2022 Gas Furnace Service part 2

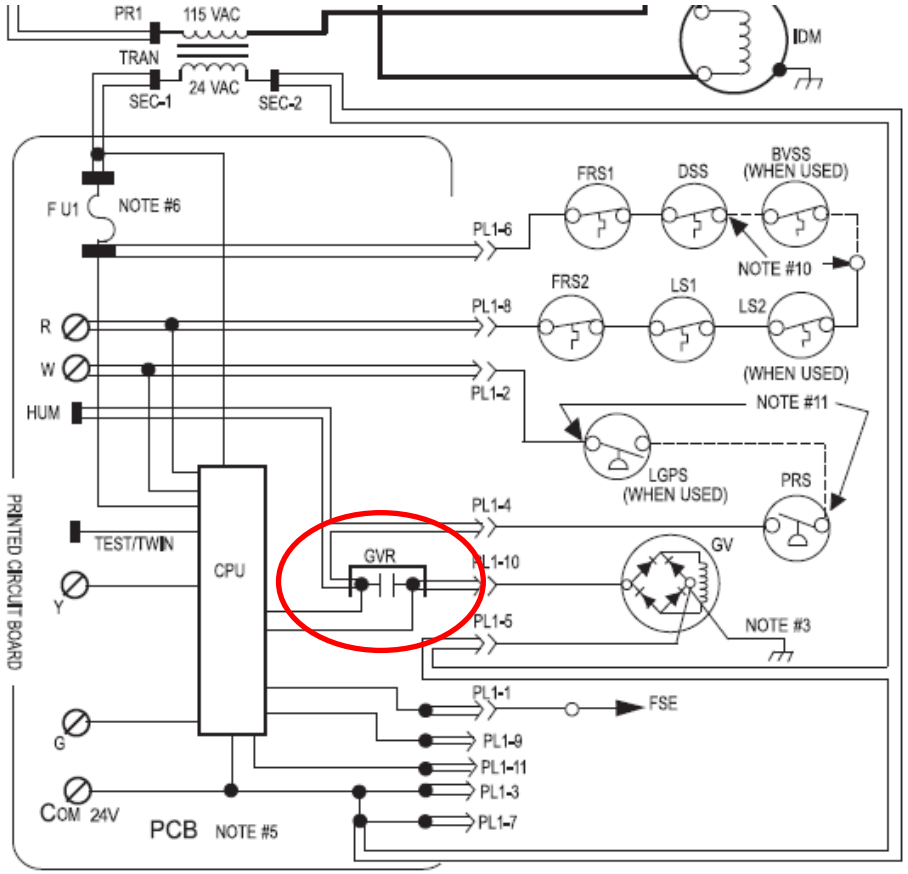
Beginning of deck 2

Carrier

CE

bryant
Heating & Cooling Systems

Status Code 21 – Gas Valve Lockout



Board constantly monitors voltage across Gas Valve Relay(GVR).

If voltages are abnormal (voltage on output when it shouldn't be) heating will be locked out until condition fixed.

Possible causes:

- Short on gas valve wiring
- Faulty GVR (Bad board)

Status Code 22 – Abnormal Flame Proving Signal

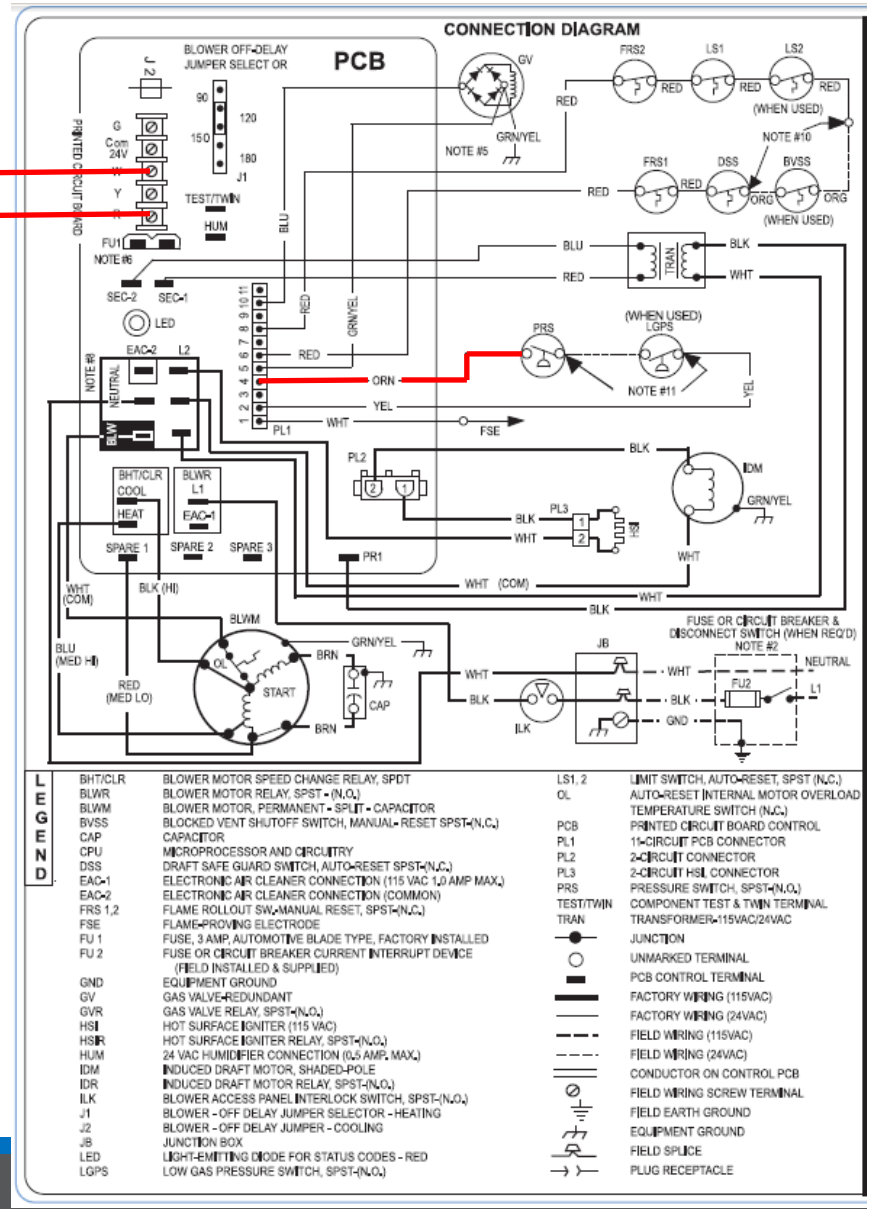
If the flame sensor senses flame when the gas valve is supposed to be closed, the board will flash a Code 22.

Check for leaky gas valve or stuck open gas valve.

If no flame is present, suspect a board problem.

Do not cycle power first. Turn the gas line off first then cycle power.

Code 23 - Sequence – Call for Heat



On a call for heating, before the inducer is started, the system will check to make sure the pressure switch is open. On multiple stage units there will be more than one pressure switch.

If board sees voltage back from any of the switches, the furnace board will flash a code 23 fault code and will not start until all pressure switch circuits are open.

Possible Causes:

- Inducer Motor Problem
- Wiring Issue
- Switch Issue

Code 25 Model Plug/Setup

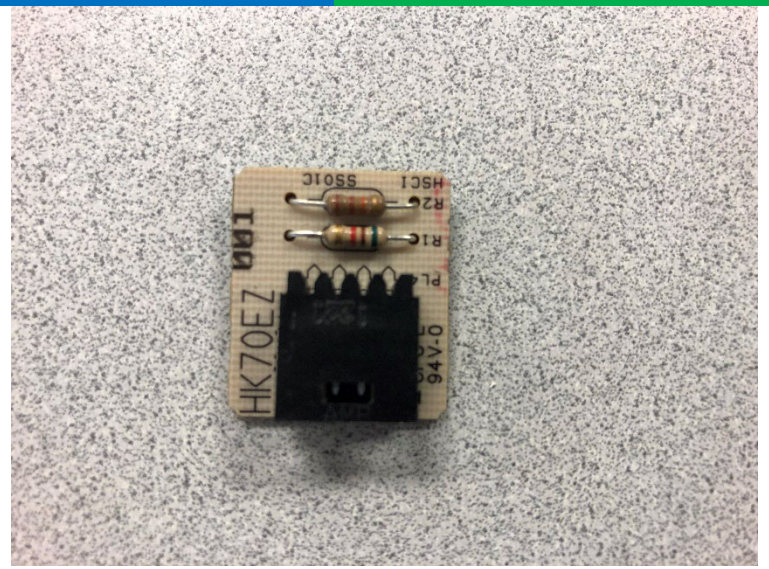
Boards with Setup Switches

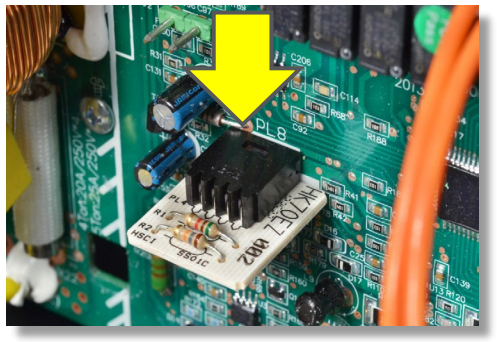
- **Indicates the model plug is missing or incorrect**
- Set up switch “SW1-1” or “SW1-6” is positioned improperly

If code flashes 4 times on power up, control is defaulting to model selection stored in memory.

Check for thermostat call with SW1-1, SW1-6 or both SW1-1 and SW1-6 in the on position.

