GE Electronic Refrigerator Diagnostics
Part II

Agenda
Thermistors
DC Powered Fans
Electronic Dampers
Multi-Speed Inverter / Compressors
Thermistor Replacement

Should a thermistor require replacement, use plastic bell connectors (part # WR01X10466). Fill each connector with RTV102 silicone, then splice a new thermistor into the harness as shown in the illustration.
Thermistor Replacement

To replace the air thermistor; remove the thermistor from the grille and cut the thermistor wiring as close to the thermistor as possible.

Strip the outer insulation from the thermistor case harness back 1”. Strip the two internal wires back 3/16” for splicing.
Prepare the replacement thermistor (WR55x10025) by cutting the wiring 4” back from the thermistor and strip the wires back 3/16”. Using two WR01X10466 (bell connectors), splice the wiring. After the splices are complete, fill the bell connectors fully with WR97X163 silicone grease. Note: Service kit coming with heat seal connectors.
Evaporator thermistor location and drip loop

Always reattach the thermistor to its original location to allow for proper temperature sensing.

Never just leave an evaporator thermistor hanging!

Route the thermistor wiring in a downward angle to create a drip loop. This will minimize the possibility of moisture migrating into the thermistor body over time.
Defrost problems?

Check the FZ Evaporator thermistor:

• If it is biased towards a high temperature, it will terminate the defrost cycle before the heater melts the frost. The thermistor is telling the board not to do defrost, so change it and verify that you get a valid temperature.

• If it is biased towards a low temperature, the defrost will run for a long time, and it will time out, and the system will run defrost too often.

• A new installation is set from the factory to defrost the refrigerator after 8 hours of compressor run time.
Defrost problems?
The main board outputs both AC and DC voltages to the refrigerator components. The one half of the board is AC inputs and outputs; while the other half of the board is DC inputs and outputs.

**Note:** Wiring connectors are not shown for a better view of the board.
All “J” connectors are labeled on the main board, check the schematic for each model; since there may be some difference. The same connector can control different functions depending on the model.
Main Electronic Board Testing DC Output

For DC voltage measurement, you will need to read between a DC common connection and the connection for the specific DC component you are checking. DC commons can be found at either J2 pin 3 or J4 pin 3.
When the refrigerator is connected to line power the main board power supply outputs two critical voltages for operation, 12vdc and 5vdc. To check the DC power supply of the main board; read the 12-13 volts DC from the J4 pins 2 and 3; 5 volts DC can be read from J1 pin 5 to either board common.
Main Electronic Board J4 Connector

One common symptom of a communication problem on the J4-1 smart trolley is for the HMI board to flash zeros when trying to change settings. Some models will flash all 8’s instead of 0’s.

To test the smart trolley communication; you can substitute the test board into the HMI connector. If you receive a Comm error the problem is not with the HMI board – check the smart trolley wiring. You can also plug the test board directly into the main board J4 connector to verify if the main board has a failed communication circuit.
Main Electronic Board J3 Connector - Encoder

Some model steel liner side by sides use knob controls (Encoder) for temperature setting. These knobs connect to a small circuit board which utilizes diodes to communicate the settings to the main board.
Main Electronic Board J3 Connector - Encoder

If you suspect an Encoder board has the refrigerator shut down, unplug the refrigerator disconnect the J3 connector from the main board. When power is reapplied the refrigerator will turn on at a default setting of 5-5. If the refrigerator starts, follow up with a diode test.

If the refrigerator has had the Encoder board replaced recently and the cabinet temperatures are incorrect, the Encoder board may have been installed upside down. The Encoder board does have markings on the front of the board indicating which side each knob controls.
Most models utilize a damper door to control air flow into the fresh food compartment. The damper door is operated by two stepper motors controlled by the main board. One motor opens the damper door – the other motor closes the damper door. The stepping voltage from the main board to the motors can not be read directly. You must read the damper voltage to the board common.

