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LENNOX LOGIC UNIT TROUBLESHOOTING GUIDE

TROUBLESHOOTING GUIDE FOR LENNOX LOGIC UNITS USING THE NOVAR ETM-2050 AND 2051 FACILITY MANAGEMENT SYSTEM

Introduction

The Lennox Logic Unit Troubleshooting Guide has four major sections.

1- Lennox ETM-2050 and 2051 Default Table

On initial unit start-up, the electronic thermostat module will automatically default unit function according to settings found in table 1. Once communications (EC or EP executive controller or processor and optional ESS engineering support system) have been connected to the system, these default schedule and settings may not apply. Determine whether the unit should be operating according to ETM default settings, or according to settings programmed into the EC/EP or ESS before troubleshooting.

2- Sequence of Operation

The following examples of normal unit operation are outlined according to system application.

1- 2-stage cool, economizer, “auto” blower
2-stage heat, economizer, “auto” blower

2- 2-stage cool, economizer, continuous blower
2-stage heat, economizer, continuous blower

3- 2-stage cool, no economizer, “auto” blower
2-stage heat, no economizer, “auto” blower

4- 2-stage cool, no economizer, continuous blower
2-stage heat, no economizer, continuous blower

3- Problems

Two specific unit problems are addressed.
A)-Unit Will Not Start
B)-Blower Runs But Unit Does Not Cool
Reference the troubleshooting flow charts provided next to each page.

4- Checking Specific Alarms

The optional ESS engineering support system will show an alarm for various unit problems. Refer to this section when responding to systems which are connected to an engineering support system.

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TABLE 1
LENNOX ETM-2050 AND 2051 DEFAULTS

Cooling Setpoint	74 deg. F (41 deg. C)
Heating Setpoint	70 deg. F (39 deg. C)
Blower	Auto
Power-Up Delay	3 minutes - No cooling or heating stages are active for 3 minutes after initial power-up or power failure.
Communication-Loss Timeout	3 minutes 1-If only communication is lost, ETM will resort to stand-alone mode and will function at current programmed settings. 2-If only power is lost, ETM will resort to normal operation if power is restored within 3 minutes. 3-If power and communications are lost, ETM will resort to the default settings.
Airflow Alarm Delay	1 minute - ETM will not monitor blower status until 1-minute delay has expired. If airflow alarm is detected, all unit functions are shut down immediately regardless of any minimum-on times associated with other functions.
Cool Minimum ON	3 minutes - Minimum run time for each cooling stage.
Blower Minimum ON	3 minutes - Minimum run time for blower if no alarm or fault is detected by the ETM. Does not apply if ETM is programmed for gas heat.
Blower Minimum OFF	3 minutes - Blower will remain off for 3 minutes after demand has been satisfied.
Cool Duct Purge	3 minutes - Blower will run for 3 minutes after “Y1” demand has been satisfied.
Elec. Heat Duct Purge	1 minute - Blower will run for 1 minute after “W1” demand has been satisfied on units with a single speed blower motor. On units with a multi-speed blower motor, the blower is controlled by the electric heat controls.
Cool Minimum Off	3 minutes - When demand has been satisfied, compressor will not restart until 3-minute delay has expired. This applies to each cooling stage.
Heat Minimum Off	4 minutes - When demand has been satisfied, furnace will not restart until 4-minute delay has expired. This applies to each heating stage.
Economizer Delay	5 minutes- Damper opens and blower will run for 5 minutes before “Y1” is allowed to start ONLY IF ETM has been programmed for economizer damper control.
Cool 1-2 Delay	3 minutes
Heat 1-2 Delay	3 minutes
Drift Alarm Timer	10 minutes - ETM will send out an alarm if zone temperature is within 3 deg. of the setpoint and temperature is not approaching the setpoint at the programmed rate of 1/2 degree per 10 minutes of run time. Has no affect on the unit operation.
Stage 1 & 2 Differential	1 deg. F (.5 deg. C).

Sequence of Operation

The following examples are outlined according to heating and cooling stages, use of an economizer, and continuous vs. automatically cycling blower.

When installing single-stage systems disregard reference to Y2 and W2.

The stage-two differential must be programmed through the ESS. (Temperature difference required to bring on second-stage heating or cooling).

NOTE - if setpoint differential is less than one degree, minimum off/on resolution is .5 degrees.

Example 1:

COOLING

ETM programmed for 2-stage cooling, economizer damper control, and "auto" blower.

