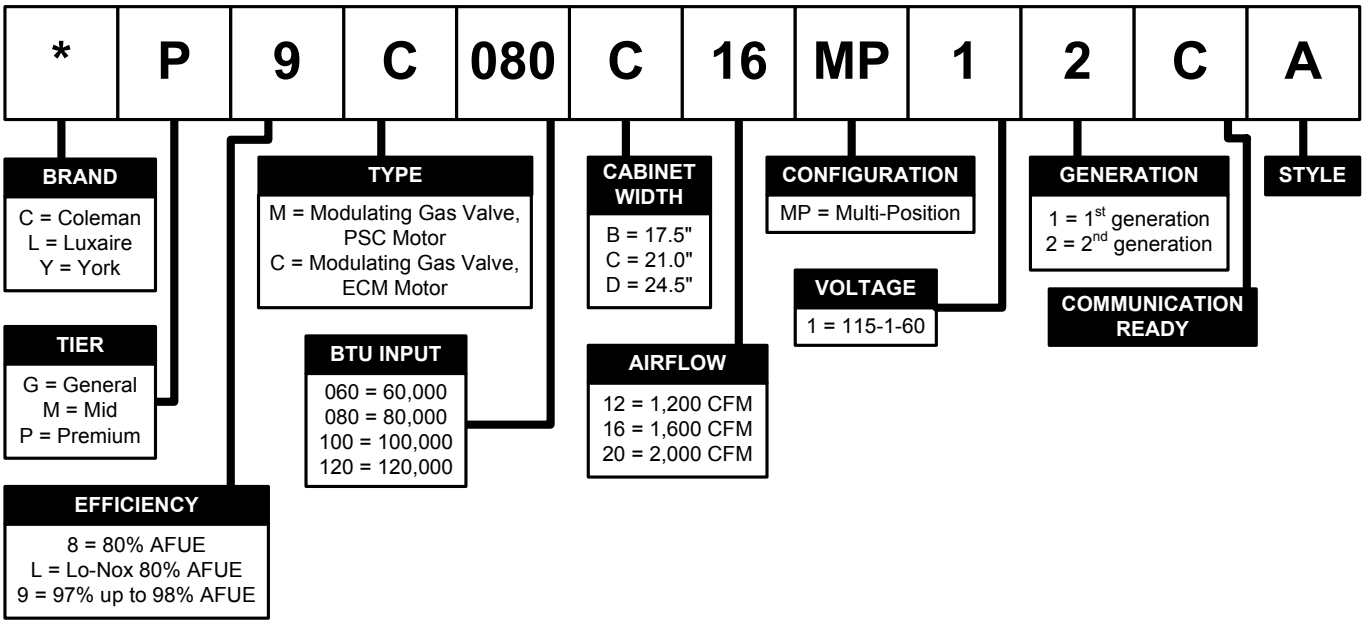
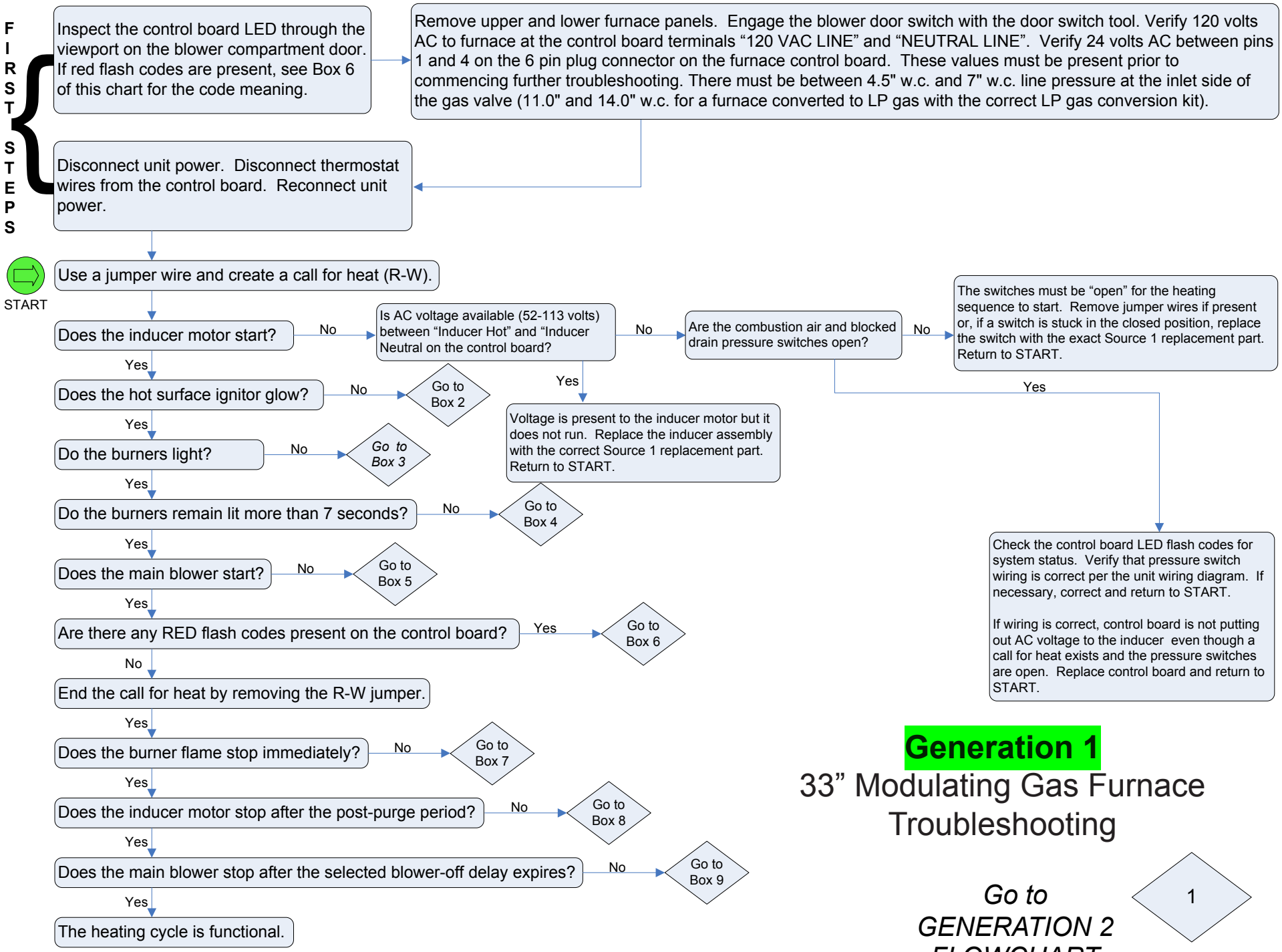
York Residential Gas Furnaces Troubleshooting

33” Modulating Furnace Troubleshooting Guide

Nomenclature

A model number change was implemented in August 2009 to distinguish between 33” Modulating Gas Furnace Generation 1 and 2, and those that have communication capability. The table below provides information to distinguish between the various models.



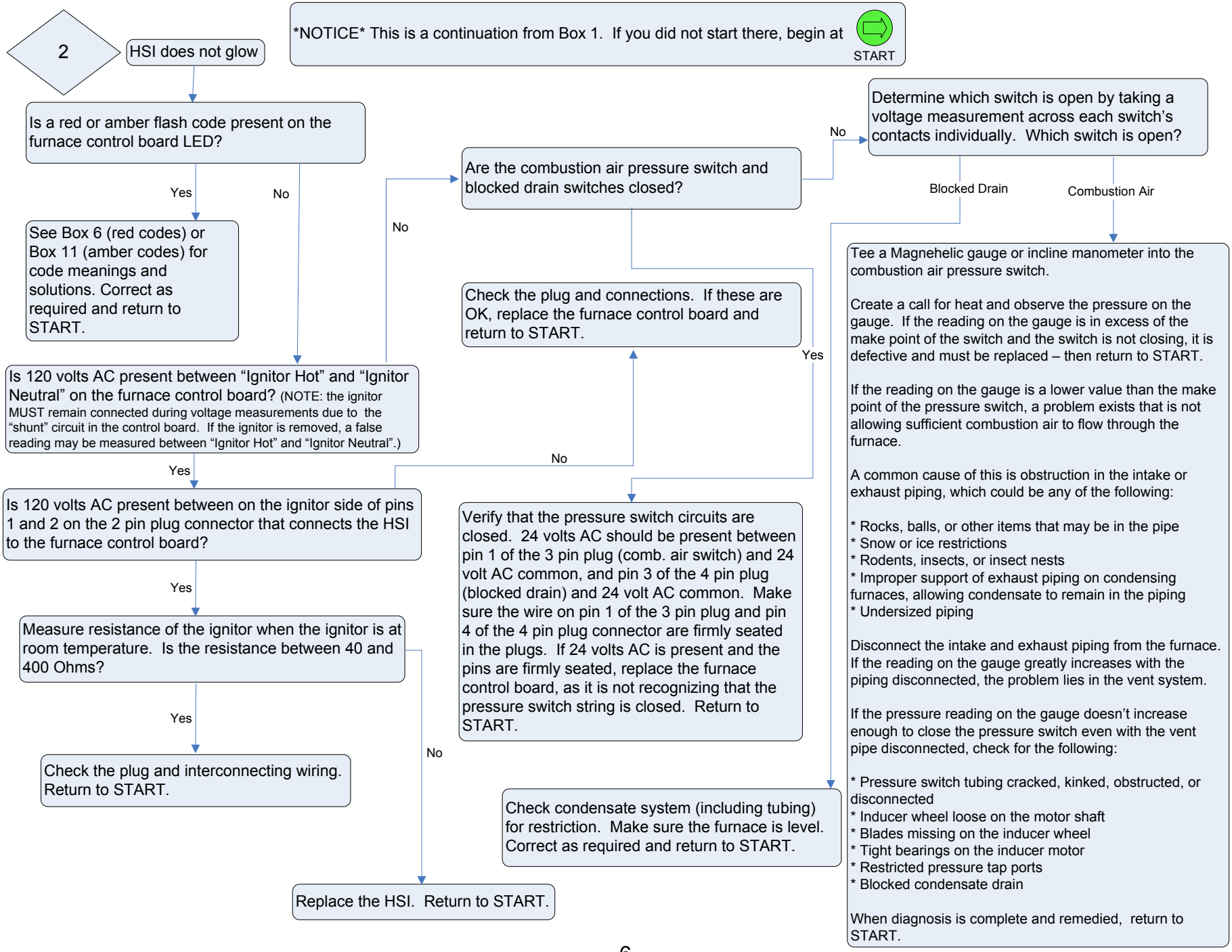


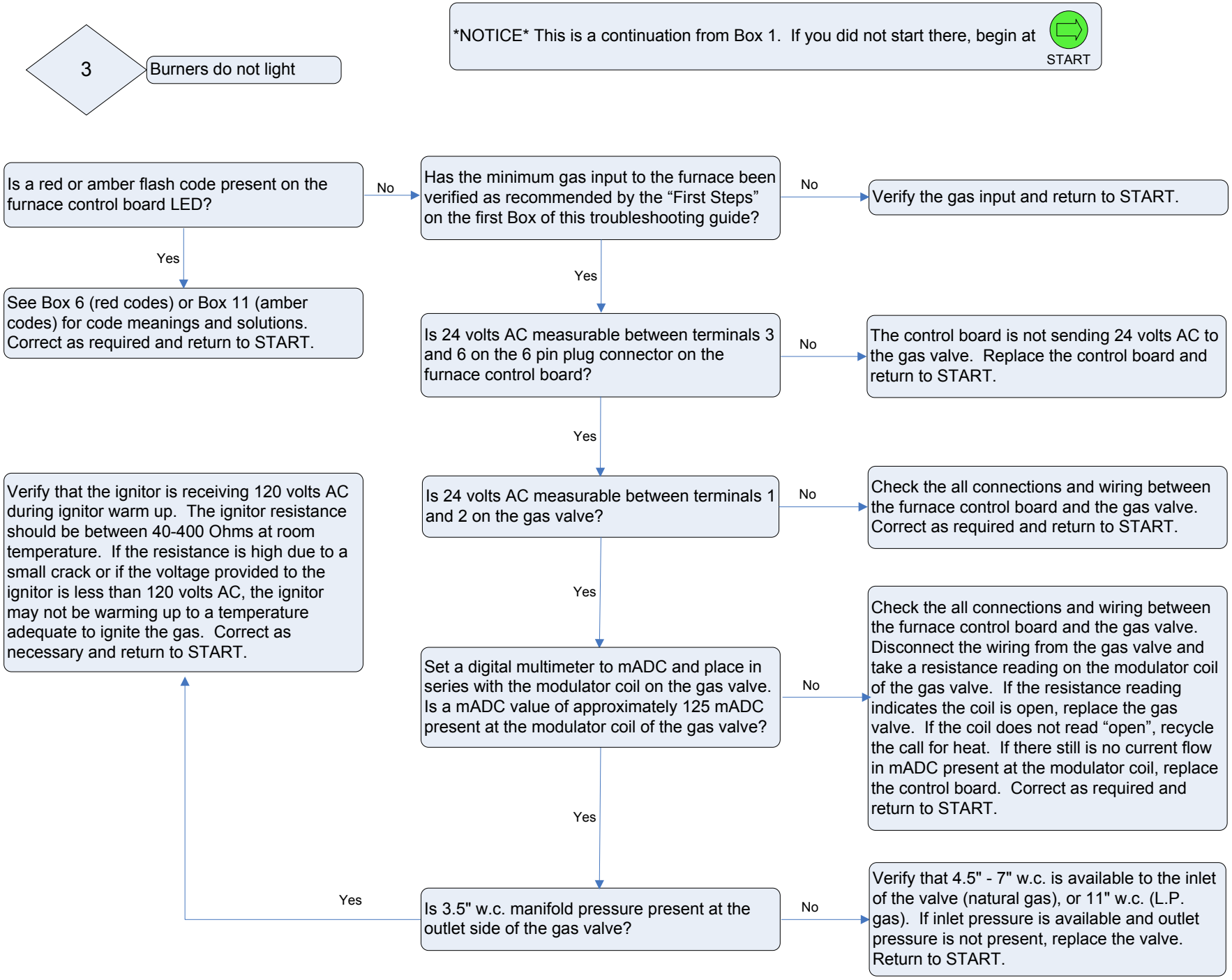
Generation 1

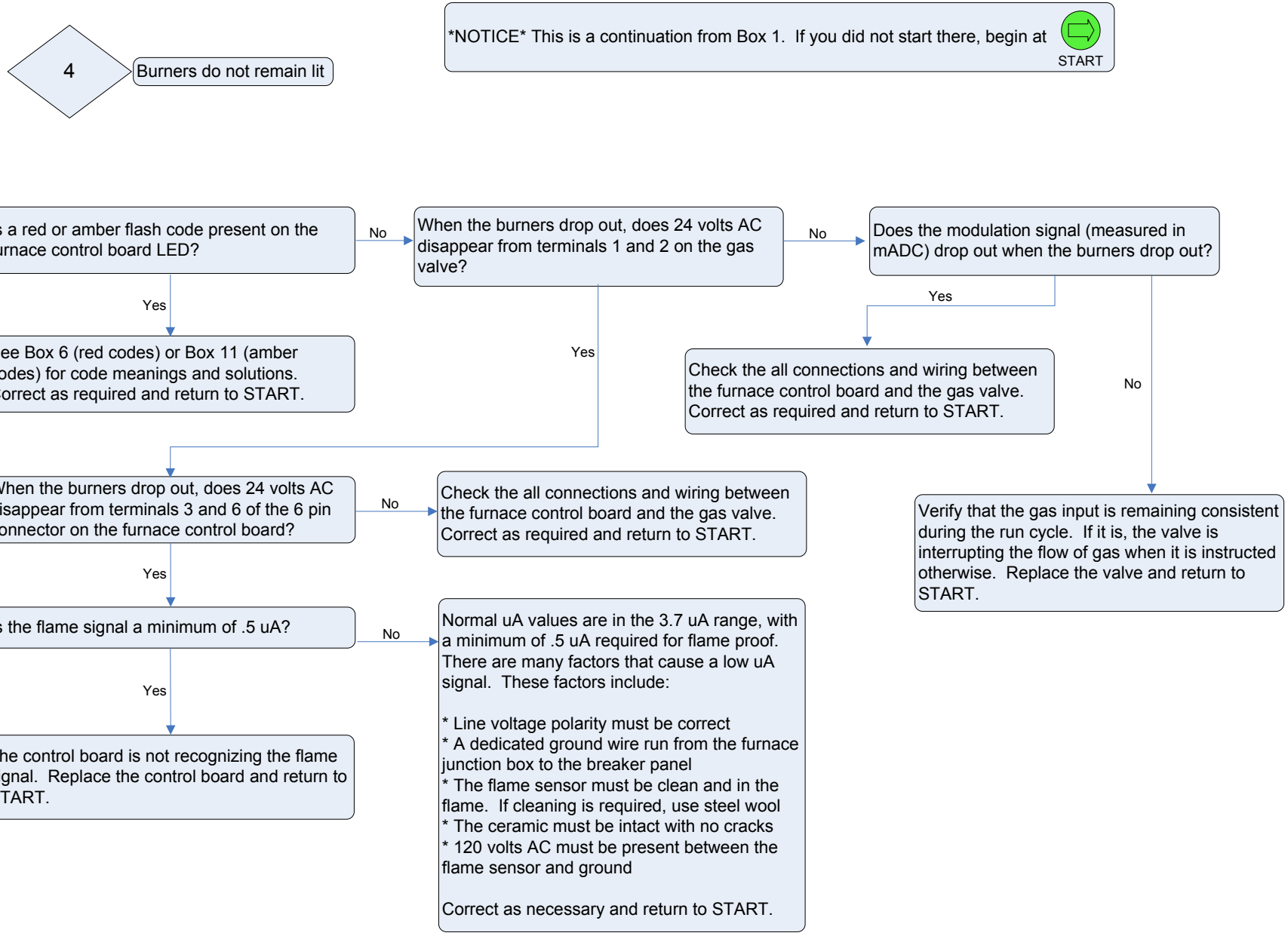
33" Modulating Gas Furnace Troubleshooting

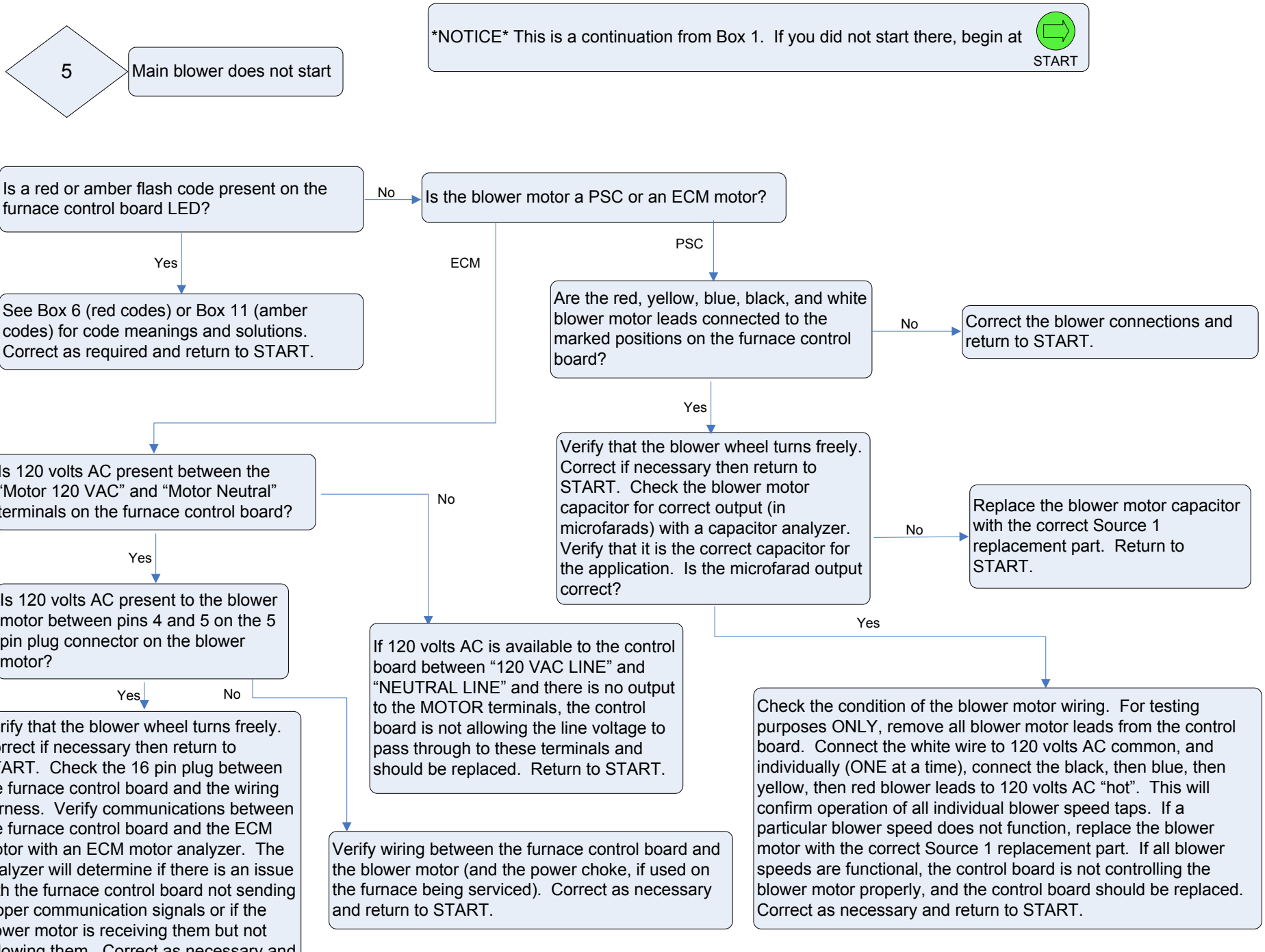
Go to GENERATION 2 FLOWCHART

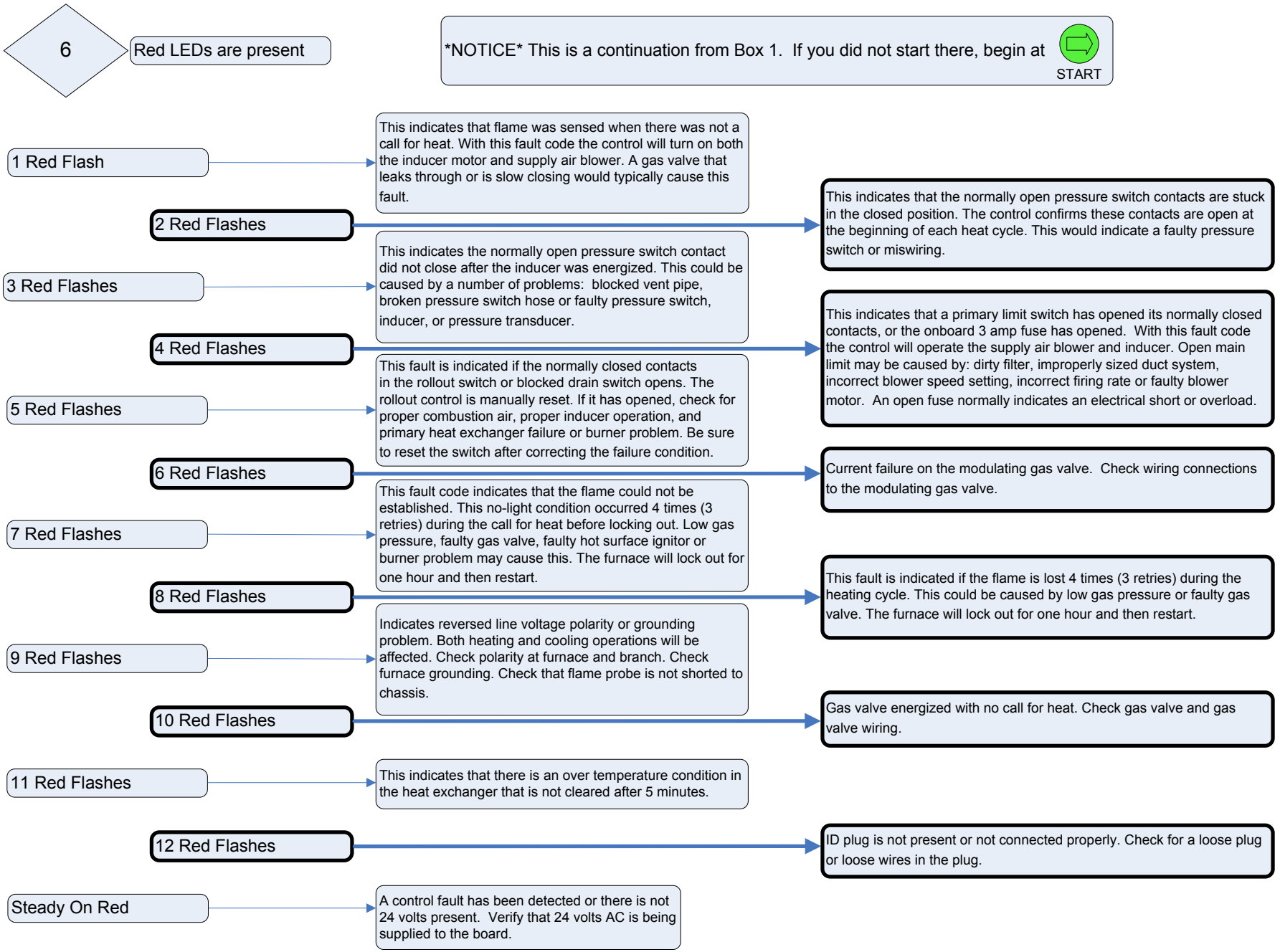
1


2
HSI does not glow
NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
Is a red or amber flash code present on the furnace control board LED?
Yes
No
See Box 6 (red codes) or Box 11 (amber codes) for code meanings and solutions. Correct as required and return to START.
Is 120 volts AC present between "Ignitor Hot" and "Ignitor Neutral" on the furnace control board? (NOTE: the ignitor MUST remain connected during voltage measurements due to the "shunt" circuit in the control board. If the ignitor is removed, a false reading may be measured between "Ignitor Hot" and "Ignitor Neutral".)
Yes
No
Are the combustion air pressure switch and blocked drain switches closed?
No
Yes
Check the plug and connections. If these are OK, replace the furnace control board and return to START.
Is 120 volts AC present between on the ignitor side of pins 1 and 2 on the 2 pin plug connector that connects the HSI to the furnace control board?
Yes
No
Verify that the pressure switch circuits are closed. 24 volts AC should be present between pin 1 of the 3 pin plug (comb. air switch) and 24 volt AC common, and pin 3 of the 4 pin plug (blocked drain) and 24 volt AC common. Make sure the wire on pin 1 of the 3 pin plug and pin 4 of the 4 pin plug connector are firmly seated in the plugs. If 24 volts AC is present and the pins are firmly seated, replace the furnace control board, as it is not recognizing that the pressure switch string is closed. Return to START.
Measure resistance of the ignitor when the ignitor is at room temperature. Is the resistance between 40 and 400 Ohms?
Yes
No
Check the plug and interconnecting wiring. Return to START.
Replace the HSI. Return to START.
Determine which switch is open by taking a voltage measurement across each switch's contacts individually. Which switch is open?
Blocked Drain
Combustion Air
Check condensate system (including tubing) for restriction. Make sure the furnace is level. Correct as required and return to START.
Tee a Magnehelic gauge or incline manometer into the combustion air pressure switch.
Create a call for heat and observe the pressure on the gauge. If the reading on the gauge is in excess of the make point of the switch and the switch is not closing, it is defective and must be replaced – then return to START.
If the reading on the gauge is a lower value than the make point of the pressure switch, a problem exists that is not allowing sufficient combustion air to flow through the furnace.
A common cause of this is obstruction in the intake or exhaust piping, which could be any of the following:
* Rocks, balls, or other items that may be in the pipe
* Snow or ice restrictions
* Rodents, insects, or insect nests
* Improper support of exhaust piping on condensing furnaces, allowing condensate to remain in the piping
* Undersized piping
Disconnect the intake and exhaust piping from the furnace. If the reading on the gauge greatly increases with the piping disconnected, the problem lies in the vent system.
If the pressure reading on the gauge doesn't increase enough to close the pressure switch even with the vent pipe disconnected, check for the following:
* Pressure switch tubing cracked, kinked, obstructed, or disconnected
* Inducer wheel loose on the motor shaft
* Blades missing on the inducer wheel
* Tight bearings on the inducer motor
* Restricted pressure tap ports
* Blocked condensate drain
When diagnosis is complete and remedied, return to START.


3
Burners do not light
NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
Is a red or amber flash code present on the furnace control board LED?
No
Has the minimum gas input to the furnace been verified as recommended by the “First Steps” on the first Box of this troubleshooting guide?
No
Verify the gas input and return to START.
Yes
See Box 6 (red codes) or Box 11 (amber codes) for code meanings and solutions. Correct as required and return to START.
Yes
Is 24 volts AC measurable between terminals 3 and 6 on the 6 pin plug connector on the furnace control board?
No
The control board is not sending 24 volts AC to the gas valve. Replace the control board and return to START.
Yes
Is 24 volts AC measurable between terminals 1 and 2 on the gas valve?
No
Check the all connections and wiring between the furnace control board and the gas valve. Correct as required and return to START.
Yes
Set a digital multimeter to mADC and place in series with the modulator coil on the gas valve. Is a mADC value of approximately 125 mADC present at the modulator coil of the gas valve?
No
Check the all connections and wiring between the furnace control board and the gas valve. Disconnect the wiring from the gas valve and take a resistance reading on the modulator coil of the gas valve. If the resistance reading indicates the coil is open, replace the gas valve. If the coil does not read “open”, recycle the call for heat. If there still is no current flow in mADC present at the modulator coil, replace the control board. Correct as required and return to START.
Yes
Is 3.5" w.c. manifold pressure present at the outlet side of the gas valve?
No
Verify that 4.5" - 7" w.c. is available to the inlet of the valve (natural gas), or 11" w.c. (L.P. gas). If inlet pressure is available and outlet pressure is not present, replace the valve. Return to START.
Yes
Verify that the ignitor is receiving 120 volts AC during ignitor warm up. The ignitor resistance should be between 40-400 Ohms at room temperature. If the resistance is high due to a small crack or if the voltage provided to the ignitor is less than 120 volts AC, the ignitor may not be warming up to a temperature adequate to ignite the gas. Correct as necessary and return to START.


4
Burners do not remain lit
NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
Is a red or amber flash code present on the furnace control board LED?
No
When the burners drop out, does 24 volts AC disappear from terminals 1 and 2 on the gas valve?
No
Does the modulation signal (measured in mADC) drop out when the burners drop out?
Yes
See Box 6 (red codes) or Box 11 (amber codes) for code meanings and solutions. Correct as required and return to START.
Yes
Check the all connections and wiring between the furnace control board and the gas valve. Correct as required and return to START.
No
Verify that the gas input is remaining consistent during the run cycle. If it is, the valve is interrupting the flow of gas when it is instructed otherwise. Replace the valve and return to START.
Yes
When the burners drop out, does 24 volts AC disappear from terminals 3 and 6 of the 6 pin connector on the furnace control board?
No
Check the all connections and wiring between the furnace control board and the gas valve. Correct as required and return to START.
Yes
Is the flame signal a minimum of .5 uA?
No
Normal uA values are in the 3.7 uA range, with a minimum of .5 uA required for flame proof. There are many factors that cause a low uA signal. These factors include:
* Line voltage polarity must be correct
* A dedicated ground wire run from the furnace junction box to the breaker panel
* The flame sensor must be clean and in the flame. If cleaning is required, use steel wool
* The ceramic must be intact with no cracks
* 120 volts AC must be present between the flame sensor and ground
Correct as necessary and return to START.
Yes
The control board is not recognizing the flame signal. Replace the control board and return to START.