- Pins 1 to 2 are the door opening voltage
- Pins 3-4 are the door closing voltage
- When the damper is not opening or closing, you will see a standing voltage on these pins to board common of approximately 2vdc
Main Electronic Board J3 Connector - Damper

Diagnostic code 1-0 operates the dampers, or,

Unplug the refrigerator and move the damper door to a partially open position as shown below. When the refrigerator is plugged back in, the main board will drive the door.

If the door fails to open or close – check the four wires of the damper to board ground. You should read 6vdc on all four wires as the damper is opening and closing.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Wire Color</th>
<th>Component Termination</th>
<th>Input/Output</th>
<th>Pin-to-Pin Voltage Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yellow</td>
<td>Damper</td>
<td>Output</td>
<td>J2 pin 3 to J3 pin 1 = 6 VDC</td>
</tr>
<tr>
<td>2</td>
<td>Red/Black</td>
<td>Damper</td>
<td>Output</td>
<td>J2 pin 3 to J3 pin 2 = 6 VDC</td>
</tr>
<tr>
<td>3</td>
<td>White/Brown</td>
<td>Damper</td>
<td>Output</td>
<td>J2 pin 3 to J3 pin 3 = 6 VDC</td>
</tr>
<tr>
<td>4</td>
<td>Blue/Yellow</td>
<td>Damper</td>
<td>Output</td>
<td>J2 pin 3 to J3 pin 4 = 6 VDC</td>
</tr>
</tbody>
</table>

(SEE INDIVIDUAL DIAGRAM)
Main Electronic Board J3 Connector - Damper

If the voltage is present and the damper still does not operate – remove the J3 connector and read the resistance of both motors. The typical resistance of the stepper motor is 380-420 ohms. If your meter is not auto ranging, set it on the 2k scale for testing resistance.

If you read an open circuit check the damper directly. If you suspect the problem may be in the wiring or a connection, jumper the wires at the damper plug. Test for full continuity at the same wiring connections as before. If the voltage and resistance are ok replace the damper.
Electronic Refrigerator Fans

Fresh Food Fan
Not available on all models.

Freezer Fan

Condenser Fan
The J2 connector controls most all refrigerator fan operation. Most of these fans are operated by a DC pulsed voltage and can be variable speed. Check the wiring diagram for fan configuration.
Fan Operation

Fans in the electronic refrigerators are DC fans and they operate on what we call Pulse Width Modulation (PWM). Each fan is pulsed with voltage (frequency) to operate that specific fan motor and can operate at different speeds depending on the PWM signal supplied to that fan motor.

The pulses can not be measured with a voltmeter because the pulse has an ON point and an OFF point (see the chart below). A voltmeter will average the ON and OFF points to read what we call “effective voltage” and that is what the chart below shows.

The slower the fan speed, the longer the OFF point will be, the faster the fan speed the longer the ON point will be; and for the fastest speed the PWM is constant.

![PWM Chart]

- **High Speed (12 VDC measured)**
- **Medium Speed (10 VDC measured)**
- **Low Speed (9 VDC measured)**
Main Electronic Board J2 Connector - Fans

Most fans receive supply voltage through the J2 pin 8 supply circuit as long as the refrigerator is connected to AC power.

The supply voltage can be measured by placing your meter leads across J2 pin 8 and J2 pin 3. You should read 12vdc. The presence of this voltage does NOT indicate that a fan should be operating.

This test should be performed with the fans connected.
Fan operation begins when the main board sends a “signal” voltage to the specific fan motor that needs to operate. This “signal” voltage is read between the J2 pin 3 and J2 pin 5 for the condenser fan, J2 pin 3 and J2 pin 4 for the evaporator fan, and J2 pin 6 and J2 pin 8 for the fresh food fan.

The voltage will depend on what speed the fan motor is supposed to operate at and the voltages will vary between 4vdc up to 12vdc.
Some fan motors send an RPM signal back to the main board, this signal lets the board monitor the fan speed. If this signal is not detected by the main board, the main board will default the fan to a fixed speed. This DC voltage feedback can be read from the RPM wire to the fan common connection.

