

Modulating Furnace Information

Pressure Transducer		Warning on Meter Setting - Read First!			
Pressure	DC Volts	When checking a transducer, the meter must be set for DC Volts . If the meter is inadvertently set to "Ohms", the meter's battery voltage will be applied to the microprocessor on the control board resulting in a failed board. The DC Volt measurement should be taken between the Black and Green wires at the Transducer plug.			
0.00"	0.25				
0.20"	0.63				
0.25"	0.72				
0.30"	0.82				
0.35"	0.91				
0.40"	1.00				
0.45"	1.09				
0.50"	1.19				
0.55"	1.28				
0.60"	1.38				
0.65"	1.47				
0.70"	1.56				
0.75"	1.66				
0.80"	1.75				
0.85"	1.84				
0.90"	1.94				
0.95"	2.03				
1.00"	2.13				
1.05"	2.22				
1.10"	2.31				
1.15"	2.41				
1.20"	2.50				
1.25"	2.59				
1.30"	2.69				
1.35"	2.78				
1.40"	2.88				
1.45"	2.97				
1.50"	3.06				
1.55"	3.16				
1.60"	3.25				

Thermostat Settings			
Electro-Mechanical Heat Anticipator - 0.1 Amps			
Digital Cycle Rate - 6 Cycles per Hour			

Modulating Gas Valve		Discharge Air Sensor	
mA DC	Firing Rate	Temp F	Ohms
40 mA	35%	70°	11832 Ω
57 mA	40%	110°	4633 Ω
90 mA	50%	120°	3733 Ω
107 mA	60%	130°	3027 Ω
125 mA	70%	140°	2470 Ω
142 mA	80%	150°	2028 Ω
160 mA	90%	160°	1674 Ω
177 mA	100%	170°	1390 Ω
		180°	1160 Ω

Pressure Switch Information				
Furnace	Operating Switch	Max. Operating Points		Cond. Switch
		Close	Open	
97%	0.67"	0.90"	0.57"	0.20"
80%	0.40"	0.63"	0.30"	

Pressure Switch Operation:

At the beginning of the ignition cycle, the inducer ramps up until the pressure switch closes, which must occur at a pressure no higher than the switch setting plus 0.10" tolerance plus 0.13" hysteresis, or in the case of an 80% modulating furnace with a 0.40" switch, the switch must close before the pressure reaches 0.63". If the switch doesn't close at the correct pressure, the control will display a three red flash error code and will not continue the ignition sequence.

After the closing point has been verified, the inducer will ramp down until the switch opens, but no lower than the switch setpoint minus 0.10" tolerance, or in the case of 80% modulating models, it will ramp down until the switch opens, but no lower than 0.30". If the switch doesn't open in a specified time, the control will display a two red flash error code and will not continue the ignition sequence.

This checking occurs not just at startup, but at any time during normal ramp up or down that should result in a switch opening or closing. So at any time during the furnace operation, if the switch is open when it should be closed or vice versa, the control will shut the furnace down.

Note: The furnace may operate with the pressure switch open if the above checks have been passed.

Modulating Furnace Information

Error Status Codes - 33" Modulating Furnace		
Flashes	Color	Condition
Off	Red	No Line Power to Control.
1	Red	Flame present with gas off.
2	Red	Pressure switch closed with inducer pressure below allowed tolerance.
3	Red	Pressure switch open with inducer pressure above allowed tolerance.
4	Red	High Limit Switch open, Fuse open, or Sensor temperature above allowed limit.
5	Red	Auxiliary Limit String or Safety Relay open when it should be closed.
6	Red	Modulated Gas Valve current failure.
7	Red	Lockout due to no ignition. (Flame could not be sensed).
8	Red	Lockout due to flame recycles. (Flame is lost after being sensed).
9	Red	Incorrect line voltage polarity.
10	Red	Gas valve circuit is shorted.
11	Red	Main Blower Failure.
12	Red	Identity Plug loose or missing.
Steady On	Red	Control Fault Detected; No 24 Volt Power
Slow	Green	Normal Operation - No call for heat.
Slow	Amber	Gas Off - Call for Heat. (Control is in ignition process, flame has not been sensed.)
1	Amber	Call for Cooling.
2	Amber	Gas On - Call for Heat. (Run 1)
3	Amber	Gas On - No Call for Heat. (Run 2)
4	Amber	Suppressed firing rate due to Soft Limit.
5	Amber	Suppressed firing rate due to Low Combustion Air.
6	Amber	Heat Pump Heating Operation
7	Amber	Compressor ON - No Call for Cooling (Cooling Run 2).
Rapid	Amber	Flame sense current is below 1.5 Microamps.
Rapid	Green	Control is in "Test Mode" with no call for heat.
Test Mode		<p>Test Mode should be used for startup and service procedures. With power on and no call for heat, press the TEST Button. The 'Fault Light' will flash red. When the Test Button is released, the Fault Light will flash Rapid Green. Initiate a call for heat. Upon proving flame, the firing rate will go directly to 100%. After proving flame and with the burners on, pressing the Last Error button 1, 2 or 3 times within 2 seconds will allow you to select a firing rate. 1 press = 35%; 2 presses = 70%; 3 presses = 100%. If left in Test Mode, the last firing rate will be used on each successive call for heat. To exit Test Mode, cycle power off then back on. The control will time out and exit Test Mode after 150 minutes.</p>
Run 1		<p>Burners are on with a call for heat. After flame is sensed, the burners modulate down to 35% and operate for 6 minutes. After 6 minutes, firing rate begins a steady modulation upward until full fire (100%) is reached if the call for heat remains on. This takes approximately 16 minutes from 35% to 100% firing rate. If the call for heat is satisfied, the control enters 'Run 2 Mode'.</p>
Run 2		<p>Burners are on without a call for heat. When the thermostat satisfies, the furnace continues to fire at a reduced rate, based on what the firing rate was when the thermostat satisfied. 35% thru 54% = Run 2. 55% thru 100% = Extended Run 2. Those are further explained in the Training Manual. Run 2 cannot be initiated unless preceded by a Run 1. The furnace attempts to cycle between Run 1 and Run 2 without shutting off, which results in the greatest efficiency and comfort.</p>

