

TROUBLESHOOTING AMES/AES Refrigerators with New Wire Harness

INTRODUCTION

The purpose of this Bulletin is to aid the service technician in the troubleshooting of AMES/AES refrigerators that are converted or equipped with new wire harnesses. The Bulletin contains information on the operational differences of various power modules used on the AMES/AES refrigerators.

TOOLS REQUIRED:

PAL® Tester
Millivolt Meter
Volt-Ohm Meter
Manometer/Gas Pressure Gauge
Small Hand Tools

QUICK-CHECK TROUBLESHOOTING LIST

1. DC Power Supply
2. Gas Supply
3. Components:

A. Thermocouple	G. Surge Protector
B. Burner/Orifice	H. Control Panel
C. Reignitor	I. Thermistor
D. Electrode	J. AC and DC Heater
E. Solenoid	K. Thermistor Adjuster
F. Power Module	
4. Grounds

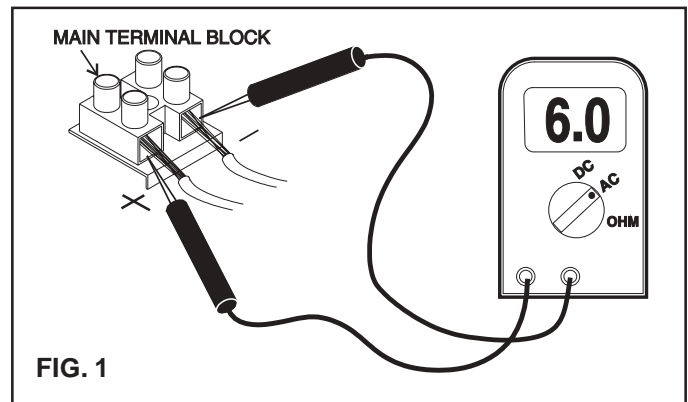
1. DC POWER SUPPLY

Clean Direct Current (DC) power is mandatory for high-tech circuits to operate as designed. The sources for DC power are a battery and a converter.

A battery will provide straight line DC power, but extended operation will require recharging of the battery by the converter or the alternator.

The converter and alternator produce DC power by a series of diodes that rectify alternating current to DC. A battery or capacitors can be used to clean up the AC ripple that is present after AC voltage has been rectified.

AC ripple can be measured by a voltmeter set on the AC scale at the main terminal block connections. Six volts AC or less is acceptable. See FIG. 1.



A brief interruption of the DC power supply while refrigerator is operating on gas can cause a check light; for example: Turning the refrigerator OFF-ON while operating in the gas mode can cause a check light. The switching of relays from converter power to battery power, when unplugging from shore power or shutting down the generator could interrupt DC power long enough to cause a check light.

The thermocouple produces 25-30 MVDC when operating on gas. A rapid on/off of the switch or the DC power source does not allow the thermocouple time to cool. When the power is restored the thermocouple has not cooled completely. If the power module reads above 6 MVDC the check light will be turned on.

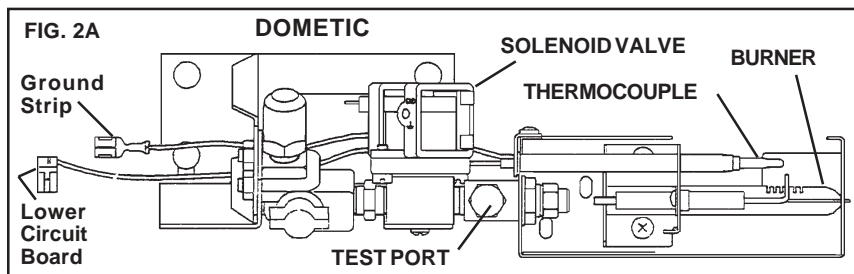
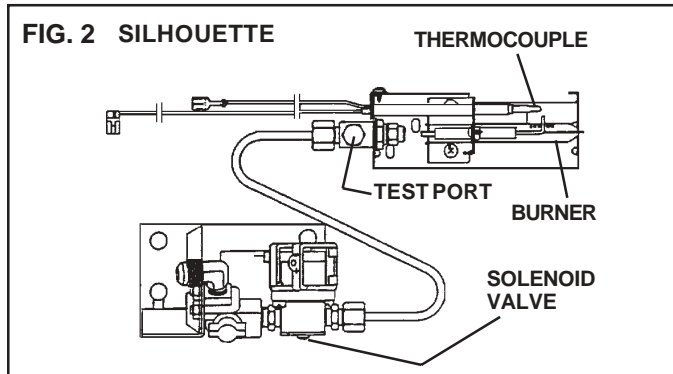
Power modules 293184037, 2931843045 (3-way) and 2931842039 without the surge protector will do this. See section 3F and 3G for more details on power modules and the surge protector.