5
Main blower does not start
NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
Is a red or amber flash code present on the furnace control board LED?
No
Is the blower motor a PSC or an ECM motor?
Yes
See Box 6 (red codes) or Box 11 (amber codes) for code meanings and solutions. Correct as required and return to START.
ECM
PSC
Are the red, yellow, blue, black, and white blower motor leads connected to the marked positions on the furnace control board?
No
Correct the blower connections and return to START.
Yes
Verify that the blower wheel turns freely. Correct if necessary then return to START. Check the blower motor capacitor for correct output (in microfarads) with a capacitor analyzer. Verify that it is the correct capacitor for the application. Is the microfarad output correct?
No
Replace the blower motor capacitor with the correct Source 1 replacement part. Return to START.
Yes
Check the condition of the blower motor wiring. For testing purposes ONLY, remove all blower motor leads from the control board. Connect the white wire to 120 volts AC common, and individually (ONE at a time), connect the black, then blue, then yellow, then red blower leads to 120 volts AC “hot”. This will confirm operation of all individual blower speed taps. If a particular blower speed does not function, replace the blower motor with the correct Source 1 replacement part. If all blower speeds are functional, the control board is not controlling the blower motor properly, and the control board should be replaced. Correct as necessary and return to START.
Is 120 volts AC present between the “Motor 120 VAC” and “Motor Neutral” terminals on the furnace control board?
No
If 120 volts AC is available to the control board between “120 VAC LINE” and “NEUTRAL LINE” and there is no output to the MOTOR terminals, the control board is not allowing the line voltage to pass through to these terminals and should be replaced. Return to START.
Yes
Is 120 volts AC present to the blower motor between pins 4 and 5 on the 5 pin plug connector on the blower motor?
Yes
No
Verify that the blower wheel turns freely. Correct if necessary then return to START. Check the 16 pin plug between the furnace control board and the wiring harness. Verify communications between the furnace control board and the ECM motor with an ECM motor analyzer. The analyzer will determine if there is an issue with the furnace control board not sending proper communication signals or if the blower motor is receiving them but not following them. Correct as necessary and return to START.
Verify wiring between the furnace control board and the blower motor (and the power choke, if used on the furnace being serviced). Correct as necessary and return to START.


6
Red LEDs are present
NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
1 Red Flash
This indicates that flame was sensed when there was not a call for heat. With this fault code the control will turn on both the inducer motor and supply air blower. A gas valve that leaks through or is slow closing would typically cause this fault.
2 Red Flashes
This indicates that the normally open pressure switch contacts are stuck in the closed position. The control confirms these contacts are open at the beginning of each heat cycle. This would indicate a faulty pressure switch or miswiring.
3 Red Flashes
This indicates the normally open pressure switch contact did not close after the inducer was energized. This could be caused by a number of problems: blocked vent pipe, broken pressure switch hose or faulty pressure switch, inducer, or pressure transducer.
4 Red Flashes
This indicates that a primary limit switch has opened its normally closed contacts, or the onboard 3 amp fuse has opened. With this fault code the control will operate the supply air blower and inducer. Open main limit may be caused by: dirty filter, improperly sized duct system, incorrect blower speed setting, incorrect firing rate or faulty blower motor. An open fuse normally indicates an electrical short or overload.
5 Red Flashes
This fault is indicated if the normally closed contacts in the rollout switch or blocked drain switch opens. The rollout control is manually reset. If it has opened, check for proper combustion air, proper inducer operation, and primary heat exchanger failure or burner problem. Be sure to reset the switch after correcting the failure condition.
6 Red Flashes
Current failure on the modulating gas valve. Check wiring connections to the modulating gas valve.
7 Red Flashes
This fault code indicates that the flame could not be established. This no-light condition occurred 4 times (3 retries) during the call for heat before locking out. Low gas pressure, faulty gas valve, faulty hot surface ignitor or burner problem may cause this. The furnace will lock out for one hour and then restart.
8 Red Flashes
This fault is indicated if the flame is lost 4 times (3 retries) during the heating cycle. This could be caused by low gas pressure or faulty gas valve. The furnace will lock out for one hour and then restart.
9 Red Flashes
Indicates reversed line voltage polarity or grounding problem. Both heating and cooling operations will be affected. Check polarity at furnace and branch. Check furnace grounding. Check that flame probe is not shorted to chassis.
10 Red Flashes
Gas valve energized with no call for heat. Check gas valve and gas valve wiring.
11 Red Flashes
This indicates that there is an over temperature condition in the heat exchanger that is not cleared after 5 minutes.
12 Red Flashes
ID plug is not present or not connected properly. Check for a loose plug or loose wires in the plug.
Steady On Red
A control fault has been detected or there is not 24 volts present. Verify that 24 volts AC is being supplied to the board.

NOTICE This is a continuation from Box 1. If you did not start there, begin at START

7

End of heating cycle – flames do not stop

Is a red or amber flash code present on the furnace control board LED?

Yes

See Box 6 (red codes) or Box 11 (amber codes) for code meanings. Three amber flashes indicates the furnace is in “Run 2” operation, which is a normal operating function. If RED flash codes are present, correct as required and return to START.

No

Verify that the heating cycle has ended by taking an AC voltage measurement between terminals “W” and “C” on the furnace control board. Zero volts measured here indicates the heat call is over. Is there a zero volt reading?

No

A heat call is still present.

Yes

Is 24 volts AC present between terminals 1 and 2 on the gas valve?

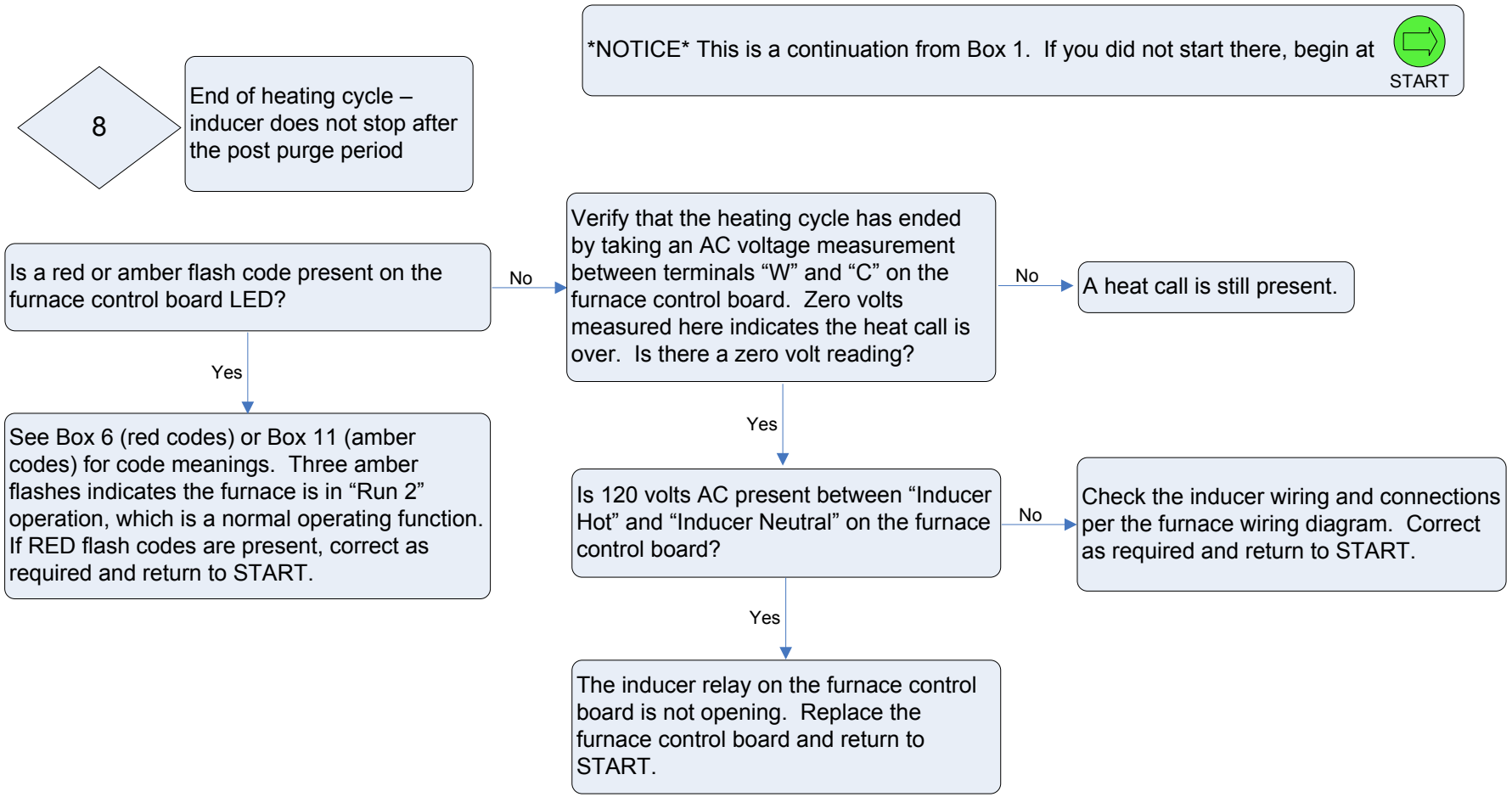
No

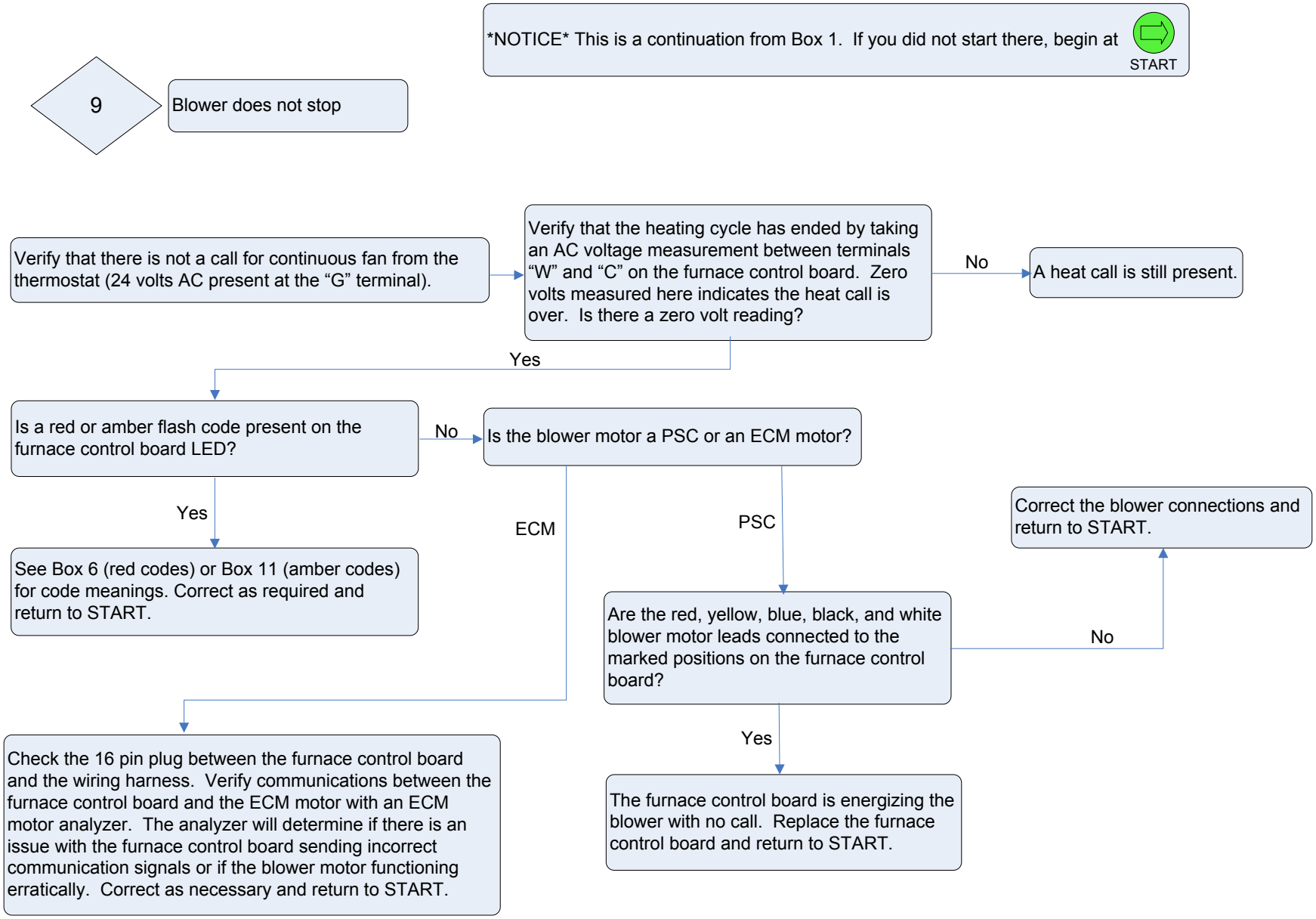
The gas valve is stuck in the open position. Replace the gas valve and return to START.

Yes

Check the wiring between the furnace control board and the gas valve. If an error exists, correct as necessary and return to START.

If the wiring is exactly per the wiring diagram, replace the furnace control board, as the board should not be energizing the gas valve after the call for heat has ended. Return to START.

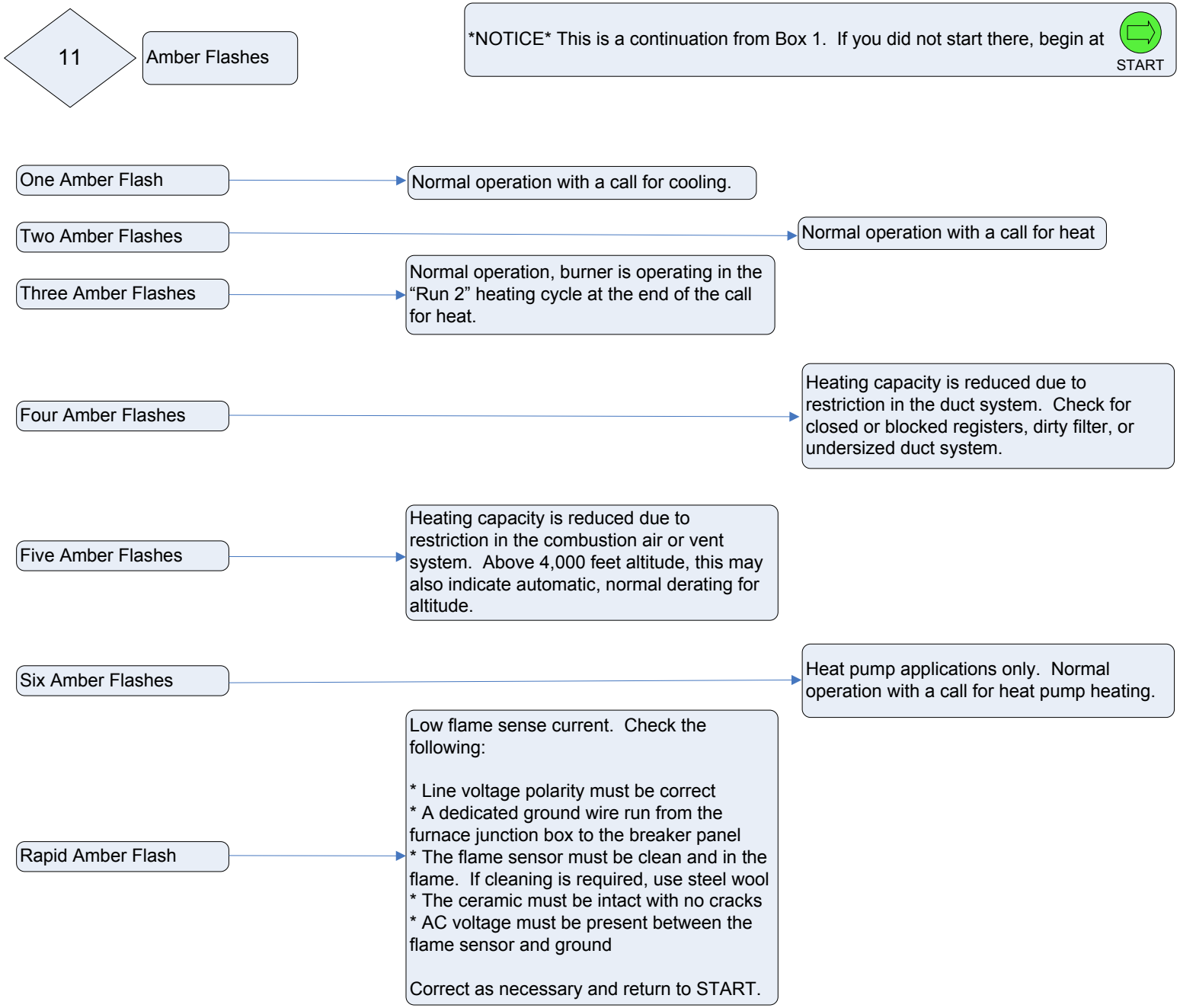

NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
8
End of heating cycle – inducer does not stop after the post purge period
Is a red or amber flash code present on the furnace control board LED?
No
Yes
See Box 6 (red codes) or Box 11 (amber codes) for code meanings. Three amber flashes indicates the furnace is in “Run 2” operation, which is a normal operating function. If RED flash codes are present, correct as required and return to START.
Verify that the heating cycle has ended by taking an AC voltage measurement between terminals “W” and “C” on the furnace control board. Zero volts measured here indicates the heat call is over. Is there a zero volt reading?
No
A heat call is still present.
Yes
Is 120 volts AC present between “Inducer Hot” and “Inducer Neutral” on the furnace control board?
No
Check the inducer wiring and connections per the furnace wiring diagram. Correct as required and return to START.
Yes
The inducer relay on the furnace control board is not opening. Replace the furnace control board and return to START.

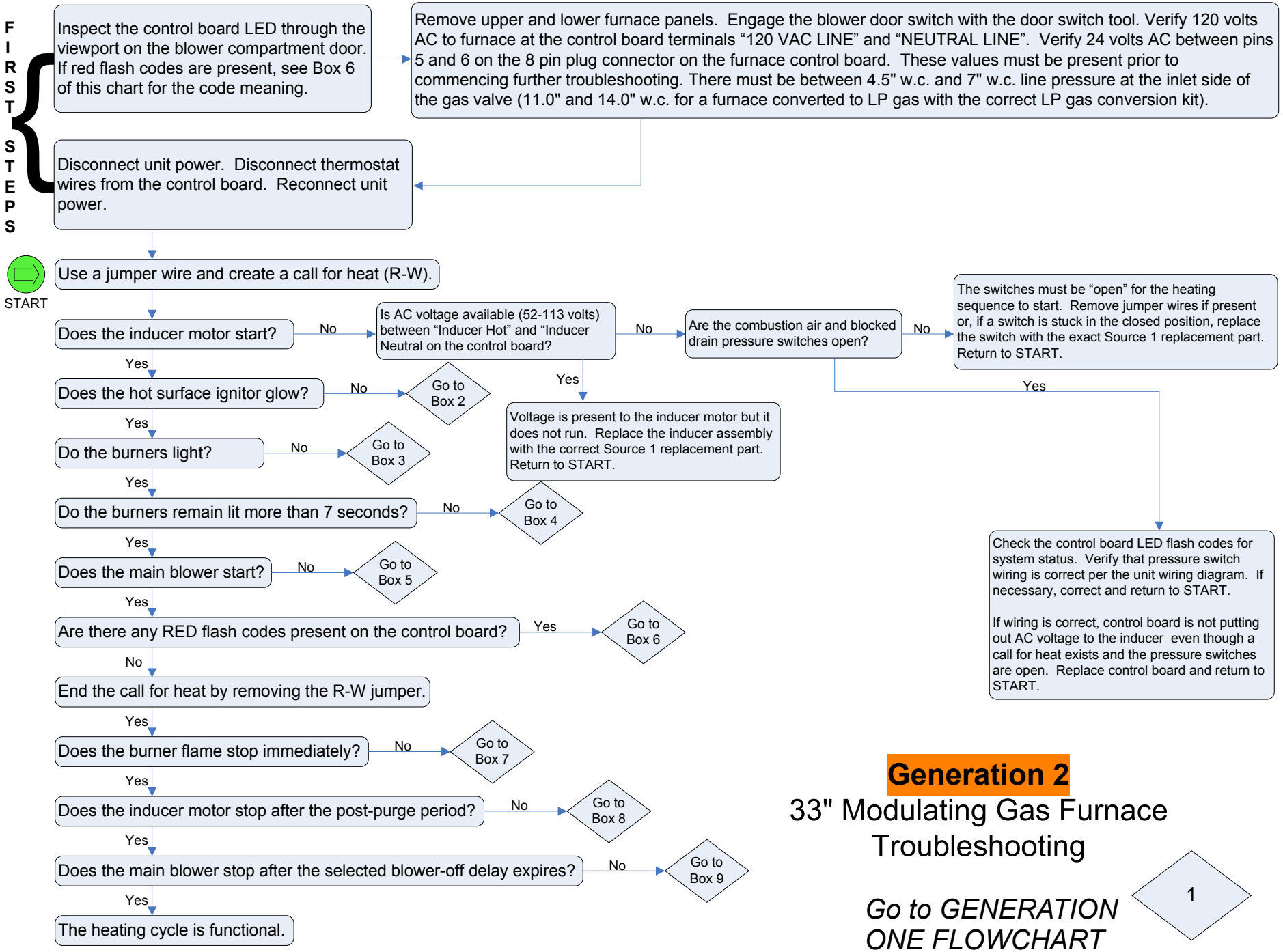

NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
9
Blower does not stop
Verify that there is not a call for continuous fan from the thermostat (24 volts AC present at the “G” terminal).
Verify that the heating cycle has ended by taking an AC voltage measurement between terminals “W” and “C” on the furnace control board. Zero volts measured here indicates the heat call is over. Is there a zero volt reading?
No
A heat call is still present.
Yes
Is a red or amber flash code present on the furnace control board LED?
No
Is the blower motor a PSC or an ECM motor?
Yes
See Box 6 (red codes) or Box 11 (amber codes) for code meanings. Correct as required and return to START.
ECM
PSC
Correct the blower connections and return to START.
Are the red, yellow, blue, black, and white blower motor leads connected to the marked positions on the furnace control board?
No
Yes
Check the 16 pin plug between the furnace control board and the wiring harness. Verify communications between the furnace control board and the ECM motor with an ECM motor analyzer. The analyzer will determine if there is an issue with the furnace control board sending incorrect communication signals or if the blower motor functioning erratically. Correct as necessary and return to START.
The furnace control board is energizing the blower with no call. Replace the furnace control board and return to START.

NOTICE This is a continuation from Box 1. If you did not start there, begin at START

10 Green Flashes

- One Green Flash → Normal operation with no call for heat.
- Two Green Flashes → Indicator for “No Error Codes In Memory”.
- Three Green Flashes → Indicator for “Error Codes Cleared From Memory”
- Rapid Green Flashes → Control is in “Factory Speed Up” mode. This mode is used only during factory run-test. To stop this mode, disconnect power to the furnace, then reconnect power.


11
Amber Flashes
NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
One Amber Flash
Normal operation with a call for cooling.
Two Amber Flashes
Normal operation with a call for heat
Three Amber Flashes
Normal operation, burner is operating in the "Run 2" heating cycle at the end of the call for heat.
Four Amber Flashes
Heating capacity is reduced due to restriction in the duct system. Check for closed or blocked registers, dirty filter, or undersized duct system.
Five Amber Flashes
Heating capacity is reduced due to restriction in the combustion air or vent system. Above 4,000 feet altitude, this may also indicate automatic, normal derating for altitude.
Six Amber Flashes
Heat pump applications only. Normal operation with a call for heat pump heating.
Rapid Amber Flash
Low flame sense current. Check the following:
* Line voltage polarity must be correct
* A dedicated ground wire run from the furnace junction box to the breaker panel
* The flame sensor must be clean and in the flame. If cleaning is required, use steel wool
* The ceramic must be intact with no cracks
* AC voltage must be present between the flame sensor and ground
Correct as necessary and return to START.

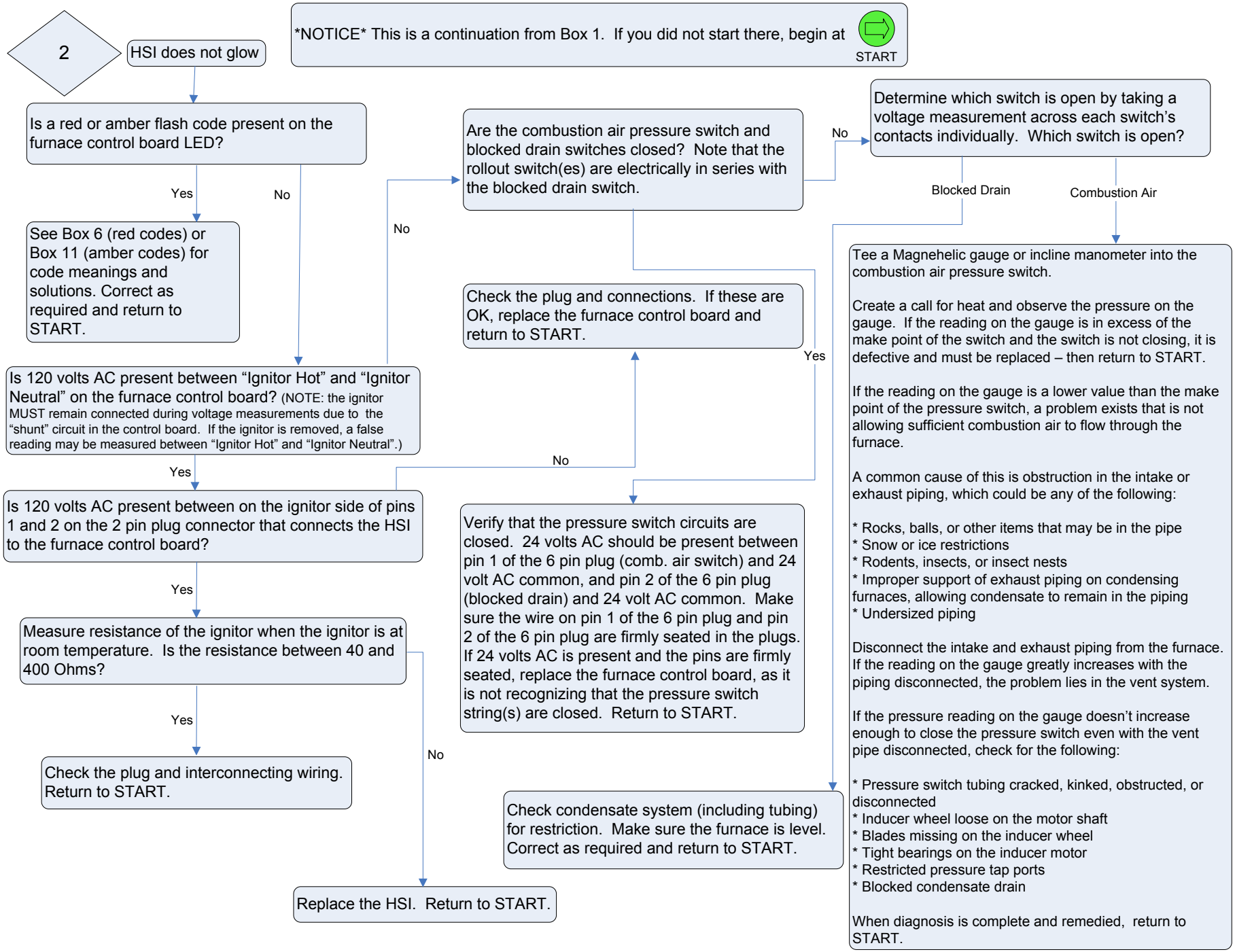


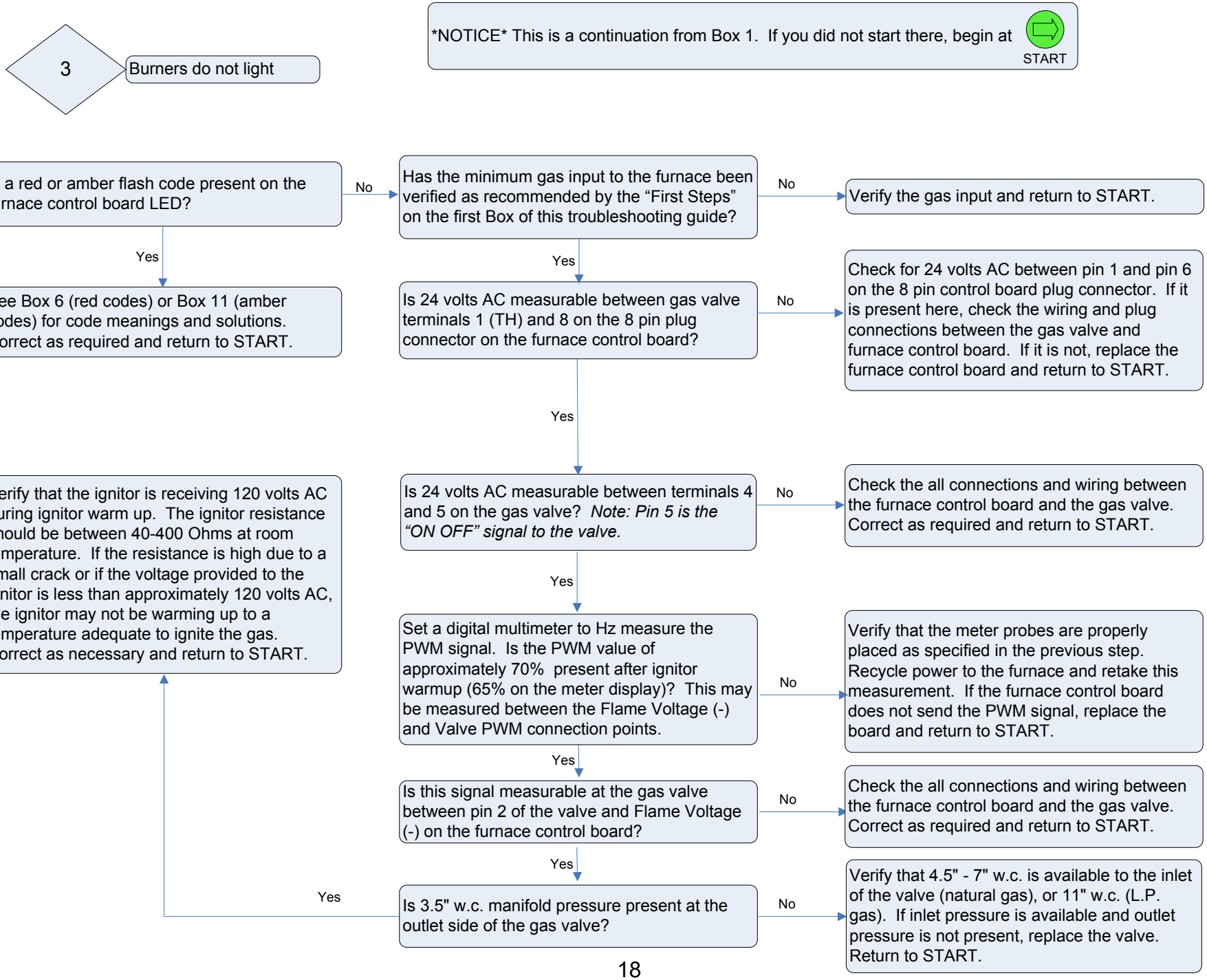
Generation 2

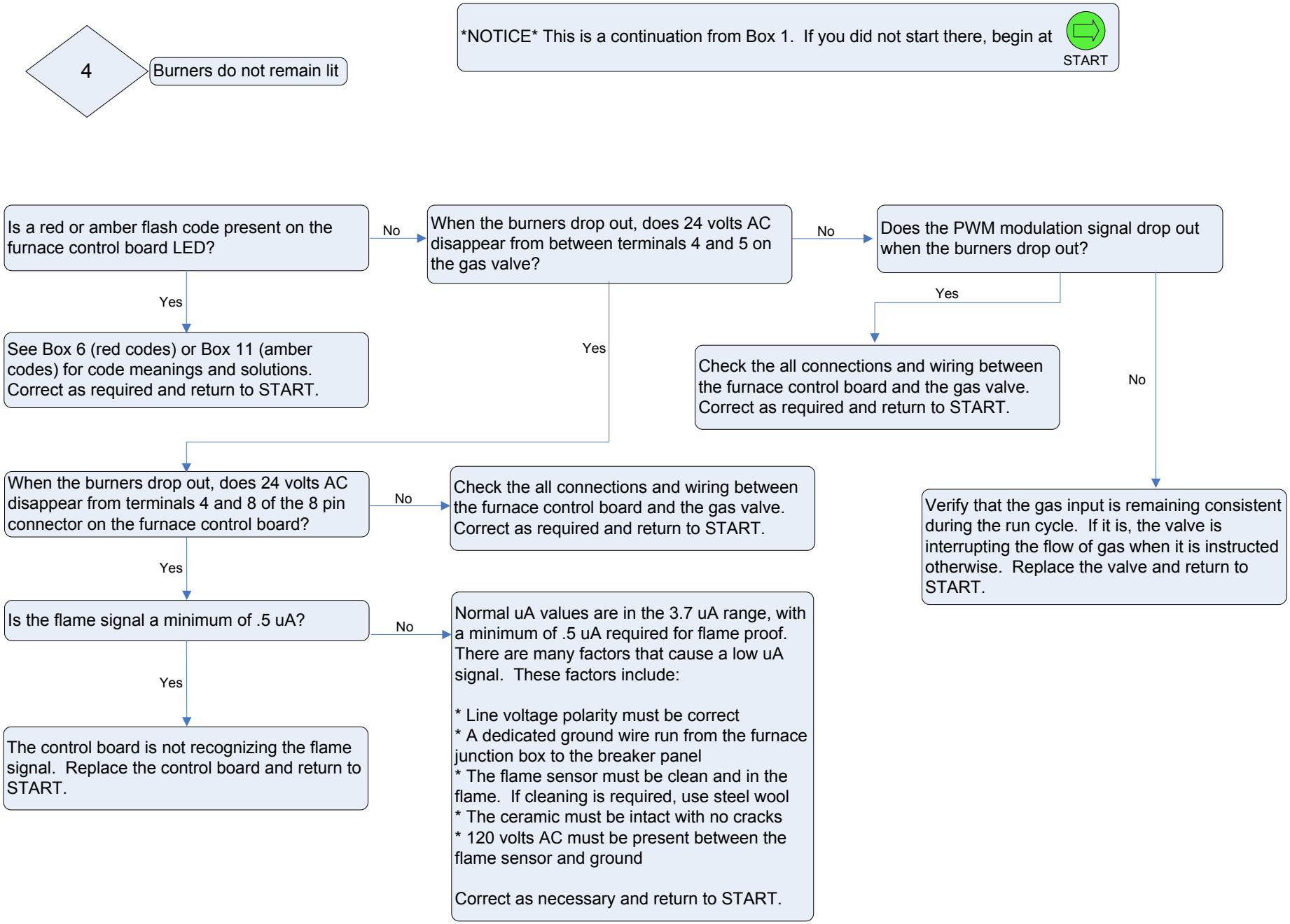
33" Modulating Gas Furnace Troubleshooting