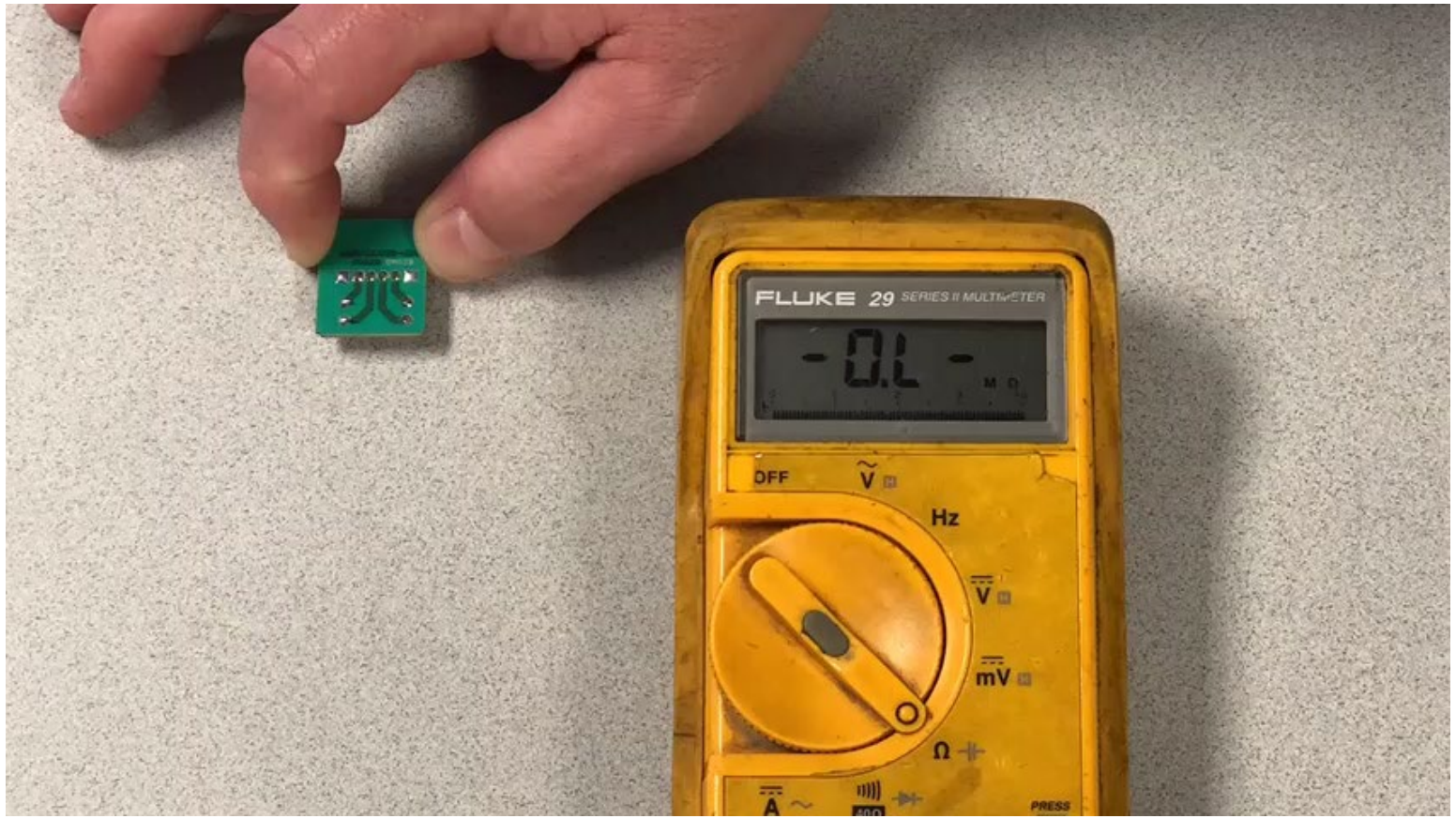
Model Plug





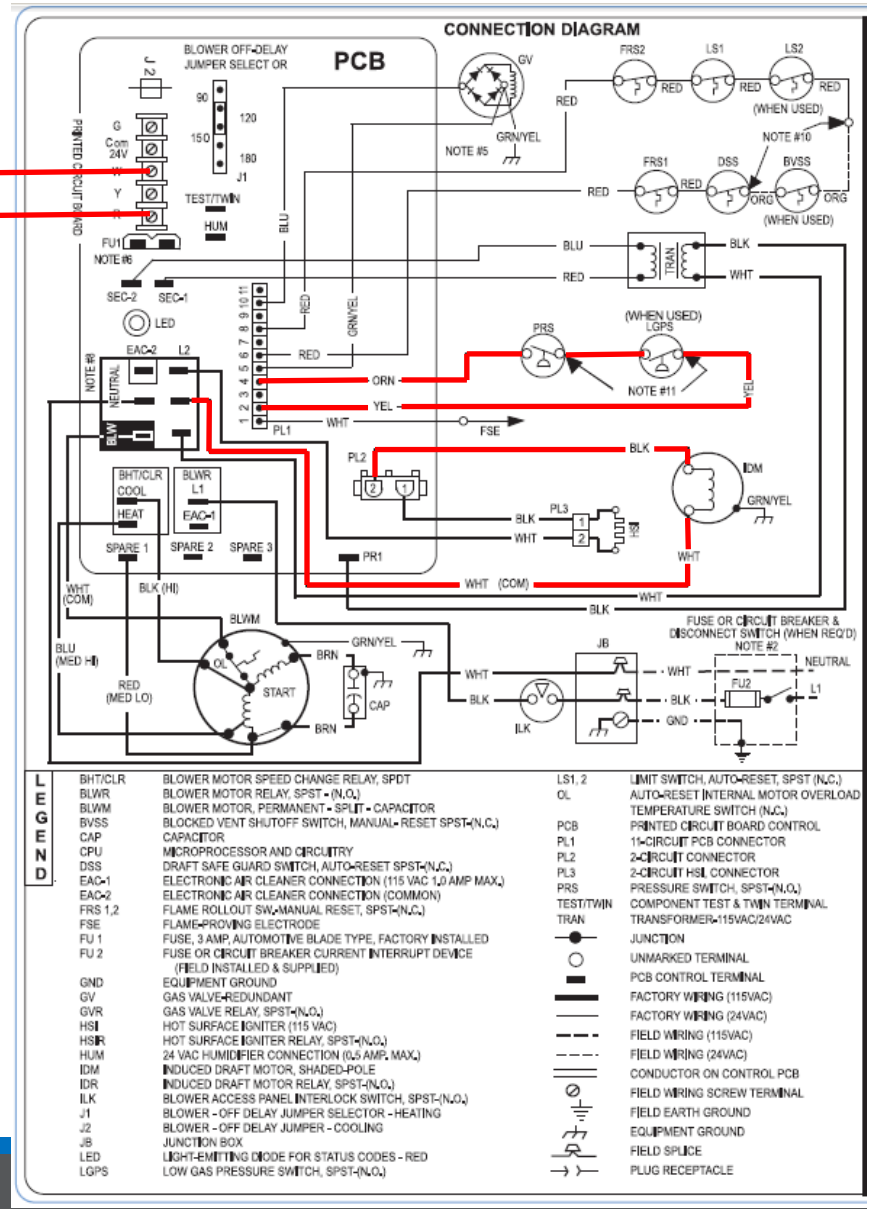
MODEL NUMBER	MODEL PLUG NUMBER	PIN RESISTANCE (K-ohms)	
		Pins 1-4	Pins 2-3
24VNA624	HK70EZ009	5.1K	91K
24VNA636	HK70EZ021	11K	39K
24VNA648	HK70EZ033	18K	11K
24VNA660	HK70EZ045	18K	220K
25VNA424	HK70EZ003	5.1K	24K
25VNA436	HK70EZ015	5.1K	360K
25VNA448	HK70EZ027	11K	150K
25VNA460	HK70EZ039	18K	62K

Model Plug



Same procedure on all system’s

Code 31 – Pressure switch



Once board verifies that pressure switch is open, the board energizes the inducer motor and waits for pressure switch to close.

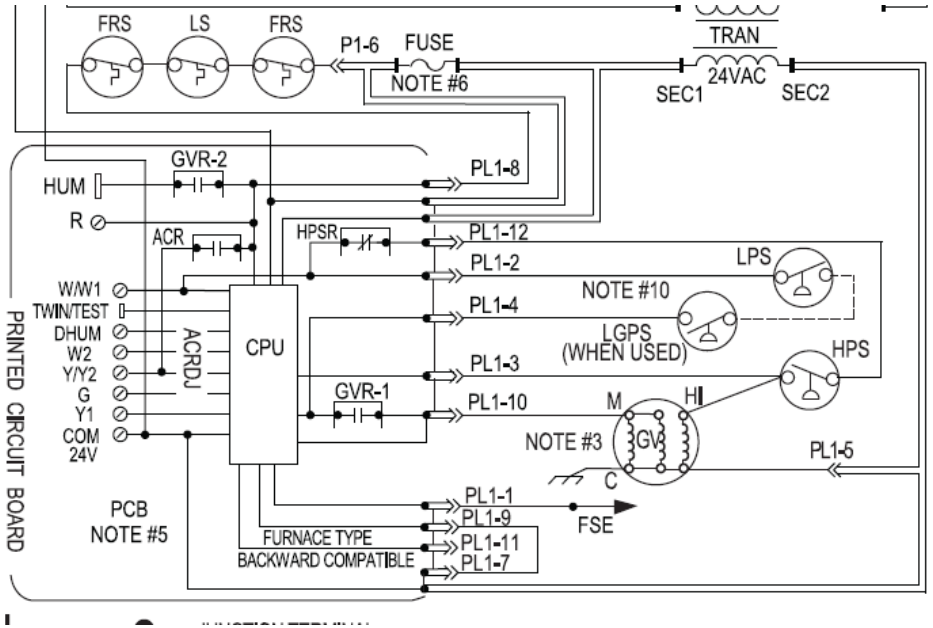
If the pressure switch fails to close or reopens after closing, the board will flash a code 31.

Possible Causes:

- Inducer Motor Problem
- Pressure Switch Issue
- LGPS Issue (LP Gas)

Open Pressure Switch will prevent sequence from continuing or close gas valve if already open. If open longer than five minutes, inducer will shut off for fifteen minutes before retrying.

Code 32 – Pressure switch



On 2-stage and modulating furnaces, code 31 refers to the medium-pressure switch, high-pressure switch not closing or reopening after closing.

On these furnaces, an additional code, Code 32, can be flashed if the low-pressure switch does not open.

Also, an additional code, Code 43, can be flashed if the high- or medium- switch is closed and the low-pressure switch is not.