Not all models use an RPM feedback, the schematic will show (RPM) for the feedback wire.
- Motors can be run for short periods using a 9-volt battery. Connect the white wire to the negative (-) battery terminal only. Connect the red and yellow wires to the positive (+) battery terminal.

**Note:** DO NOT reverse the battery leads in this test, the fan motor will be damaged.

Wire colors can vary, check the schematic with the unit.
In some cases a fan motor can fail and take down the 12vdc supply on the main board. If the refrigerator is not running and this voltage check fails; remove the J2 connector from the main board. If the refrigerator compressor starts, suspect a bad fan motor. You can isolate the condenser fan by unplugging it directly and then reinstall the J2 connector. If the refrigerator stops running, the evaporator fan is shorted, if not the condenser fan is shorted.
Main Electronic Board J2 Connector - Fans

Some main boards have $\frac{1}{4}$ watt resistors in the fan circuit directly located to the J2 connector.

If you should find a burnt resistor, replace the main board and the fan motor – the fan motor has shorted out which caused the resistor to burn. The evaporator fan resistor is closest to the capacitors and the condenser fan resistor is farthest from the capacitors.
ARCTICA
SXS
REFRIGERATOR
INVERTER
COMPRESSOR
TECHNICAL SERVICE GUIDE

Pub # 31-9090
Arctica Side-By-Side Refrigerator
Inverter Compressor
Low Noise - High Performance
NOMENCLATURE

PSH23SGNAFBS

P --- Brand / Product
S --- Configuration
H --- Power (Inverter Compressor)
23 --- Volume
S --- Interior / Shelves
G --- Icemaker / Exterior
N --- Model Year
A --- Engineering Nomenclature
F --- Door Type
BS --- Exterior Color
ATTENTION

SERVICE TECHNICIAN

Power Compressor Through Inverter Only.

Connecting compressor directly to A/C power will result in permanent compressor damage.
INVERTER COMPRESSOR

• The new inverter compressor does not receive 120 VAC from the main control board, as in previous models.

• The inverter compressor receives it’s power from the inverter.

• It is not possible to start the compressor without the inverter.
The compressor is a reciprocating, variable speed, 4 pole type.

It operates on 3-phase, 80 to 230 VAC within a range of 57 to 104 Hz.

Compressor speed is controlled by voltage, frequency and pulse wave modulation.

Increasing frequency from the inverter will produce an increase in compressor speed.
INVERTER COMPRESSOR con’t

• **NOTE:** Many voltmeters will not be able to read the voltage output from the inverter.

• Compressor wattages at various speeds are:

  LOW - 65 Watts

  MED - 100 Watts

  HIGH - 150 Watts
INVERTER COMPRESSOR con’t

• Compressor speed is based on the temperature setpoint in conjunction with the cabinet temperature.

8°F to 19.5°F above setpoint = high speed
3.5°F to 7.5°F above setpoint = medium speed
1°F to 3°F above setpoint = low speed

• NOTE: The compressor will run at medium speed if the cabinet temperature is 20°F or more above the setpoint.
• The use of 3-phase power eliminates the need for the PTCR relay, capacitor, and individual start and run windings.

• Compressor pin functions are identical and compressor lead wire configuration is of no importance.

• A resistance of 9 to 11 ohms should be read between any 2 of 3 pins.
INVERTER COMPRESSOR con’t

• Should an open or short occur in the compressor winding or should one of the compressor lead wires become open or disconnected, the inverter will stop voltage output to the compressor.

• High compressor torque enables the compressor to start against high pressure in the sealed system.
Compressor and sealed system operation is extremely smooth & cool.

The compressor exterior may be room temperature while operating.

A running unit may be difficult to detect.

To verify that the compressor is running:

Remove power from the unit and place a hand on the compressor. Reconnect power and feel for a vibration when the compressor tries to re-start.
ACCESSING THE INVERTER - (Freestanding Inverter)

Remove the water valve and fresh food drain tube from the cabinet. Carefully bend the process stub out of the way.
ACCESSING THE INVERTER

Remove the ¼” (1.6cm) hex head screw holding the inverter to the mounting bracket.
ACCESSING THE INVERTER

Disengage the inverter from the mounting bracket by twisting to the left and pulling it from the cabinet.
ACCESSING THE INVERTER - (Mounted Inverter)

- Remove the hex-head screw that holds the water valve to the cabinet, then carefully pull the water valve out from the cabinet.