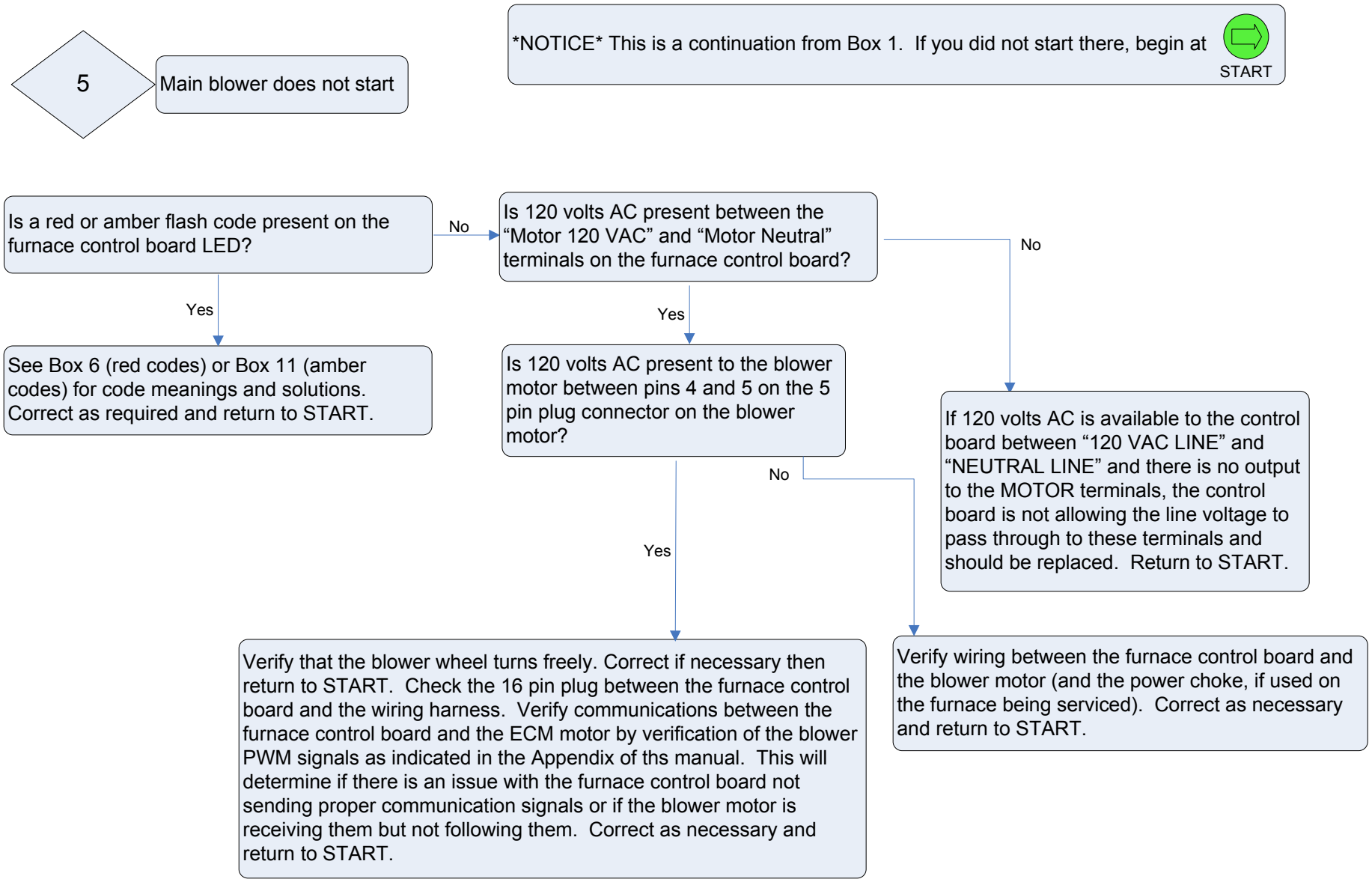
Go to GENERATION ONE FLOWCHART

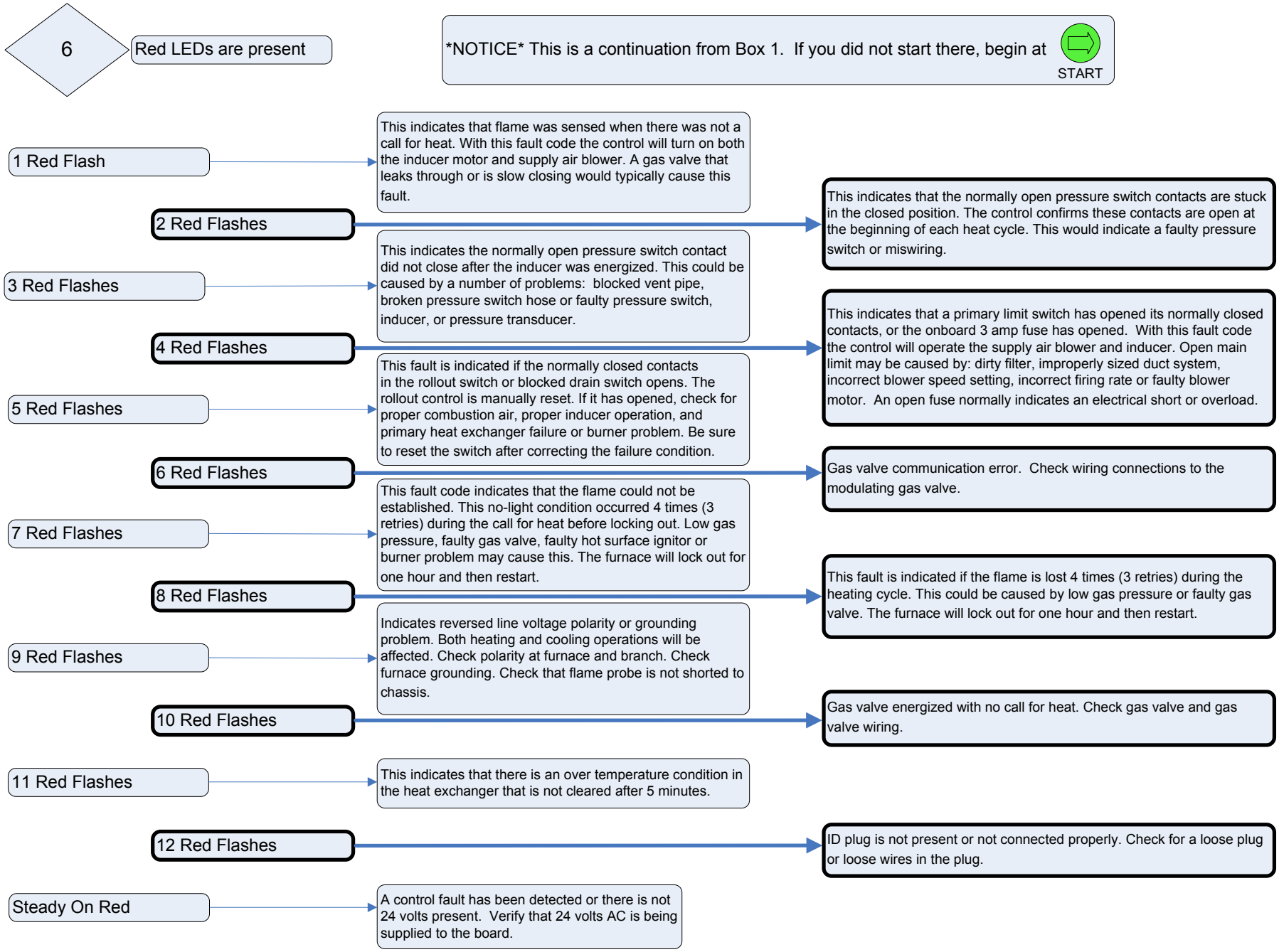
1

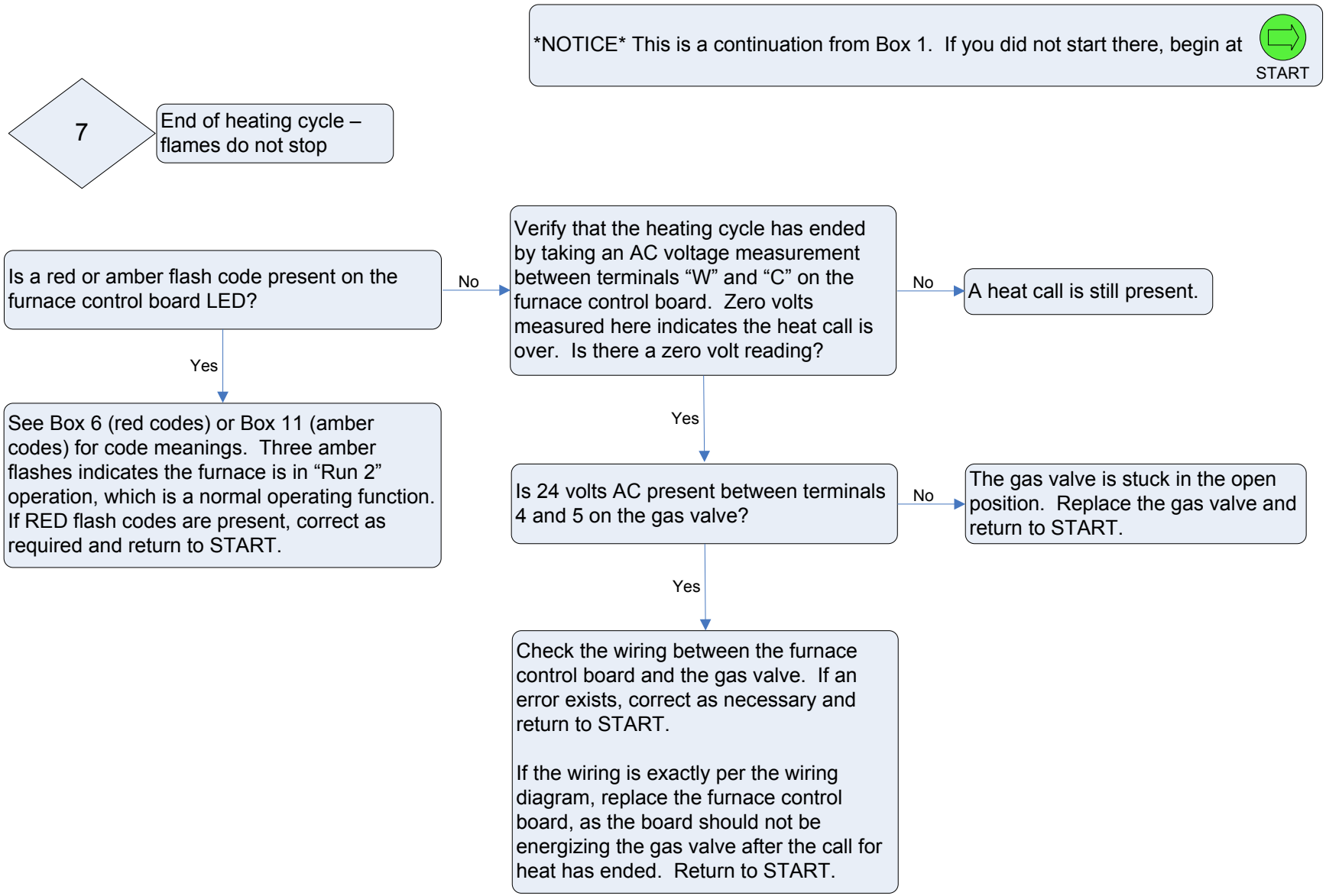

2
HSI does not glow
NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
Is a red or amber flash code present on the furnace control board LED?
Yes
No
See Box 6 (red codes) or Box 11 (amber codes) for code meanings and solutions. Correct as required and return to START.
Is 120 volts AC present between "Ignitor Hot" and "Ignitor Neutral" on the furnace control board? (NOTE: the ignitor MUST remain connected during voltage measurements due to the "shunt" circuit in the control board. If the ignitor is removed, a false reading may be measured between "Ignitor Hot" and "Ignitor Neutral".)
Yes
No
Is 120 volts AC present between on the ignitor side of pins 1 and 2 on the 2 pin plug connector that connects the HSI to the furnace control board?
Yes
No
Measure resistance of the ignitor when the ignitor is at room temperature. Is the resistance between 40 and 400 Ohms?
Yes
No
Check the plug and interconnecting wiring. Return to START.
Replace the HSI. Return to START.
Are the combustion air pressure switch and blocked drain switches closed? Note that the rollout switch(es) are electrically in series with the blocked drain switch.
No
Yes
Check the plug and connections. If these are OK, replace the furnace control board and return to START.
Verify that the pressure switch circuits are closed. 24 volts AC should be present between pin 1 of the 6 pin plug (comb. air switch) and 24 volt AC common, and pin 2 of the 6 pin plug (blocked drain) and 24 volt AC common. Make sure the wire on pin 1 of the 6 pin plug and pin 2 of the 6 pin plug are firmly seated in the plugs. If 24 volts AC is present and the pins are firmly seated, replace the furnace control board, as it is not recognizing that the pressure switch string(s) are closed. Return to START.
Determine which switch is open by taking a voltage measurement across each switch's contacts individually. Which switch is open?
Blocked Drain
Combustion Air
Check condensate system (including tubing) for restriction. Make sure the furnace is level. Correct as required and return to START.
Tee a Magnehelic gauge or incline manometer into the combustion air pressure switch.
Create a call for heat and observe the pressure on the gauge. If the reading on the gauge is in excess of the make point of the switch and the switch is not closing, it is defective and must be replaced – then return to START.
If the reading on the gauge is a lower value than the make point of the pressure switch, a problem exists that is not allowing sufficient combustion air to flow through the furnace.
A common cause of this is obstruction in the intake or exhaust piping, which could be any of the following:
* Rocks, balls, or other items that may be in the pipe
* Snow or ice restrictions
* Rodents, insects, or insect nests
* Improper support of exhaust piping on condensing furnaces, allowing condensate to remain in the piping
* Undersized piping
Disconnect the intake and exhaust piping from the furnace. If the reading on the gauge greatly increases with the piping disconnected, the problem lies in the vent system.
If the pressure reading on the gauge doesn't increase enough to close the pressure switch even with the vent pipe disconnected, check for the following:
* Pressure switch tubing cracked, kinked, obstructed, or disconnected
* Inducer wheel loose on the motor shaft
* Blades missing on the inducer wheel
* Tight bearings on the inducer motor
* Restricted pressure tap ports
* Blocked condensate drain
When diagnosis is complete and remedied, return to START.

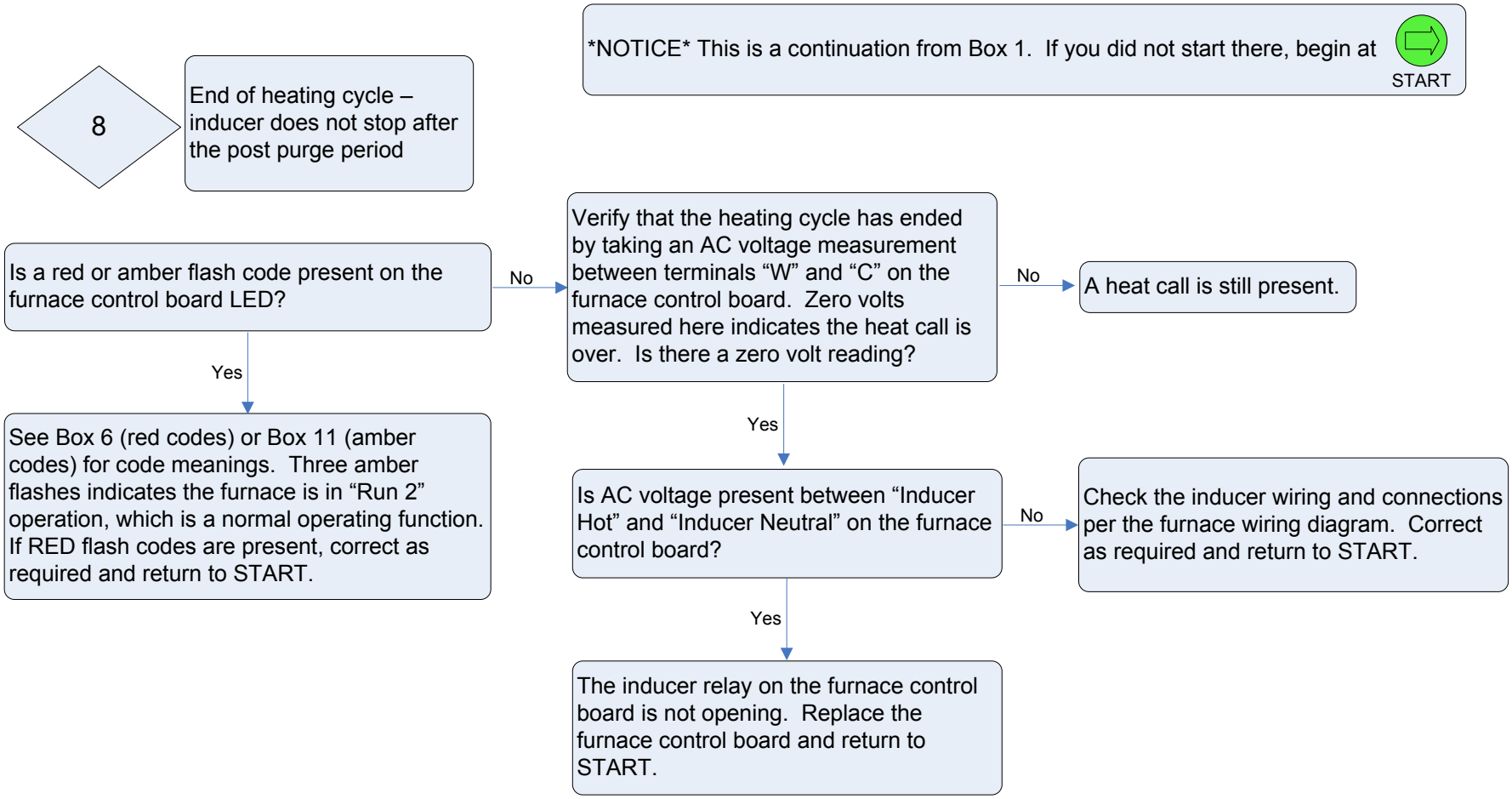

3
Burners do not light
NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
Is a red or amber flash code present on the furnace control board LED?
No
Has the minimum gas input to the furnace been verified as recommended by the "First Steps" on the first Box of this troubleshooting guide?
No
Verify the gas input and return to START.
Yes
See Box 6 (red codes) or Box 11 (amber codes) for code meanings and solutions. Correct as required and return to START.
Yes
Is 24 volts AC measurable between gas valve terminals 1 (TH) and 8 on the 8 pin plug connector on the furnace control board?
No
Check for 24 volts AC between pin 1 and pin 6 on the 8 pin control board plug connector. If it is present here, check the wiring and plug connections between the gas valve and furnace control board. If it is not, replace the furnace control board and return to START.
Yes
Is 24 volts AC measurable between terminals 4 and 5 on the gas valve? Note: Pin 5 is the "ON OFF" signal to the valve.
No
Check the all connections and wiring between the furnace control board and the gas valve. Correct as required and return to START.
Yes
Set a digital multimeter to Hz measure the PWM signal. Is the PWM value of approximately 70% present after ignitor warmup (65% on the meter display)? This may be measured between the Flame Voltage (-) and Valve PWM connection points.
No
Verify that the meter probes are properly placed as specified in the previous step. Recycle power to the furnace and retake this measurement. If the furnace control board does not send the PWM signal, replace the board and return to START.
Yes
Is this signal measurable at the gas valve between pin 2 of the valve and Flame Voltage (-) on the furnace control board?
No
Check the all connections and wiring between the furnace control board and the gas valve. Correct as required and return to START.
Yes
Is 3.5" w.c. manifold pressure present at the outlet side of the gas valve?
No
Verify that 4.5" - 7" w.c. is available to the inlet of the valve (natural gas), or 11" w.c. (L.P. gas). If inlet pressure is available and outlet pressure is not present, replace the valve. Return to START.
Yes
Verify that the ignitor is receiving 120 volts AC during ignitor warm up. The ignitor resistance should be between 40-400 Ohms at room temperature. If the resistance is high due to a small crack or if the voltage provided to the ignitor is less than approximately 120 volts AC, the ignitor may not be warming up to a temperature adequate to ignite the gas. Correct as necessary and return to START.

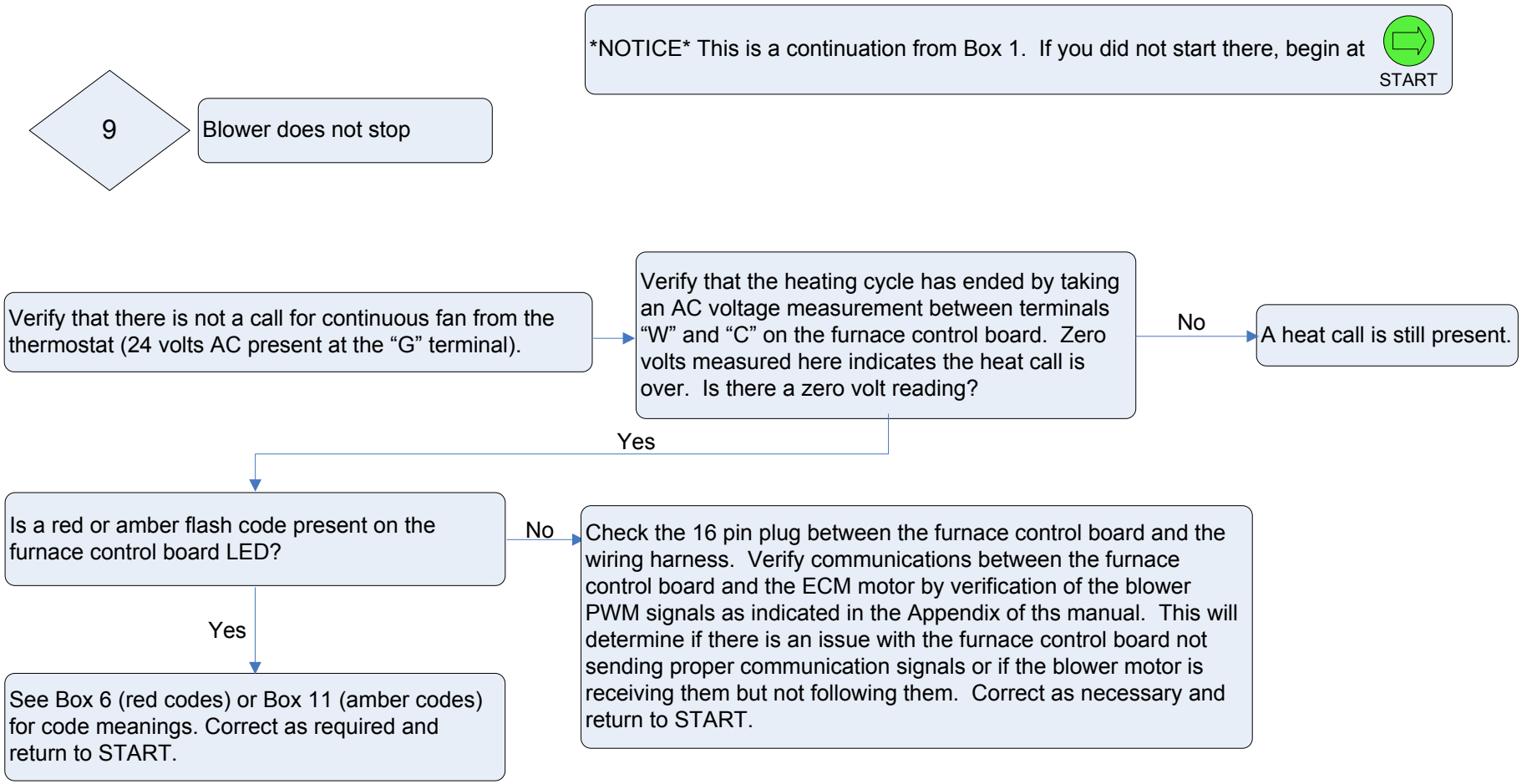

4
Burners do not remain lit
NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
Is a red or amber flash code present on the furnace control board LED?
No
When the burners drop out, does 24 volts AC disappear from between terminals 4 and 5 on the gas valve?
No
Does the PWM modulation signal drop out when the burners drop out?
Yes
See Box 6 (red codes) or Box 11 (amber codes) for code meanings and solutions. Correct as required and return to START.
Yes
Check the all connections and wiring between the furnace control board and the gas valve. Correct as required and return to START.
No
Verify that the gas input is remaining consistent during the run cycle. If it is, the valve is interrupting the flow of gas when it is instructed otherwise. Replace the valve and return to START.
Yes
When the burners drop out, does 24 volts AC disappear from terminals 4 and 8 of the 8 pin connector on the furnace control board?
No
Check the all connections and wiring between the furnace control board and the gas valve. Correct as required and return to START.
Yes
Is the flame signal a minimum of .5 uA?
No
Normal uA values are in the 3.7 uA range, with a minimum of .5 uA required for flame proof. There are many factors that cause a low uA signal. These factors include:
* Line voltage polarity must be correct
* A dedicated ground wire run from the furnace junction box to the breaker panel
* The flame sensor must be clean and in the flame. If cleaning is required, use steel wool
* The ceramic must be intact with no cracks
* 120 volts AC must be present between the flame sensor and ground
Correct as necessary and return to START.
Yes
The control board is not recognizing the flame signal. Replace the control board and return to START.


5
Main blower does not start
NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
Is a red or amber flash code present on the furnace control board LED?
No
Is 120 volts AC present between the "Motor 120 VAC" and "Motor Neutral" terminals on the furnace control board?
No
Yes
Yes
See Box 6 (red codes) or Box 11 (amber codes) for code meanings and solutions. Correct as required and return to START.
Is 120 volts AC present to the blower motor between pins 4 and 5 on the 5 pin plug connector on the blower motor?
If 120 volts AC is available to the control board between "120 VAC LINE" and "NEUTRAL LINE" and there is no output to the MOTOR terminals, the control board is not allowing the line voltage to pass through to these terminals and should be replaced. Return to START.
No
Yes
Verify that the blower wheel turns freely. Correct if necessary then return to START. Check the 16 pin plug between the furnace control board and the wiring harness. Verify communications between the furnace control board and the ECM motor by verification of the blower PWM signals as indicated in the Appendix of ths manual. This will determine if there is an issue with the furnace control board not sending proper communication signals or if the blower motor is receiving them but not following them. Correct as necessary and return to START.
Verify wiring between the furnace control board and the blower motor (and the power choke, if used on the furnace being serviced). Correct as necessary and return to START.


6
Red LEDs are present
NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
1 Red Flash
This indicates that flame was sensed when there was not a call for heat. With this fault code the control will turn on both the inducer motor and supply air blower. A gas valve that leaks through or is slow closing would typically cause this fault.
2 Red Flashes
This indicates that the normally open pressure switch contacts are stuck in the closed position. The control confirms these contacts are open at the beginning of each heat cycle. This would indicate a faulty pressure switch or miswiring.
3 Red Flashes
This indicates the normally open pressure switch contact did not close after the inducer was energized. This could be caused by a number of problems: blocked vent pipe, broken pressure switch hose or faulty pressure switch, inducer, or pressure transducer.
4 Red Flashes
This indicates that a primary limit switch has opened its normally closed contacts, or the onboard 3 amp fuse has opened. With this fault code the control will operate the supply air blower and inducer. Open main limit may be caused by: dirty filter, improperly sized duct system, incorrect blower speed setting, incorrect firing rate or faulty blower motor. An open fuse normally indicates an electrical short or overload.
5 Red Flashes
This fault is indicated if the normally closed contacts in the rollout switch or blocked drain switch opens. The rollout control is manually reset. If it has opened, check for proper combustion air, proper inducer operation, and primary heat exchanger failure or burner problem. Be sure to reset the switch after correcting the failure condition.
6 Red Flashes
Gas valve communication error. Check wiring connections to the modulating gas valve.
7 Red Flashes
This fault code indicates that the flame could not be established. This no-light condition occurred 4 times (3 retries) during the call for heat before locking out. Low gas pressure, faulty gas valve, faulty hot surface ignitor or burner problem may cause this. The furnace will lock out for one hour and then restart.
8 Red Flashes
This fault is indicated if the flame is lost 4 times (3 retries) during the heating cycle. This could be caused by low gas pressure or faulty gas valve. The furnace will lock out for one hour and then restart.
9 Red Flashes
Indicates reversed line voltage polarity or grounding problem. Both heating and cooling operations will be affected. Check polarity at furnace and branch. Check furnace grounding. Check that flame probe is not shorted to chassis.
10 Red Flashes
Gas valve energized with no call for heat. Check gas valve and gas valve wiring.
11 Red Flashes
This indicates that there is an over temperature condition in the heat exchanger that is not cleared after 5 minutes.
12 Red Flashes
ID plug is not present or not connected properly. Check for a loose plug or loose wires in the plug.
Steady On Red
A control fault has been detected or there is not 24 volts present. Verify that 24 volts AC is being supplied to the board.


NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
7
End of heating cycle – flames do not stop
Is a red or amber flash code present on the furnace control board LED?
No
Verify that the heating cycle has ended by taking an AC voltage measurement between terminals "W" and "C" on the furnace control board. Zero volts measured here indicates the heat call is over. Is there a zero volt reading?
No
A heat call is still present.
Yes
See Box 6 (red codes) or Box 11 (amber codes) for code meanings. Three amber flashes indicates the furnace is in "Run 2" operation, which is a normal operating function. If RED flash codes are present, correct as required and return to START.
Yes
Is 24 volts AC present between terminals 4 and 5 on the gas valve?
No
The gas valve is stuck in the open position. Replace the gas valve and return to START.
Yes
Check the wiring between the furnace control board and the gas valve. If an error exists, correct as necessary and return to START.
If the wiring is exactly per the wiring diagram, replace the furnace control board, as the board should not be energizing the gas valve after the call for heat has ended. Return to START.

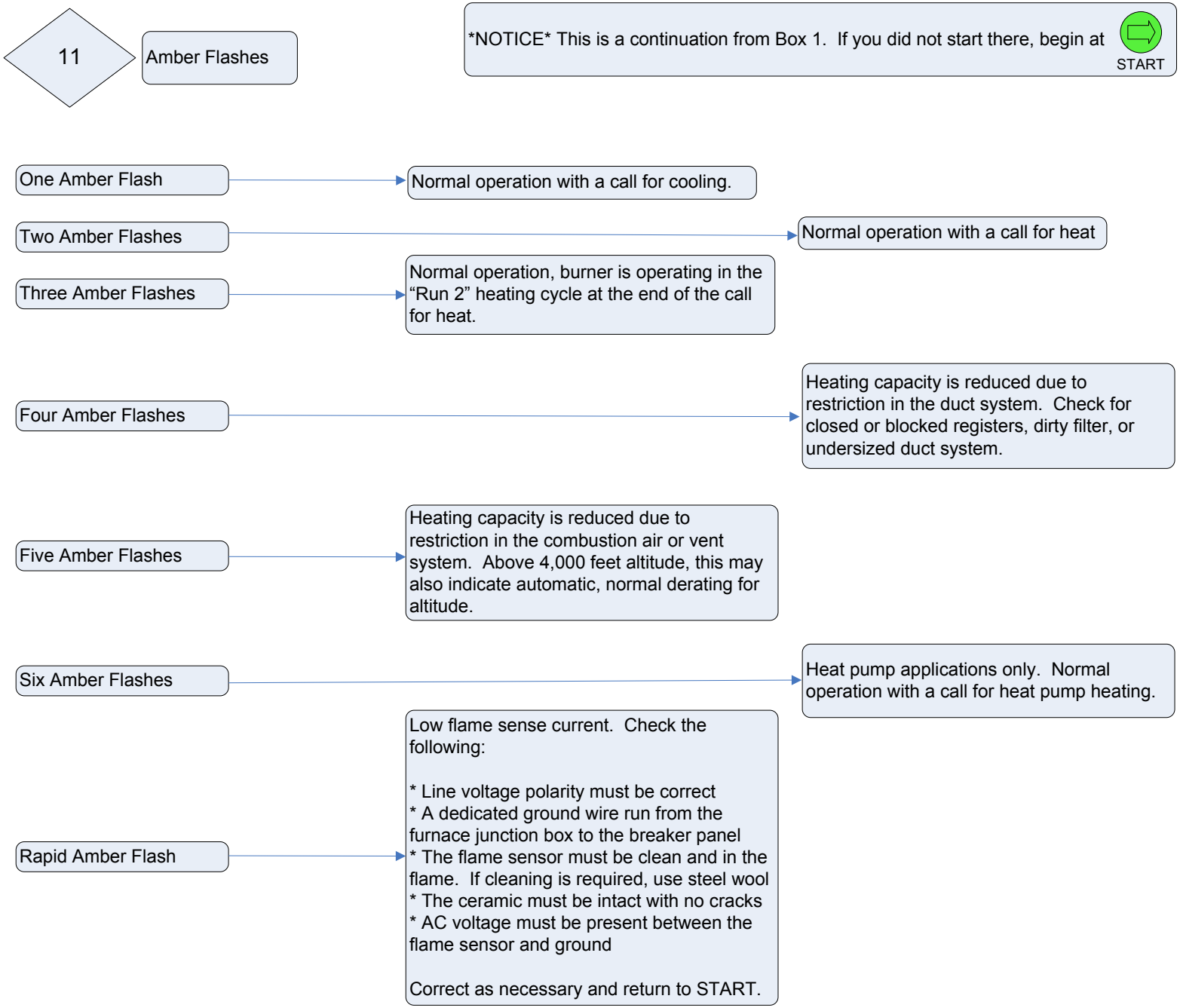

NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
8
End of heating cycle – inducer does not stop after the post purge period
Is a red or amber flash code present on the furnace control board LED?
No
Verify that the heating cycle has ended by taking an AC voltage measurement between terminals “W” and “C” on the furnace control board. Zero volts measured here indicates the heat call is over. Is there a zero volt reading?
No
A heat call is still present.
Yes
See Box 6 (red codes) or Box 11 (amber codes) for code meanings. Three amber flashes indicates the furnace is in “Run 2” operation, which is a normal operating function. If RED flash codes are present, correct as required and return to START.
Yes
Is AC voltage present between “Inducer Hot” and “Inducer Neutral” on the furnace control board?
No
Check the inducer wiring and connections per the furnace wiring diagram. Correct as required and return to START.
Yes
The inducer relay on the furnace control board is not opening. Replace the furnace control board and return to START.


NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
9
Blower does not stop
Verify that there is not a call for continuous fan from the thermostat (24 volts AC present at the “G” terminal).
Verify that the heating cycle has ended by taking an AC voltage measurement between terminals “W” and “C” on the furnace control board. Zero volts measured here indicates the heat call is over. Is there a zero volt reading?
No
A heat call is still present.
Yes
Is a red or amber flash code present on the furnace control board LED?
No
Check the 16 pin plug between the furnace control board and the wiring harness. Verify communications between the furnace control board and the ECM motor by verification of the blower PWM signals as indicated in the Appendix of ths manual. This will determine if there is an issue with the furnace control board not sending proper communication signals or if the blower motor is receiving them but not following them. Correct as necessary and return to START.
Yes
See Box 6 (red codes) or Box 11 (amber codes) for code meanings. Correct as required and return to START.

NOTICE This is a continuation from Box 1. If you did not start there, begin at START

10 Green Flashes

One Green Flash	Normal operation with no call for heat.
Two Green Flashes	Indicator for “No Error Codes In Memory”.
Three Green Flashes	Indicator for “Error Codes Cleared From Memory”
Rapid Green Flashes	Control is in “Factory Speed Up” mode. This mode is used only during factory run-test. To stop this mode, disconnect power to the furnace, then reconnect power.


11
Amber Flashes
NOTICE This is a continuation from Box 1. If you did not start there, begin at
START
One Amber Flash
Normal operation with a call for cooling.
Two Amber Flashes
Normal operation with a call for heat
Three Amber Flashes
Normal operation, burner is operating in the "Run 2" heating cycle at the end of the call for heat.
Four Amber Flashes
Heating capacity is reduced due to restriction in the duct system. Check for closed or blocked registers, dirty filter, or undersized duct system.
Five Amber Flashes
Heating capacity is reduced due to restriction in the combustion air or vent system. Above 4,000 feet altitude, this may also indicate automatic, normal derating for altitude.
Six Amber Flashes
Heat pump applications only. Normal operation with a call for heat pump heating.
Rapid Amber Flash
Low flame sense current. Check the following:
* Line voltage polarity must be correct
* A dedicated ground wire run from the furnace junction box to the breaker panel
* The flame sensor must be clean and in the flame. If cleaning is required, use steel wool
* The ceramic must be intact with no cracks
* AC voltage must be present between the flame sensor and ground
Correct as necessary and return to START.

33” Modulating Gas Furnace Troubleshooting Matrix Generations 1 and 2

The control that operates the furnace has built-in, self-diagnostic capability. The control continuously monitors its own operation and the operation of the system. The LED on the control indicates the current system state, warnings and failures. The LED is located behind a clear view port in the blower compartment door.

This is a modulating furnace. It will operate at an initial firing rate when the thermostat is on (Run 1) and may move to a lower firing rate (Run 2) when the thermostat is off. Make sure the thermostat cycle rate is set to 6 CPH, cycles per hour, (.1 amps for traditional heat anticipators) for best performance of the modulating furnace system.

While the furnace is in stand-by mode, the operator can retrieve up to the last five fault codes saved by the control by pushing the ERROR button. A fault code is indicated by a number of RED FLASHES follow by a 2-second pause. The last five fault 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 fault code is displayed. A fault code is retained until the system is reset or a new fault is detected. Hold the ERROR button down for 5 seconds to “clear” all fault code memory; the LED will display three (3) green flashes when clear. If there are no fault codes, the LED will display two (2) green flashes when checked.

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

The fault code identifies the system error detected, but not exact cause of failure. For any fault code, the technician should check the appropriate area of the system, including short and open wires, condensate hoses, duct problems, dirty or otherwise restrictive filters, protection switches such as primary, rollout and pressure switches, temperature sensor, air measurement hoses, loose mounting, incorrect wiring and installation.

Code	Description	Response Comments	Probable Cause	Solutions
Continuous Slow Green Flash	Stand-by mode	Furnace is ready to accept calls for heating or cooling.		
Rapid Green Flash	Control is in “Factory Speed Up” mode.	This mode is used only during factory run-test.		To stop this mode, disconnect power to the furnace, then reconnect power.
1 Green Flash	Normal operation	Normal operation with no call for heat.		
2 Green Flashes	Indicates “No Error Codes in Memory”			
3 Green Flashes	Indicates “Error Codes Cleared from Memory”			
1 Red Flash	Improper Flame Sensed	Flame is sensed when gas valve is not energized.	A. Flame remains lit in “Off” cycle.	1. Gas valve leaks - check wiring to remove continuous 24V to gas valve. 2. Gas valve is stuck open – 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 transducer values. If they do not agree, the unit locks out.	A. Faulty wiring or connections. Gen. 1 Wiring Diagram Gen. 2 Wiring Diagram	1. Check pressure switch wiring. 2. Check inducer wiring. 3. Check for broken or disconnected air tube hoses. 4. Check air inlet and outlet for blockage. 5. Check inlet stack length.
			B. Faulty pressure switch.	1. Replace pressure switch.
			C. Faulty pressure transducer	1. Replace transducer.
3 Red Flashes	Pressure switch contacts are open when they should be closed	The control validates combustion air comparing the pressure switch and pressure sensor values. If they do not agree, the unit locks out.	A. Faulty wiring or connections. Gen. 1 Wiring Diagram Gen. 2 Wiring Diagram	1. Check pressure switch wiring. 2. Check inducer wiring. 3. Check for broken or disconnected pressure switch tubing. 4. Check venting for restriction. 5. Check venting length and size.
			B. Faulty pressure switch.	1. Replace pressure switch.
			C. Faulty Pressure Transducer	1. Replace transducer.

Code	Description	Response Comments	Probable Cause	Solutions
4 Red Flashes * IF PAIRED UP WITH FC-11 RED, AND MOTOR RUNS WITH G CALL, PULL THE DISCHARGE AIR SENSOR AND CHECK RESISTANCE ON IT; COULD BE FAULTY	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. Gen. 1 Wiring Diagram Gen. 2 Wiring Diagram	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 the four pin plug connector.
	Open onboard fuse	Indicates open onboard fuse	B. Fuse is blown	1. Check and replace fuse on the board.
			C. Temperature Sensor probe not connected.	1. Check Temperature Sensor Probe connection.
5 Red Flashes	Roll out switch open or blocked drain pressure switch contacts open	This indicates flame roll out into the combustion vestibule has been detected. *Be sure to reset the rollout switch after correcting the failure condition, if it is open.*	A. Improper combustion air. Gen. 1 Wiring Diagram Gen. 2 Wiring Diagram	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.	1. Check if rollout switch has failed open. 2. Replace roll out switch.
			C. Blocked drain pressure switch open.	1. Check pressure at blocked drain pressure switch. Replace switch if pressure is correct and switch does not close.
6 Red Flashes	Modulation failure	Indicates an improper ratio of gas and air has been detected.	A. Faulty gas valve.	1. Check for faulty gas valve wiring. 2. Replace modulating gas valve.
			B. Improper combustion airflow	1. Check for proper combustion airflow 2. Check air inlet pipes. 3. Check measurement hoses. 4. Check pressure switch.
			C. Faulty pressure transducer	1. Check pressure sensor and reconnect hoses. 2. Replace Pressure transducer if pressure transducer is broken.

Code	Description	Response Comments	Probable Cause	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. Gen. 1 Wiring Diagram Gen. 2 Wiring Diagram	A. Insufficient gas line pressure.	1. Ensure 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 mADC 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 ignitor. 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.
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.

Code	Description	Response Comments	Probable Cause	Solutions
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 gas valve connector on the control board. 2. Replace board.
11 Red Flashes *IF PAIRED UP WITH FC-4, CHECK DISCHARGE AIR SENSOR.	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. After 5 minutes in this condition, the control puts the furnace in a continuous lockout.	1. Check wiring to blower. 2 . Check blower wheel/re-install . 3 . Replace blower motor . 4 . Check Discharge Air Sensor
12 Red Flashes	Identity Plug	Furnace does not operate.	A. Furnace Identity Plug is loose or not connected.	1. Check that ID Plug wires are all connected to the proper pin. 2. Connect furnace ID plug to board. 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	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	1. Retry ignition sequence and see if the system responds. 2. Replace control board.
Rapid Amber Flash	Flame rod is below 1.5 microampere	Measure flame rod terminals at the control board test points. 1 Volt DC corresponds to 1 microampere at the test point.	A. Loose or incorrect flame rod connections or positioning.	1. Check flame rod wiring and connections. 2. Re-install / replace flame rod.
			B. Flame rod dirty or corroded.	1. Clean and re-install. 2. Replace flame rod. 3. Correct condition causing corrosion.
Slow Amber Flash	Heating cycle initiated, gas OFF			
1 Amber Flash	Cooling cycle with call for cooling			

Code	Description	Response Comments	Probable Cause	Solutions
2 Amber Flashes	Heating cycle initiated	All safety checks have passed and gas is ON.		
3 Amber Flashes	Thermostat is OFF and Burner is ON	This is Modulation Run 2.		
4 Amber Flashes	Suppressed firing rate	Due to soft limit or reduced firing rate.		
5 Amber Flashes	Suppressed firing rate	Due to low combustion air.		
6 Amber Flashes	Heat pump heating cycle			
7 Amber Flashes	Compressor ON	No call for Cooling or Heating (Run 2)		
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.	1. Check the 120V path to the board including external circuit breakers, disconnects, wires, connections, and furnace door safety switch. 2. Replace control board.

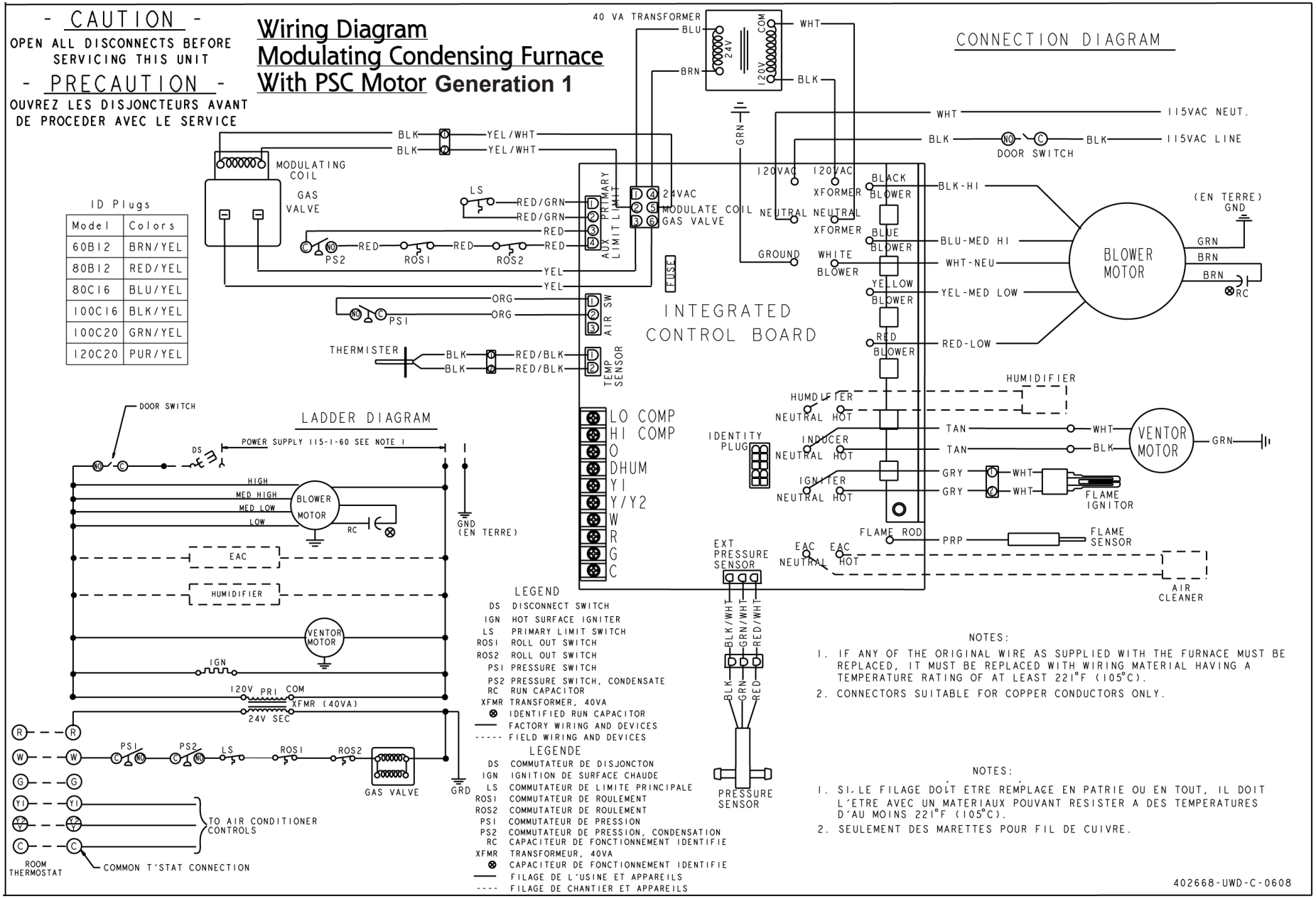
Lockout States With Automatic Reset After Lockout

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.


- CAUTION -
OPEN ALL DISCONNECTS BEFORE SERVICING THIS UNIT
- PRECAUTION -
OUVREZ LES DISJONCTEURS AVANT DE PROCEDER AVEC LE SERVICE
Wiring Diagram
Modulating Condensing Furnace
With PSC Motor Generation 1
CONNECTION DIAGRAM
LADDER DIAGRAM
INTEGRATED CONTROL BOARD
40 VA TRANSFORMER
ID Plugs
Model | Colors
60B12 | BRN/YEL
80B12 | RED/YEL
80C16 | BLU/YEL
100C16 | BLK/YEL
100C20 | GRN/YEL
120C20 | PUR/YEL
MODULATING COIL
GAS VALVE
PS2
ROS1
ROS2
PSI
THERMISTER
AUX PRIMARY LIMIT LIMIT
AIR SW
TEMP SENSOR
FUSE
24VAC
MODULATE COIL
GAS VALVE
LO COMP
HI COMP
O
DHUM
Y1
Y/Y2
W
R
G
C
DOOR SWITCH
115VAC NEUT.
115VAC LINE
BLOWER MOTOR
(EN TERRE) GND
BLK-HI
BLU-MED HI
WHT-NEU
YEL-MED LOW
RED-LOW
HUMIDIFIER
VENTOR MOTOR
IDENTITY PLUG
INDUCER
IGNITER
FLAME IGNITOR
FLAME ROD
FLAME SENSOR
EXT PRESSURE SENSOR
PRESSURE SENSOR
EAC
AIR CLEANER
POWER SUPPLY 115-1-60 SEE NOTE 1
HIGH
MED HIGH
MED LOW
LOW
RC
GND (EN TERRE)
IGN
120V PRI COM
XFMR (40VA)
24V SEC
GRD
TO AIR CONDITIONER CONTROLS
ROOM THERMOSTAT
COMMON T'STAT CONNECTION
LEGEND
DS DISCONNECT SWITCH
IGN HOT SURFACE IGNITER
LS PRIMARY LIMIT SWITCH
ROS1 ROLL OUT SWITCH
ROS2 ROLL OUT SWITCH
PSI PRESSURE SWITCH
PS2 PRESSURE SWITCH, CONDENSATE
RC RUN CAPACITOR
XFMR TRANSFORMER, 40VA
IDENTIFIED RUN CAPACITOR
FACTORY WIRING AND DEVICES
FIELD WIRING AND DEVICES
LEGENDE
DS COMMUTATEUR DE DISJONCTON
IGN IGNITION DE SURFACE CHAUDE
LS COMMUTATEUR DE LIMITE PRINCIPALE
ROS1 COMMUTATEUR DE ROULEMENT
ROS2 COMMUTATEUR DE ROULEMENT
PSI COMMUTATEUR DE PRESSION
PS2 COMMUTATEUR DE PRESSION, CONDENSATION
RC CAPACITEUR DE FONCTIONNEMENT IDENTIFIE
XFMR TRANSFORMEUR, 40VA
CAPACITEUR DE FONCTIONNEMENT IDENTIFIE
FILAGE DE L'USINE ET APPAREILS
FILAGE DE CHANTIER ET APPAREILS
NOTES:
1. IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE FURNACE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 221°F (105°C).
2. CONNECTORS SUITABLE FOR COPPER CONDUCTORS ONLY.
NOTES:
1. SI, LE FILAGE DOIT ETRE REMPLACE EN PATRIE OU EN TOUT, IL DOIT L'ETRE AVEC UN MATERIAUX POUVANT RESISTER A DES TEMPERATURES D'AU MOINS 221°F (105°C).
2. SEULEMENT DES MARETTES POUR FIL DE CUIVRE.
402668-UWD-C-0608

CAUTION

OPEN ALL DISCONNECTS BEFORE SERVICING THIS UNIT

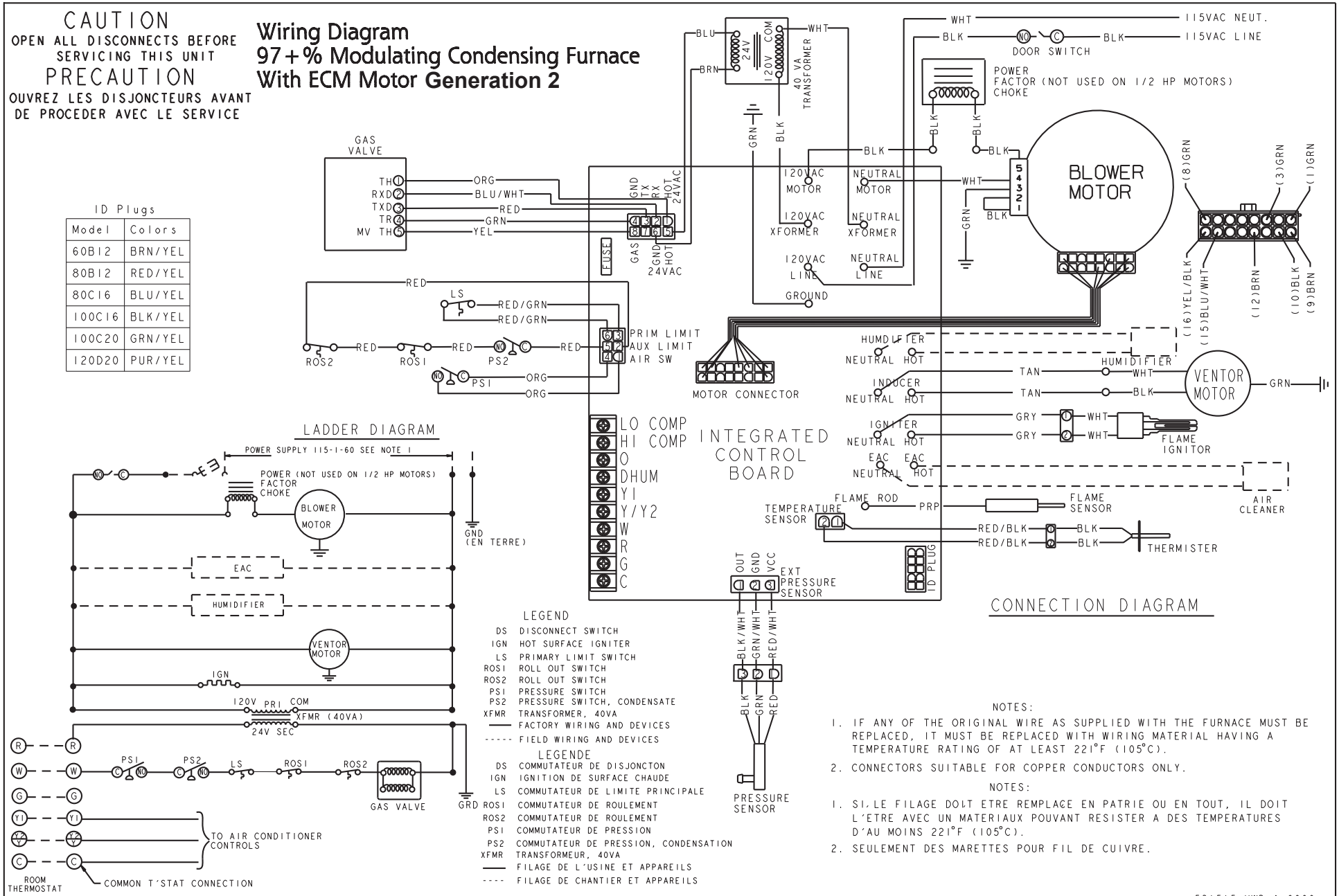
PRECAUTION

OUVREZ LES DISJONCTEURS AVANT DE PROCEDER AVEC LE SERVICE

Wiring Diagram
97+% Modulating Condensing Furnace With ECM Motor **Generation 2**

ID Plugs

Model	Colors
60B12	BRN/YEL
80B12	RED/YEL
80C16	BLU/YEL
100C16	BLK/YEL
100C20	GRN/YEL
120D20	PUR/YEL



LEGEND

DS	DISCONNECT SWITCH
IGN	HOT SURFACE IGNITER
LS	PRIMARY LIMIT SWITCH
ROS1	ROLL OUT SWITCH
ROS2	ROLL OUT SWITCH
PS1	PRESSURE SWITCH
PS2	PRESSURE SWITCH, CONDENSATE
XFMR	TRANSFORMER, 40VA
——	FACTORY WIRING AND DEVICES
-----	FIELD WIRING AND DEVICES

LEGENDE

DS	COMMUTATEUR DE DISJONCTON
IGN	IGNITION DE SURFACE CHAUDE
LS	COMMUTATEUR DE LIMITE PRINCIPALE
ROS1	COMMUTATEUR DE ROULEMENT
ROS2	COMMUTATEUR DE ROULEMENT
PS1	COMMUTATEUR DE PRESSION
PS2	COMMUTATEUR DE PRESSION, CONDENSATION
XFMR	TRANSFORMEUR, 40VA
——	FILAGE DE L'USINE ET APPAREILS
----	FILAGE DE CHANTIER ET APPAREILS

CONNECTION DIAGRAM

NOTES:

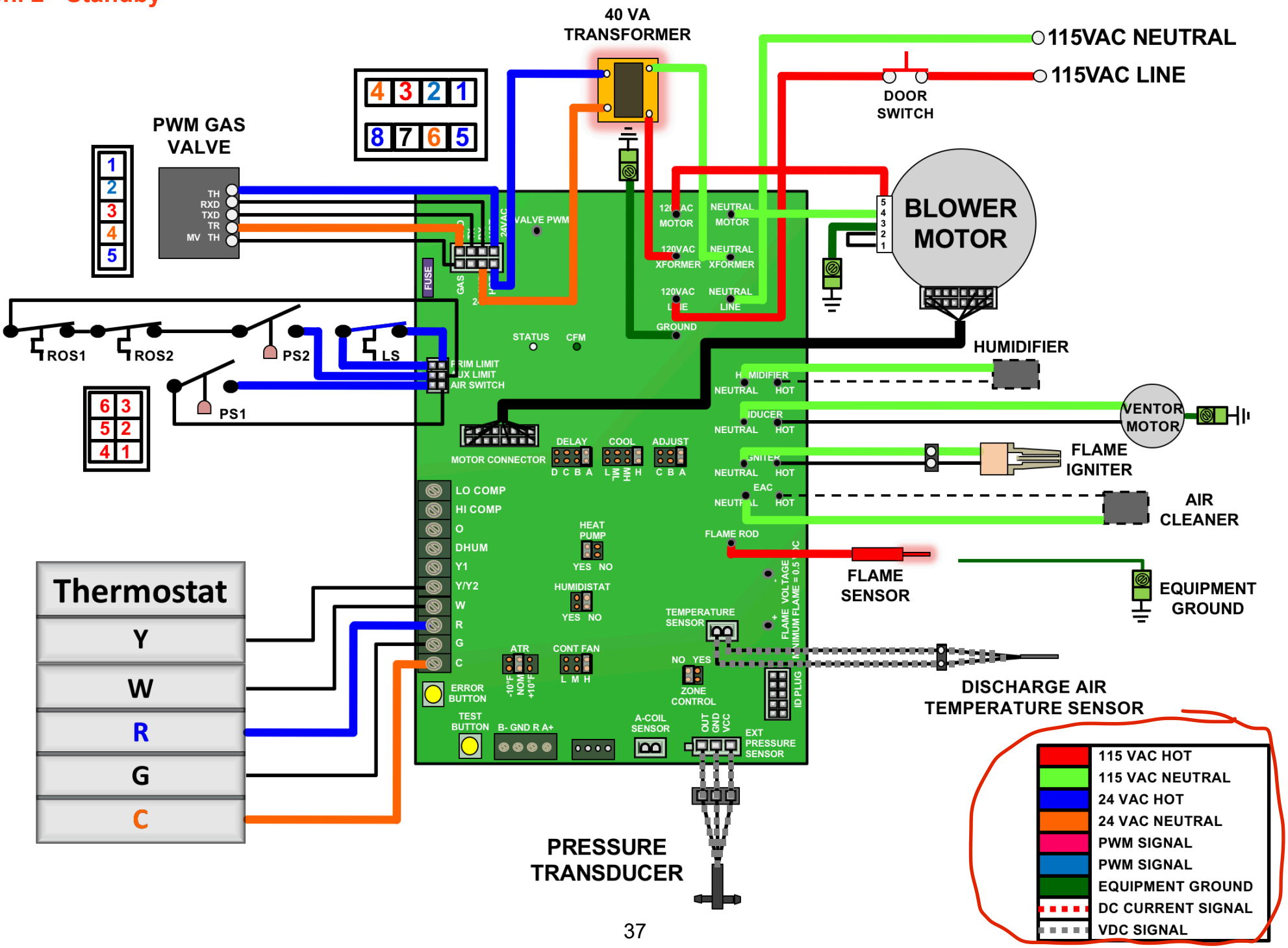
1. IF ANY OF THE ORIGINAL WIRE AS SUPPLIED WITH THE FURNACE MUST BE REPLACED, IT MUST BE REPLACED WITH WIRING MATERIAL HAVING A TEMPERATURE RATING OF AT LEAST 221°F (105°C).
2. CONNECTORS SUITABLE FOR COPPER CONDUCTORS ONLY.