Checking Pressure switches

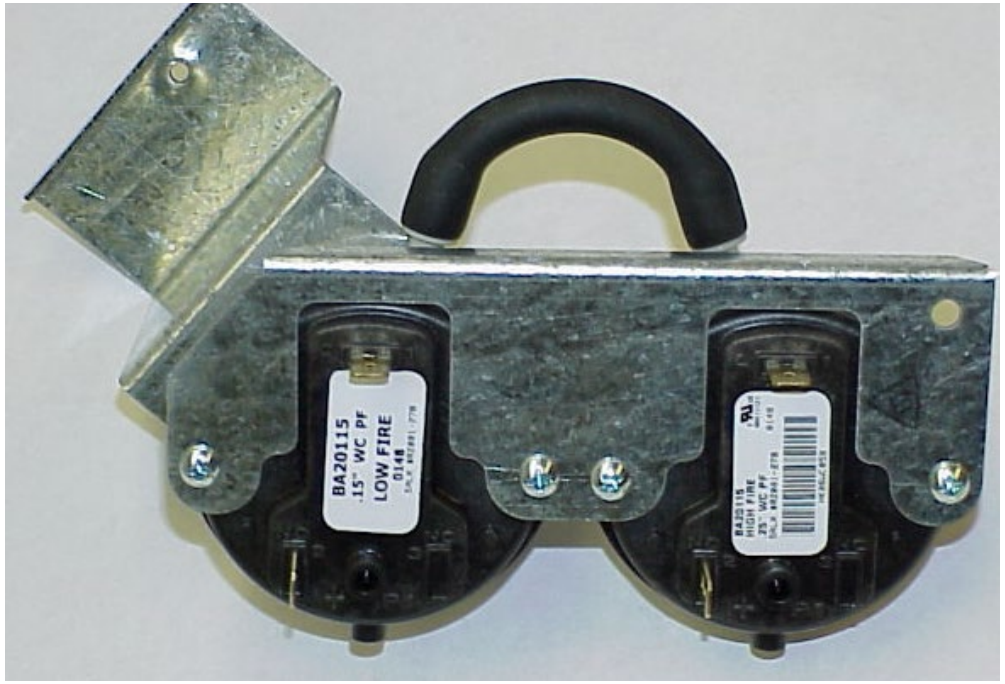
- Verify All wiring and hose connections.
- Measure the pressure drop across the pressure switch(s).
- Pressure requirement to make contact information is located on the switch
- Use a manometer or other tool with the ability to measure pressure in Inches of Water Column

How identify the pressure needed for the switch to make contact.

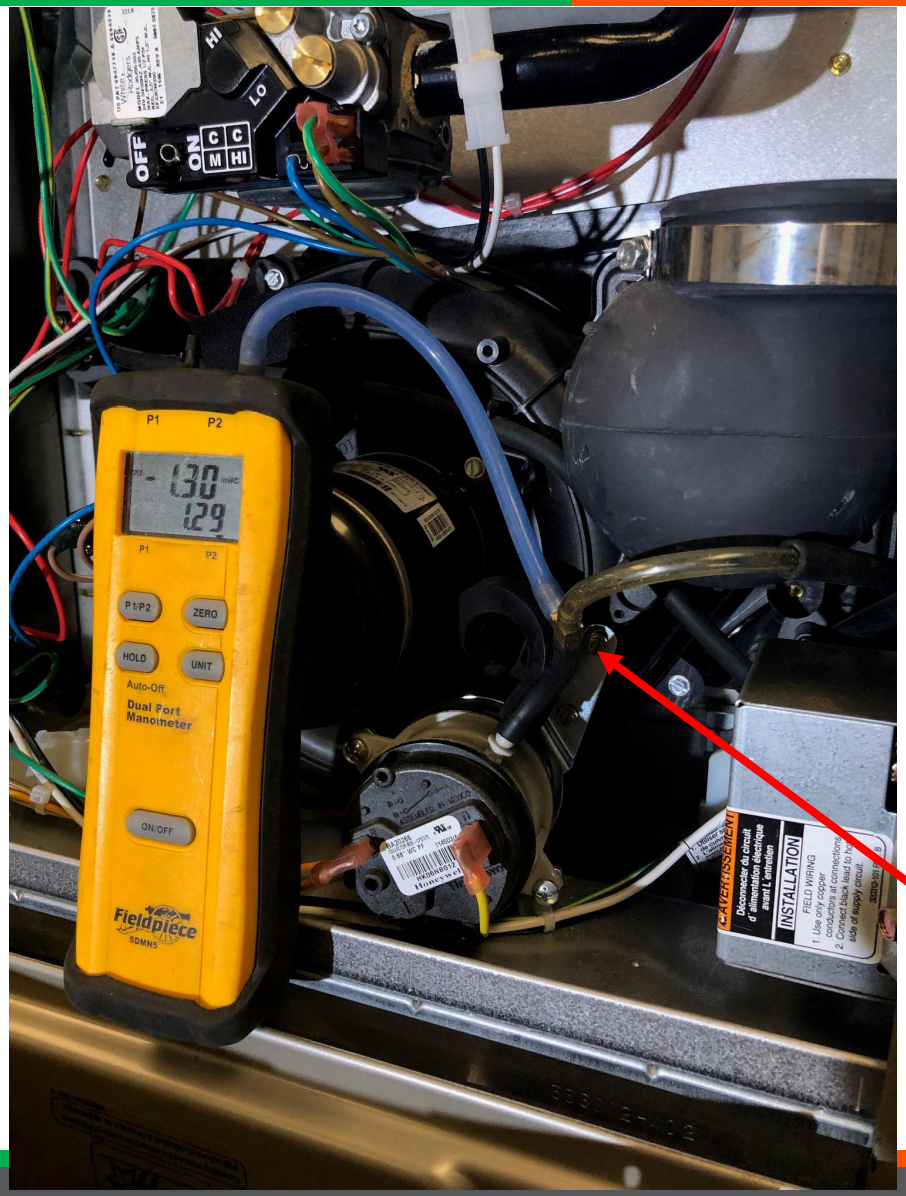
Sometimes can be found in the Product data

PRESSURE SWITCH MAKE/BREAK POINTS

UNIT SIZE (BTUH)	HIGH-HEAT PRESSURE SWITCH		MED-HEAT PRESSURE SWITCH		LOW-HEAT PRESSURE SWITCH	
	Make Point	Break Point	Make Point	Break Point	Make Point	Break Point
60,000	1.91 in.wc max	1.70 in. wc +/- 0.09	1.06 in. wc max	0.91 in. wc +/- 0.05	0.60 in. wc max	0.45 in. wc +/- 0.05
80,000						
100,000						
120,000						



Using a tee attach a hose to the pressure switch



Field provided Tee

Understanding HXDP – Heat eXchanger Pressure Differential

- Pressure switch operation is the function of heat exchanger design
- The switch set points are matched to the combustion requirements of heat exchanger design
- The set point ranges are fairly consistent across a particular model family or size
  - The part number may change, but the set points typically are the same or very close

Understanding 80% HXDP

- As unit warms up
  - Flue gas is mostly products of combustion
  - But has some excess air in it
    - Density decreases as flue gas temperature increases to steady-state temperatures
- At steady-state operation
  - HXDP may be at, or slightly below pressure switch make point
  - HXDP should not fall below break point during operation

80% Furnace Erratic Switch Operation

- *If the switch doesn't close during start up*
  - Is the inducer running up to speed?
  - Is the switch making at the recommended set point?
  - Is the pressure tube kinked, cracked, plugged or disconnected?
  - Is the reference port on the collector box blocked?
    - Scale and corrosion in this area indicates flue gas condensation in the collector box and vent

80% Switch Stuck Closed

- Switch must be open before ignition sequence can begin
- *If switch is stuck closed*
  - Pressure switch tube is blocked with water
  - Under-fired
  - Short cycling
  - Low return air temperature
  - Vent cap missing
  - Bleed port on pressure switch obstructed

80% Furnace Erratic Switch Operation

- *If the switch falls below set point during steady-state operation*
  - Unit may be severely under-fired
    - Low volume of flue products
    - Low density due to high temperature
    - Equals low HXDP

Understanding 90% HXDP

- HXDP-90% furnaces
  - This is the difference in pressure between the burner box and the collector box
- 90% HXDP increases slightly on ignition
  - Density change in flue gas is offset by fan performance
  - Fan rpm changes slightly with density
  - Vent static plays a significant part
    - HXDP can be high or low if vent is not sized correctly

Erratic Switch Operation 90% Furnaces

- *If the switch doesn't close during start up*
  - Is the inducer running up to speed?
  - Is the switch making at the recommended set point?
  - Is the pressure tube kinked, cracked, plugged or disconnected?
  - Is the reference port on the collector box or burner box blocked?
  - Vent exhaust unobstructed?
  - Vent intake clear?

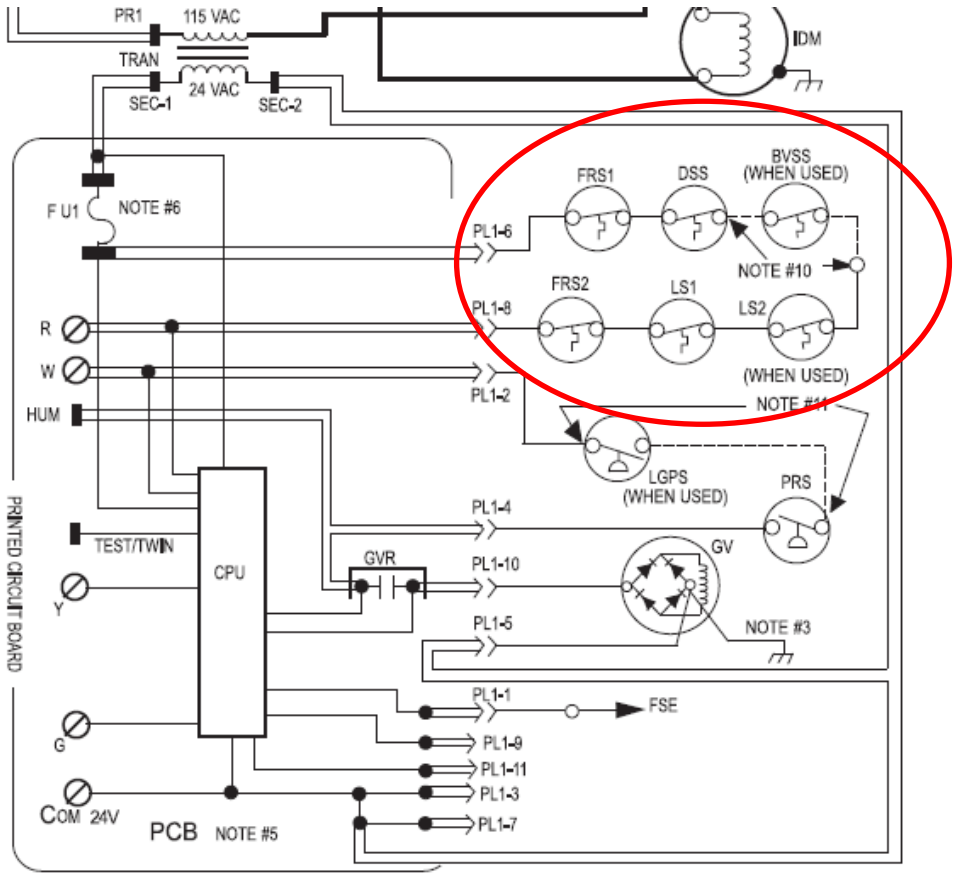
90% Switch Stuck Closed

- Switch must be open before ignition sequence can begin
- *If switch is stuck closed*
  - Pressure switch tube is blocked with water
    - Check inducer/collector box drain system
    - Clean drain trap
  - Bleed port on pressure switch obstructed
  - Water in pressure switch-see above

Erratic Switch Operation 90% Furnaces

- *Nuisance pressure switch faults, If the switch falls below set point during steady-state operation*
  - Clean drain trap
    - Slow trap fills up collector box
  - Clean reference ports
    - Usually due to slow running drain trap
  - Check for burner pulsation
    - Vent sizing
    - Combustion air disks installed?
  - Check for high HXDP-causes burner pulsations
    - Vent sizing
    - Combustion air disks installed?