A-As zone temperature rises, the ETM changes to the cooling mode at the mid-point between the heating setpoint and the cooling setpoint:

1-The damper is opened.

2-Blower is enabled.

3-A three-minute minimum on timer for the blower is started.

NOTE - If damper is at minimum position due to economizer control, the blower does not operate.

B-Assuming damper is open, when the zone temperature rises above the cooling setpoint plus 1/2 of the stage one differential and the blower has been on for five minutes:

1-Y1 is activated.

2-A three-minute minimum on timer for Y1 is started.

C-If damper is at minimum position when the zone temperature rises above the cooling setpoint plus 1/2 of the stage one differential:

1-Blower is enabled.

2-Y1 is activated.

3-A three-minute minimum on timer for Y1 and blower is started.

D-When the zone temperature rises above the cooling setpoint plus the second stage differential, and the second stage delay (3 min.) has been satisfied:

1-Y2 is activated.

2-A three-minute minimum on timer for Y2 is started.

E-When the zone temperature falls below the cooling setpoint plus 1/2 of the stage one differential:

1-Y2 is turned off.

2-A three-minute minimum off timer is started for Y2.

F-When the zone temperature falls below the cooling setpoint minus 1/2 of the stage one differential:

1-Y1 and blower is turned off.

2-A three-minute minimum off timer is started for Y1 and blower.

HEATING

ETM is programmed for 2-stage heat, economizer damper control, and "auto" blower:

A-As zone temperature falls, at the mid-point between the heating setpoint and the cooling setpoint:

1-The blower is turned off.

2-Damper is closed to minimum position.

3-A three-minute minimum off timer for the blower is started.

B-Electric Heat

When the zone temperature falls below the heating setpoint minus 1/2 of the stage one differential:

1-W1 is activated

2-Blower is activated.

3-A three-minute minimum on timer for blower is started.

NOTE: Blower is controlled by the ETM on heat pumps units, but by the electric heater controls on air conditioning units. Refer to the electric heat and unit wiring diagrams for blower operation.

C-Gas Heat

When the zone temperature falls below the heating setpoint minus 1/2 of the first stage differential:

1-W1 is activated.

2-Blower is activated after the unit's internal blower delay has been satisfied.

NOTE - Blower is controlled by the unit on gas heat units. Refer to unit wiring diagram for blower operation.

D-When the zone temperature falls below the heating setpoint minus the stage two differential, and the second-stage delay (3 min.) has been satisfied:

1-W2 is activated.

E-When the zone temperature rises above the heat setpoint minus 1/2 of the first stage differential:

1-W2 is turned off.

2-When the temperature rises above the setpoint plus 1/2 of the first stage differential:

a-W1 is turned off.

b-A three-minute off timer for blower is started on heat pumps and air conditioning units. On units with gas heat, the blower is turned off by the unit's internal controls.

Example 2:

COOLING

ETM is programmed for 2-stage cool, economizer damper control, and continuous blower:

A-As zone temperature rises, the ETM changes to the cooling mode at the mid-point between the heating setpoint and the cooling setpoint and:
1-The damper is opened. (Blower is already ON).

B-When the zone temperature rises above the cooling setpoint plus 1/2 of the stage one differential and the blower has been on for five minutes:
1-Y1 is activated.
2-A three-minute minimum on timer for Y1 is started.

C-When the zone temperature rises above the cooling setpoint plus the second stage differential, and the second stage delay (3 min.) has been satisfied:
1-Y2 is activated.
2-A three-minute minimum on timer for Y2 is started.

D-When the zone temperature falls below the cooling setpoint plus 1/2 of the stage one differential:
1-Y2 is turned off.
2-A three-minute minimum off timer is started for Y2.

E-When the zone temperature falls below the cooling setpoint minus 1/2 of the stage one differential:
1-Y1 is turned off.
2-A three-minute minimum off timer is started for Y1.
3-Blower remains on.

HEATING

ETM is programmed for 2-stage heat, economizer damper control, and continuous blower:

A-As zone temperature falls, at the mid-point between the heating setpoint and the cooling setpoint:
1-Damper is closed to minimum position.(Blower is already ON).

As the temperature falls below the heat setpoint plus 1/2 of the first stage differential, the ETM changes from cool mode to heat mode.

B-When the zone temperature falls below the heating setpoint minus 1/2 of the first stage differential:
1-W1 is activated.

C-When the zone temperature falls below the heating setpoint minus the stage two differential, and the second stage delay (3 min.) has been satisfied:
1-W2 is activated.