Modulating Furnace Trouble Shooting Guide

LED INDICATIONS DURING FURNACE TEST MODE:

The Test Mode allows the furnace to be tested at low, medium, and high firing rate to verify the modulation range.

The Test mode will operate for 150 minutes. After 150 minutes, the furnace will turn off and return to normal operation.

Test mode is initiated by:

1. Turn power OFF
2. Depress “test button” for one second and release.
3. Apply power and turn the thermostat “ON”.
4. After the unit has completed the initial warm-up, it will fire at the maximum rate. The firing rate can be changed by pressing error button 1, 2, or 3 times (1= low fire, 2= medium fire, 3= high fire).

The furnace test mode starts as soon as the button is released and will be indicated by RAPID GREEN FLASHES, followed by a four second pause. The control is then ready to accept a call for heat in the factory test mode. An operator can alternate among three firing rates by pressing the error button one, two, or three times during a two second period (1= low fire, 2= medium fire, 3= high fire).

STEADY ON RED: The test button is depressed.

RAPID GREEN FLASH: indicates that furnace in factory test mode.

1 GREEN FLASH: indicates a low firing rate heating cycle is underway.

2 GREEN FLASHES: indicates a medium firing rate heating cycle is underway.

3 GREEN FLASHES: indicates a high firing rate heating cycle is underway.

INDICATION OF FURNACE FAILURES:

While the furnace is in stand-by mode, meaning there is no call from the thermostat for heating, cooling or fan, the operator can retrieve up to the last five failure codes saved by the control by pushing the Error Code button. A failure code is indicated by a number of RED FLASHES follow by a 2-second pause. The last five failure codes will be displayed. For example, code 7 is a sequence of seven (7) red flashes “on” followed by a 2-second pause and then the next failure code is displayed. A failure code is retained until the system is reset or a new failure is detected. Hold the Error Code button down for 5 seconds to “clear” all failure code memory; the LED will display three (3) green flashes when clear. If there are no failure codes, the LED will display two (2) green flashes when checked.

Modulating Furnace Trouble Shooting Guide

The control puts the system in lockout mode and displays the last failure code when a failure is detected. See **LOCKOUT STATE** for description for details.

The failure code identifies the system error detected, but not exact cause of failure. For any failure code, the technician should check for short and open wires, hoses, ducts, filters, protection switches such as primary, rollout and pressure switches, temperature sensor, air measurement hoses, loose mounting, wrong wiring and installation.

Code	Description	Response Comments	Probable Causes	Solutions
1 Red Flash	Improper Flame Sensed	Flame is sensed when gas valve is commanded off.	A. Flame remains lit in "Off" cycle.	<ol style="list-style-type: none"> 1. Gas valve leaks - check wiring to remove continuous 24V to gas valve. 2. Gas valve is stuck open – remove, repair or replace gas valve.
2 Red Flashes	Pressure switch contacts are closed when they should be open.	The control validates combustion air comparing the pressure switch and pressure sensor values. If they do not agree, the unit locks out. NOTE: Item "C" does not apply to 40" furnaces as the sensor is mounted on the board.	A. Faulty wiring or connections.	<ol style="list-style-type: none"> 1. Check pressure switch wiring. 2. Check remote pressure sensor wiring. 3. Check inducer wiring. 4. Check for broken or disconnected air tube hoses. 5. Check air inlet and outlet for blockage. 6. Check inlet stack length.
			B. Faulty pressure switch.	1. Replace pressure switch.
			C. Faulty pressure Sensor.	1. Replace pressure sensor.
			D. Faulty board.	1. Replace board.