REVISION:

Form No. 3108430.012 10/04
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2. GAS SUPPLY

The refrigerator requires 11 inches water column with half of all the BTU's of the RV turned on (half of all *appliances* turned on). With all the appliances off, the gas pressure should not exceed 12 inches water column. The gas pressure for the refrigerator is taken at the test port after the solenoid valve and the refrigerator is operating on gas. See FIG. 2 & 2A.



3. COMPONENTS

- A. The Thermocouple** is a component that extends over the three burner slots. The flame heats the tip of the thermocouple, and it produces 25-30 MVDC power. Any reading of 18MV or less could cause erratic gas operation

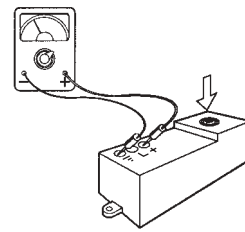
Note: A reading of 18MV or less could be caused by low gas pressure or improper thermocouple location. The thermocouple should be centered and extend three slots over the burner. See FIG. 2 & 2A.

B. Burner and Orifice

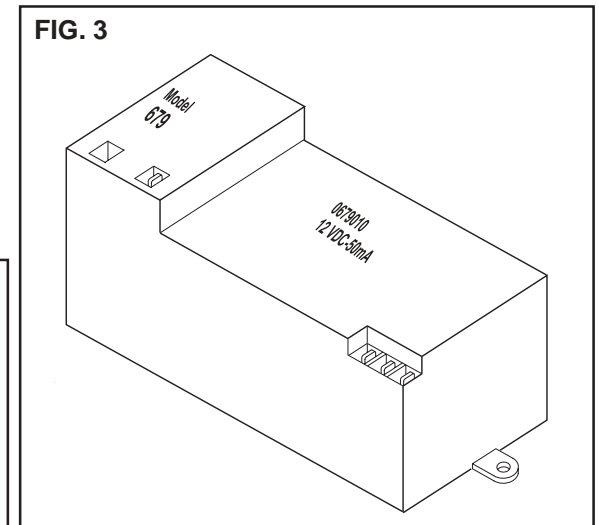
The burner is a horizontal slotted metal tube located below the flue tube of the cooling unit. The burner should be cleaned periodically (at least once a year). To clean the burner, remove from the refrigerator and check for any foreign residue (rust, spider webs, etc.) that could cause a deflection of the gas flow or flame. Soak the orifice in an alcohol based solvent and allow to air dry. Reinstall in refrigerator and leak check all gas connections with an approved leak check solution. See FIG. 2 & 2A.

- C. The Reignitor** is an electronic device that produces high voltage to create a spark at the burner, only on gas mode.

Verify proper DC power is at the positive (+) and ground (-) terminals. The reading should be within one volt of the voltage at the main terminal block during the trial-for-ignition.



The reignitor installed as original equipment on the refrigerator is part number 2931132019 (RV Gas Model 679). This reignitor is rated 50 milliamperere, and can be used on any other Dometic refrigerator. See FIG. 3.



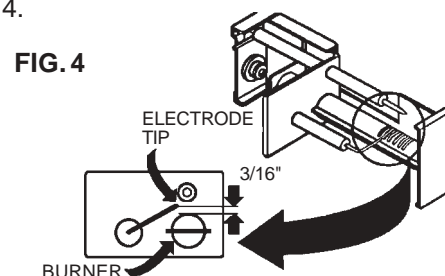
Note: Do Not install the Channel Mark 6, Model 12E reignitor as a service replacement.

Installing the Channel Mark 6, Model 12E ignitor rated at 25 milliamperere can result in failure to ignite on gas if the DC voltage supplied to the device is below 12.5 DC volts. Installation of the Channel Products, Inc. Gaslitter Mark 6, Model 12E will **VOID** the Warranty on the refrigerator

D. Electrode

First, do a visual check for cracks or breaks on the ceramic insulator. Check the high-voltage wire for cuts, cracks in the insulation and bare or pinched wire. If any of the above is found, replace the electrode.