D-When the zone temperature rises above the heat setpoint minus 1/2 of the first stage differential:
1-W2 is turned off.
2-When the temperature rises above the setpoint plus 1/2 of the first stage differential:
a-W1 is turned off.
b-Blower remains on.

Example 3:

COOLING

ETM is programmed for 2-stage cool, manual (inactive) damper, and "auto" blower:

A-When the zone temperature rises above the cooling setpoint plus 1/2 of the stage one differential:
1-Blower is activated.
2-Y1 is activated.
3-A three-minute minimum on timer for Y1 and the blower is started.

NOTE - If compressor is locked out by outdoor temperature blower will not operate.

B-When the zone temperature rises above the cooling setpoint plus the second stage differential, and the second stage delay (3 min.) has been satisfied:
1-Y2 is activated.
2-A three-minute minimum on timer for Y2 is started.

C-When the zone temperature falls below the cooling setpoint plus 1/2 of the stage one differential:
1-Y2 is turned off.
2-A three-minute minimum off timer is started for Y2.

D-When the zone temperature falls below the cooling setpoint minus 1/2 of the stage one differential:
1-Y1 and blower are turned off.
2-A three-minute minimum off timer is started for Y1 and blower.

Example 3 (continued):

HEATING

ETM is programmed for 2-stage heat, manual (inactive) damper, and "auto" blower:

As zone temperature falls, the ETM changes to the heating mode when the zone temperature falls below the heating setpoint plus 1/2 of the first stage differential.

A-Electric Heat

When the zone temperature falls below the heating setpoint minus 1/2 of the first-stage differential:

1-W1 is activated.

2-Blower is activated.

3-A three-minute minimum on timer is started.

NOTE-Blower is controlled by the ETM on heat pumps, but by electric heater controls on air conditioning units. Refer to the electric heat and unit wiring diagrams for blower operation.

B-Gas Heat

When the zone temperature falls below the heating setpoint minus 1/2 of the first stage differential:

1-W1 is activated.

2-Blower is activated after the unit's internal blower delay has been satisfied.

NOTE - Blower is controlled by the unit on gas heat units. Refer to the unit wiring diagram for blower operation.

C-When the zone temperature falls below the heating setpoint minus the stage two differential, and the second stage delay (3 min.) has been satisfied:

1-W2 is activated.

D-When the zone temperature rises above the heat setpoint minus 1/2 of the first stage differential:

1-W2 is turned off.

2-When the temperature rises above the setpoint plus 1/2 of the first stage differential:

a-W1 is turned off.

b-A three-minute minimum off timer for the blower is started on heat pumps and air conditioning units. On gas heat units, the blower is turned off by the unit's internal controls.

Example 4:

COOLING

ETM is programmed for 2-stage cool, manual (inactive) damper, and continuous blower:

A-When the zone temperature rises above the cooling setpoint plus one half of the stage one differential:

1-Y1 is activated. (Blower is already ON).

2-A three-minute minimum on timer for Y1 is started.

NOTE - If compressor is locked out by outdoor temperature, the blower will continue to operate.

B-When the zone temperature rises above the cooling setpoint plus the second stage differential and the second stage delay (3 min.) has been satisfied:

1-Y2 is activated.

2-A three-minute minimum on timer for Y2 is started.

C-When the zone temperature falls below the cooling setpoint plus 1/2 of the stage one differential:

1-Y2 is turned off.

2-A three-minute minimum off timer is started for Y2.

D-When the zone temperature falls below the cooling setpoint minus 1/2 of the stage one differential:

1-Y1 is turned off.

2-A three-minute minimum off timer is started for Y1.

3-Blower remains on.

HEATING

ETM is programmed for two-stage heat, manual (inactive) damper, and continuous blower:

As the zone temperature falls, the ETM changes to the heating mode when the zone temperature falls below the heating setpoint minus 1/2 of the first stage differential.

A-When the zone temperature has fallen below the heating setpoint minus 1/2 of the first stage differential:

1-W1 is activated. (Blower is already ON).

B-When the zone temperature falls below the heating setpoint minus the stage-two differential, and the second-stage delay (3 min.) has been satisfied:

a-W2 is activated.

C-When the zone temperature rises above the heat setpoint minus 1/2 of the first stage differential:

1-W2 is turned off.

2-When the temperature rises above the setpoint plus 1/2 of the first-stage differential:

a-W1 is turned off.

b-Blower remains on.