NOTES:

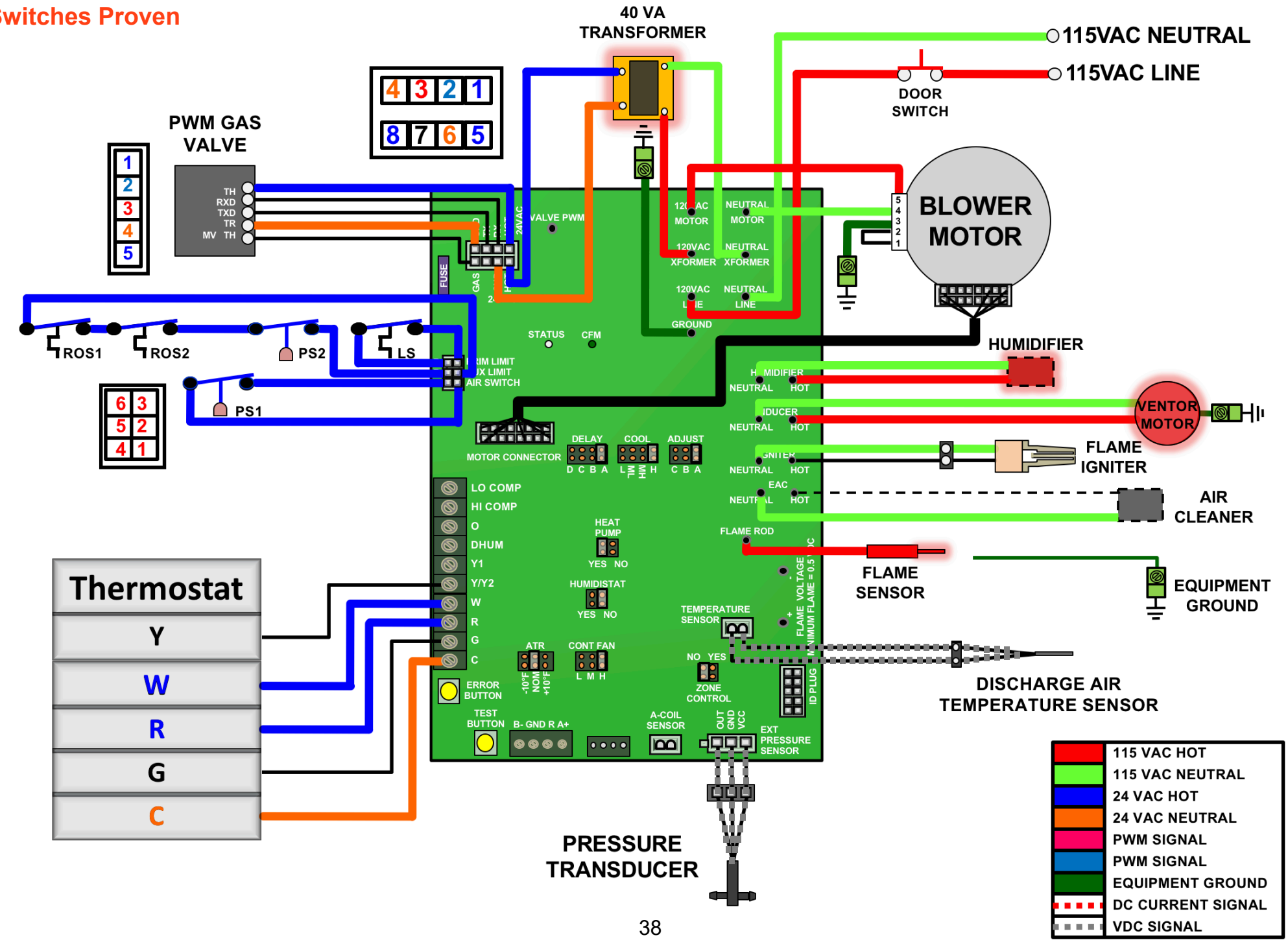
1. SI, LE FILAGE DOIT ETRE REMPLACE EN PATRIE OU EN TOUT, IL DOIT L'ETRE AVEC UN MATERIAUX POUVANT RESISTER A DES TEMPERATURES D'AU MOINS 221°F (105°C).
2. SEULEMENT DES MARETTES POUR FIL DE CUIVRE.

531515-UWD-A-0609

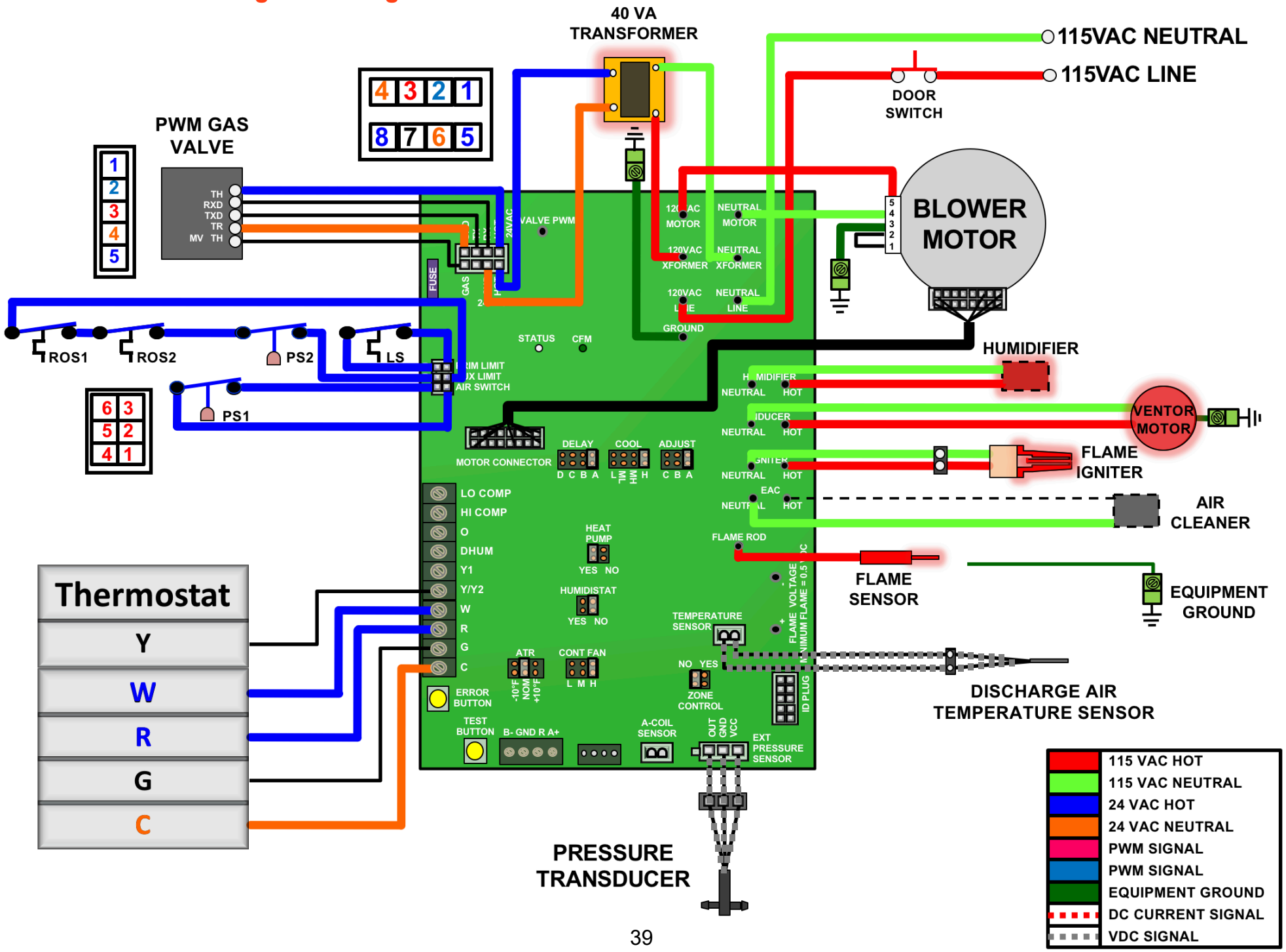
Gen. 2 - Standby



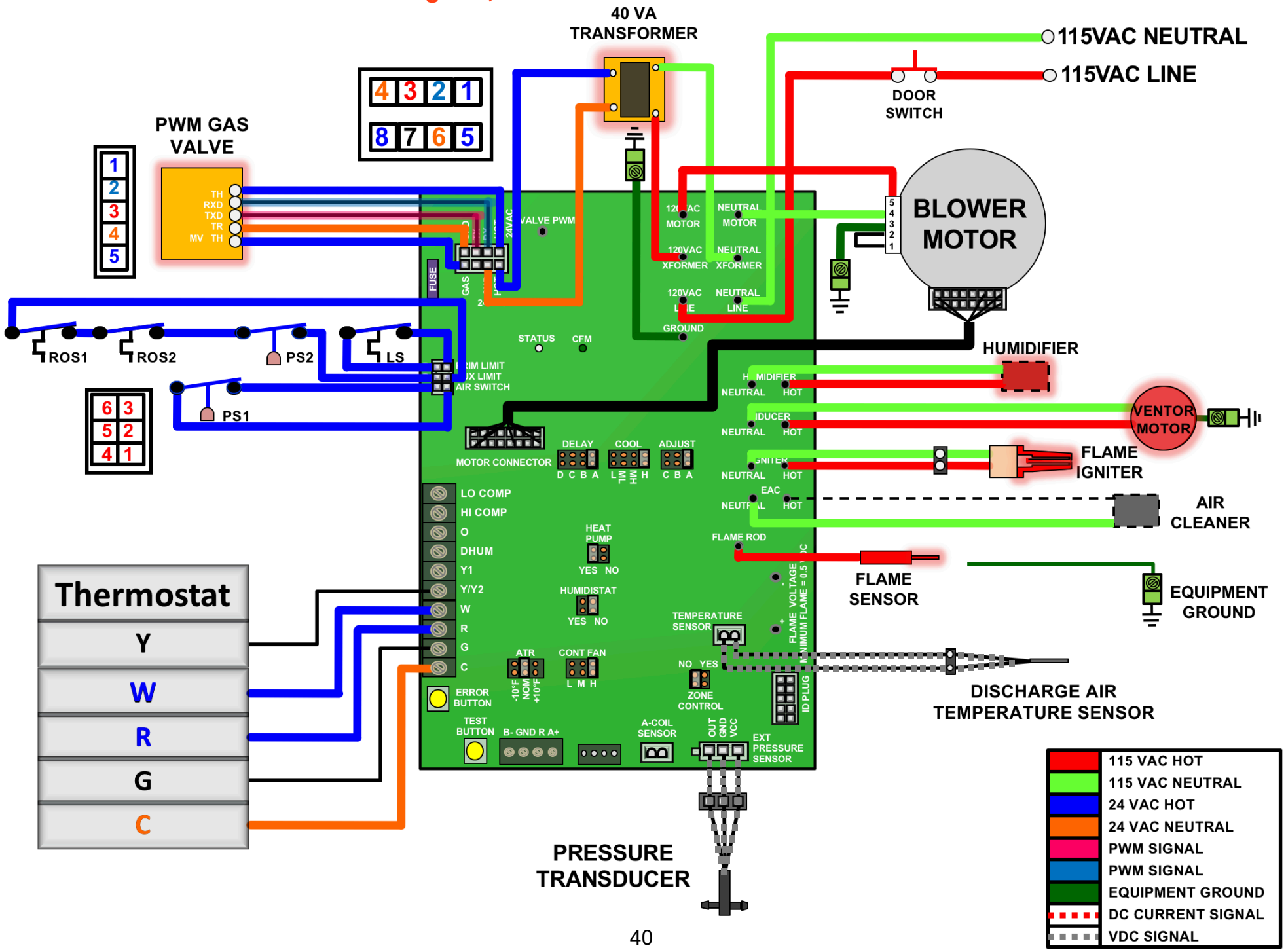
Gen. 2 - Call For Heat - Inducer and Pressure Switches Proven



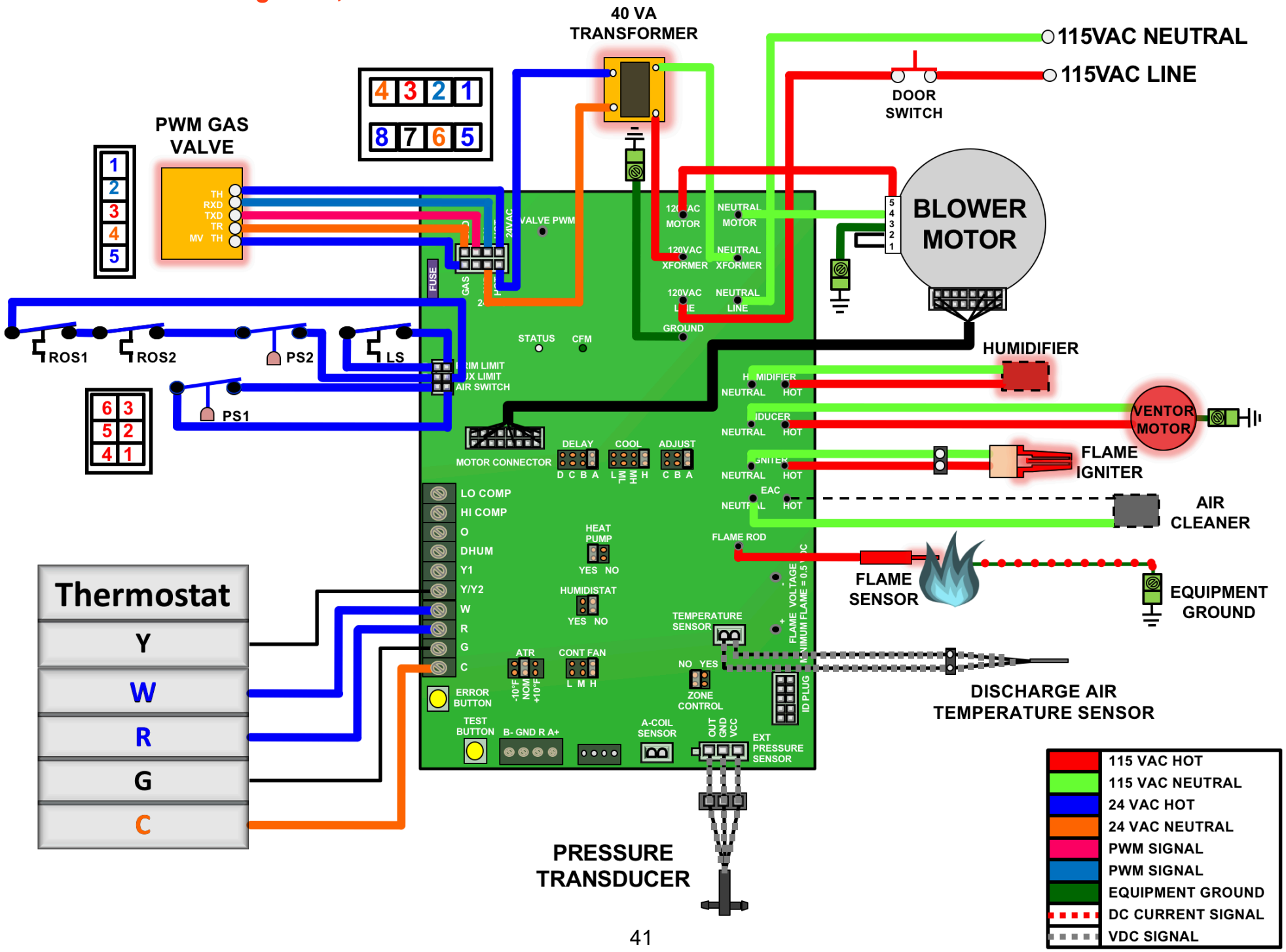
Gen. 2 - Call For Heat - Ignitor Energized



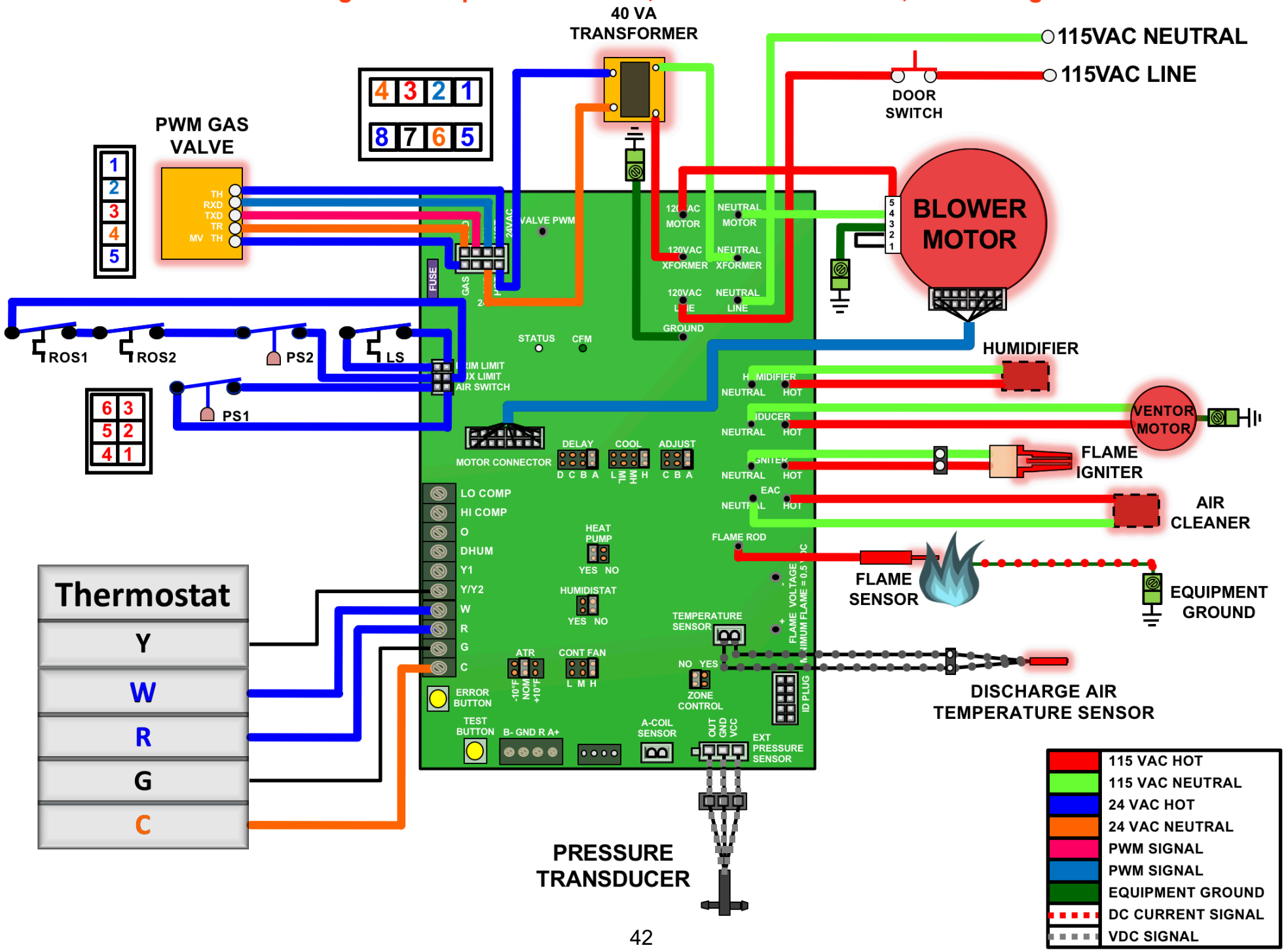
Gen. 2 - Call For Heat - Gas Valve Energized, PWM Communication



Gen. 2 - Call For Heat - Ignition, Flame Proof



Gen. 2 - Call For Heat - Discharge Air Temperature Sensor, Indoor Blower Starts, EAC Energized



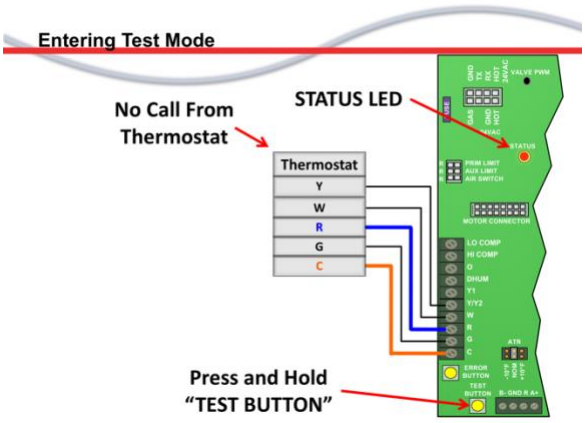
Test Mode

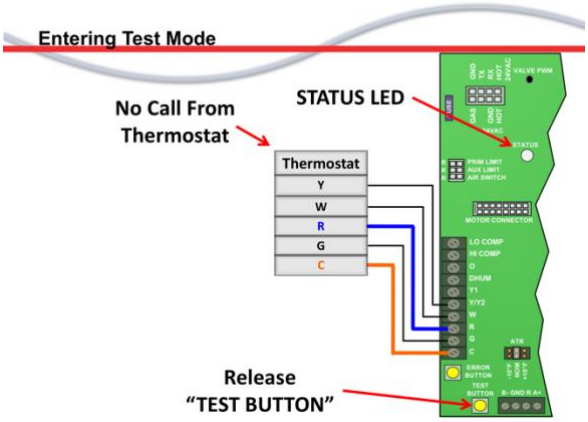
During normal operation, the furnace input rate can vary between 35% and 100% of full nameplate input for 97% - 98% AFUE models and 50% to 100% of full nameplate input for 80% AFUE models. The furnace control “TEST MODE” allows the furnace firing rate to remain constant for setup purposes .

ERROR and TEST Buttons

Accessing “TEST MODE”:

1 . With **power to the board ON** and with **no thermostat calls** (no call for heating, cooling or continuous fan), push and hold the “TEST” button on the board for one second . The LED on the board will glow red.

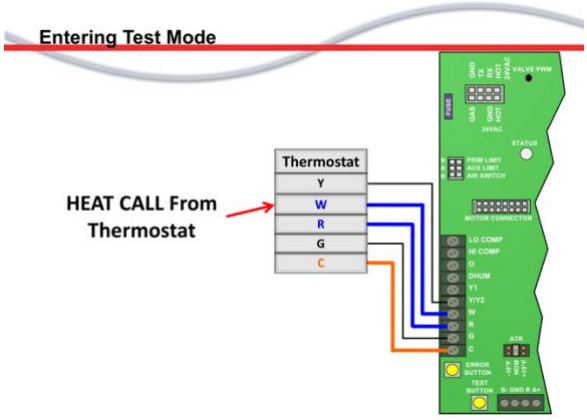




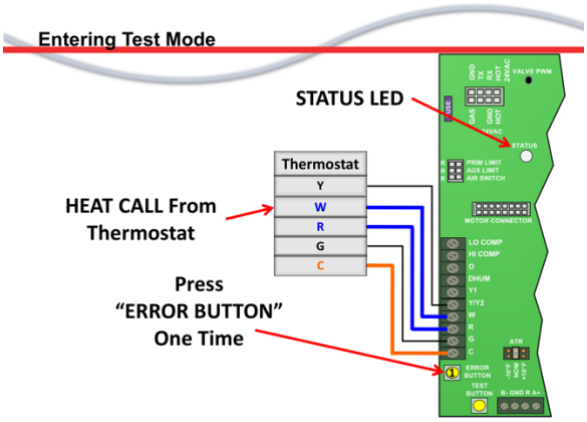
2. Release the “TEST” button. The LED on the board will flash a rapid green signal, indicating that “TEST MODE” is activated.

3. Turn the thermostat to “call for heat” (R to W signal).

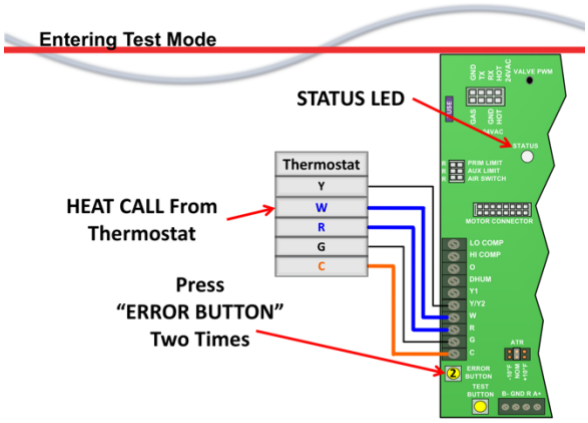
4. On Generation 1 and 2 units, the furnace will light at **70% firing rate and remain there for 30 seconds**. After this period, the gas valve will **step up to 100% firing rate**. The manifold pressure should be checked ONLY when the firing rate is locked at the 100% firing rate.



5. To fire at the **minimum rate** (35%) for 97% - 98% AFUE models and (50%) for 80% AFUE models, press the “ERROR” button **once**. The LED will flash one green flash to confirm.



6. To fire at **middle rate**, press the “ERROR” button twice within a five-second period. The LED will flash green two times to confirm.



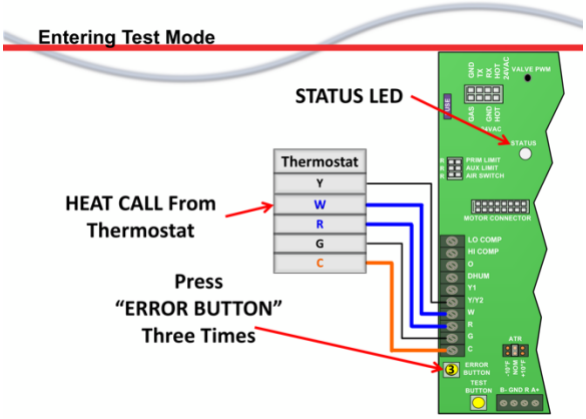
Generation 1 models

- 97% - 98% AFUE models (70% firing rate)
- 80% AFUE models (75% firing rate)

Generation 2 models

- 80% and 97% - 98% AFUE models (70% firing rate)

7. To fire at the **maximum** (100%) rate, press the “ERROR” button three times within a five-second period. The LED will flash green three times to confirm.



8. If the thermostat call for heat is removed, the LED will flash a rapid green signal, indicating that the furnace is still in “TEST MODE”.

9. When start up tests are completed, turning off power to the board will take the furnace out of “TEST MODE” and will restore normal operation . The furnace will automatically return to normal operation after 150 minutes if power is not cycled.

The following manifold pressure (gas valve outlet) values are required during furnace set up, firing at 100% rate during TEST mode:

Natural Gas 3 .5” w .c . (0 .87 kPa)
Propane (LP) 10 .0” w .c . (2 .49 kPa)

Polarity and Ground

The furnace control system requires correct polarity of the power supply and proper ground connection. The furnace will not operate properly until polarity is correct.

Proper grounding is critical. Connection to a water or gas pipe is illegal and unsafe in many cases. **To verify proper grounding, measure voltage between "L1" and "neutral", then compare the reading with "L1" and "ground". These readings should be within two volts of each other. A reading taken between "neutral" and "ground" should read zero volts**.

A dedicated ground wire **must run from the furnace junction box to the breaker panel**!

See "**How to Verify Transformer Phasing/Polarity/Grounding on Residential Furnaces**" for additional verification methods.

How to Verify Transformer Phasing on Residential Furnaces

What are the symptoms of reversed polarity or a bad ground?

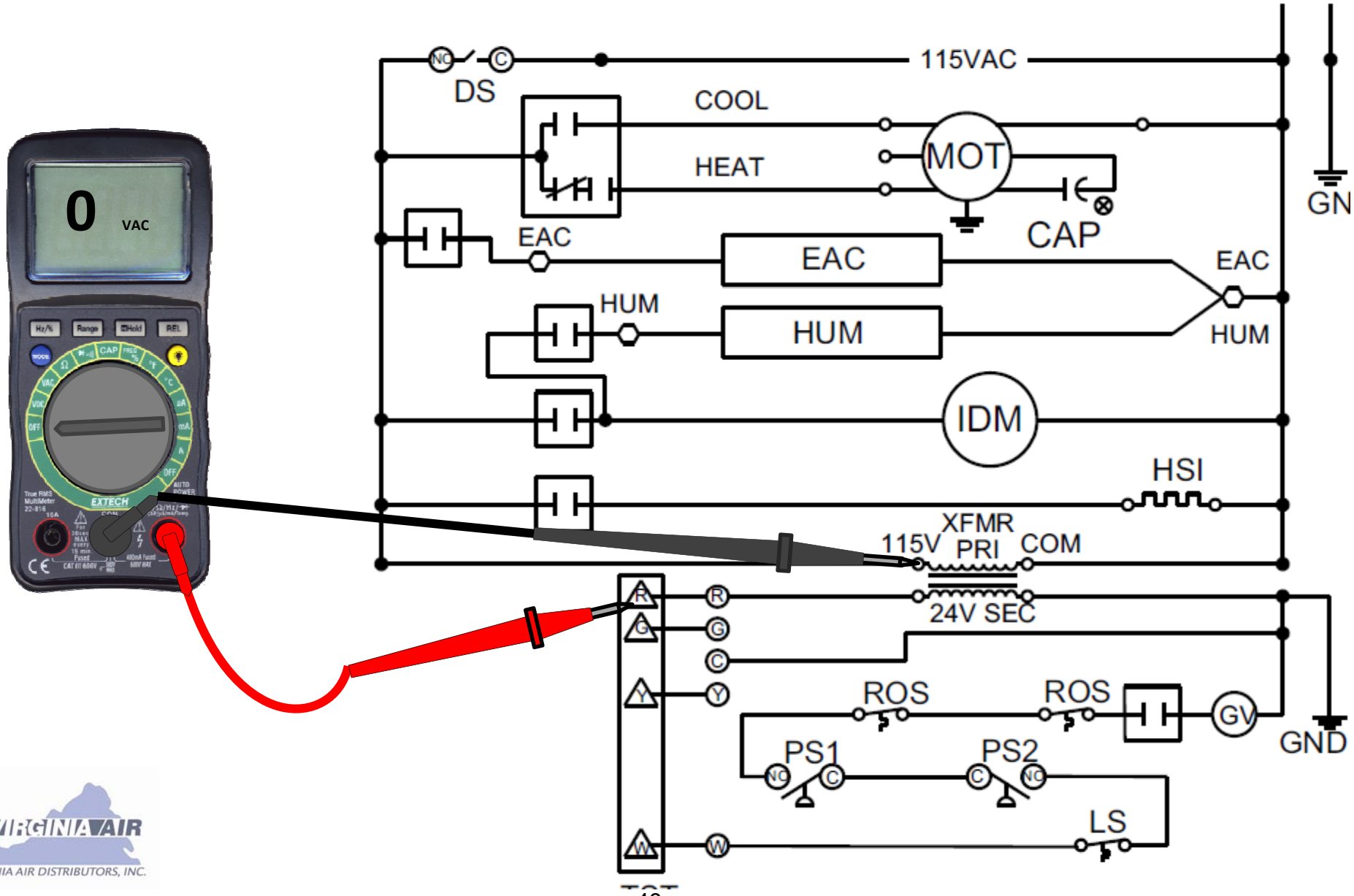
- Some furnace ignition control boards have Fault Codes that identify reverse polarity
  - Often shows up when replacing a failed or *suspected* failed board with a newer version
- Installing a new furnace where grounding is critical to control boards functioning correctly
  - Intermittent faults or not proving flame

So how can we verify polarity and grounding?

VIRGINIA AIR
VIRGINIA AIR DISTRIBUTORS, INC.