Modulating Furnace Trouble Shooting Guide

Code	Description	Response Comments	Probable Causes	Solutions
3 Red Flashes	Pressure switch contacts are open when they should be closed.	<p>The control validates combustion air comparing the pressure switch and pressure sensor values. If they do not agree, the unit locks out.</p> <p>NOTE: Item “C” does not apply to 40” furnaces as the sensor is hard wired to the board.</p>	A. Faulty wiring or connections.	<ol style="list-style-type: none"> 1. Check pressure switch wiring. 2. Check remote pressure sensor wiring. 3. Check inducer wiring. 4. Check for broken or disconnected air tube hoses. 5. Check air inlet and outlet for blockage. 6. Check inlet stack length.
			B. Faulty pressure switch.	1. Replace pressure switch.
			C. Faulty pressure sensor	1. Replace pressure sensor.
			D. Faulty board	1. Replace board.
4 Red Flashes	Over temperature in heat exchanger.	This is caused by open primary limit string or temperature sensor located in plenum heat exchanger.	A. Improper inlet airflow.	<ol style="list-style-type: none"> 1. Check filter / replace if dirty. 2. Check for improperly sized duct system. 3. Check for faulty blower motor. 4. Check for faulty wiring. 5. Check for temperature sensor connection, reconnect or replace temperature sensor. 6. Check for any open primary limit string switch. 7. Check primary wiring on pins 1 & 2 at Board location J4.
			B. Fuse is blown	1. Check and replace fuse on the board.
			C. Temperature Sensor probe not connected.	1. Check Temperature Sensor Probe connection.

Modulating Furnace Trouble Shooting Guide

Code	Description	Response Comments	Probable Causes	Solutions
5 Red Flashes	Auxiliary limit (flame roll-out switch) is open.	<p>This indicates flame roll out into the combustion vestibule has been detected.</p> <p><i>Be sure to reset the rollout switch after correcting the failure condition, if it is open.</i></p>	A. Improper combustion air.	<ol style="list-style-type: none"> 1. Check for proper combustion air. 2. Check for proper inducer operation. 3. Check for primary heat exchanger failure. 4. Check for burner problem. 5. Check for faulty wiring.
			B. Defective roll out switch or temperature switch on the inducer.	<ol style="list-style-type: none"> 1. Check if rollout switch or inducer temperature switch has failed open. 2. Replace roll out switch. 3. Check auxiliary wiring on pins 3 & 4 at Board location J4.
6 Red Flashes	Modulation failure.	Indicates an improper ratio of gas and air in the combustion burner has been detected.	A. Faulty gas valve.	<ol style="list-style-type: none"> 1. Check for faulty gas valve wiring. 2. Replace modulating gas valve.
			B. Improper airflow in combustion burner.	<ol style="list-style-type: none"> 1. Check for proper airflow in combustion burner due to inducer. 2. Check air inlet pipes. 3. Check measurement hoses. 4. Check pressure switch.
			C. Faulty air pressure sensor.	<ol style="list-style-type: none"> 1. Check air pressure sensor on the control and reconnect hoses. 2. Replace board if air pressure sensor on the board is broken.

Modulating Furnace Trouble Shooting Guide

Code	Description	Response Comments	Probable Causes	Solutions
7 Red Flashes	Flame could not be established.	This fault code indicates that the flame could not be established during the time provided. This no-light condition occurs after 4 attempts (3 retries) during an initial call for heat. Then the furnace is locked out for one hour and will automatically reset.	A. Insufficient gas line pressure.	1. Insure gas supply is connected to furnace and check for proper line pressure.
			B. Gas valve control turned "OFF".	1. Turn gas valve to the "ON" position.
			C. No ignition from hot surface igniter.	1. Check igniter voltage and wiring. 2. Replace hot surface igniter.
			D. Faulty gas valve.	1. Check for faulty gas valve wiring. 2. Replace modulating gas valve.
			E. Insufficient manifold pressure, gas valve "ON" at 100% fire.	1. Check 24 VAC to gas valve. 2. Check for 170 – 190 mAmps to gas valve. 3. Check inlet gas pressure. 4. Adjust valve for proper manifold pressure at 100% rate. 5. If gas valve will not adjust, replace gas valve.
			F. Burners do not light.	1. Check for proper mounting and placement of hot surface igniter. 2. Check for proper mounting of the burner assembly.
			G. Burners light and remain lit for about 5 seconds.	1. Check flame rod wiring and connections. 2. Check for proper alignment of flame rod.

