter
200 V Class	600 V 0.01 A min.	300 V range
400 V Classs	100 V 0.1 A min.	600 V range

V Class	Diode Bridge	Voltmeter
200 V Class	600 V 0.01 A min.	300 V range
400 C Class	100 V 0.1 A min.	600 V range

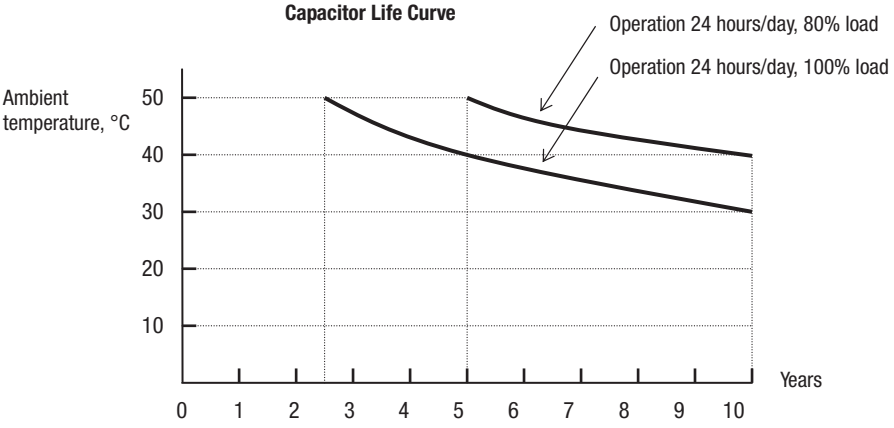
⚠ HIGH VOLTAGE Be careful not to touch wiring or connector terminals when working with the inverters and taking measurements. Be sure to place the measurement circuitry components above in an insulated housing before using them.

6-4-6 Capacitor Life Curves

The DC bus inside the inverter uses a large capacitor as shown in the diagram below. The capacitor handles high voltage and current as it smoothes the power for use by the inverter. So, any degradation of the capacitor will affect the performance of the inverter.



Capacitor life is reduced in higher ambient temperatures, as the graph below demonstrates. Under the condition of average ambient temperature 40°C, 80% load, 24 hours operation, the lifetime is 10 years. Be sure to keep the ambient temperature at acceptable levels, and perform maintenance inspections on the fan, heat sink, and other components. If the inverter is installed on a cabinet, the ambient temperature is the temperature inside the cabinet.



6-5 Warranty

6-5-1 Warranty Terms

The warranty period under normal installation and handling conditions is two (2) years from the date of manufacture, or one (1) year from the date of installation, whichever occurs first. The warranty shall cover the repair or replacement, at Omron's sole discretion, of ONLY the inverter that was installed.

1. Service in the following cases, even within the warranty period, shall be charged to the purchaser:
   a) Malfunction or damage caused by mis-operation or modification or improper repair
   b) Malfunction or damage caused by a drop after purchase and transportation
   c) Malfunction or damage caused by fire, earthquake, flood, lightening, abnormal input voltage, contamination, or other natural disasters
2. When service is required for the product at your work site, all expenses associated with field repair shall be charged to the purchaser.
3. Always keep this manual handy; please do not lose it. Please contact your Omron distributor to purchase replacement or additional manuals.