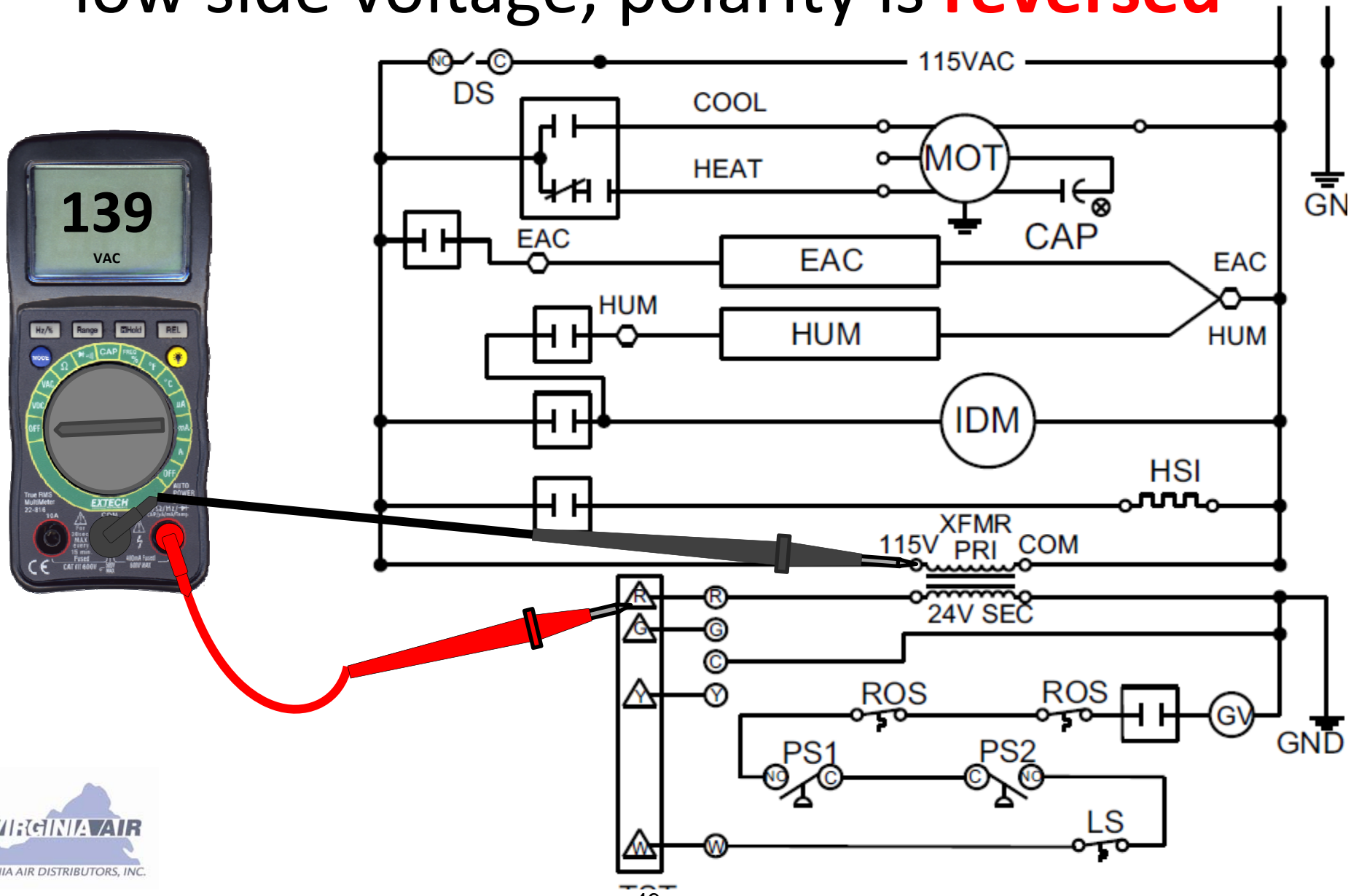
Always best to take values with no call from stat

Place leads on L1 and R with Meter set for AC volts



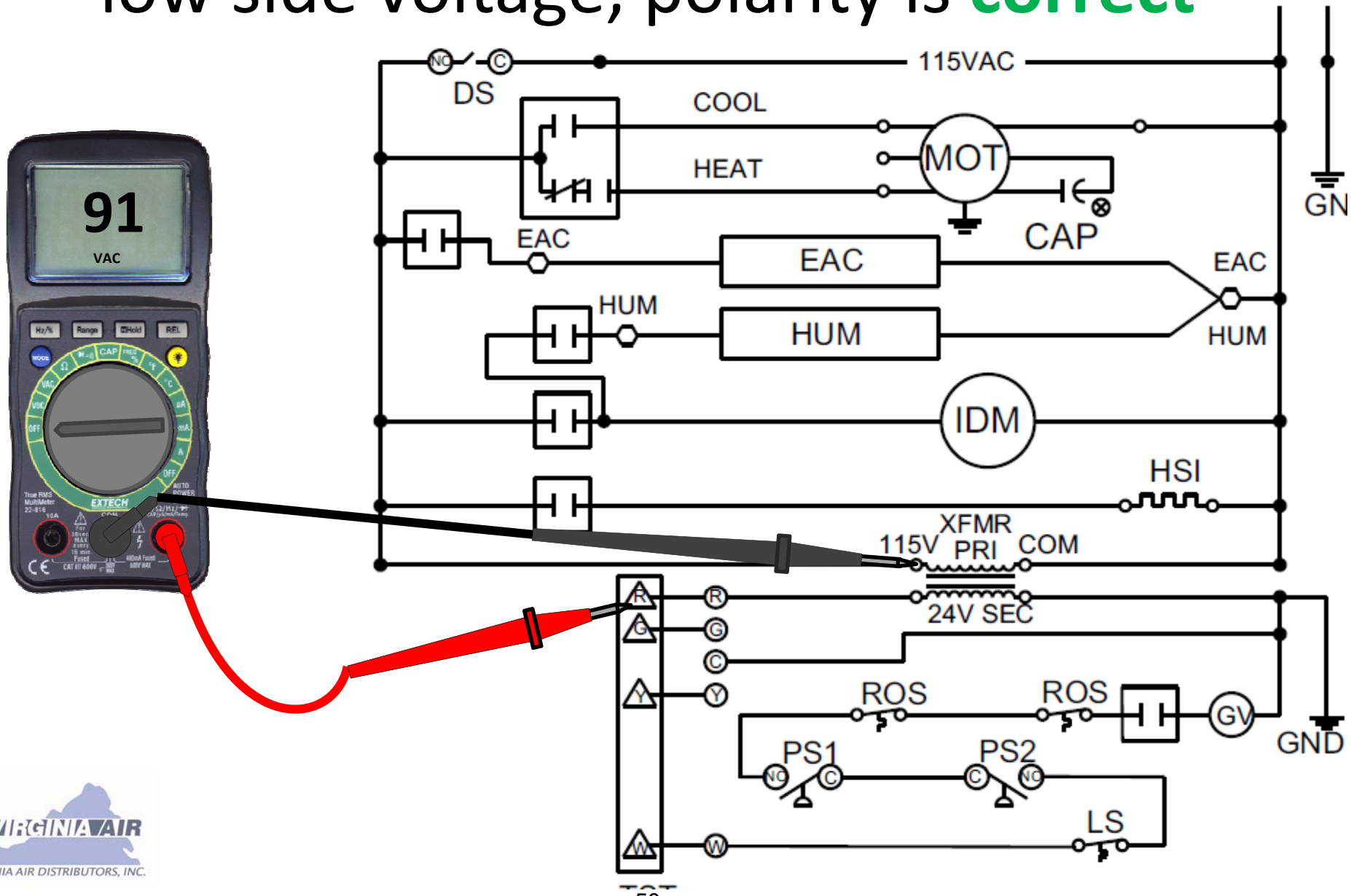
VIRGINIA AIR DISTRIBUTORS, INC.

If measured value is line side voltage plus low side voltage, polarity is **reversed**



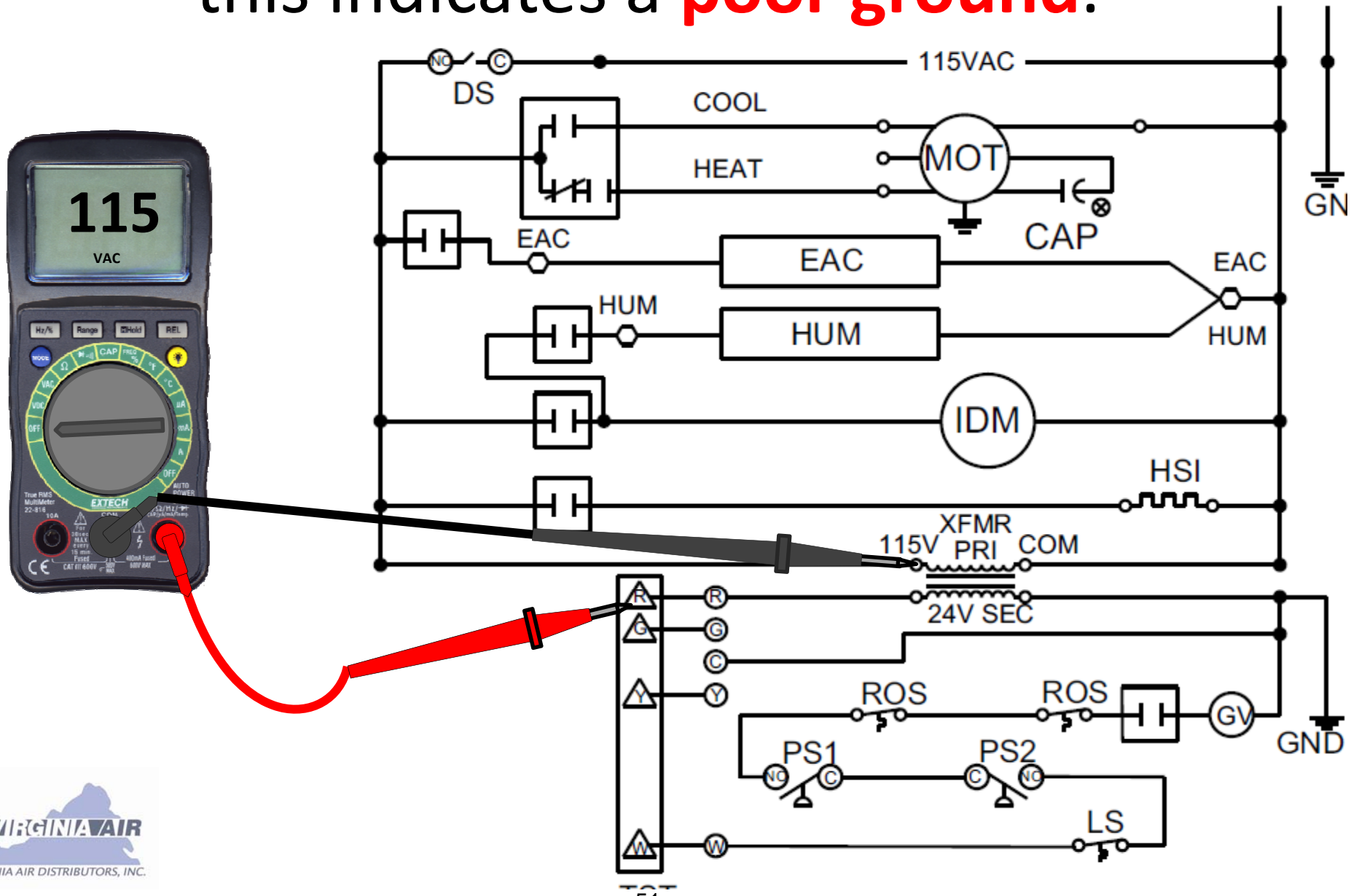
VIRGINIA AIR DISTRIBUTORS, INC.

If measured value is line side voltage minus low side voltage, polarity is **correct**



VIRGINIA AIR DISTRIBUTORS, INC.

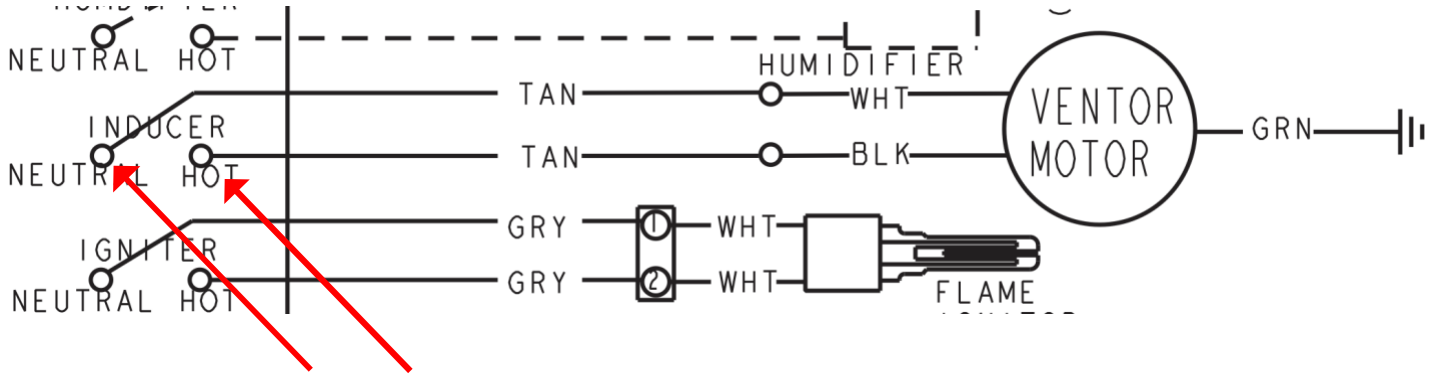
If measured value is line side voltage this indicates a **poor ground**.



VIRGINIA AIR DISTRIBUTORS, INC.

Inducer Wiring

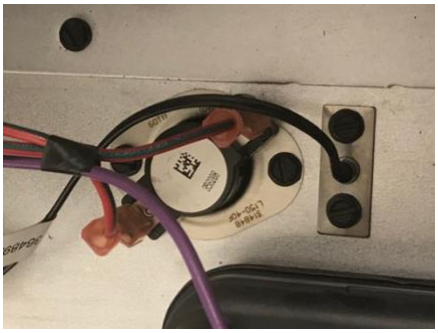
Generation 1 and Generation 2

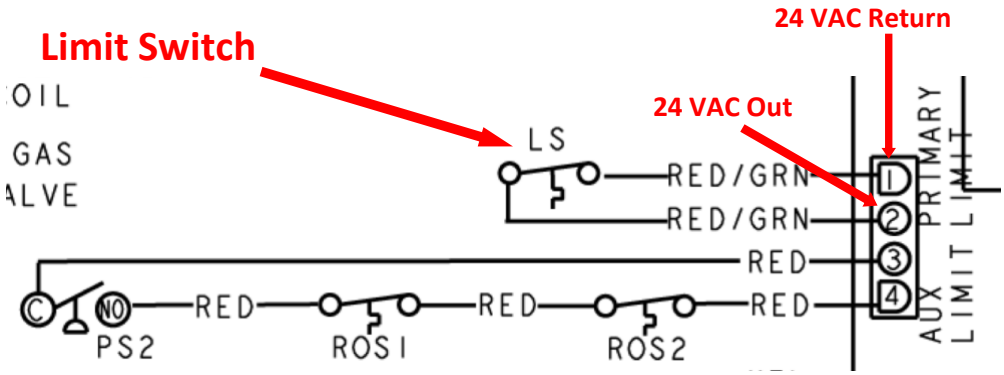


The speed of the inducer is dictated by the heating requirement of the structure and the amount of restriction in the vent system, and is controlled by a variable voltage output from the furnace control board, ranging from 52 to 113 volts .

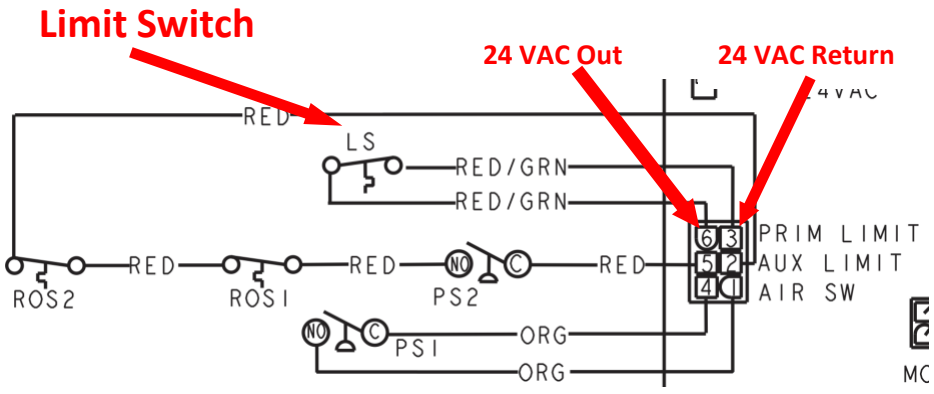
Limit Switch Wiring

Generation 1





Generation 2



The Limit Switch is an auto-reset snap disc control, look on the switch body for its rated opening point...it's closing point will usually be 40 degrees below the rated opening point (ex. L140–40, closing point will be 100 degrees).

Condensate Tubing Connections (97% - 98% AFUE Models)

The collector box contains many connection points for condensate drainage. The connection points used are determined by the chosen furnace position. The connections used are as follows:

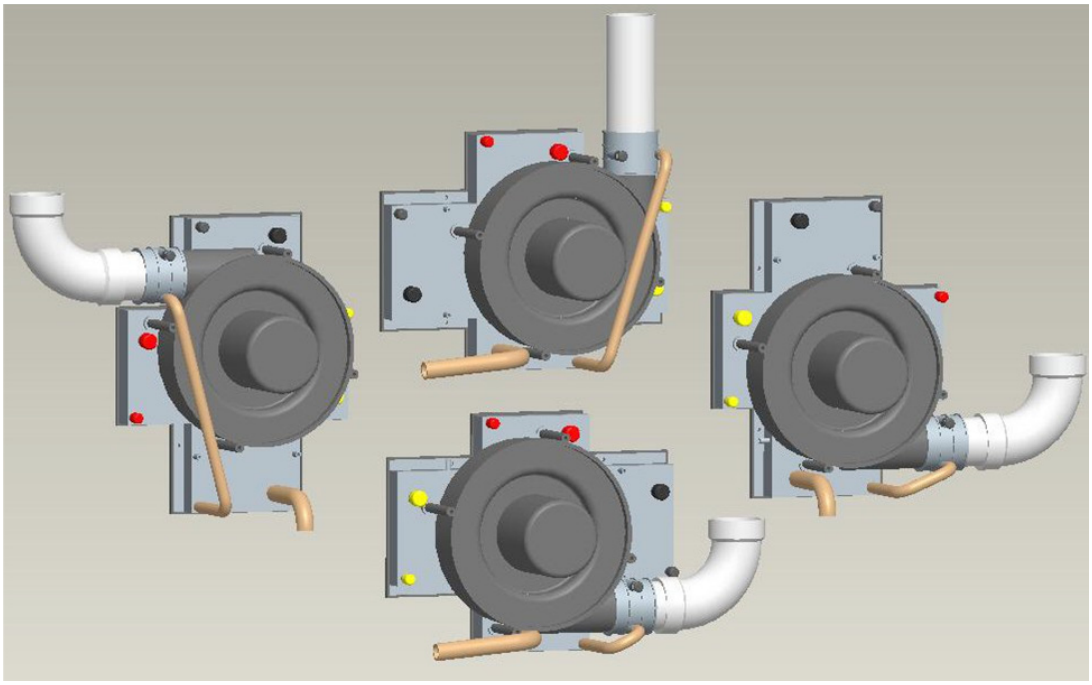


Figure 2-19 - Condensate Tubing Configurations (97% - 98% AFUE Models)

Raingutter to Collector Box

Regardless of the furnace configuration or inducer position, the raingutter connection is connected from the Raingutter to the tap at the BOTTOM of the collector box for the position the furnace is installed in. When reconfiguring the factory connected drain system, remove the black cap from the desired collector box tap and place on the unused tap.

External Drain

The external drain piping is connected to the tap that is at the BOTTOM of the collector box.

Blocked Drain Pressure Switch

The smallest of the ports on the collector box connects to the blocked drain pressure switch.

The hoses must be cut to length for the various applications. There should be no sags in the hoses. Proper hose length will prevent condensate from collecting in the hoses and possible pressure switch trips.

When drain hose routing changes are required, be sure to cap all un-used openings.
If rerouting hoses - excess length should be cut off so that no sagging loops will collect and hold condensate, which will cause the furnace to not operate.

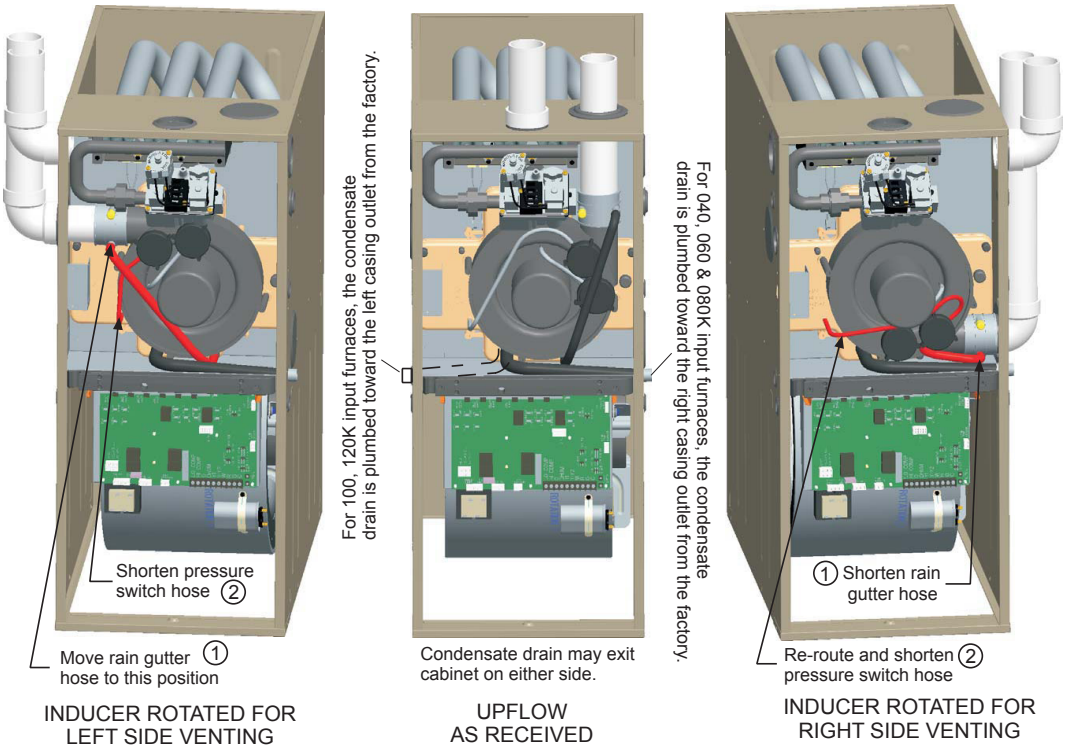


Figure 2-20 - Upflow Furnace Configuration

When drain hose routing changes are required, be sure to cap all un-used openings.
If rerouting hoses - excess length should be cut off so that no sagging loops will collect and hold condensate, which will cause the furnace to not operate.

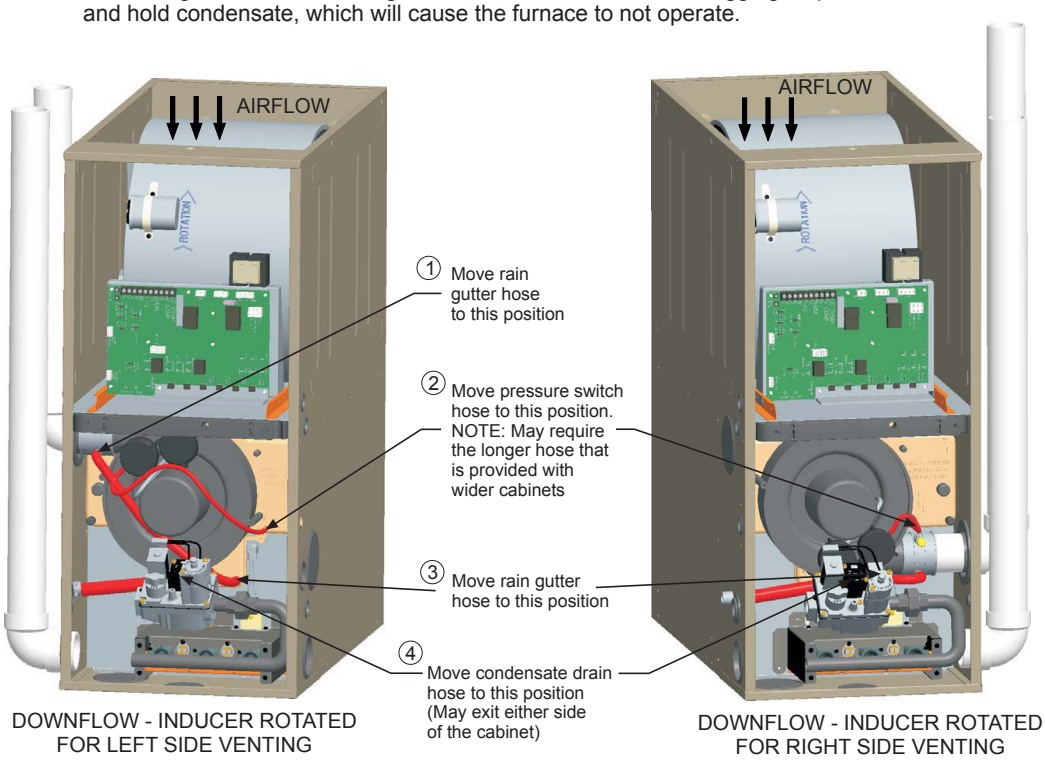


Figure 2-21 - Downflow Furnace Configuration

When drain hose routing changes are required, be sure to cap all un-used openings.
If rerouting hoses - excess length should be cut off so that no sagging loops will collect and hold condensate, which will cause the furnace to not operate.

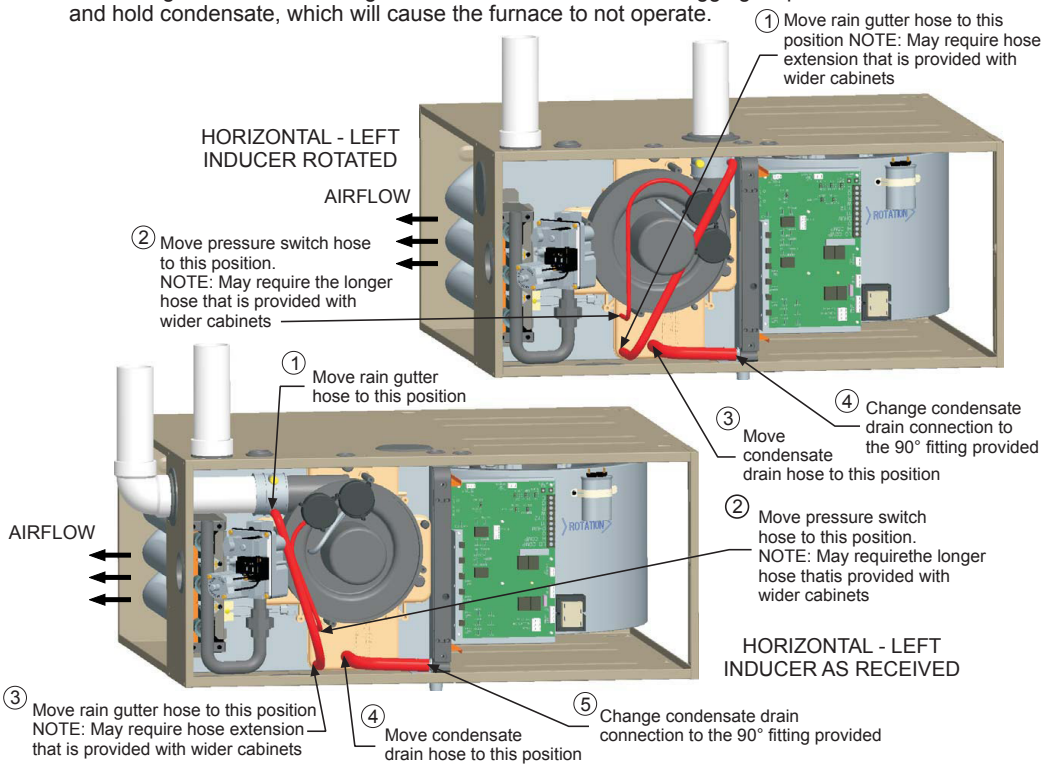


Figure 2-22 - Horizontal Left Furnace Configuration

When drain hose routing changes are required, be sure to cap all un-used openings.
If rerouting hoses - excess length should be cut off so that no sagging loops will collect and hold condensate, which will cause the furnace to not operate.

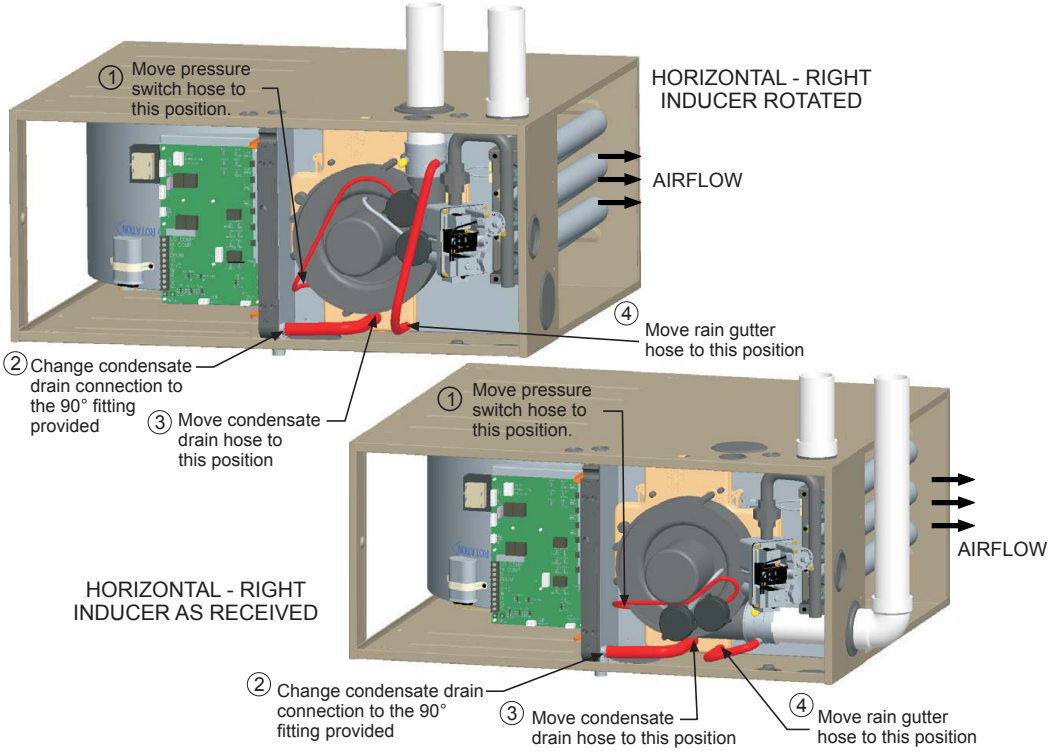
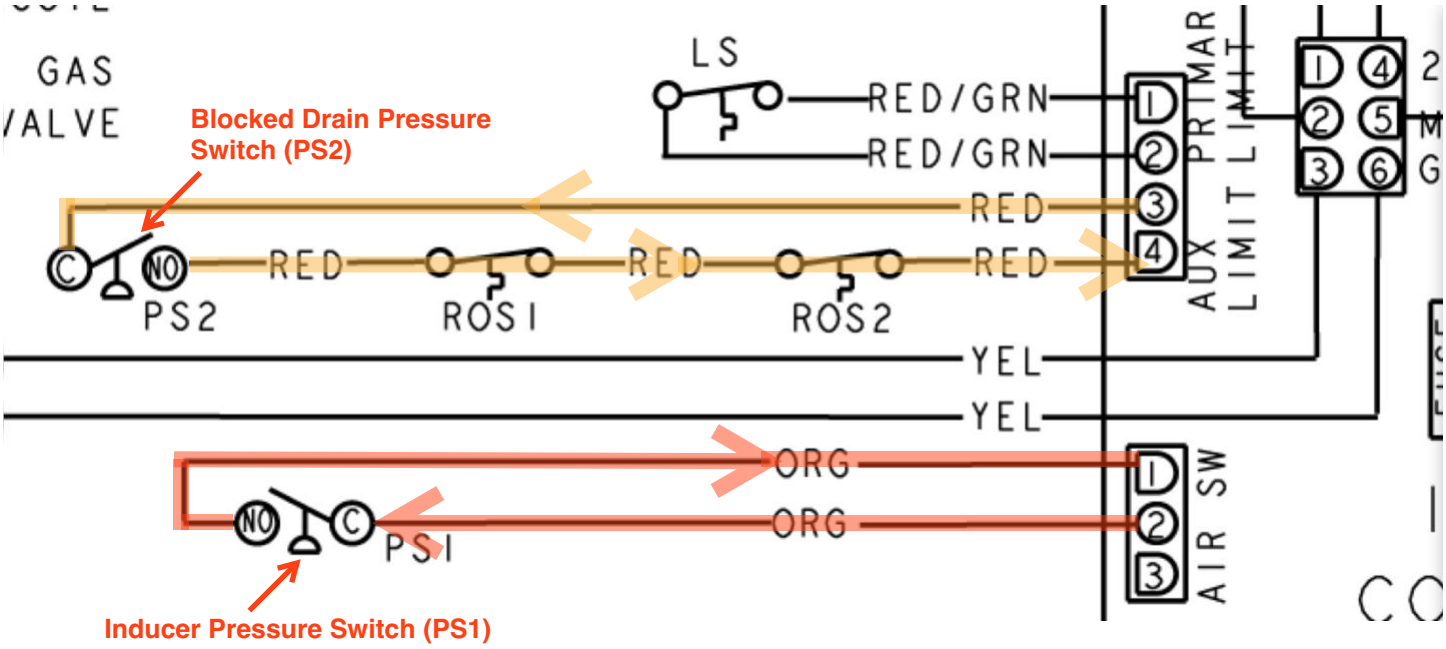


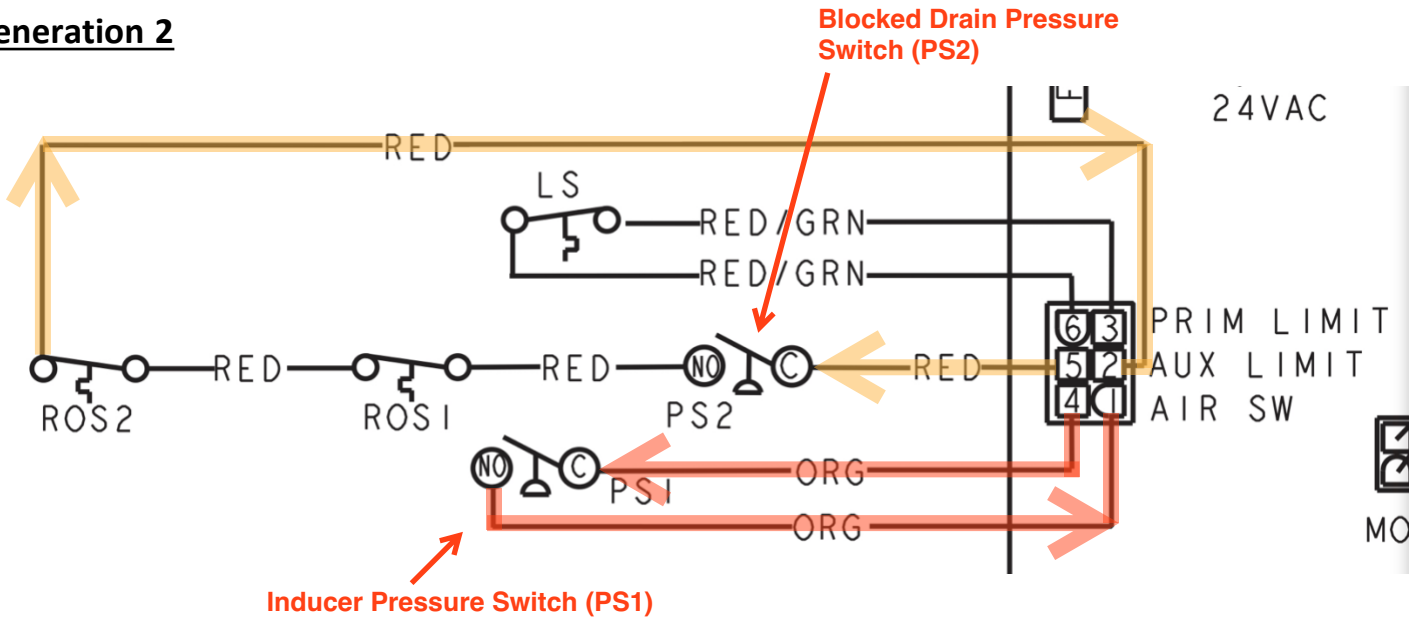
Figure 2-23 - Horizontal Right Furnace Configuration

Pressure Switch Wiring

Generation 1



Generation 2



Pressure Switch Diagnosis (General)

The pressure switch is present to ensure that the induced draft motor is coming up to speed and that there are no restrictions within the vent system. Pressure switches are “normally open” (N/O) and close after the inducer motor is energized. Pressure switch closure must occur to allow the ignition sequence to continue.