Code 33 - Limit Circuit Fault



If any of the safeties in the limit circuit opens, a Code 33 will flash.

The type of furnace will govern how the board will handle Code 33.

All furnaces will stop gas and run the blower for 4 minutes.

If the circuit remains open for more than three minutes, the furnace will flash a code of 13 and be locked out for 3 hours.

Roll out and blocked vent safety switches require manual reset and will result in lockout.

Code 33 - Limit Circuit Fault

UNIT SIZE		045–08	045–12	070–08	070–12	070–16	090–14	090–16
RATINGS AND PERFORMANCE								
Input Btuh*	58STX Upflow; all 58STA	44,000	44,000	66,000	66,000	66,000	88,000	88,000
Nonweatherized ICS	58STX Downflow/ Horizontal	42,000	42,000	63,000	63,000	63,000	84,000	84,000
Output Capacity (Btuh)†	58STX Upflow; all 58STA	35,000	36,000	53,000	54,000	53,000	71,000	71.000
Nonweatherized ICS	58STX Downflow/ Horizontal	34,000	34,000	51,000	51,000	51,000	68,000	68,000
AFUE†		80.0	80.0	80.0	80.0	80.0	80.0	80.0
Certified Temperature Rise Range – °F (°C)		30-60 (17–33)	20-50 (11–28)	40-70 (22–39)	30-60 (17–33)	25-55 (14–30)	40-70 (22–39)	30-60 (17–33)
Certified External Static Pressure	Heat/Cool	0.10/0.50	0.10/0.50	0.12/0.50	0.12/0.50	0.12/0.50	0.15/0.50	0.15/0.50
Airflow CFM‡	Heating	865	1250	720	1195	1350	1300	1505
	Cooling	835	1160	870	1200	1505	1385	1635
ELECTRICAL								
Unit Volts–Hertz–Phase		115-60-1						
Operating Voltage Range	Min-Max	104-127						
Maximum Unit Amps		5.2	7.2	5.1	7.2	9.5	8.6	10.0
Maximum Wire Length (Measure 1 Way in Ft (M)		49 (14.9)	37 (11.2)	51 (15.5)	38 (11.5)	29 (8.8)	32 (9.7)	28 (8.5)
Minimum Wire Size		14						

58STA/STX

58STA
Single stage 80%

Let’s say this furnace is 17 years old and our company replaced it.

Code 33 - Limit Circuit Fault

Heating Capacity and Efficiency		040E14–10	040E17–12	060E14–12	060E17–14	080E17–16	080E21–20	100E21–20	120E24–20
Input	High Heat (BTUH)	40,000	40,000	60,000	60,000	80,000	80,000	100,000	120,000
Output	High Heat (BTUH)	37,000	37,000	56,000	56,000	75,000	75,000	93,000	111,000
Certified Temperature Rise Range °F (°C)	High Heat	35 – 65 (19 – 36)	35 – 65 (19 – 36)	35 – 65 (19 – 36)	35 – 65 (19 – 36)	40 – 70 (22 – 39)	35 – 65 (19 – 36)	40 – 70 (22 – 39)	45 – 75 (25 – 42)
Airflow Capacity and Blower Data									
Rated External Static Pressure (in. w.c.)	Heating	0.1	0.10	0.12	0.15	0.15	0.15	0.20	0.20
	Cooling	0.50	0.50	0.50	0.50	0.50	0.50	0.50	0.50
Airflow Delivery @ Rated ESP (CFM)	Heat	765	740	1100	1000	1350	1460	1675	1735
	Cooling	985	985	1035	1190	1370	1815	1855	1800
Cooling Capacity (tons) @ 400, 350 CFM/ton	400 CFM/ton	2	2.50	2.50	3	3.50	4.50	4.50	4.50
	350 CFM/ton	2.50	3	3	3.50	4	5	5	5
Direct–Drive Motor Type		Electronically Commutated Motor (ECM)							
Direct–Drive Motor HP		1/2	1/2	1/2	1/2	1/2	3/4	3/4	3/4
Motor Full Load Amps		6.4	6.4	6.4	6.4	6.4	8.8	8.8	8.8
RPM Range		600 – 1200							
Speed Selections		5							
Blower Wheel Dia x Width	in.	11 x 7	11 x 8	11 x 7	11 x 8	11 x 8	11 x 10	11 x 10	11 x 11
Air Filtration System		Field Supplied Filter							
Filter Used for Certified Watt Data		KGAWF1506UFR							
Electrical Data									

59SC2D
Single stage 92%

We offered the homeowner a 92% option, lets look at our new airflow requirements.
It is no longer just push pull on furnace BTU’s

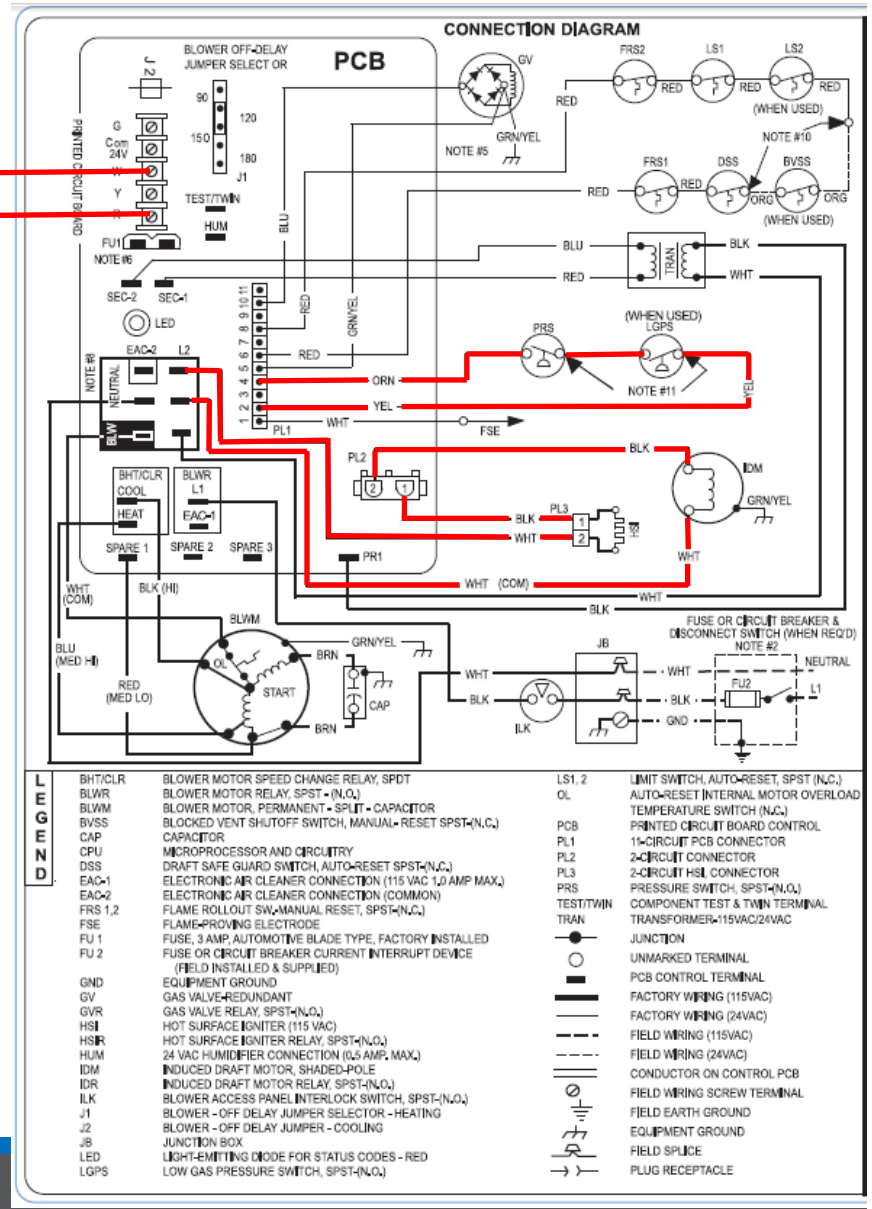
Code 33 - Limit Circuit Fault

Unit Size			045C14–12	070C14–12	070C17–16	070C21–20
RATINGS AND PERFORMANCE						
Input Btuh* Nonweatherized ICS	All Standard, Low Nox Upflow	High	44,000	66,000	66,000	66,000
		Low	29,000	43,500	43,500	43500
Input Btuh* Nonweatherized ICS	All Low NoxDownflow/ Horizontal	High	42,000	63,000	63,000	63,000
		Low	29,000	43,500	43,500	43500
Output Capacity (Btuh) Nonweatherized ICS ^	All Standard, Low Nox Upflow	High	35,000	54,000	53,000	53,000
		Low	23,000	35,000	35,000	35,000
Output Capacity (Btuh) Nonweatherized ICS ^	All Low NOx Downflow/ Horizontal	High	34,000	51,000	51,000	51,000
		Low	23,000	35,000	35,000	35,000
AFUE			80.00			
Certified Temperature Rise Range – °F (°C)		High	30–60 (17–33)	30–60 (17–33)	25–55 (14–30)	25–55 (14–30)
		Low	20–50 (11–28)	30–60 (17–33)	15–45 (8–25)	15–45 (8–25)
Certified External Static Pressure		Heat/Cool	0.10/0.50	0.12/0.50	0.12/0.50	0.12/0.50
Airflow CFM ‡		Heating High/Low	730/605	1160/735	1245/1040	1195/1085
		Max Cooling	1345	1395	1380	2150
ELECTRICAL						