Check the spark gap by using a 3/16" drill bit. The drill bit should pass under the tip of the electrode with a slight drag. The tip of the electrode should be centered over the first three burner slots. See FIG. 4.



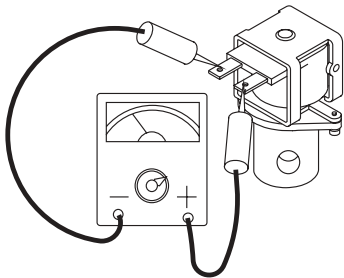
E. Solenoid Valve

Both the Solenoid Valve and reignitor receive DC voltage from the power module when LP gas is selected. The solenoid coil opens an internal valve seat and gas flows to the main orifice.

Check the solenoid valve with a properly calibrated ohmmeter. Remove one or both of the leads from the solenoid. Measure the resistance between the terminals. The proper ohm reading is 44-53. See FIG. 5.

The solenoid valve should allow gas to flow when the coil is energized. Connect a manometer to the test port and read the gas pressure when the solenoid is energized. If no or low pressure is present at the test port, replace the solenoid, as it is defective.

FIG. 5



Note: Verify the RV gas system has proper pressure. If the test reveals low LP gas pressure it should be adjusted according to the vehicle/regulator manufacturer's specifications.

F. Power Module

The Power Module monitors the DC and AC power supplied to the refrigerator. It coordinates the operation between DC, AC and LP gas, in conjunction with the setting on the display panel.

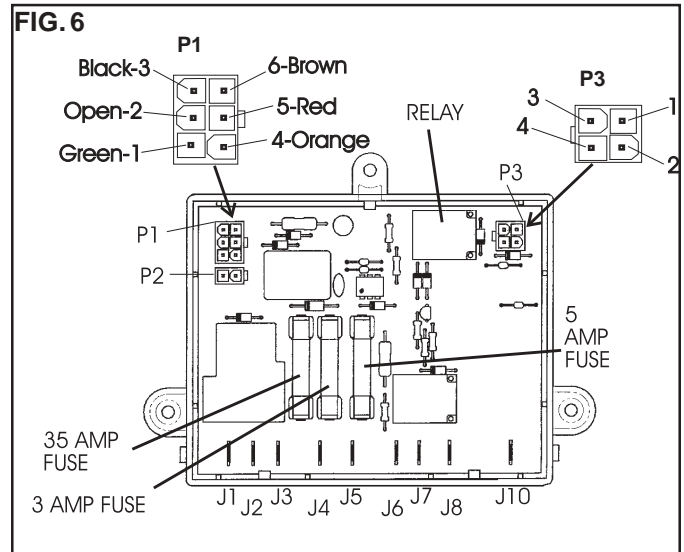
When the refrigerator requires additional cooling, the power module will send AC power to the electric heater. If AC power is not available and the DC voltage is above 13.8 VDC the power module will operate the DC heating element (3-way units only). When DC operation is not available or the display is set for gas operation, the power module will send DC power on the yellow wire to the solenoid valve and reignitor.

The power module controls all modes of operation. The following steps must be followed in sequence and at the proper terminal or damage to the board will result.

1. Check for DC voltage on the main terminal block at the back of the refrigerator.
2. Make sure DC voltage is present on the plug (P1) terminal 4 orange/white wire (positive +) of the 6 pin connector, to the same as applied to the main terminal block. If the voltage reading is not present or less, check fuses and wiring.

3. AC operation requires a minimum of 100 volts AC to be present between the large black and white wire at the power module. If the voltage is below 100 volts AC the board will select another mode.

Note: Before replacing the circuit board, correct the cause of failure. Most power module failures are caused by wiring or the electric heaters. See FIG. 6.



Note: The PAL® Tester will allow for proper testing of the intensity of the upper and lower circuit boards. The PAL® Tester is available from Dometic Factory Dealer Direct.

The 2931842013, 291842021 and 2931842039 two way power modules and 2931843011, 2931843029, 2931843037 and 2931843045 three way modules do not have any built in delay or restarts when used in conjunction with the new wire harness 3108702.675 and 3108702.683. They can be used with the surge protector and the thermistor adjuster. See sections 3G and 3K.

These power modules have an internal diagnostic test sequence which aid in troubleshooting. It will allow testing of the gas solenoid, reignitor, DC heater and AC heater.