If the switch is not closing with the inducer operating, the technician must determine if there is a problem with the switch itself, or if there is another problem causing the switch to not close. The best method of doing this is with a Magnehelic® gauge or incline manometer. A scale of 0-1” w.c. will work well for testing pressure switches on the modulating gas furnaces.

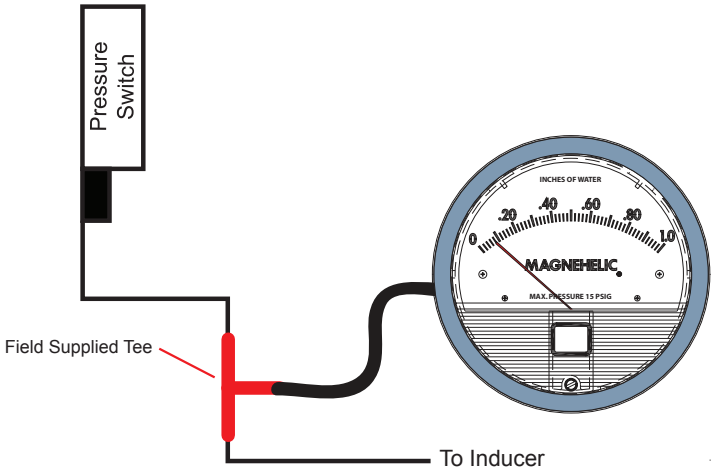


Figure 6-2 - Teeing Magnehelic® Into Pressure Switch

The Magnehelic® or incline manometer should be teed into the pressure switch tubing on both sides using 1/8” tees. Doing so puts the Magnehelic® gauge in parallel with the pressure switch, and it will read the same pressure that is being seen at the pressure switch.

After the Magnehelic® gauge is connected to the pressure switch, the gauge tubing must be run outside the furnace cabinet and the panel must be put back in place. If this is not done, the gauge reading will not reflect actual system operating conditions.

Create a “call for heat” and observe the pressure on the gauge. If the reading on the gauge is in excess of the make point of the switch and the switch is not closing, it is defective and must be replaced.

If the reading on the gauge is a lower value than the make point of the pressure switch, a problem exists that is not allowing sufficient combustion air to flow through the furnace.

A common cause of this is obstruction in the intake or exhaust piping, which could be any of the following:

- Rocks, balls, or other items that may have been placed in the pipe
- Snow or ice restrictions
- Rodents, insects, or insect nests
- Improper support of exhaust piping on condensing furnaces, allowing condensate to remain in the piping
- Undersized piping, too long of piping run, or too many elbows in the piping run

The best way to determine if one of these items is the problem is to disconnect the intake and exhaust piping from the furnace. If the reading on the gauge greatly increases with the piping disconnected, the problem lies in the vent system.

If the pressure reading on the gauge doesn't increase enough to close the pressure switch even with the vent pipe disconnected, check for the following:

- Pressure switch tubing cracked, kinked, obstructed or disconnected
- Inducer wheel loose on the motor shaft
- Blades missing on the inducer wheel
- Tight bearings on the inducer motor
- Restricted pressure tap ports
- Blocked condensate drain

Never attempt to adjust a pressure switch or use a different switch than the one specified for the furnace model being serviced. Never attempt to jumper the switch to allow the furnace to operate. Doing so could allow the furnace to operate under hazardous conditions leading to bodily injury, property damage or loss of life.

Pressure Switch Ratings:

Inducer - .67 iwc on fall Blocked Drain - .15 on fall

Pressure Switch Information

Furnace	Operating Switch	Max. Operating Points		Condensate 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.

Pressure Transducer Verification

The following procedure uses the DC voltage readings that correspond to specific static pressure points to determine if the pressure transducer is operating properly.

When checking a transducer, the meter must be set for DC volts. If the meter is set to “Ohms”, the meter’s battery voltage will be applied to the microprocessor on the control board resulting in a failed board.

1. Multimeter MUST be set to volts DC.
2. Multimeter leads are placed on Black and Green on the three pin plug connector.

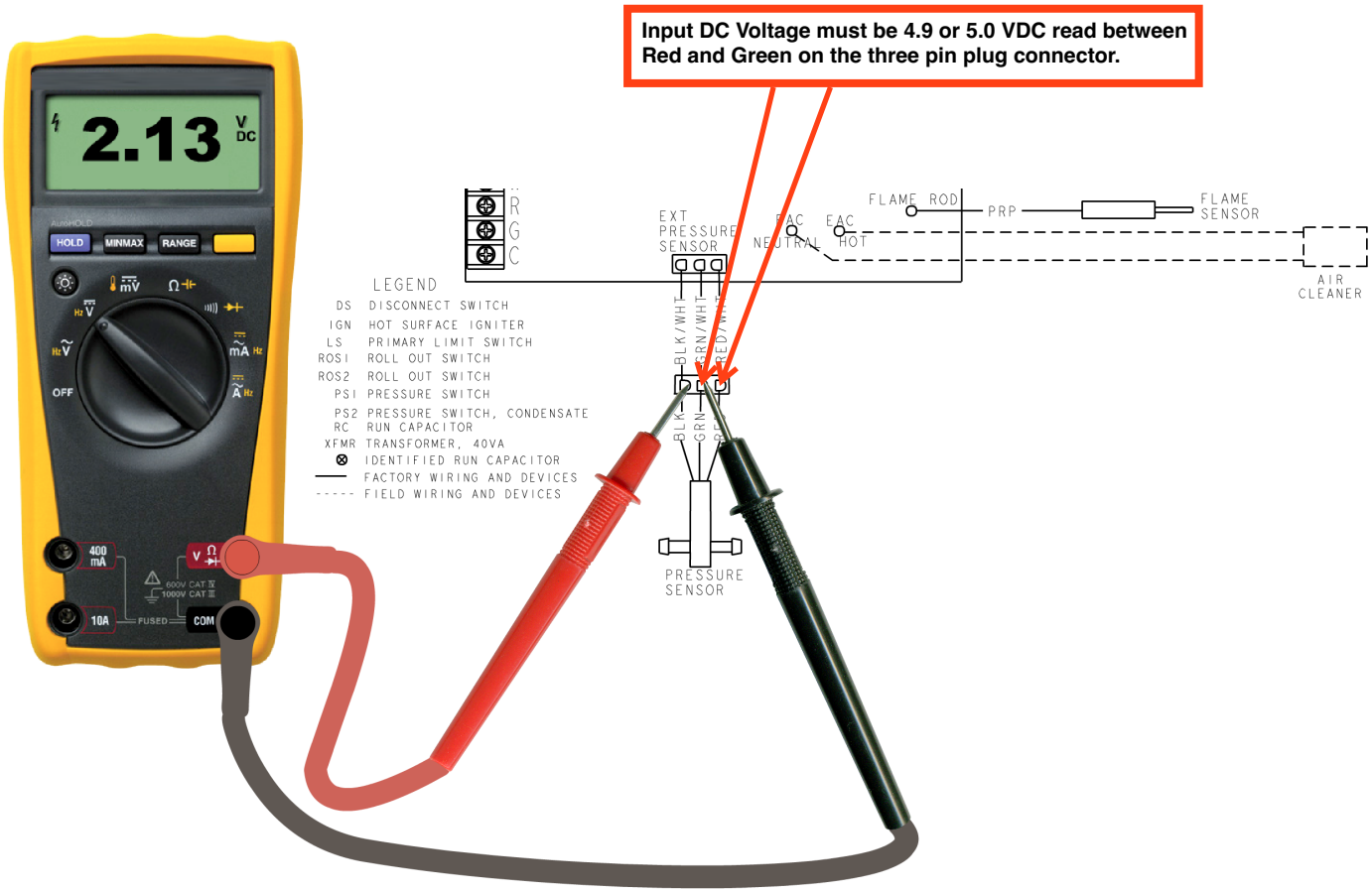


Figure 6-7 - Multimeter Lead Placement on the Three Pin Plug Connector

3. If DC voltage reading is negative, the meter probes are reversed.
4. Tee a Magnehelic or incline manometer as shown in Figure 6-8.

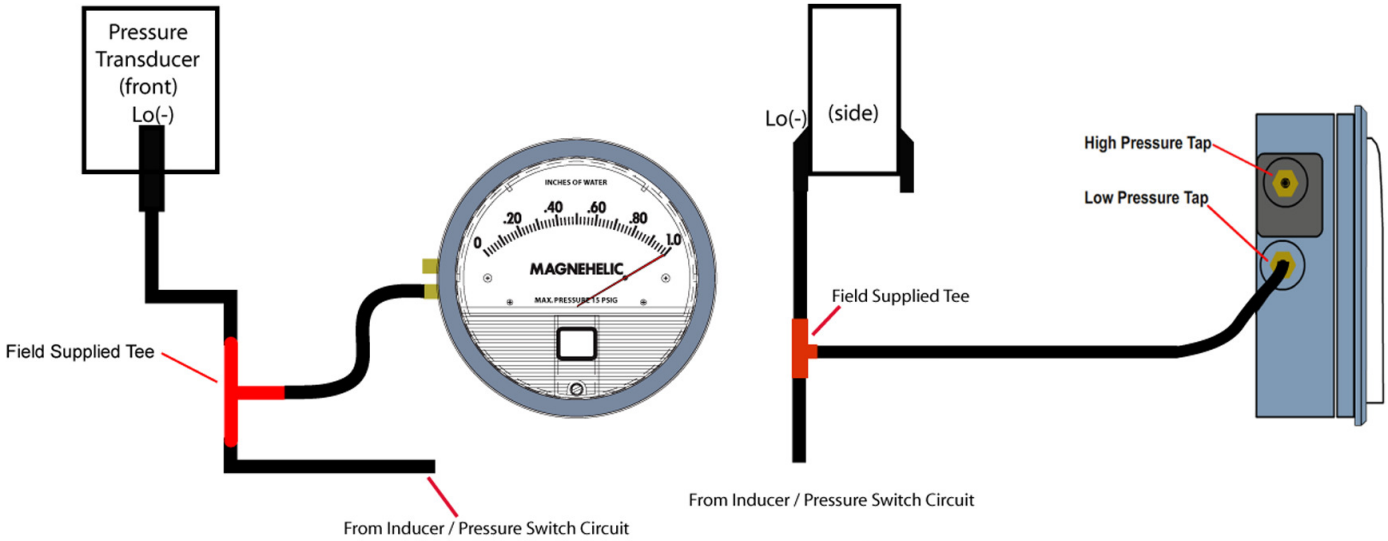


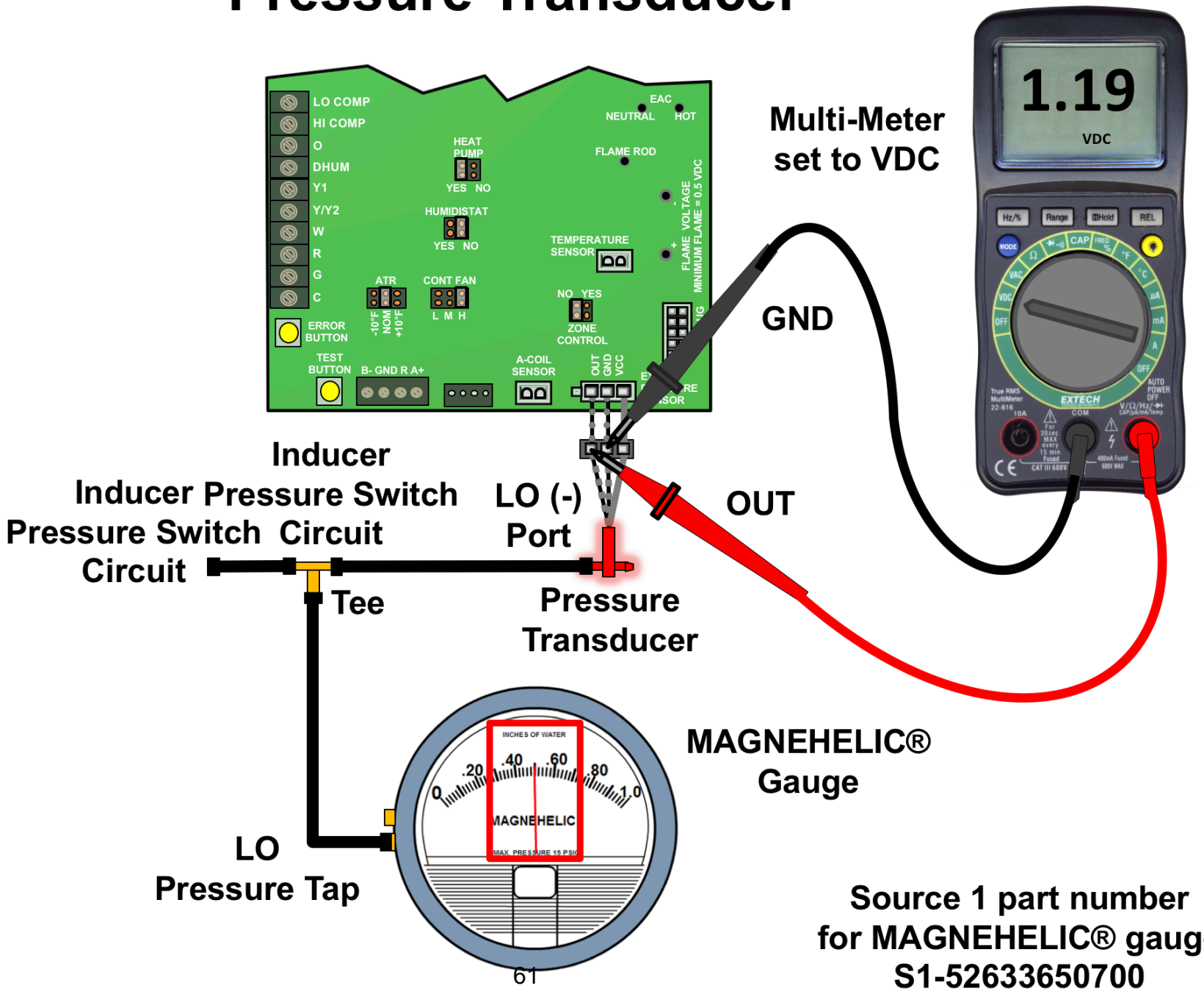
Figure 6-8 - Pressure Transducer Verification

5. Compare the DC voltage to the pressure measured in the pressure/voltage table. They should correspond to +/- 0.1” w.c.

Pressure (in. w.c.)	Voltage (VDC)	Pressure (in. w.c.)	Voltage (VDC)	Pressure (in. w.c.)	Voltage (VDC)
0.00	0.25	0.80	1.75	1.25	2.59
0.40	1.00	0.85	1.84	1.30	2.69
0.45	1.09	0.90	1.94	1.35	2.78
0.50	1.19	0.95	2.03	1.40	2.88
0.55	1.28	1.00	2.13	1.45	2.97
0.60	1.38	1.05	2.22	1.50	3.06
0.65	1.47	1.10	2.31	1.55	3.16
0.70	1.56	1.15	2.41	1.60	3.25
0.75	1.66	1.20	2.50		

Pressure Transducer

Pressure (in. w.c.)	Volts DC
0.00	0.25
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



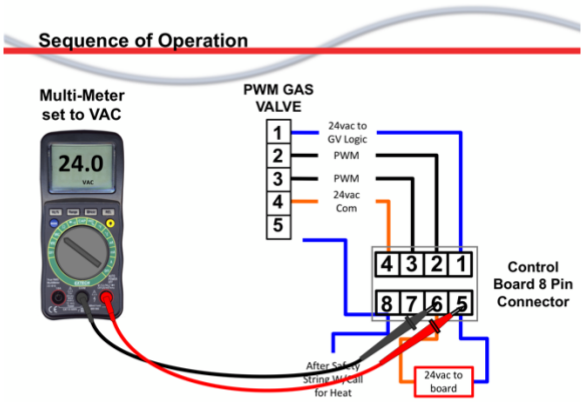
Source 1 part number for MAGNEHELIC® gauge S1-52633650700

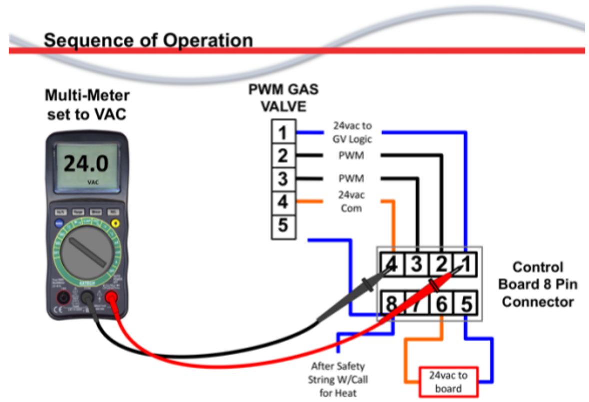
Testing Board Communication with the Gas Valve (Gen. 2)

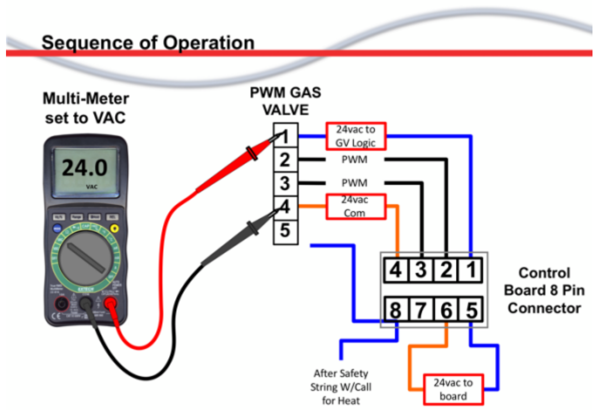
24 VAC Readings

With **power on** the furnace and **no calls** for heat, 24 VAC should be read between:

- Pins 5 and 6 on the 8 pin plug on the board.
- Pins 1 and 4 on the 8 pin plug on the board.
- Pins 1 and 4 on the 5 pin plug on the gas valve.

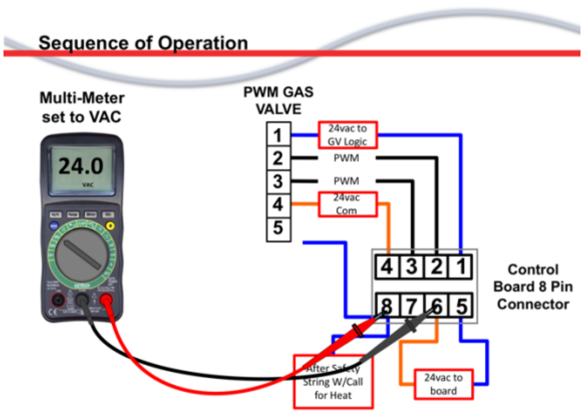


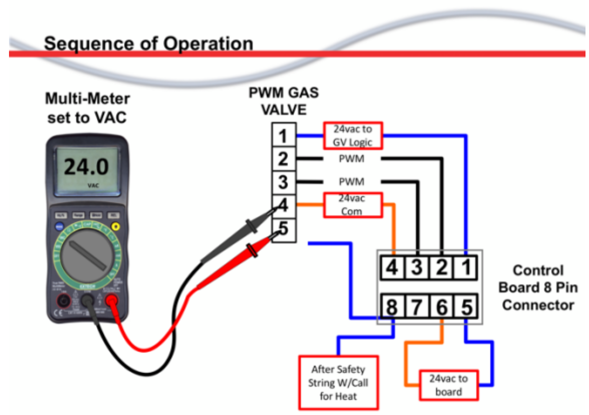




After **giving the furnace a heat call,** and the **igniter starts to glow**, 24 VAC should also be read between:

- Pins 6 and 8 on the 8 pin plug on the board.
- Pins 4 and 5 on the 5 pin plug on the gas valve.

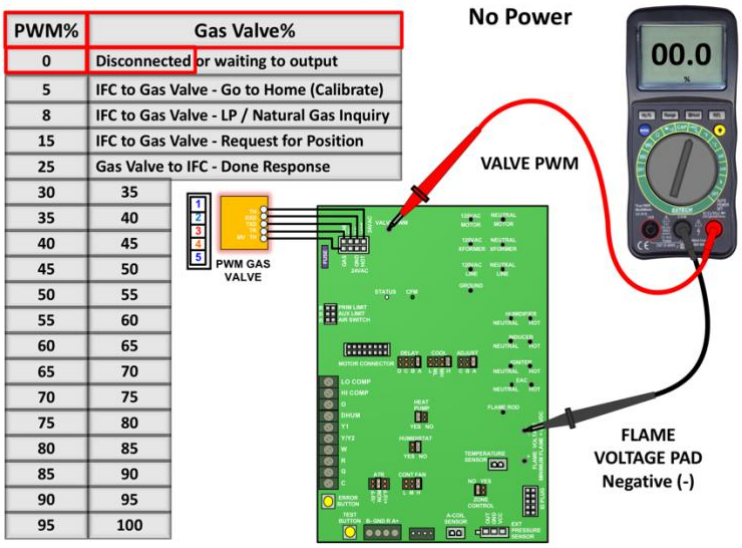




PWM/Duty Cycle Board/Gas Valve Readings

After confirming the 24 VAC Readings, the **meter must be set up to read PWM or Duty Cycle (Hz%)**. With the meter set up for PWM/Duty Cycle, we'll check the PWM communication between the board and the valve by doing the following:

- Place the **POSITIVE** lead from the meter on the **Valve PWM pad** on the board.
- Place the **NEGATIVE** Lead from meter touching the **Negative Flame Voltage pad** on the board.



With **no power** to the unit, you will read 00.0 % between the two test pads/points.

With a **Natural Gas** furnace, after powering on the unit and NO calls present, you should read the following sequence of readings between the two test pads/points:

PWM/Hz%	Action	Communication 'Direction'
08.0 %	Natural Gas Inquiry	From Board to Gas Valve
30.0 %	Natural Gas	From Gas Valve back to Board
25.0 %	Done Response	From Gas Valve back to Board
08.0 %	Natural Gas Inquiry	From Board to Gas Valve
30.0 %	Natural Gas	From Gas Valve back to Board
25.0 %	Done Response	From Gas Valve back to Board
00.0 %	Waiting to Output	

With an **LP Gas** furnace, after powering on the unit and NO calls present, you should read the following sequence of readings:

PWM/Hz%	Action	Communication 'Direction'
08.0 %	Natural Gas Inquiry	From Board to Gas Valve
70.0 %	LP Gas	From Gas Valve back to Board
25.0 %	Done Response	From Gas Valve back to Board
08.0 %	Natural Gas Inquiry	From Board to Gas Valve
70.0 %	LP Gas	From Gas Valve back to Board
25.0 %	Done Response	From Gas Valve back to Board
00.0 %	Waiting to Output	

Give the unit a **call for heat**. On this INITIAL call for heating, AFTER the igniter starts to glow and the gas valve is energized with 24 VAC (read between Pins 4 and 5 on the gas valve plug), **you should read the following sequence of readings at the Valve PWM pad and the Negative Flame Voltage pad**:

PWM/Hz%	Action	Communication 'Direction'
05.0 %	Request for Home	From Board to Gas Valve
25.0 %	Done Response	From Gas Valve back to Board
00.0 %	Waiting to Output	

At this point, for the **first 30 seconds** (during the ignition cycle), the board will tell the valve to go to a firing rate of 70%, communicating with the gas valve as follows:

PWM/Hz%	Action	Communication 'Direction'
15.0 %	Request for Position	From Board to Gas Valve
65.0 %	Gas Valve 70% Firing Rate Position	From Board to Gas Valve
25.0 %	Done Response	From Gas Valve back to Board

After the first 30 seconds of combustion/flame proof, the board will tell the valve to **go to minimum firing rate** of 35% (or 50% for 80% furnaces), communicating the following PWM/Duty Cycle values:

PWM/Hz%	Action	Communication 'Direction'
15.0 %	Request for Position	From Board to Gas Valve
30.0 or 45.0 %	Gas Valve 35% or 50% Firing Rate Position	From Board to Gas Valve
25.0 %	Done Response	From Gas Valve back to Board
15.0 %	Request for Position	From Board to Gas Valve
30.0 or 45.0 %	Gas Valve 35% or 50% Firing Rate Position	From Board to Gas Valve
25.0 %	Done Response	From Gas Valve back to Board

The firing rate will remain at minimum for 6 minutes. **After the 6 minutes**, the firing rate will **start to climb up to 100% or until the heating call is satisfied**. When the board is telling the valve to give a 100% firing rate, the following PWM/Duty Cycle values will be read:

PWM/Hz%	Action	Communication 'Direction'
15.0 %	Request for Position	From Board to Gas Valve
95.0 %	Gas Valve 100% Firing Rate Position	From Board to Gas Valve
25.0 %	Done Response	From Gas Valve back to Board
15.0 %	Request for Position	From Board to Gas Valve
95.0 %	Gas Valve 100% Firing Rate Position	From Board to Gas Valve
25.0 %	Done Response	From Gas Valve back to Board

NOTE: Another good way to call for known firing rate values is to place the furnace in **TEST MODE**. In test mode, the furnace can be **forced to run at minimum firing rate, 70% firing rate, or 100% firing rate**. The board and valve readings can then be tested for accuracy at the appropriate KNOWN firing rate.

Vent Pressure/Gas Valve PWM/Manifold Pressure Table

Furnace Model	Firing Rate %	Vent Pressure IWC	Vent Pressure VDC	Gas Valve PWM	Manifold Pressure Nat. Gas	Manifold Pressure LP Gas
9B12N060	35	0.55	1.28	30	0.43	1.23
	70	1.12	2.34	65	2.09	5.97
	100	1.60	3.25	95	3.50	10.0
9B12N080	35	0.55	1.28	30	0.43	1.23
	70	1.09	2.30	65	2.09	5.97
	100	1.55	3.16	95	3.50	10.0
9C16N080	35	0.55	1.28	30	0.43	1.23
	70	1.09	2.30	65	2.09	5.97
	100	1.55	3.16	95	3.50	10.0
9C16N100	35	0.55	1.28	30	0.43	1.23
	70	1.01	2.14	65	2.09	5.97
	100	1.40	2.88	95	3.50	10.0
9C20N100	35	0.55	1.28	30	0.43	1.23
	70	1.01	2.14	65	2.09	5.97
	100	1.40	2.88	95	3.50	10.0
9D20N120	35	0.45	1.09	30	0.43	1.23
	70	0.96	2.06	65	2.09	5.97
	100	1.40	2.88	95	3.50	10.0

Natural Gas to LP Conversion

The natural gas to LP conversion on Generation 1 units differs from the conversion process on Generation 2 units. Unlike the gas valve used on Generation 1 units, the 36J gas valve used on the Generation 2 units may be converted in the field. The 36J valve and Generation 2 control board **Are Not Backward Compatible** with Generation 1 units.

To convert **Generation 1** 33” modulating gas furnaces from natural gas to LP the following steps must be followed:

1. Remove the access door.

2. Shut off the gas supply to the valve and then disconnect the electrical power.

The gas supply must be shut off prior to disconnecting the electrical power, before proceeding with the conversion.

3. Disconnect the electrical power from the gas valve.

4. Carefully remove the wires from the gas valve and note their location so they may be properly replaced.

5. Remove the screws that hold the manifold to the manifold brackets and slide the manifold off of the burners.

6. On 80% Low-NOx models, remove the NOx screens by removing the entire burner assembly, removing and discarding the NOx screens from the heat exchanger tubes, and reinstalling the burner assembly.

7. Remove the natural gas valve from the manifold.

8. Install the LP gas valve from the conversion kit, making sure that the gas valve is tightly connected and in the same position as the old valve.

9. Remove the main burner orifices from the manifold and retain for future use.

10. Install the propane main burner orifices in the manifold and tighten them. Any leftover propane orifices may be discarded.

11. Reinstall the manifold in the assembly by reversing the removal process.

12. Reconnect the wires to the proper terminals on the gas valve.

13. Install the tapped gas pipe nipple (supplied with kit) into the inlet fitting of the gas valve.

14. Install the gas line pressure switch (supplied with kit) into the 1/8 NPT tapped hole in nipple after applying pipe dope to the switch fitting. Tighten the switch to make sure the connection does not leak.