Specific Unit Problems

A-UNIT WILL NOT START

1- Check zone temperature with a thermometer at the RTS (return air sensor) or WTS (wall/room sensor). If a wall sensor is used make sure return air sensor plug P62 is disconnected from return air sensor jack J62. Check the setpoint and program schedule to determine if the unit should be running.

A-If the zone temperature, setpoint, and program schedule indicate that the unit should not be on, contact the customer to have the setpoint or program schedule changed to create a cooling or heating demand. If the unit still will not start, go to to step B below.

B-If the zone temperature, setpoint, and program schedule indicate that the unit should be running, proceed to the roof to troubleshoot at the unit. Go to step 2.

2- Verify that the disconnect is closed. If the disconnect is open, close it and then check the status LED on the left side of the ETM. The status LED should be blinking (after the three-minute delay) to indicate that the ETM has power and is communicating. Other LED's indicate the ETM's outputs for G, Y1, Y2, W1, and W2 demands.

A-If the status LED on the ETM is off, go directly to step 3.

B-If the status LED is on, wait five minutes for the unit to start. If the unit does not start after five minutes, go to step 6.

3- Check voltage at TB1 terminals 6 and 7. Voltage should be 24vac +/- 6.

A-If voltage is correct, go to step 5.

B-Check the unit's 24 vac transformer (T1).

(1)-Check line voltage to transformer (T1). If no voltage or low voltage conditions exist, go to step "C" below.

(2)-Check output side of transformer. Voltage reading should be 24vac +/-6. Look for smoke detector and/or fire alarm interface relays in the low voltage circuit. Frequently these devices are added after the job is complete and may be installed improperly. Correct wiring connections if smoke detector or alarm interface relays are installed improperly.

a-If proper voltage does not exist, check fuse on transformer (T1).

1-If transformer fuse is open, replace fuse and repeat troubleshooting procedure if needed.

2-If transformer fuse is O.K., transformer (T1) is defective. Replace transformer and repeat troubleshooting procedure if needed.

b-If proper voltage exists, disconnect harness plug P17 from unit jack J16. Check voltage across pins #6 and 7 of unit jack J16.

1-If 24vac+/-6 exists, connect P17 to J16 and go directly to step 5.

2-If 24vac +/- 6 does not exist, the wiring between unit jack J16 and transformer (T1) is faulty. Replace or repair wiring and repeat troubleshooting procedure if needed.

C-Check for proper voltage at line side of disconnect switch.

(1)-If no power at line side of fuses, go to step 4.

(2)-Check and replace any faulty fuses. Repeat troubleshooting procedure if needed.

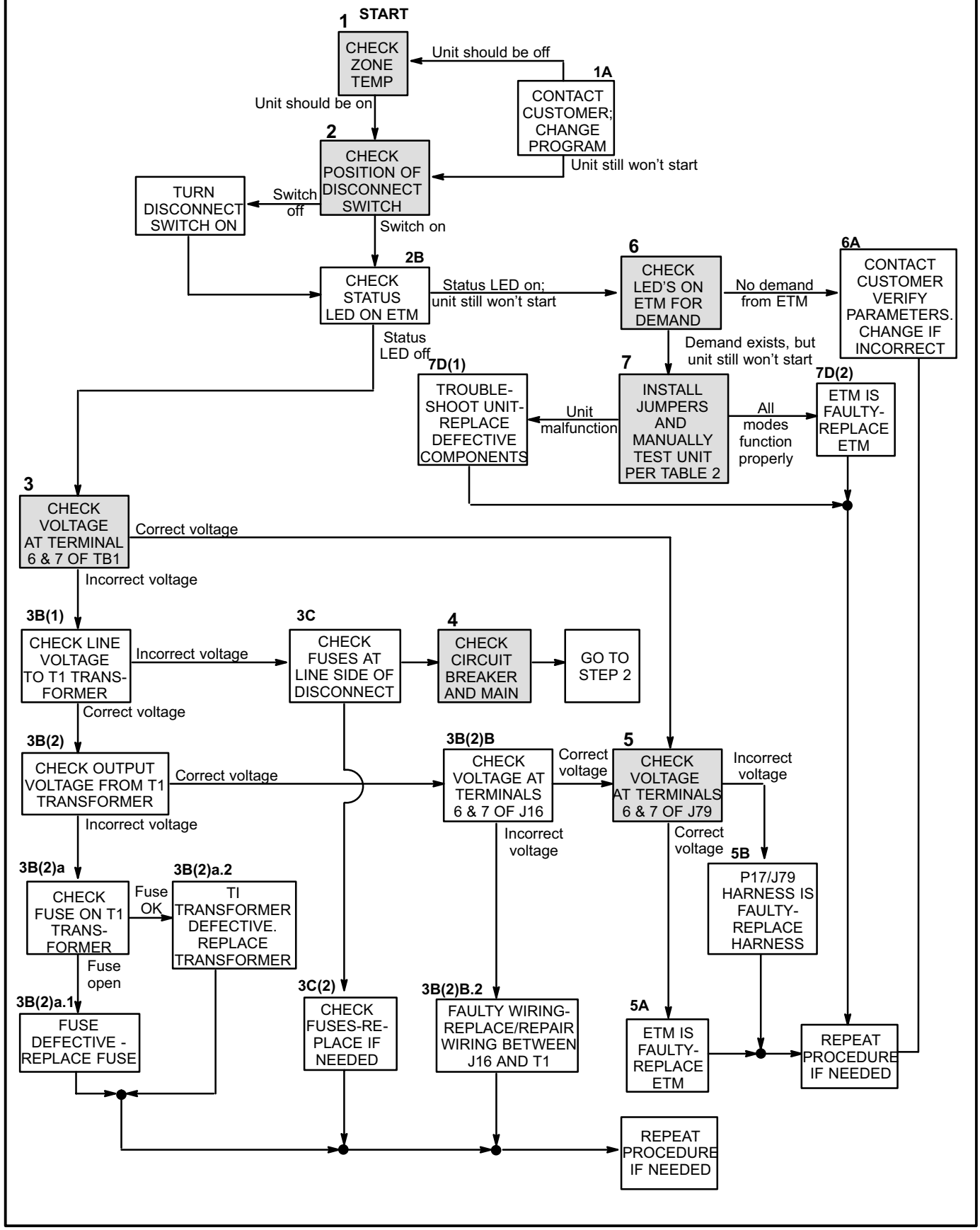
4- Check circuit breaker and mains. Turn circuit breaker off and back on. Go back to unit and repeat steps 2 and 3.