58TN0A
2 stage 80% Variable speed

We offered the homeowner an 80% variable speed option but our airflow

Code 34 – Ignition Proving Failure



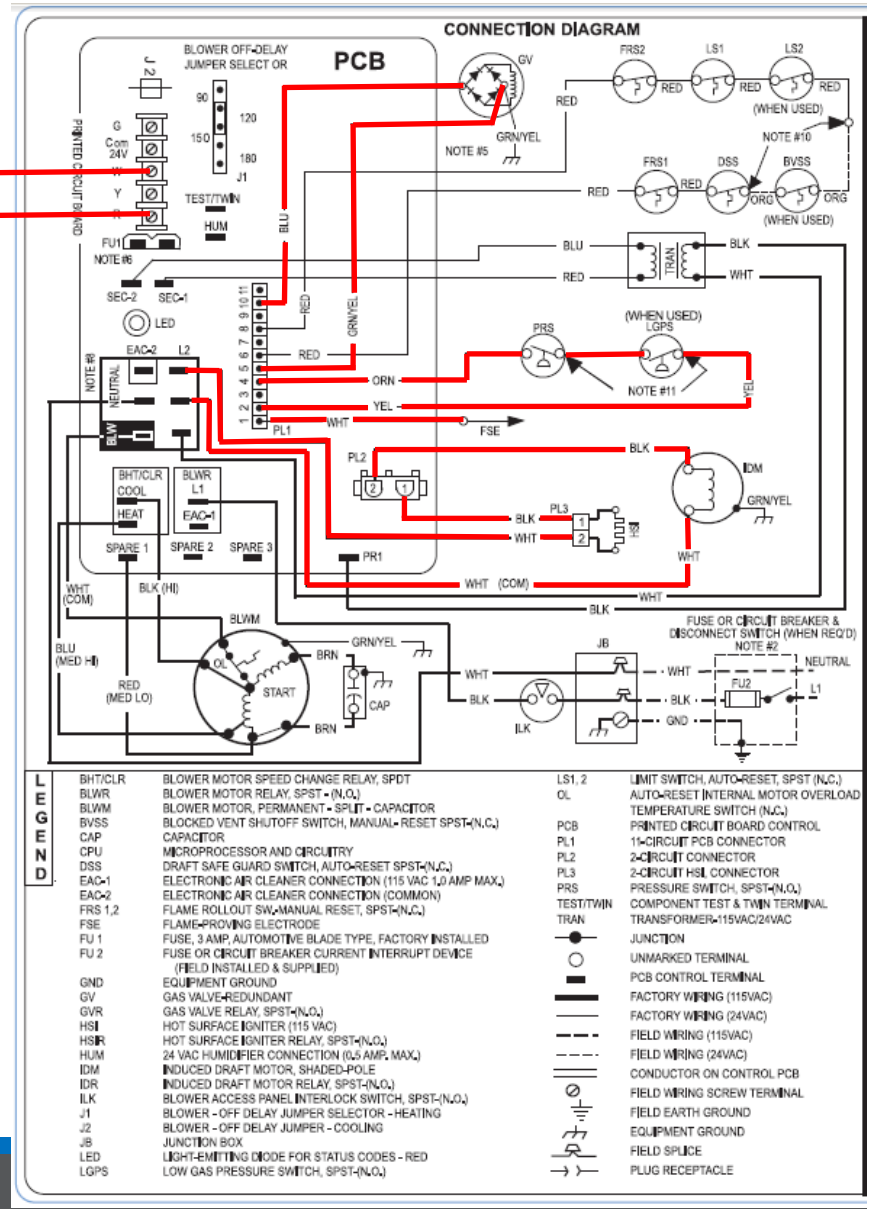
LEGEND			
BHT/CLR	BLOWER MOTOR SPEED CHANGE RELAY, SPDT	LS1, 2	LIMIT SWITCH, AUTO-RESET, SPST (N.C.)
BLWR	BLOWER MOTOR RELAY, SPST - (N.O.)	OL	AUTO-RESET INTERNAL MOTOR OVERLOAD TEMPERATURE SWITCH (N.C.)
BLWM	BLOWER MOTOR, PERMANENT - SPLIT - CAPACITOR	PCB	PRINTED CIRCUIT BOARD CONTROL
BVSS	BLOCKED VENT SHUTOFF SWITCH, MANUAL- RESET SPST-(N.C.)	PL1	11-CIRCUIT PCB CONNECTOR
CAP	CAPACITOR	PL2	2-CIRCUIT CONNECTOR
CPU	MICROPROCESSOR AND CIRCUITRY	PL3	2-CIRCUIT HSI CONNECTOR
DSS	DRAFT SAFE GUARD SWITCH, AUTO-RESET SPST-(N.C.)	PRS	PRESSURE SWITCH, SPST-(N.O.)
EAC-1	ELECTRONIC AIR CLEANER CONNECTION (115 VAC 1.0 AMP MAX.)	TEST/TWIN	COMPONENT TEST & TWIN TERMINAL
EAC-2	ELECTRONIC AIR CLEANER CONNECTION (COMMON)	TRAN	TRANSFORMER-115VAC/24VAC
FRS 1,2	FLAME ROLLOUT SW.-MANUAL RESET, SPST-(N.C.)		JUNCTION
FSE	FLAME-PROVING ELECTRODE		UNMARKED TERMINAL
FU 1	FUSE, 3 AMP, AUTOMOTIVE BLADE TYPE, FACTORY INSTALLED		PCB CONTROL TERMINAL
FU 2	FUSE OR CIRCUIT BREAKER CURRENT INTERRUPT DEVICE (FIELD INSTALLED & SUPPLIED)		FACTORY WIRING (115VAC)
GND	EQUIPMENT GROUND		FACTORY WIRING (24VAC)
GV	GAS VALVE-REDUNDANT		FIELD WIRING (115VAC)
GVR	GAS VALVE RELAY, SPST-(N.O.)		FIELD WIRING (24VAC)
HSI	HOT SURFACE IGNITER (115 VAC)		CONDUCTOR ON CONTROL PCB
HSIR	HOT SURFACE IGNITER RELAY, SPST-(N.O.)		FIELD WIRING SCREW TERMINAL
HUM	24 VAC HUMIDIFIER CONNECTION (0.5 AMP. MAX.)		FIELD EARTH GROUND
IDM	INDUCED DRAFT MOTOR, SHADED-POLE		EQUIPMENT GROUND
IDR	INDUCED DRAFT MOTOR RELAY, SPST-(N.O.)		FIELD SPLICE
ILK	BLOWER ACCESS PANEL INTERLOCK SWITCH, SPST-(N.O.)		PLUG RECEPTACLE
J1	BLOWER - OFF DELAY JUMPER SELECTOR - HEATING		
J2	BLOWER - OFF DELAY JUMPER - COOLING		
JB	JUNCTION BOX		
LED	LIGHT-EMITTING DIODE FOR STATUS CODES - RED		
LGPS	LOW GAS PRESSURE SWITCH, SPST-(N.O.)		

Once board verifies that pressure switch is closed, unit will go through a pre-purge period. (See sequences)

After pre-purge period, hot surface ignitor is energized for 17 second warm-up period, before board energizes gas valve.

Furnace has no feed back on hot surface ignitor. If ignitor does not glow, valve will open, and gas will not ignite. This will eventually cause a code 34 ignition failure.

Code 34 – Ignition Proving Failure



After the hot surface ignitor, has gone through its warm-up period, the gas valve relay(GVR) on the board is energized and power applied to gas valve.

Five seconds after GVR is energized, a 2-second flame-proving period begins.

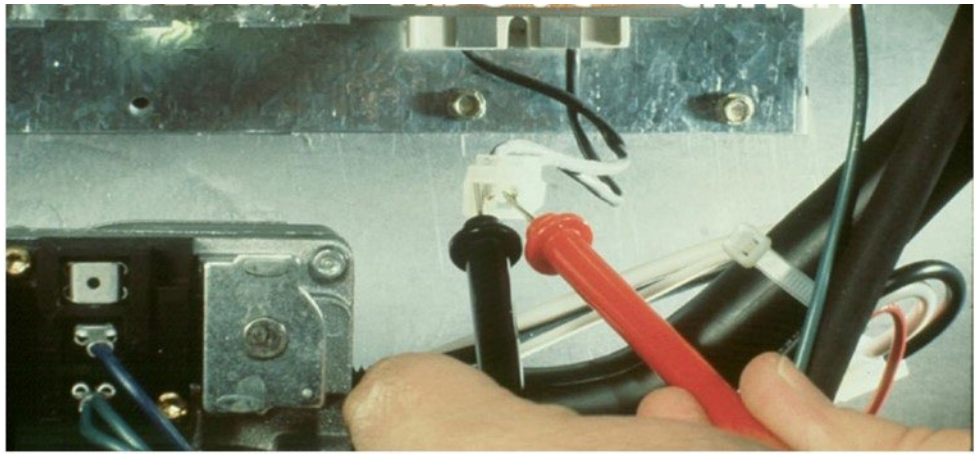
If flame is not proven through flame rectification, ignition sequence will repeat 3 times and then a code 14 (ignition lock-out) will occur. Control will reset after 4 hours.

Code 34-Ignition Proving Failure Causes

- Hot Surface Igniter Failure
  - HSI failed
  - HSI Relay did not close (no 115v)
  - Defective harness connection
- No Flame Sensing
  - Oxide build up on sensor
  - Flame sensor grounded

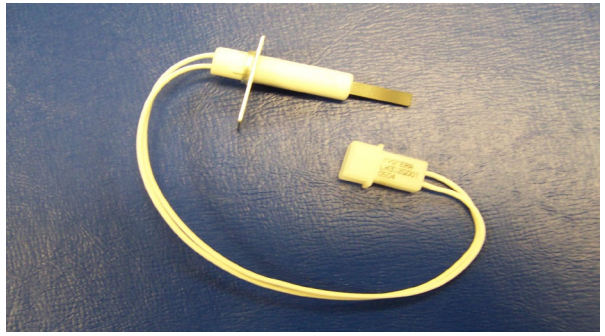
Checking Hot Surface Igniters

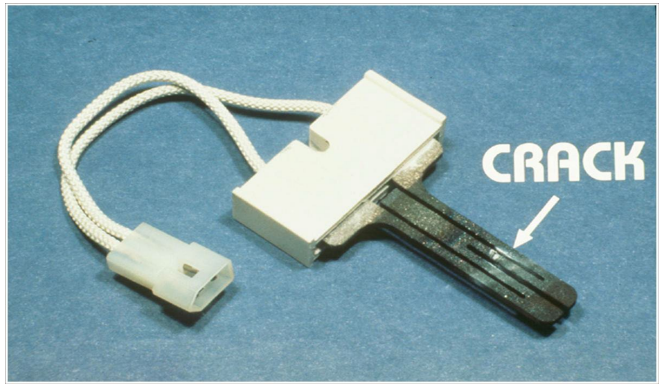
- Inspect for breaks and cracks.
- Measure resistance at room temperature
- Verify proper voltage at correct timing in furnace sequence.