Access to the diagnostic test sequence is gained by holding the temperature selector switch down for 3 seconds after the ON/OFF switch is turned to "ON". The control will indicate the diagnostic test sequence is operational by illuminating the mode and temperature lamps one at a time. This auto sequence is repeated a total of two times. The check lamp will then flash on and off, and the #1 position temperature will be on.

The test sequence can be operated manually or automatically. The manual operation of the test sequence is done by pressing the temperature selector switch once to advance to the next lamp.

The manual test sequence is as follows:

Position #1: Idle, all loads off

Position #2: AC Heater, check for AC voltage between terminals J7 and J8.

Position #3: Gas solenoid and reignitor, check for DC volts between the yellow wire (+) on the solenoid and reignitor, and the DC(-) white wire of the solenoid valve. Position #4: DC heater (3-way only), check DC volts between J1 (+) and the DC (-) main terminal of the refrigerator.

Position #5: Test port, blue wire, check DC voltage (+) during the gas trial for ignition. DC voltage should be present for 45 seconds if burner fails to light, and when the burner lights, DC voltage will turn "OFF" after the thermocouple is producing 13MVDC.

If you do not have the same readings as the above tests, verify the fuses on the power module board.

For the Automatic test sequence, press the AUTO/GAS Mode selector switch to the DOWN position. The AUTO Mode lamp will light. In the automatic test mode each light is activated for approximately four seconds, then released. The control system will automatically exit the test sequence in four minutes or when the power is turned "OFF". In the automatic test mode the lamps are turned "ON" and each position means the same as those listed in the manual test.

Note: The PAL® Tester will allow for proper testing of the integrity of the upper and lower circuit boards. The PAL® Tester is available from Dometic Factory Dealer Direct.

Power module part numbers 2931842039, 2931843037, 2931843045 (with purple connectors), 2932695014, 2932881010 and 2932882018 should not be used with the surge protector. They have the surge protector features built in. If they are used with a surge protector erratic or no operation can result.

The purple connector boards 2931842069, 2931843037 and 2931846045 and boards 2932881010 and 2932882018 when equipped with a thermistor adjuster resistor may over cool. See thermistor adjuster 3J.

The purple connector boards 2931842069, 2931843037, and 2931843045 and boards 2932881010 and 2932882018 have the built in diagnostic test sequence listed previously. Operation of boards will differ slightly as follows:

1. At power up in the auto mode (with AC present), there will be a 5 second delay before the AC cooling mode is activated (thermistor must be calling for cooling). The power module monitors the AC and if it must drop below 13 VAC RMS for 15 seconds, it will then switch to the gas cooling mode.
2. At power up in the auto mode (No AC present), there will be a 5 second delay before the gas cooling mode is activated (thermistor must be calling for cooling). At start up the power module checks the condition of the thermocouple, if it is cold, power is sent to the solenoid valve and reignitor. At the end of 45 seconds the flame must be sensed by the power module. If the thermocouple still shows cold, the solenoid valve and reignitor are turned "off" and check light "on".
3. If the burner is lit during the trial for ignition period, the reignitor will sense the flame and stop sparking. The solenoid valve will remain open until the thermistor reaches its set temperature.
4. If the thermocouple is hot at the start of the gas mode operation, a 20 second delay is started by the power module. At the end of the 20 second delay the power module will attempt a second ignition of the burner. If the thermocouple is still showing, hot gas operation will be terminated and the check light turned on.
5. While operation is in the gas mode, the power module and ignitor are constantly monitoring the presence of flame. If the flame is blown out, the reignitor will immediately start sparking. When the power module senses the loss of flame (thermocouple voltage below 13MVDC) the 45 seconds trial for ignition period is started.
6. The 20 second thermocouple cool down is also started under these conditions:
 - Loss of DC
 - Thermistor shuts down solenoid
 - Lowering thermostat setting
 - Changing from gas to AC or DC
7. If a DC power interruption of 0.1 second occurs, the power module will retain its setting and resume operation after the 5 second delay. If the DC power loss is longer, the memory will be lost. When DC power is restored, the control panel will show auto and the temperature will be set at 3.