5- Remove ETM cover if used. Check P17/J79 harness for faulty connections. Disconnect jack J79 from plug P79 on ETM. Check voltage across pins #6 and 7 of harness jack J79.

A-If 24vac +/-6 exist, the ETM is defective. Replace the ETM and repeat troubleshooting procedure if needed.

B-If 24vac +/- 6 does not exist, the P17/J79 harness is defective. Replace or repair J79/P17 harness and repeat troubleshooting procedure if needed.

LENNOX LOGIC UNIT TROUBLESHOOTING FLOWCHART



6- If ETM has power, check LED's on ETM to see if system is calling for blower, cooling, etc..

A-If the system is not calling for cooling or heating operation, contact customer to verify program parameters. Change program parameters if incorrect and repeat troubleshooting procedure if needed.

B-If ETM is calling for unit operation and unit is not functioning, go to step 7.

7- The ETM-2050 and 2051 contain relays for individual outputs. Field installed jumpers or toggle switches may be connected to the tabs on these relays to manually activate the various stages of cooling and heating when troubleshooting the unit. See figure 1.

A-Turn off power.

B-Remove fuse (F1) from the ETM to disable automatic control of the ETM outputs.

C-Install jumpers or toggle switches on the appropriate relays and test the unit for proper operation according to table 2.

NOTE-DO NOT JUMPER COOLING AND HEATING OUTPUTS TO BE ON AT THE SAME TIME!

D-Restore power and manually cycle unit through all cooling and heating stages individually.

(1)-If any mechanical functions do not operate when manually cycled on, the problem IS NOT with the ETM. Troubleshoot the unit and replace or repair defective components.

(2)-If all mechanical functions operated properly when manually cycled on, the problem IS WITH THE ETM. Replace the ETM.

E-Turn off power.

F-Remove all jumpers or toggle switches.

G-Replace fuse (F1) on ETM.

H-Restore power to unit.

J-Go to step 1.