Silicone Carbide
45-90 Ohms

Silicone Nitride
Carrier 45-70 but some 11-17 Ohms





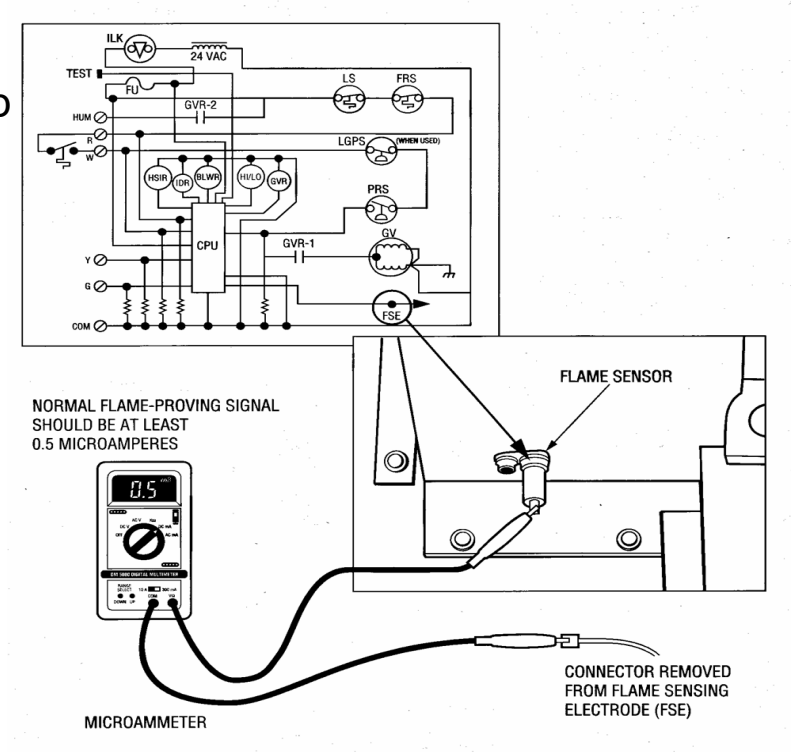
Flame Rectification

Code 34-Ignition Proving Failure Causes

Inspect electrode for corrosion, film build up and cracks in ceramic insulator.

Verify flame rectification

Replace FSE
If below 0.5
DC Microamps



IFC check: If you measured for voltage from the flame rectification wire to ground. You should measure between 40-100 Vac

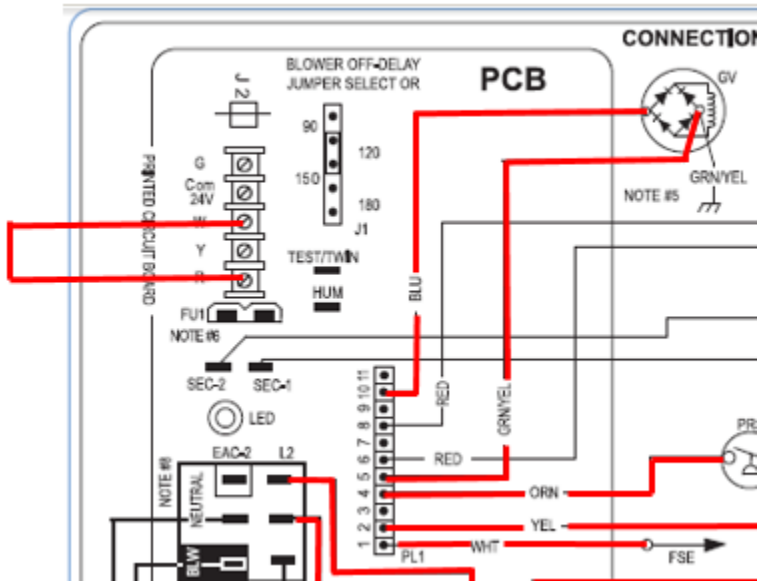
This will tell you if the board if looking for a flame, if no voltage, check for voltage at IFC connection, if still no voltage, replace the IFC

Code 34-Ignition Proving Failure Causes

- Rough Ignition or Flame Disturbance
  - Supply pressure fluctuates
    - Check regulator
    - Contact utility
  - Orifice alignment
    - Cross-threaded
  - Burner alignment
    - Not installed correctly
    - Flame retainers crooked

Code 34-Ignition Proving Failure Causes

- Gas Valve Relay (GVR) failed
  - Check 24 vac signal from board (to common)
- Harness Integrity
  - 24 vac valve signal at board (to common),
  - But no 24 vac at Valve (to common)
- Main Gas Valve Failed to open
  - 24 vac at valve (to common)
    - Valve does not open
      - Gas ON
      - Electric switch ON
      - Supply pressure above minimums



Code 35 Gas Valve Fault

Furnace with Modulating Valves
59MN7 987M

GAS VALVE FAULT - This status code indicates that the modulating gas valve failed to respond to a command from the modulating furnace control or power to the gas valve electronics was interrupted.

Use Troubleshooting Guide to Troubleshoot fault. CEMA Training Website

Code 35 Gas Valve Fault

Fault code 35 can be caused by:

- Bad Gas Valve
- Corrosion
  - Check gas valve pins for corrosion
    - Replace valve if pins are corroded
  - Check harness for corrosion
    - Clean harness connections
  - Add moisture trap to the intake air pipe (KGAET0201ETK)
- Electrical noise (interference)
  - Internal
  - External

Code 35 Gas Valve Fault

On every cycle after the medium pressure switch MPS makes

- The modulating furnace control sends a PWM (pulse width modulation) command to the gas valve
  - for a duration of 1 second.
- Following this the gas valve responds back with the PWM command it received
  - for a duration of 1 second.
- If the PWM response does not match the command sent
  - The modulating furnace control will resend the PWM command up to 5 more times.
- After the gas valve sends the PWM response it operates the stepper motor.

Code 35 Gas Valve Fault

After the stepper motor is done moving the gas valve

- Gas valve will send a PWM-DONE command to the modulating furnace control
- If the gas valve fails to respond back with the PWM command it received
- Or the PWM-DONE command
- The modulating furnace control will:
  - flash status code 35
  - Shut the unit down
  - Wait 2 minutes, stop flashing status code 35
  - And restart the heating cycle.

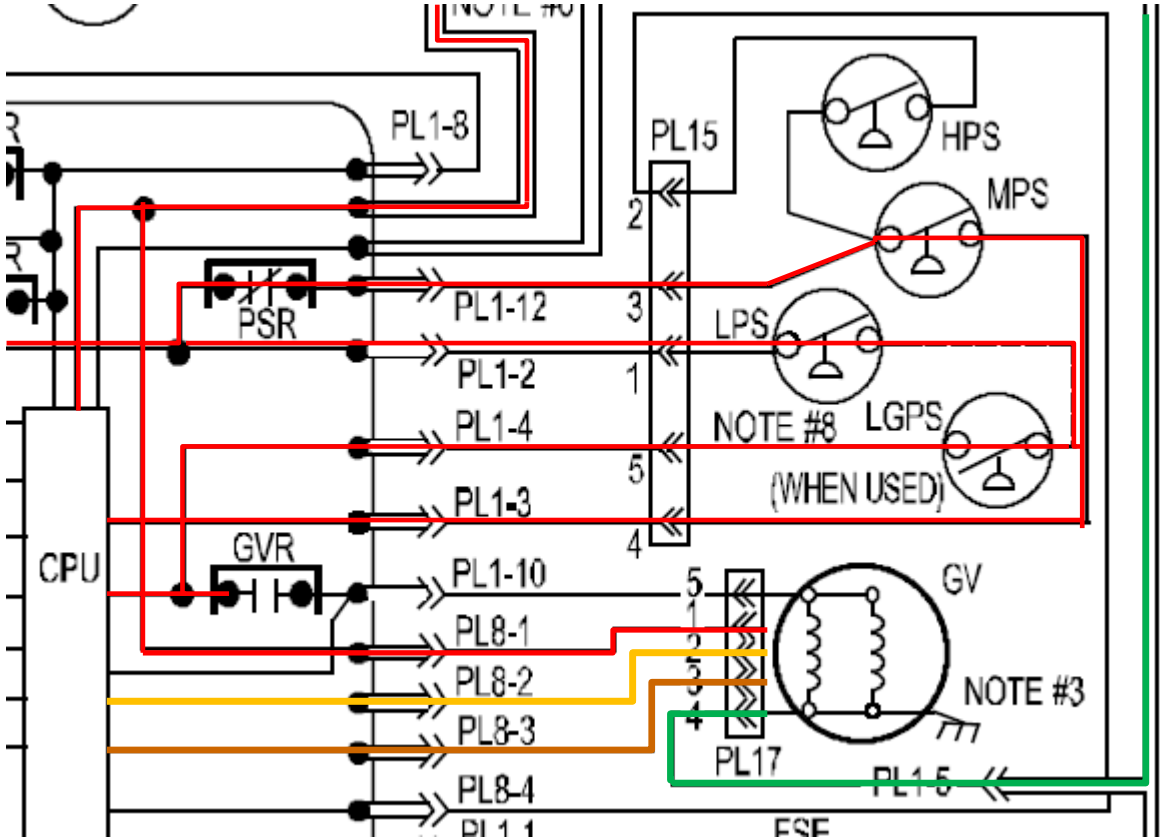
Code 35 Gas Valve Fault

PLUG/PIN FUNCTIONS

Control Board			Modulating Gas Valve	
Plug/Pin Number	Pin Name		Pin Name	Plug/Pin Number
PL8-1	24 VAC Output		24 VAC Input	PL17-1
PL8-2	PWM Rate		PWM Input	PL17-2
PL8-3	PWM Input		PWM Output	PL17-3
PL1-5	Ground		Ground	PL17-4
PL1-10	GVR Output		Main Valve Solenoid	PL17-5

Code 35 Gas Valve Fault

- From the modulating furnace wiring diagram:



Verify you have **24 VAC** between **Pins 1 and Pin 4** at the gas valve.

Verify you have **4 VDC** between **Pins 2 and Pin 4** at the gas valve.