The gas line pressure switch will cause the furnace to lock out if the gas supply pressure drops below 6” w.c.. The ignition control will display a fault code 7, and will reset after one hour.

15. Disconnect the purple wire from the flame sensor.

16. Using the wiring harness supplied with the kit, connect the purple wire from the flame sensor into the insulated male connector. Connect the two 1/4” insulated terminals to the pressure switch; and connect the remaining insulated terminal to the flame sensor.

17. Install the propane gas conversion label to the gas valve.

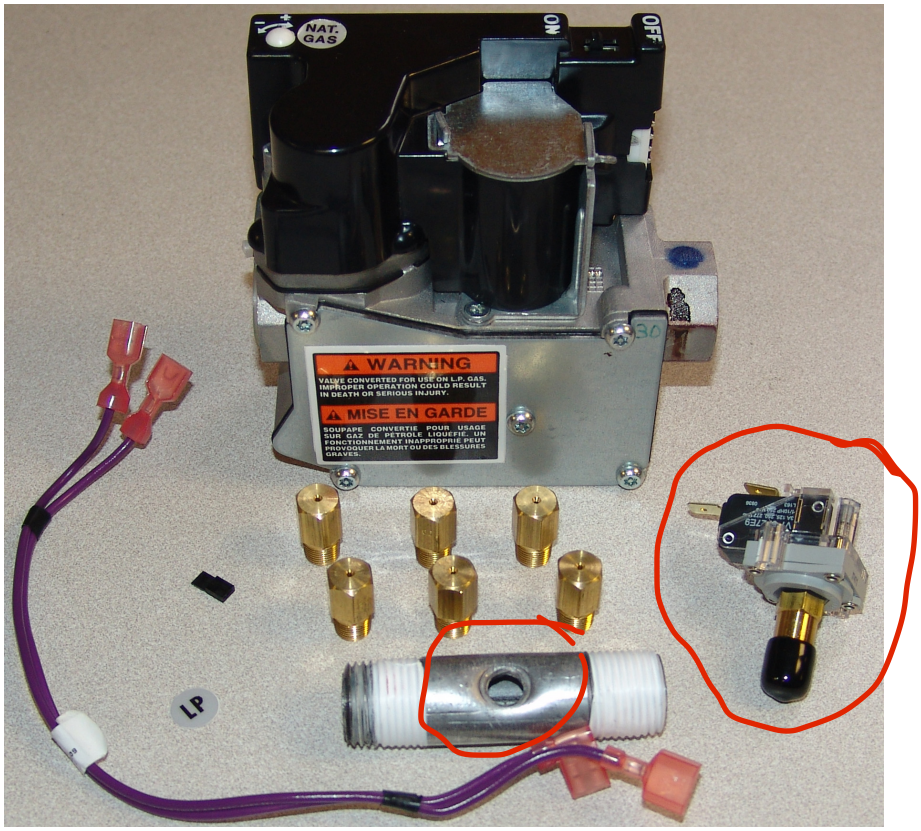


Figure 3-5 - Generation 2 LP Conversion Kit Components

To convert Generation 2 33” modulating gas furnaces from natural gas to LP the following steps must be followed:

1. Remove the upper access door.

2. Unplug the wires from the gas valve.

3. Remove the screws that hold the manifold to the manifold bracket and slide the manifold off the burners.

4. On 80% Low-NOx models, remove the NOx screens by removing the entire burner assembly, removing and discarding the NOx screens from the heat exchanger tubes, and reinstalling the burner assembly.

5. Move the switch located on the gas valve to the OFF position.

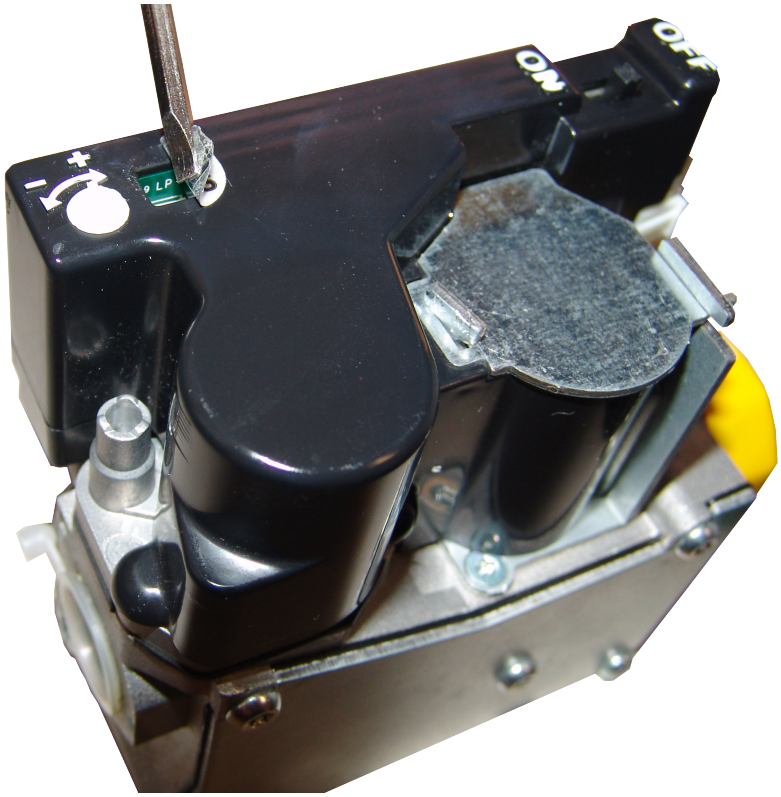


Figure 3-6 - Removing the Natural Gas Label from the Gas Valve

6. Remove the “NAT. GAS” label from the top of the gas valve.

7. Using a pair of tweezers or needle nose pliers, place the jumper (supplied with kit) on the receptacle located beneath the label that was removed in step 5.

Make sure that both of the prongs on the receptacle engage the jumper.

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8. Place the “LP” label (supplied with kit) on the gas valve over the opening to the jumper.

9. Attach the “WARNING” label (supplied with kit) to the gas valve where it can be readily seen.

10. Move the switch located on the gas valve back to the ON position.

11. Remove the main burner orifices from the manifold and retain for future use.

12. Install the propane main burner orifices in the manifold and tighten them. Any leftover propane orifices may be discarded.

13. Reinstall the manifold in the assembly by reversing the removal process.

14. Reconnect the wires to the proper terminals on the gas valve.

15. Install the tapped gas pipe nipple (supplied with kit) into the inlet fitting of the gas valve.

16. Install the gas line pressure switch (supplied with kit) into the 1/8 NPT tapped hole in nipple after applying approved thread sealant to the switch fitting. Tighten the switch to make sure the connection does not leak.

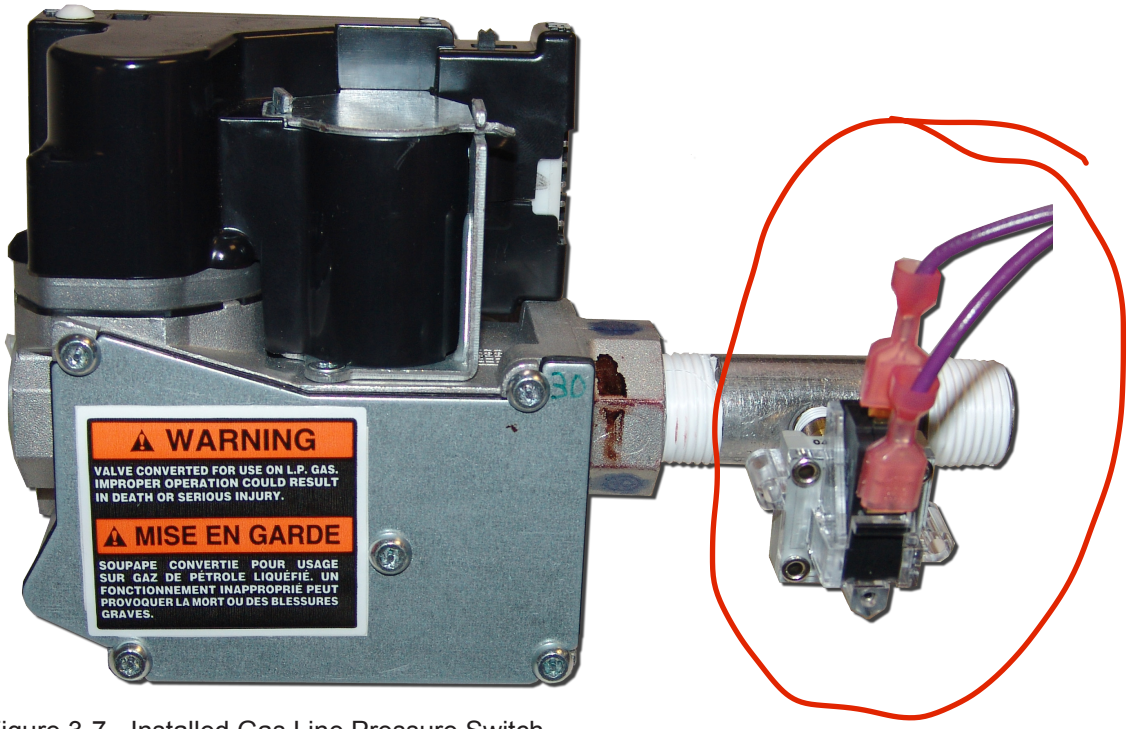


Figure 3-7 - Installed Gas Line Pressure Switch

The gas line pressure switch will cause the furnace to lock out if the gas supply pressure drops below 6” w.c.. The ignition control will display a fault code 7, and will reset after one hour.

17. Disconnect the purple wire from the flame sensor.

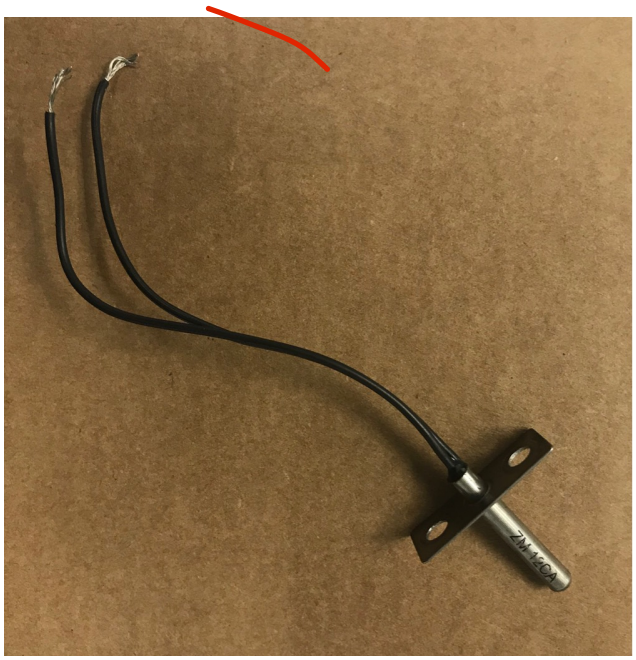
18. Using the wiring harness supplied with the kit, connect the purple wire from the flame rod board terminal into the insulated male connector . Connect the two 1/4” insulated terminals to the pressure switch; and connect the remaining insulated terminal to the flame sensor .

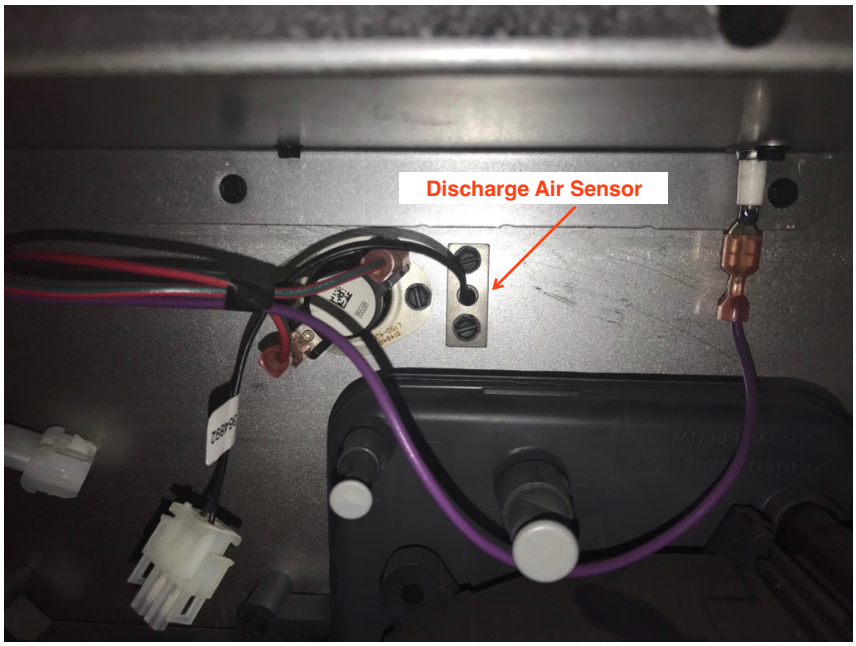
Discharge Air Temperature Sensor

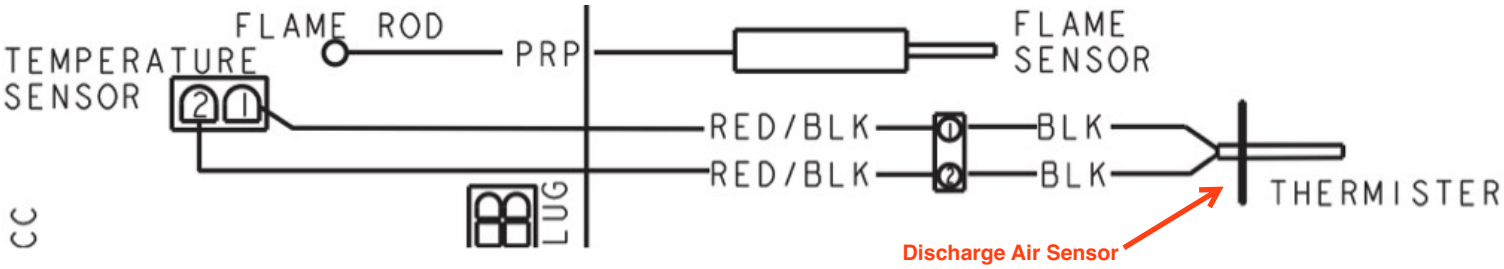
The discharge air temperature sensor extends through the vestibule panel, into the heat exchanger section . The sensor monitors the temperature of the air being supplied to the structure . If the sensor detects discharge air temperature out of range, the furnace control will increase the speed of the blower motor in order to try to increase the amount of airflow being delivered, thereby reducing the discharge air temperature . If the blower motor is already operating at full speed, the control will reduce the firing rate to reduce the air temperature. If the supply air temperature is
too high, even at the minimum input rate (35% for 97% - 98% AFUE models, 50% for 80% AFUE models), the control will de-energize the gas valve .

The sensor is a Negative Temperature Coefficient thermistor. This means that as the measured temperature goes up, the resistance value of the sensor goes down .

The following temperature and resistance chart (on the next page) may be used to determine if the expected resistance value is present at a given temperature .







NOTE: Disconnecting the Discharge Air Temperature Sensor from the board (or a sensor that has failed open should cause the Indoor Blower to ramp up to full speed. A faulty sensor is a very common cause for **Fault Codes 4 and 11**.

10k Thermistor Chart

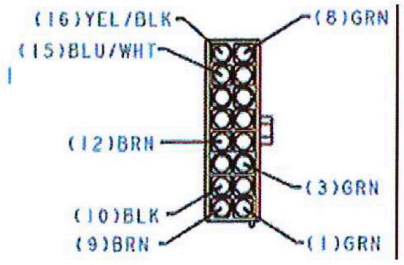
Temperature vs Resistance - 10k Negative Temperature Coefficient											
Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms	Temp	Ohms
-10	118,050	38	27,586	86	8,057	134	2,808	182	1,128	229	518
-9	114,230	39	26,831	87	7,868	135	2,751	183	1,108	230	510
-8	110,540	40	26,099	88	7,685	136	2,696	184	1,089	231	502
-7	106,990	41	25,390	89	7,506	137	2,642	185	1,070	232	494
-6	103,560	42	24,703	90	7,332	138	2,589	186	1,051	233	487
-5	100,260	43	24,036	91	7,163	139	2,538	187	1,033	234	479
-4	97,070	44	23,390	92	6,998	140	2,488	188	1,015	235	472
-3	93,994	45	22,763	93	6,838	140	2,438	189	997	236	465
-2	91,027	46	22,155	94	6,682	142	2,390	190	980	237	458
-1	88,162	47	21,566	95	6,530	143	2,343	191	963	238	451
0	85,398	48	20,994	96	6,381	144	2,297	192	947	239	445
1	82,730	49	20,439	97	6,237	145	2,252	193	931	240	438
2	80,154	50	19,900	98	6,097	146	2,208	194	915	241	431
3	77,668	51	19,377	99	5,960	147	2,166	195	899	242	425
4	75,268	52	18,870	100	5,827	148	2,124	196	884	243	419
5	72,950	53	18,377	101	5,697	149	2,083	197	869	244	412
6	70,712	54	17,899	102	5,570	150	2,042	198	855	245	406
7	68,550	55	17,435	103	5,447	151	2,003	199	841	246	400
8	66,462	56	16,985	104	5,327	152	1,965	200	827	247	395
9	64,444	57	16,546	105	5,209	153	1,927	201	813	248	389
10	62,495	58	16,122	106	5,095	154	1,891	202	799	249	383
11	60,611	59	15,710	107	4,983	155	1,855	203	786	250	378
12	58,791	60	15,309	108	4,875	156	1,820	204	773	251	372
13	57,031	61	14,920	109	4,768	157	1,785	205	761	252	367
14	55,350	62	14,542	110	4,665	158	1,752	206	748	253	361
15	53,685	63	14,175	111	4,564	159	1,719	207	736	254	356
16	52,095	64	13,818	112	4,466	160	1,686	208	724	255	351
17	50,557	65	13,472	113	4,370	161	1,655	209	712	256	346
18	49,070	66	13,135	114	4,276	162	1,624	210	700	257	341
19	47,632	67	12,808	115	4,184	163	1,593	211	689	258	336
20	46,240	68	12,490	116	4,095	164	1,564	212	678	259	332
21	44,894	69	12,181	117	4,008	165	1,535	213	667	260	327
22	43,591	70	11,881	118	3,923	166	1,506	214	656	261	322
23	42,330	71	11,589	119	3,840	167	1,479	215	646	262	318
24	41,110	72	11,305	120	3,759	168	1,451	216	635	263	313
25	39,929	73	11,030	121	3,680	169	1,425	217	625	264	309
26	38,785	74	10,761	122	3,603	170	1,399	218	615	265	305
27	37,678	75	10,501	123	3,527	171	1,374	219	606	266	300
28	36,607	76	10,247	124	3,454	172	1,349	220	596	267	296
29	35,569	77	10,000	125	3,382	173	1,324	221	587	268	292
30	34,565	78	9,759	126	3,312	174	1,301	222	578	269	288
31	33,592	79	9,526	127	3,243	175	1,277	223	569	270	284
32	32,650	80	9,268	128	3,177	176	1,255	224	560	271	280
33	31,738	81	9,077	129	3,111	177	1,232	225	551	272	276
34	30,854	82	8,862	130	3,048	178	1,210	226	542	273	273
35	29,998	83	8,653	131	2,986	179	1,189	227	534	274	269
36	29,168	84	8,449	132	2,925	180	1,168	228	526	275	265
37	28,364	85	8,250	133	2,866	181	1,148				

Reading PWM on 33” Modulating Furnace Board and Motor Plugs

PIN ARRANGEMENT FOR 33" MODULATING FURNACES

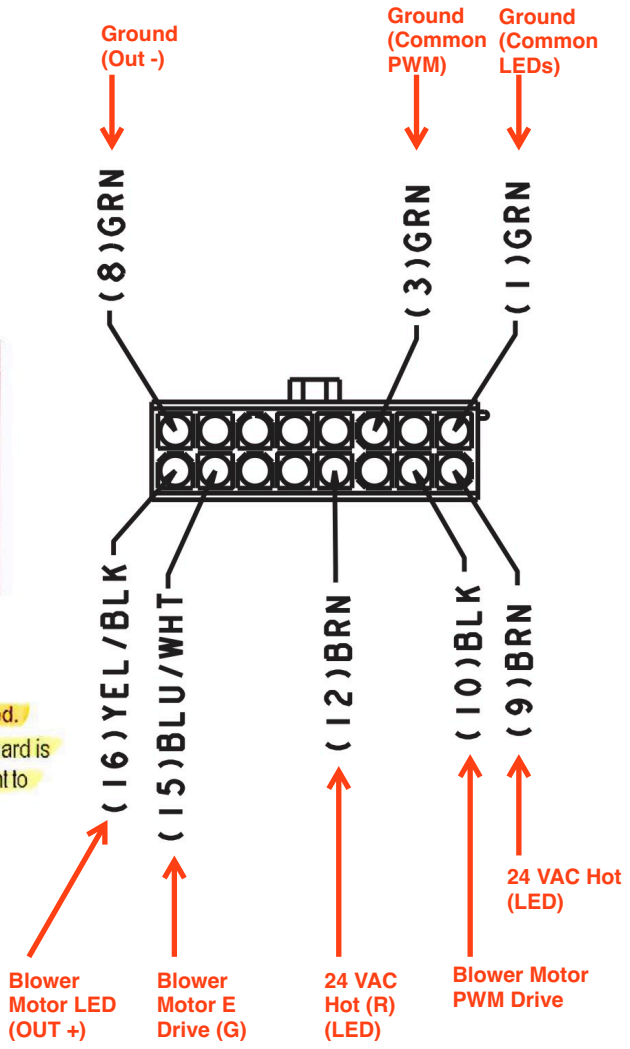
(Motor end of harness pictured below when looking at wire lead end)

	FUNCTION	WIRE COLOR
PIN 1	24 VAC	GRN
PIN 2	NOT USED	
PIN 3	GROUND	GRN
PIN 4	NOT USED	
PIN 5	NOT USED	
PIN 6	NOT USED	
PIN 7	NOT USED	
PIN 8	LED GROUND	GRN
PIN 9	24 VAC NEUTRAL	BRN
PIN 10	PWM SIGNAL (5%-95%)	BLK
PIN 11	NOT USED	
PIN 12	24 VAC HOT	BRN
PIN 13	NOT USED	
PIN 14	NOT USED	
PIN 15	ENABLE PWM	BLU/WHT
PIN 16	LED	YEL/BLK



Note: Pins 9 & 15 have 18 VAC without R-G jumpered. When R-G is jumpered, 27 VAC measured.

Check for PWM signal (or DC volts) between pins 10 and 3-It will bounce, but should show it is there if board is outputting. Then if you unplug the disch air sensor, that reading should go up as the board would want to ramp the blower up.



33” Modulating Furnaces PWM-CFM Chart

Blower Motor PWM Signals and Airflow Delivery (ECM) Models)	
Minimum fan control signal, [PWM %]	5%
Maximum fan control signal, [PWM %]	95%
Minimum airflow limit all furnaces [CFM]	400 (minimum CFM for proper operation of electronic air cleaner)
Fan control signal accuracy, [PWM %]	+/-1 (deviation of fan blower control PWM signal from programmed curve)

ID Plug number indicates furnace model -- (9=97/98%, 8=80%, A-D=Cab. Width, 12-20=Nom. CFM, 60-120=Htg Cap.)

ID Plug	9D20N120	9C20N100	9C16N100	9C16N080	9B12N080	9B12N060	8D20N120	8C20N100	8C16N100	8C16N080	8B12N080	8A12N060
control signal [PWM %]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]
0	187	512	411	305	310	298	239	0	210	101	341	279
1	187	512	411	305	310	298	239	0	210	101	341	279
2	187	512	411	305	310	298	239	0	210	101	341	279
3	187	512	411	305	310	298	239	0	210	101	341	279
4	187	512	411	305	310	298	239	0	210	101	341	279
5	223	519	412	335	323	311	269	92	234	123	351	286
6	259	525	413	364	336	324	298	184	257	144	362	293
7	282	527	421	369	347	337	321	208	273	165	373	300
8	306	529	428	375	358	350	343	232	289	186	383	306
9	325	565	442	396	370	367	368	266	304	211	395	321
10	345	601	457	417	382	385	394	300	319	235	407	335
11	371	608	462	458	397	396	412	314	339	265	419	342
12	398	615	466	500	411	407	430	329	359	295	431	348
13	421	618	471	504	425	422	451	359	379	319	441	367
14	444	621	476	508	439	438	472	389	399	344	452	386
15	484	630	495	525	451	451	499	423	420	374	470	391
16	523	639	514	543	464	464	525	458	442	405	489	397
17	552	641	517	563	482	475	565	500	461	424	498	420
18	581	643	519	583	500	486	605	542	481	443	506	442
19	607	663	537	592	512	498	627	584	500	464	521	447
20	634	683	555	602	525	511	649	627	518	486	535	453
21	664	691	557	622	537	521	673	649	543	512	548	464
22	693	700	559	642	549	531	697	671	568	538	561	476
23	717	716	581	665	558	540	719	703	585	558	575	493
24	740	732	603	689	566	549	742	734	602	578	590	511
25	764	748	623	699	582	564	766	758	623	597	601	525
26	788	764	643	709	597	580	791	782	644	616	613	539
27	810	781	654	717	607	590	814	808	661	635	623	549
28	832	800	665	724	616	601	838	833	678	653	633	559

33” Modulating Furnaces PWM-CFM Chart

ID Plug	9D20N120	9C20N100	9C16N100	9C16N080	9B12N080	9B12N060	8D20N120	8C20N100	8C16N100	8C16N080	8B12N080	8A12N060
control signal [PWM %]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]
29	853	810	685	751	626	613	861	857	698	673	644	577
30	873	821	704	778	635	625	884	880	719	692	655	596
31	904	841	714	789	652	636	899	898	734	709	665	615
32	936	859	724	800	670	646	915	916	748	726	676	634
33	957	882	740	810	682	663	936	939	760	743	699	642
34	977	904	756	821	694	680	957	963	771	759	722	650
35	1002	920	769	844	707	694	970	982	785	776	727	664
36	1027	935	782	867	719	708	983	1000	800	793	733	679
37	1049	954	790	881	731	721	1003	1024	820	813	746	695
38	1070	974	797	895	742	734	1023	1048	840	832	760	711
39	1099	986	813	914	766	743	1037	1067	856	853	769	725
40	1128	998	829	934	789	753	1051	1085	872	874	779	738
41	1148	1007	850	953	804	769	1069	1107	891	896	795	750
42	1168	1016	871	971	820	785	1088	1129	910	918	811	761
43	1188	1034	890	986	835	800	1106	1156	929	937	824	776
44	1208	1052	910	1000	851	814	1125	1184	947	956	836	791
45	1231	1066	928	1022	863	827	1158	1205	964	971	853	804
46	1254	1080	947	1045	875	841	1190	1226	981	986	870	816
47	1283	1110	956	1058	887	847	1211	1244	994	1002	884	823
48	1312	1140	964	1072	899	853	1232	1262	1007	1018	898	831
49	1330	1162	983	1087	915	866	1250	1285	1024	1033	908	849
50	1349	1185	1003	1102	931	880	1268	1309	1041	1049	918	868
51	1372	1197	1016	1118	942	886	1282	1333	1056	1066	929	873
52	1395	1209	1029	1134	952	893	1297	1357	1071	1083	941	878
53	1415	1235	1041	1148	963	901	1327	1383	1087	1098	952	885
54	1435	1262	1054	1162	974	910	1357	1409	1102	1113	963	891
55	1456	1275	1076	1177	984	918	1376	1429	1117	1133	976	906
56	1478	1294	1099	1192	994	926	1395	1450	1131	1154	989	920
57	1496	1313	1111	1207	1006	942	1413	1467	1151	1166	1001	937
58	1514	1332	1123	1222	1019	958	1432	1484	1170	1178	1014	954
59	1531	1354	1139	1234	1025	969	1455	1504	1183	1193	1024	966
60	1547	1320	1156	1245	1032	980	1478	1524	1195	1207	1035	978
61	1566	1391	1178	1258	1041	988	1495	1543	1213	1222	1042	979
62	1585	1364	1201	1271	1050	996	1512	1562	1230	1236	1048	980
63	1594	1429	1224	1285	1066	1009	1534	1571	1245	1248	1058	994
64	1604	1455	1247	1299	1083	1022	1556	1579	1260	1260	1069	1008
65	1631	1472	1266	1305	1090	1032	1571	1599	1275	1263	1077	1019
66	1659	1489	1284	1310	1097	1043	1587	1619	1290	1265	1085	1030
67	1676	1509	1306	1325	1111	1054	1601	1631	1300	1287	1103	1043

33” Modulating Furnaces PWM-CFM Chart

ID Plug	9D20N120	9C20N100	9C16N100	9C16N080	9B12N080	9B12N060	8D20N120	8C20N100	8C16N100	8C16N080	8B12N080	8A12N060
control signal [PWM %]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]	air flow [CFM]
68	1694	1529	1328	1340	1125	1065	1615	1643	1309	1309	1120	1056
69	1716	1549	1349	1348	1140	1080	1631	1666	1320	1318	1133	1067
70	1737	1540	1370	1356	1155	1095	1647	1689	1330	1327	1147	1077
71	1759	1608	1420	1366	1164	1105	1663	1708	1344	1343	1157	1088
72	1782	1646	1471	1377	1173	1116	1679	1728	1358	1359	1168	1098
73	1800	1661	1493	1392	1188	1126	1695	1746	1371	1375	1178	1110
74	1819	1676	1515	1408	1203	1137	1712	1765	1383	1391	1188	1123
75	1837	1698	1518	1419	1215	1148	1736	1782	1393	1406	1201	1135
76	1856	1719	1521	1431	1227	1159	1760	1800	1402	1420	1213	1147
77	1876	1744	1545	1445	1240	1171	1775	1824	1417	1435	1228	1158
78	1897	1769	1568	1460	1253	1182	1790	1849	1432	1451	1243	1170
79	1917	1790	1586	1471	1270	1191	1810	1870	1447	1468	1252	1178
80	1937	1810	1603	1482	1287	1200	1829	1891	1463	1485	1262	1186
81	1958	1836	1620	1498	1304	1204	1852	1910	1478	1502	1279	1201
82	1979	1862	1637	1515	1320	1207	1875	1929	1493	1518	1295	1216
83	2005	1876	1657	1525	1330	1220	1898	1948	1506	1532	1304	1221
84	2031	1890	1678	1536	1340	1233	1921	1967	1518	1545	1314	1227
85	2050	1915	1706	1550	1347	1244	1935	1988	1537	1563	1328	1240
86	2069	1941	1734	1564	1354	1256	1949	2008	1556	1582	1341	1253
87	2090	1963	1757	1582	1355	1266	1964	2023	1568	1597	1353	1260
88	2111	1985	1781	1601	1355	1277	1980	2039	1580	1612	1364	1267
89	2128	2012	1803	1624	1358	1284	2008	2060	1598	1628	1366	1280
90	2145	2040	1826	1647	1360	1292	2036	2082	1616	1644	1369	1292
91	2173	2061	1848	1661	1362	1292	2059	2103	1631	1659	1371	1304
92	2200	2082	1871	1675	1363	1292	2082	2124	1646	1674	1373	1317
93	2220	2105	1896	1683	1364	1293	2098	2149	1659	1688	1373	1328
94	2239	2129	1921	1692	1364	1294	2114	2174	1673	1703	1373	1340
95	2257	2151	1946	1695	1365	1298	2141	2199	1690	1717	1375	1346
96	2275	2174	1970	1697	1366	1303	2168	2225	1707	1731	1378	1351
97	2302	2194	1974	1717	1366	1305	2188	2244	1723	1749	1378	1375
98	2329	2214	1977	1736	1366	1307	2208	2263	1739	1768	1378	1400
99	2329	2214	1977	1736	1366	1307	2208	2263	1739	1768	1378	1400
100	2329	2214	1977	1736	1366	1307	2208	2263	1739	1768	1378	1400