TABLE 2
UNIT CHECK-OUT

INSTALL JUMPER ON RELAY	UNIT FUNCTION
G (fan)	Blower on; leave jumper on until cooling tests are complete
Damper/econ and Nite Close/Nite	Day/occupied mode - Low enthalpy: outdoor air damper open High enthalpy: outdoor air damper minimum
Damper/ econ only	Night/unoccupied mode - Low enthalpy: outdoor air damper closed High enthalpy: outdoor air damper closed
Y1 (cool 1)	First-stage cooling on
Y2 (cool 2)	Second-stage cooling on
W1 (heat 1)	First-stage heating on
W2 (heat 2)	Second-stage heating on

NOTE - Allow for built-in time delays, timed off delays and delays between first and second stage compressor when troubleshooting

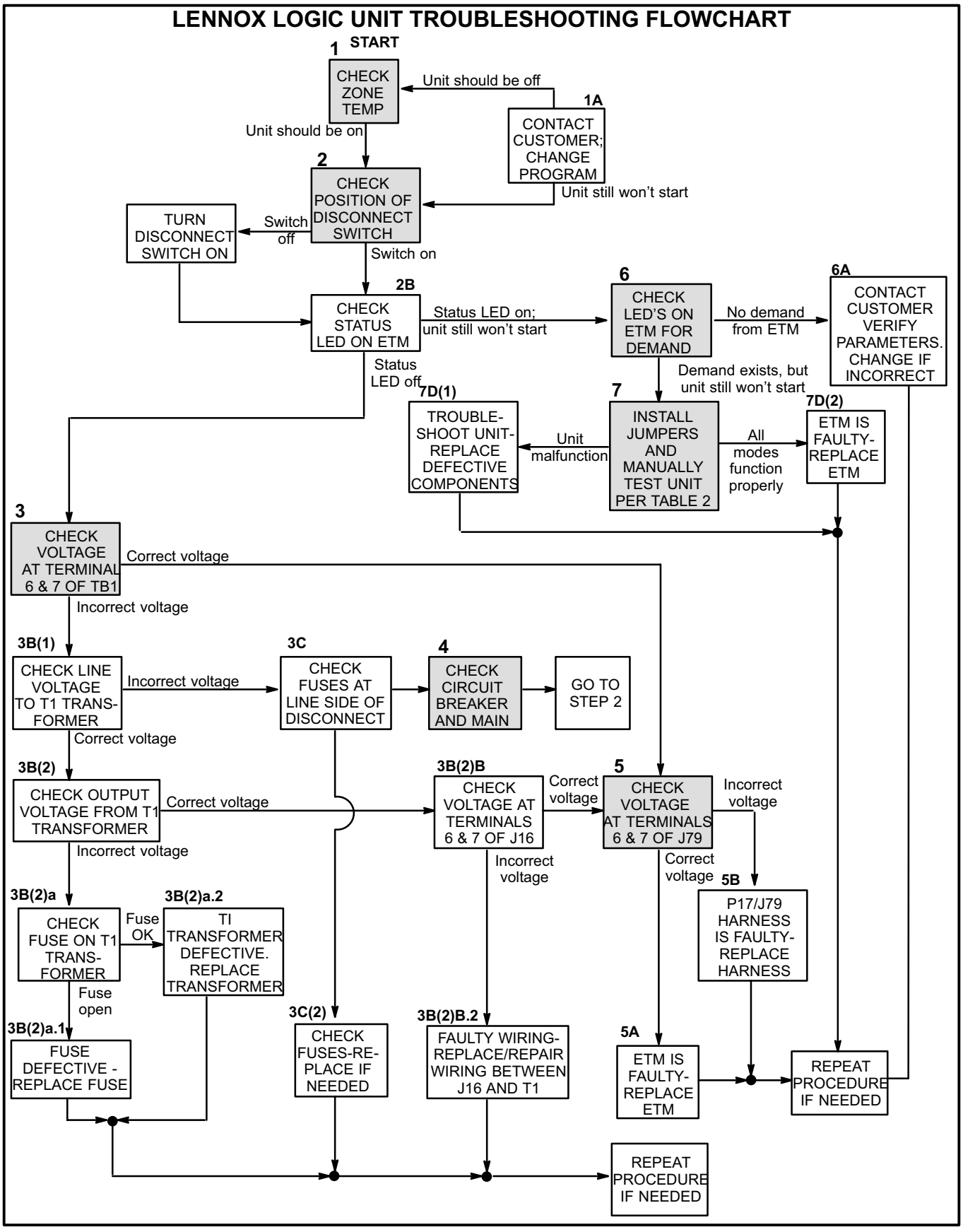
B-BLOWER RUNS BUT UNIT DOES NOT COOL

1- Check zone temperature with thermometer at the RTS (return air sensor) or WTS (wall/room sensor). If a wall sensor is used make sure return air sensor plug P62 is disconnected from return air sensor jack J62. Verify that the unit should be on in the cooling mode based on the setpoint and program schedule. The default cooling setpoint is 74°F and the default cooling setback is 85°F.