Verify you have **5 VDC** between **Pin 3 and Pin 4** at the gas valve.

On every cycle after the medium pressure switch MPS closes, during the 25 sec pre-purge

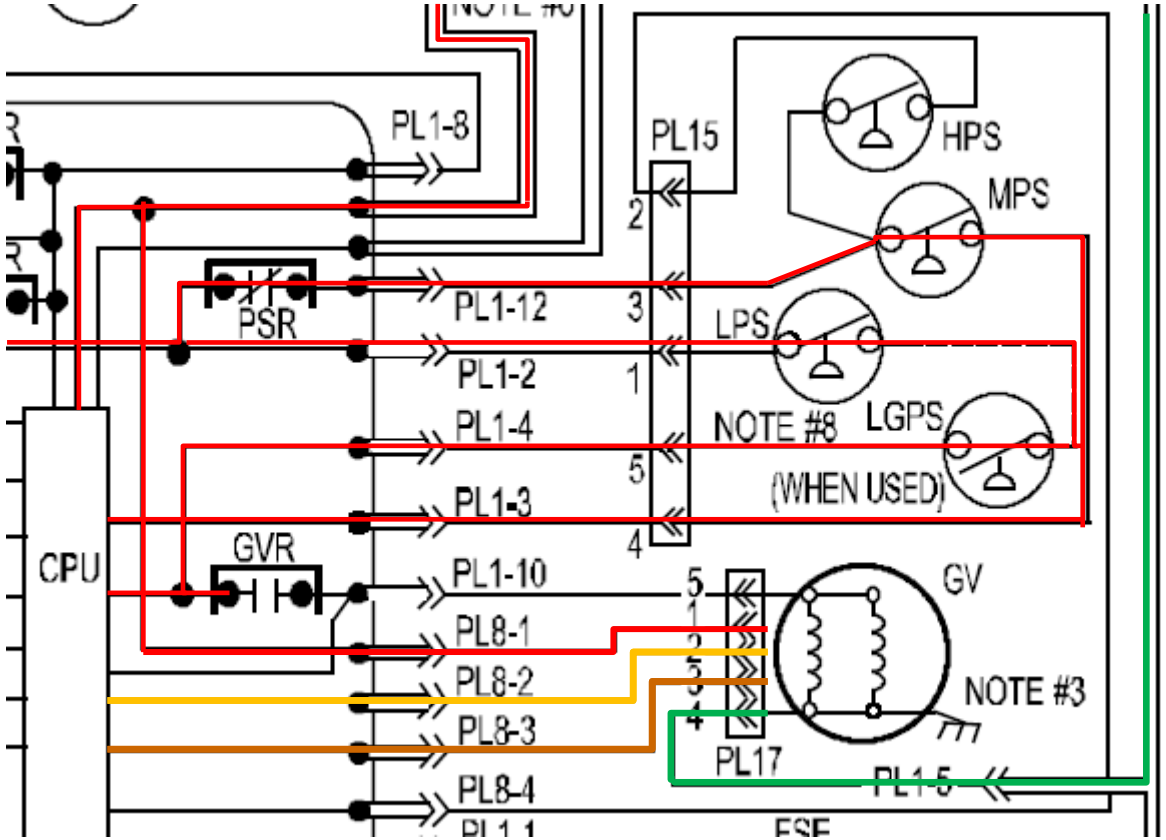
The modulating furnace control sends a PWM (pulse width modulation) command to the gas valve GV for a duration of 1 second.

Monitor the DC voltage between **Pin 2 to Pin 4**. A voltage drop will occur when the PWM is sent and lasts about 1 sec

Using the component test it will be 15 secs before you see the pulse

Code 35 Gas Valve Fault

- From the modulating furnace wiring diagram:



Once confirmed the CPU is sending the PWM to the gas valve.

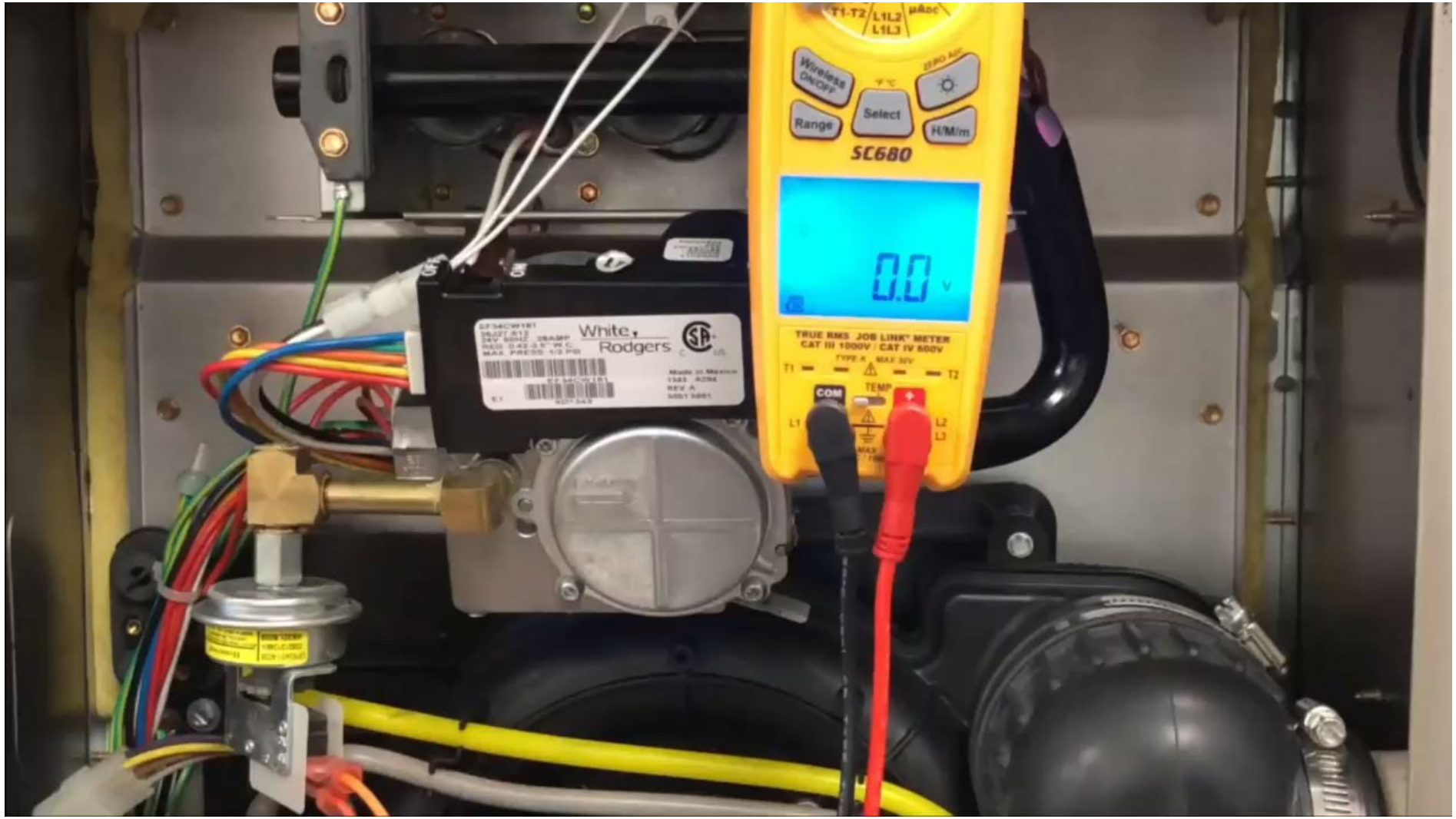
Now monitor the voltage between **Pin 3 and Pin 4**, you should still measure **5 vdc**. A voltage drop will occur when the PWM is sent back to the CPU and lasts about 1-2 secs.

Using the component test it will be 17 secs before you see the pulse.

If everything is working properly you will see this happen once.

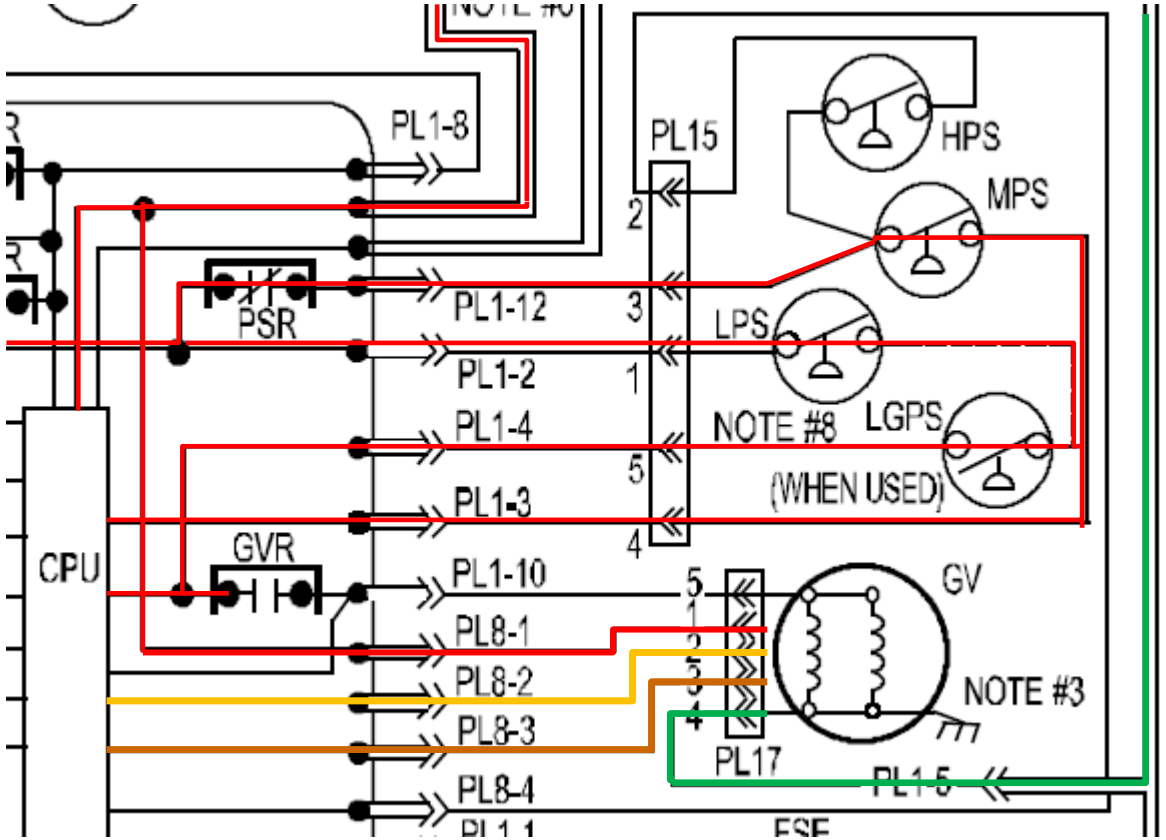
Using the component test it will be 15 secs before you see the pulse