Modulating Furnace Trouble Shooting Guide

Code	Description	Response Comments	Probable Causes	Solutions
8 Red Flashes	Lost flame signal after flame is established with call for heating.	This indicates that the flame sensor signal has been lost after flame is established during a call for heating.	A. Flame sensor coated.	1. Clean flame rod sensor.
			B. Flame sensor improperly mounted or grounded.	1. Check flame sensor wiring and connections. 2. Re-install / replace flame sensor.
			C. Unstable flame pattern.	1. Check that all burner assembly components are properly installed. 2. Check that all seals between the vestibule area and the heat exchanger area are tight. 3. Insure that the combustion door gasket is in place and the door is properly installed.
			D. Low gas pressure.	1. Check for low inlet gas pressure. 2. Replace modulating gas valve.
			E. Flame sensor too hot, shorts to ground.	1. Replace flame sensor.
9 Red Flashes	Reverse line voltage polarity or grounding problem.	Furnace ignores call for heating or cooling.	A. Polarity is reversed or faulty.	1. Line voltage polarity at furnace or branch circuit serving the furnace is reversed. 2. Check furnace grounding.
10 Red Flashes	Gas valve circuit shorted to 24 VAC or ground.	The control allows the gas on only with call for heating or when in Run 2 modulation in the heating stage. Run 2 is indicated by three AMBER flashes.	A. Faulty gas valve wiring.	1. Check gas valve wiring. 2. Re-install / replace gas valve.
			B. Control Board	1. Check wiring and connections into the J5 location on the control board. 2. Replace board.

Modulating Furnace Trouble Shooting Guide

Code	Description	Response Comments	Probable Causes	Solutions
11 Red Flashes	Main blower failure.	This indicates that there is an over temperature condition in the heat exchanger that is not cleared after 5 minutes.	A. Failed blower motor. <i>After 5 minutes in this condition, the control puts the furnace in a continuous lockout.</i>	<ol style="list-style-type: none"> 1. Check wiring to blower. 2. Check blower wheel/re-install. 3. Replace blower motor.
12 Red Flashes	Identity Plug	Furnace does not operate.	A. Furnace Identity Plug is loose or not connected.	<ol style="list-style-type: none"> 1. Check that ID Plug wires are all connected to the proper pin. 2. Connect furnace ID plug to board at J11 location. 3. Obtain the proper ID Plug from manufacturer.
Steady Red On	Firmware has detected an error.	The control has detected a system failure. This means that a component is on, or off, when it should not be.	A. Transformer	<ol style="list-style-type: none"> 1. Check 24-volt transformer for correct output. 2. Check connections and wiring to control board and other components connected to the 24 volt source. 3. Replace if necessary.
			B. Control Board	<ol style="list-style-type: none"> 1. Re-try ignition sequence and see if the system responds. 2. Replace control board.

Modulating Furnace Trouble Shooting Guide

Code	Description	Response Comments	Probable Causes	Solutions
Rapid Amber Flash	Flame rod is below 1.5 microampere	Measure flame rod terminals at the control board test points. 1 Volt corresponds to 1 microampere at the test point.	A. Loose or incorrect flame rod connections or positioning.	<ol style="list-style-type: none"> 1. Check flame rod wiring and connections. 2. Re-install / replace flame rod.
			B. Flame rod dirty or corroded.	<ol style="list-style-type: none"> 1. Clean and re-install. 2. Replace flame rod. 3. Correct condition causing corrosion.
No Light / LED off	No light indication on LED.	This indicates a problem with power to the control board.	A. Check the 120V path to the control board.	<ol style="list-style-type: none"> 1. Check the 120V path to the board including external circuit breakers, disconnects, wires, connections, and furnace door safety switch. 2. Replace control board.

LOCKOUT STATES WITH AUTOMATIC RESET AFTER LOCKOUT.

Any time that a failure occurs, the control brings the furnace to a lockout state.

The control will automatically reset itself under these conditions:

- a. If the airflow problem is detected after pre-purge and is cleared within 30 seconds with no other pending failures, the system will attempt to re-start
- b. When an overheating condition in the heat exchanger is cleared, no failures are detected for duration of at least 10 seconds, and there are no requests for cooling and heating the system will attempt to restart.
- c. After a 1-hour reset, if all active failure conditions are cleared during the reset period. To clear the 1-hour reset period immediately, turn the power off and then back on.

HARD LOCKOUT STATES REQUIRING MANUAL RESET AFTER LOCKOUT.

Detection of a main blower failure puts the furnace into a continuous lockout state. This lockout requires that the furnace power to be turned off and then back on to reset the control and allow an attempt to re-start.