8. If there is an AC power loss (no loss of DC) of less than 15 seconds, the power module will remain in the AC mode of operation. If the AC power interruption is over 15 seconds in length, the AC mode of cooling will stop and the power module will select the gas mode.
9. The following is a summary of the delays used in purple connector boards 293182069, 29318430378 and 2931843045 and boards 2932881010 and 2932882018:
 - a. Time delay prior to selection of a cooling mode after power up: 5 seconds.
 - b. Time delay to detect AC at power up: 5 seconds.
 - c. Time delay to detect AC not available at power up: 5 seconds.
 - d. Time delay to detect AC available after power up: 15 seconds.
 - e. Time delay to detect AC not available after power up: 15 seconds.
 - f. Time delay to allow a hot thermocouple to cool: 20 seconds.
 - g. Time required to reset power module after loss of DC voltage: .01 second.

G. Surge Protector

The surge protector is connected between the control panel and one of the above power modules on the AMES/AES refrigerator. It will not change normal operation of the refrigerator. It monitors the signal from the Power Module to the Control Panel. If a signal for turning on the check light is received, the Surge Protector will verify if it is a valid signal.

If the signal received is not valid, the Surge Protector will reset the Power Module by turning OFF and ON the DC voltage, which allows the check light relay to reset.

If the Power Module does not receive the proper millivolt reading from the thermocouple, the Surge Protector (after a two minute delay) will allow a second attempt to light the burner. If flame is not detected in 45 seconds, the check light is turned on.

When the controls call for gas operation, and a hot thermocouple is detected, the Surge Protector will delay 20 seconds to allow the thermocouple to cool. If a hot thermocouple is still detected after the 20 second delay, the check light will come on and gas operation will stop.

Loss of the gas flame will cause the reignitor to immediately resume sparking. If the thermocouple shows it is cold, the Power Module will continue trying to relight the burner for 45 seconds, then turn on the check light.

The Surge Protector will change the operation of the Power Module as follows:

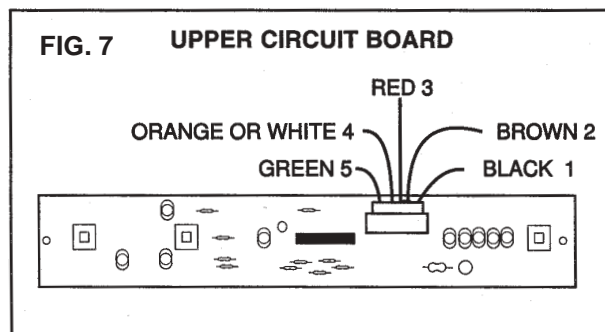
1. Time delay prior to selection of cooling mode after power is turned on: 1 second.
2. Time delay prior to selection of an energy source for cooling: 3 seconds.
3. Time delay to detect AC is available (at power up): 1 second.
4. Time delay to detect AC not available (at power up) : 1 second.
5. Time delay to allow a hot thermocouple to cool: 20 seconds.

H. Control Panel

The control panel is in the OFF position. Measure the DC voltage at plug 1 (P1) between terminal 4 (orange or white wire) and (P1) terminal 5 (red wire) at the Power Module. See FIG. 6. The presence of voltage shows the fuse is good.

The control panel switch is in the ON position. Measure the DC voltage at plug 1 (P1) between terminal 4 (orange or white wire) and (P1) terminal 5 (red wire) at the power module. See FIG. 6. The DC voltage should be within 1 volt of the supply to the refrigerator.

If voltage is present check for DC voltage between plug 1 (P1), terminal 1 (green wire) and terminal 5 (red wire) of the Power Module. If no voltage is present on the power module, check for voltage between the same color wire on the Control Board. If voltage is present at the Control Panel, check the cable for continuity. No voltage reading at the Control Panel indicates that it is defective and should be replaced. See FIG. 7.



If DC voltage is present at plug 1 (P1) and terminal 1 (green wire) on the power module, check for voltage at plug 1 (P1) and terminal 3 (black wire) on the Power Module. If there is no DC power, the Power Module is defective, and should be replaced. See FIG. 6.

Note: The PAL® Tester will allow for proper testing of the integrity of the upper and lower circuit cards. The PAL® Tester is available from Dometic Factory Dealer Direct.