A-If the zone temperature, setpoint, and program schedule indicate that the unit should not be on, contact customer to have the setpoint or program schedule changed to create a cooling demand.

B-If the zone temperature, setpoint, and program schedule indicate that the unit should be running in the cooling mode, proceed to the roof to troubleshoot the unit. Go to step 2 of the troubleshooting procedure.

LENNOX LOGIC UNIT TROUBLESHOOTING FLOWCHART



Checking Specific Alarms

A-Communications losses:

Causes

1-No power to the ETM. Check status LED on ETM.

a-If status LED is off, refer to step 2 of troubleshooting procedure.

b-If alarm still exists, check the dip switch setting on the ETM. If the module address is incorrect or duplicate addresses exist in the system, correct the switch settings. See figure 16.

IMPORTANT- If duplicate module addresses exist, there can be multiple communication losses indicated on the ESS computer screen. It is extremely important that module addresses are the same as indicated in program!

Checkout Procedure

After you have confirmed that the ETM has 24vac power and that the module is addressed correctly:

1-Checking ETM Output Voltage

DIsconnect communication wires from unit TB1 terminals 2, 3 and 8. Measure the voltage from terminals 2 to 3 and terminals 8 to 3 at TB1 terminal strip. Output voltage should be approximately 2.5vdc. If voltage is incorrect, turn disconnect off and back on to reset ETM. If output voltage is still not correct and the ETM has the correct input voltage, this would indicate a problem within the ETM. Replace the ETM. If output voltage is correct, re-connect the communication wires and wait three minutes to verify that communication is established. After a three-minute start-up delay, the status LED should be on steadily, and then flash off approximately every twenty seconds to indicate normal communication. The LED flashes constantly to indicate the ETM is not communicating with the executive module. The status LED will be off during the three-minute start-up. A16 negative communication wire MUST go to TB1 terminal 2, A16 positive wire MUST go to TB1 terminal 8 and A16 shield wire (SH) MUST go to terminal 3. If communication loss still exists, proceed to step 2 below.

2-Checking Communication Line Voltage

Disconnect communication wires from terminals 2 and 8 of TB1 and measure the voltage of each of the wires from plus (+) to shield and minus (-) to shield. The voltage should be fluctuating and have a value of approximately 2.5vdc. If voltage measured is 2.5 volts continuous, this indicates an open condition in the communication network between this unit and the executive module. If voltage measured is 0 volts continuous, this indicates an open condition between this unit and all modules. This condition is external to the unit and is normally the responsibility of the installing contractor.