- Disconnect the 2 wire harnesses to the inverter.

- Remove the hex-head screw and the inverter ground wire from the cabinet.
ACCESSING THE INVERTER

- The inverter is attached to the compressor by a lip above the compressor terminals, a tab (located at the bottom rear corner), and a Phillips-head screw.
- Remove the Phillips-head screw from the inverter.

- Lift and rotate the inverter counterclockwise.
- Disconnect the compressor harness from the compressor terminals.
ACCESSING THE INVERTER

- Disconnect Inverter plug from compressor terminals

NOTE: DO NOT ATTEMPT TO DIRECT-START THE COMPRESSOR
Inverter Compressor Testing

1) 4-6VDC
2) 120VAC
3) 10 ohms

The inverter receives commands from the main control board. The main control board will send a PWM run signal from the J15 connector of between 4-6 VDC effective voltage to the inverter (all wires must be connected). The inverter will select compressor speed (voltage output) based on this signal. The main control board will only send a run signal to the inverter when the compressor should be on.

Note: When measuring signal voltage (from the main control board) at the inverter, a reading of 4-6 VDC will be measured with all wires connected. If the inverter wiring is disconnected, the board output will measure between 10-12 VDC.
Compressor & Inverter

- Communication signal from main control board J15 enables inverter output
  (4-6 VDC connected)
  (11-15 VDC unplugged)

- Variable voltage output to compressor from inverter

- Excessive current draw > 4amps stops briefly, 12 attempts, one every 12 seconds, then 8 minute rest.

- Operates between 80VAC and 230VAC

- Hz range of 57 Hz to 104 Hz

Dead compressor?
- 3 tests to make
Inverter Line Voltage

Measure the input AC voltage for the Inverter at the connector with black & orange wires, you should measure ~120VAC.
Inverter Command Voltage

Measure either at connector or at J15 pins 1&2 = 4 to 6VDC.
Inverter

• J 15 Red & White terminals for signal voltage
• 4-6 VDC with wires connected
• 11-15 VDC Disconnected
• Frequency changes compressor speed.
Compressor Terminals

Read \( \sim 10\Omega \) between any 2 terminals - \( \infty \Omega \) to Compressor case.
Compressor (Review)

- 3 Phase Compressor

Compressor wattages at various speeds are:

- LOW - 65 watts  (1700 rpm)  57Hz
- MED - 100 watts  (2100 rpm)  70Hz
- HIGH - 150 watts  (3120 rpm)  104Hz

Compressor speed is based on the temperature set point in conjunction with the specific cabinet temperature. Speeds are selected according to the following cabinet temperatures, with freezer temperature being the primary:

- 7°F to 19.5°F above freezer set point = high speed.
- 4.5°F to 6.5°F above freezer set point = medium speed.
- 1°F to 4°F above freezer set point = low speed.

*Note:* The compressor will run at medium speed if the freezer temperature is 20°F or more above the set point.
Reference Material

Electronic Refrigerator models:

1) Pub number 31-9062 (Adaptive Defrost Service Guide)
2) Pub number 31-9071 (GE Electronic Knob Control SxS)
3) Pub number 31-9072 (Arctica Electronic Control SxS)
4) Pub number 31-9077 (TMNF Electronic Control)
5) Pub number 31-9110 (Profile Electronic Control SxS)
6) Pub number 31-9112 (BMNF Electronic Control)
7) Pub number 31-9139CD, includes the above Service Guides plus videos
8) Pub number 31-9090 (Inverter Compressor Model SxS)
9) Pub number 31-9153 (Profile Dual Evaporator Model SxS)
10) Pub number 31-9154 (Profile Variable Speed BMNF)
11) Pub number 31-9117CD (Monogram SxS)
12) Pub number 31-9122CD (Monogram Bottom Mount)