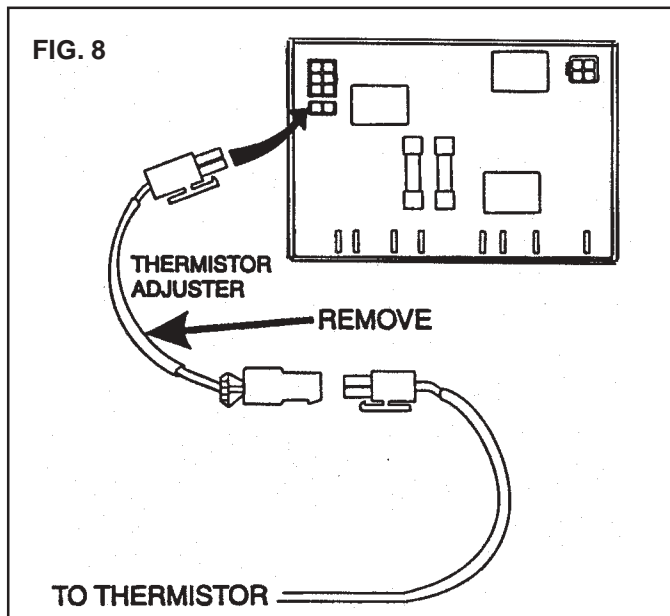
I. Thermistor

The thermistor senses the temperature inside the food storage compartment of the refrigerator. The thermistor is an electronic device that changes in resistance with temperature.

The best way to test a thermistor is in a solution of crushed ice and water. Place the thermistor in the ice and water along with a thermometer. Using a good, digital ohmmeter, measure the resistance, at 33°- 34°F. The thermistor reading should be 9100 ohm ($\pm 10\%$). See section 3K: Thermistor Adjuster.

J. AC and DC Heater

The AC heater is designed to deliver a pre-determined amount of heat to the cooling unit. To check the AC heating element, remove the leads from the power module and measure for resistance with a properly calibrated ohmmeter. This check is to be done with the heating element at room temperature. The DC heating element is designed to maintain the temperature inside the refrigerator, while the Recreational Vehicle is being driven or towed. Check the heating element with an ohmmeter for resistance. This check is to be done at room temperature. The DC heating element has very low resistance (0.67 ohms for a RM2807 and RM2607). If the resistance is within $\pm 10\%$, the heating element is good.



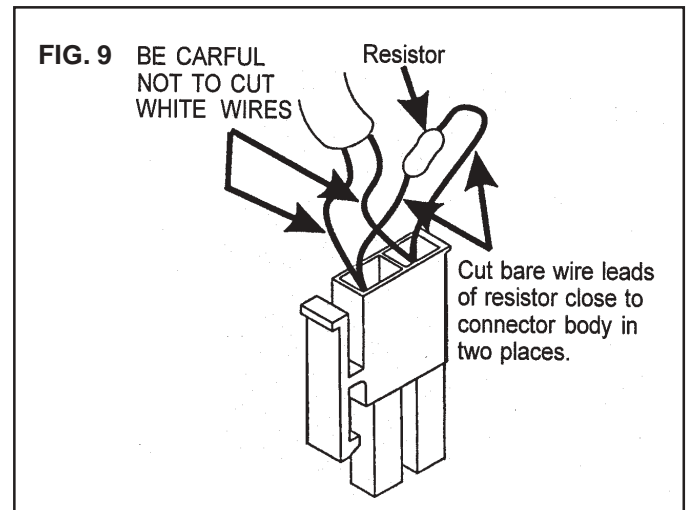
Another way to determine if a heating element is good is by an amp draw reading. The amp draw reading should only be done if the heating element is not shorted or grounded.

K. Thermistor Adjuster

The first thermistor adjuster (part number 2932164011) was an adapter harness used to put a 22,000 ohm resistor in parallel with the refrigerator thermistor. The resistor changed the value of the thermistor, allowing the refrigerator to cool an extra 5° F. See FIG. 8.

Another type of thermistor adjuster that can be used had the resistor across the thermistor plug and covered with shrink insulation. See FIG. 9.

Power Modules with purple connectors, or part numbers 2932695014, 2932881010 and 2932882018 have built in thermistor adjusters.



The thermistor adjuster should not be used with the Power Modules that have purple connectors or part numbers 2932695014, 2932881010 or 2932882018. Over cooling of the refrigerator will result. The thermistor with a built in adjuster will show a resistance of 7,500 ohms ($\pm 10\%$) when submerged in ice and water at 33° - 34°F.

4. GROUNDS

The operation of the AMES/AES refrigerator is also dependent on good, clean ground connections. Loose or corroded ground terminals create a resistance factor that can affect the DC/AC voltage seen by the Power Module. Check the integrity of the grounds from the refrigerator all the way to the battery. Clean or tighten any suspicious looking connections.