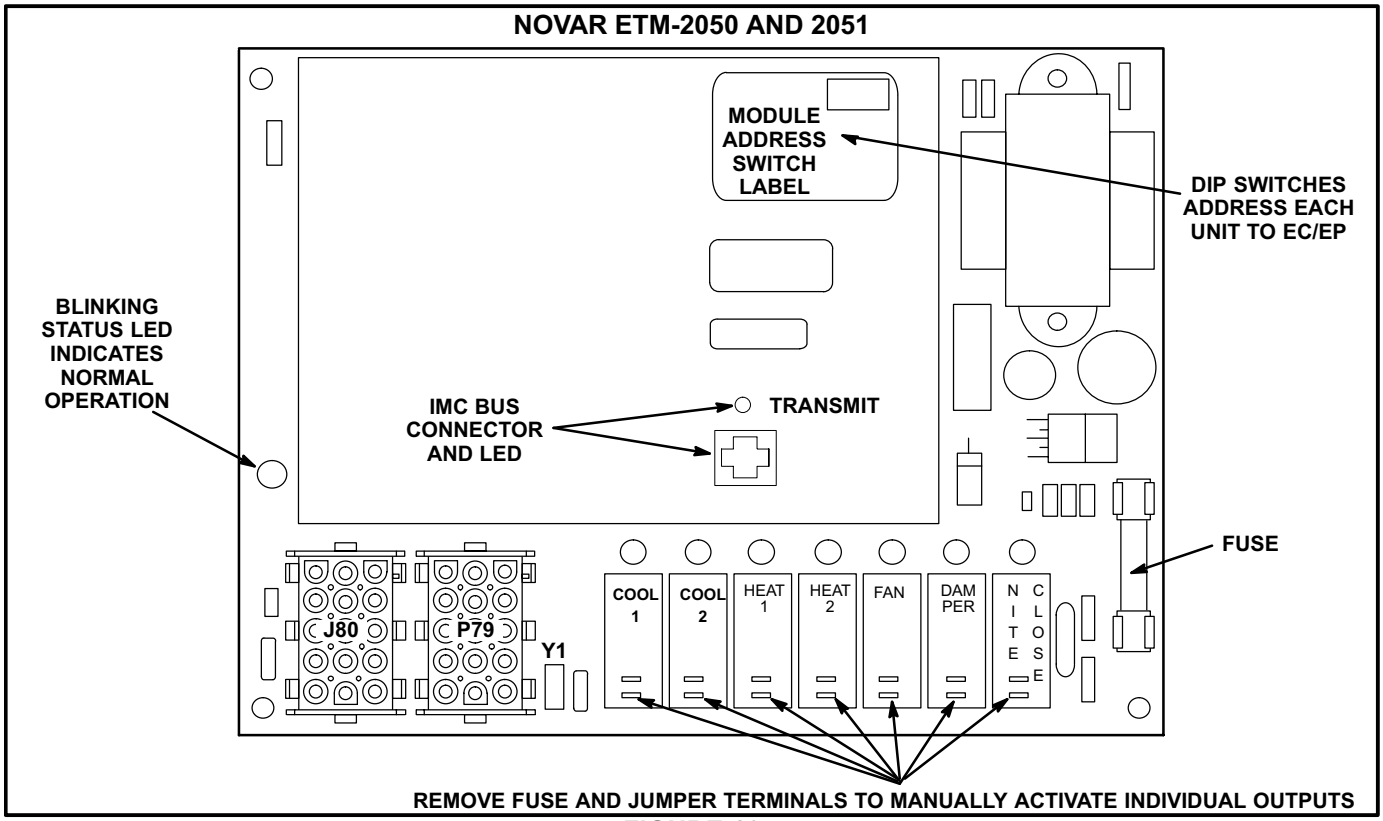


FIGURE 16

B-Sensor Faults

Causes

1- Damaged sensor

2- Terminations incorrect (see wiring diagram)

(A2) ZONE SENSOR	(RT1) DISCH. SENSOR
Red (+) connect to term. 9 of TB1	Red (+) connects to pin 11 of plug P17
Black (-) connects to term. 5 of TB1	Black (-) connects to pin 5 of plug P17

3- Polarity reversed

4- Open or short in wiring

5- Faulty sensor

Checkout procedure

Visually check sensor(s) for damage or tampering. If sensor(s) appear OK, use a voltmeter to check sensor(s). Connect voltmeter across sensor(s) as follows:

VOLTMETER	(A2) ZONE SENSOR	(RT1) DISCH. SENSOR
(+) Lead connects	To term. 9 of TB1	To pin 11 of plug P17
(-) Lead connects	To term. 5 of TB1	To pin 5 of plug P17

TABLE 3
SENSOR VOLTAGE VS. TEMPERATURE

APPROXIMATE TEMPERATURE (DEG. F)	APPROX. VOLTAGE (VOLTS DC)
50	.591
57	.582
77	.557
95	.535
115	.510
150	.465

Compare voltage measured to the values shown in table 3 for the given temperature. If voltage is not within range, this indicates the sensor may be defective. Replace sensor(s).

C-Airflow Alarms

Causes

1- Damaged or dislodged tubing

2- Switch mounted incorrectly

3- Poor electrical connections

4- Switch damaged or out of calibration

Checkout procedure

When blower is activated the switch contacts should close, indicating that the blower motor is running and circulating air. If airflow switch does not close, check to see if tubing has been damaged, dislodged, or kinked.

If everything checks out but airflow alarms still exist, remove wiring from switch. Activate the blower and measure the resistance across the switch contacts with an ohmmeter. Resistance should be LESS THAN 5 ohms. If resistance is more than 5 ohms, replace switch.

D-Dirty Filter Alarms

Causes

1- Damaged or dislodged tubing

2- Switch mounted incorrectly

3- Poor electrical connections

4- Switch damaged or out of calibration

5- Dirty filter

Checkout procedure

1-To indicate an approximately 50% filter blockage, the dirty filter switch should be calibrated to close at .5 inches differential on 2/5-ton units and 1-inch differential on 6.25/25-ton units. If filter is O.K. and alarm still exists proceed to step 2.

2- Visually check to see if tubing has been damaged, dislodged, or kinked.

3- Remove wires from switch. Activate the blower and measure the resistance across the switch contacts with an ohmmeter. If filter is not dirty, the resistance should be infinite. If the resistance is not infinite this indicates that the contacts are closed and the switch should be replaced.