Code 35 Gas Valve Fault



Code 35 Gas Valve Fault

- From the modulating furnace wiring diagram:



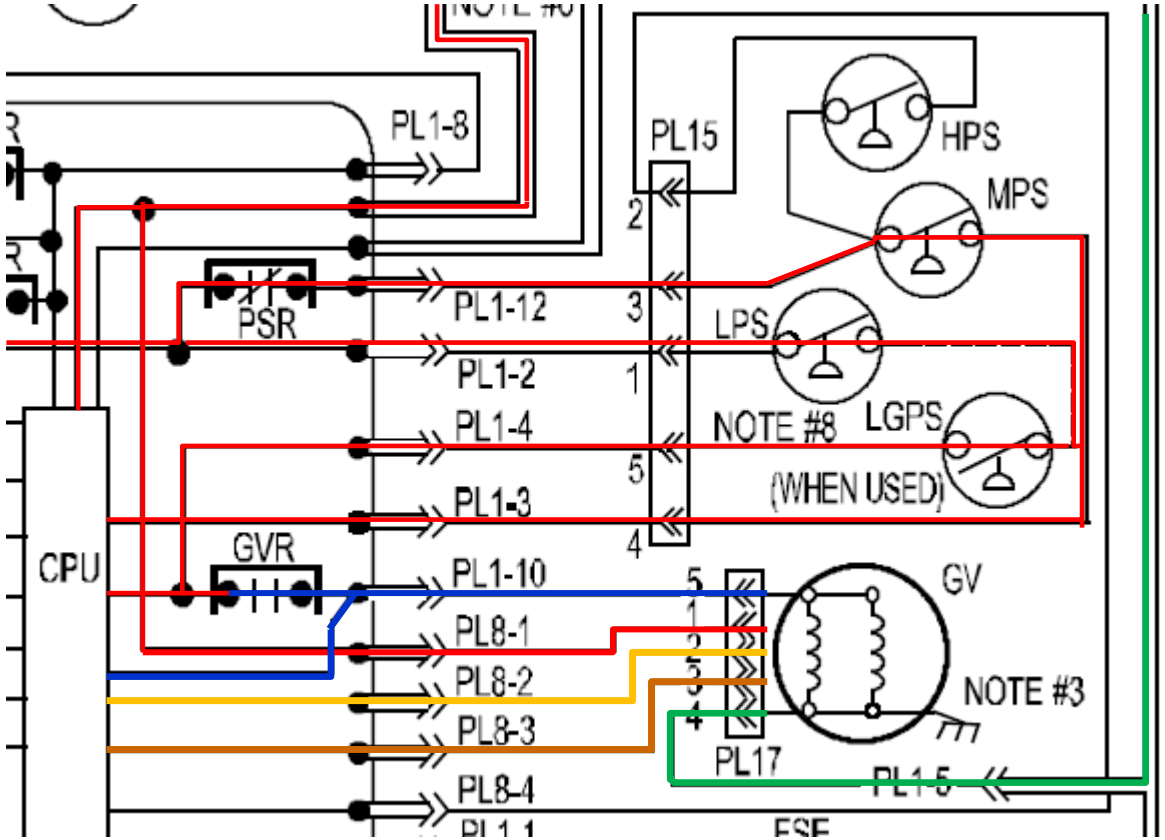
If the PWM response does not match the command sent, the modulating furnace control will resend the PWM command up to 5 more times.

After the gas valve sends the PWM response it operates the stepper motor. After the stepper motor is done moving the gas valve, the gas valve will send a PWM-Done command to the furnace control.

After the (PWM-Done) confirmation signal is sent and the 25 second inducer pre-purge is complete, the furnace control will close the hot surface igniter relay, energizing the igniter. The igniter will not energize if the confirmation signal is not sent from the gas valve or received by the control board.

Code 35 Gas Valve Fault

- From the modulating furnace wiring diagram:

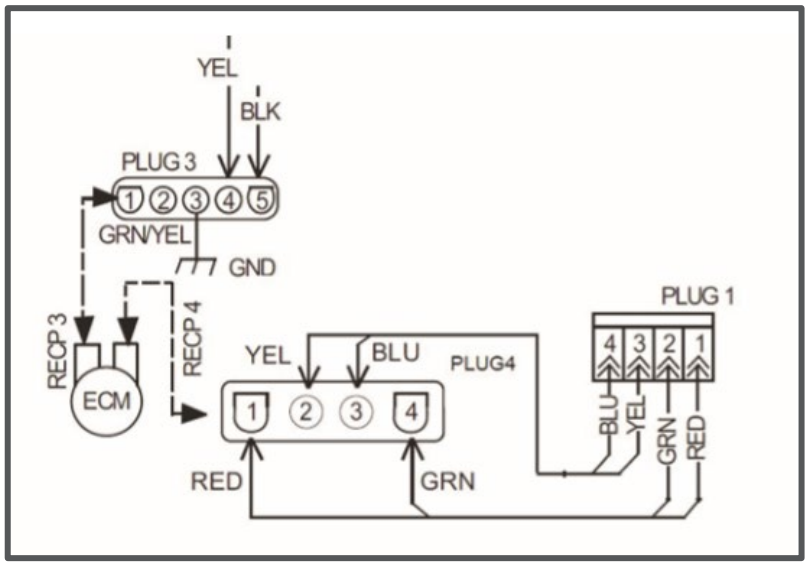


After the igniter warm-up period has completed, the furnace control closes the gas valve relay (GVR), energizing the main gas valve solenoid (24 VAC to Pin 5 of the gas valve).

If the furnace control decides to change the firing rate of the furnace, A PWM signal to move the stepper valve is sent from the control board to the gas valve and confirmed back to the control board by the gas valve. The furnace control will also change inducer and blower RPM as necessary. At the end of the call for heat, the stepper motor holds its last position.

Code 41/44 Blower Motor

Fault Code 41: The module failed to communicate within 30 secs of being powered up or within 10 secs during steady-state operation, or failed to reach 250 RPM

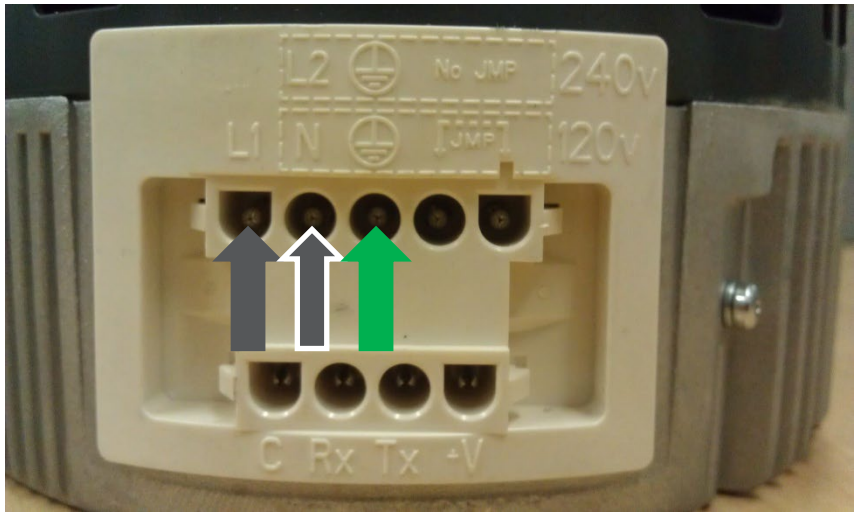


- PL1-4 Blue wire +
  - Com from the module back to the board
- PL1-3 Yellow wire +
  - Com from the board to the module
- PL1-2 Green wire –
  - Common
- PL1-1 Red wire +
  - Power

1st Make sure the blower wheel rotates freely and that the motor is not locked up or bound up.

Code 41/44 Blower Motor

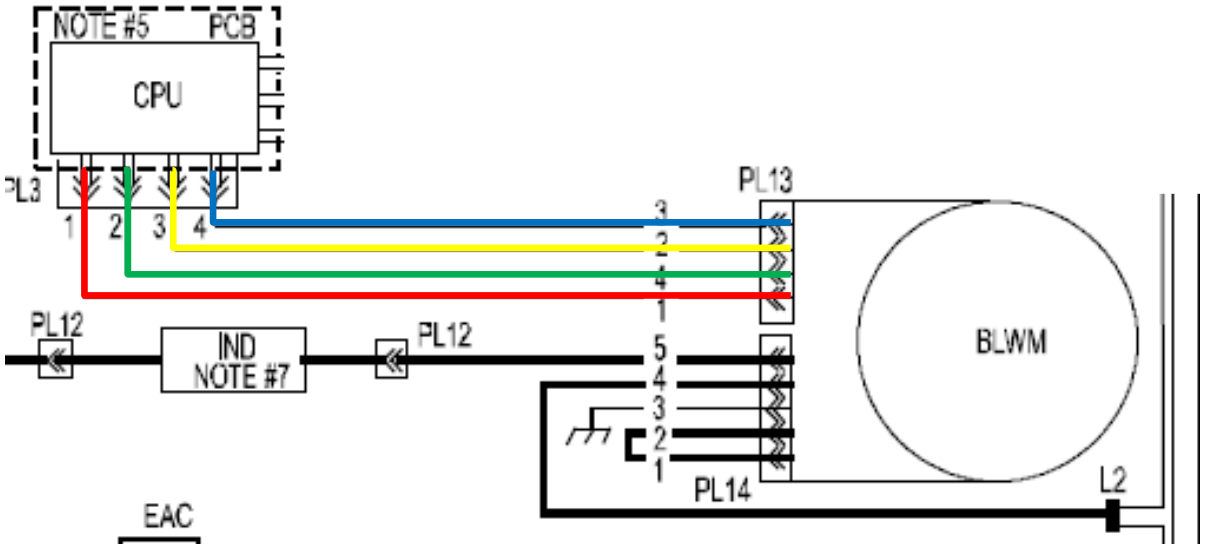
Verify Supply Voltage
120 Volt System



- Black L1
- Black L2
- Green Ground
- Note no jumper on harness
- Jumper indicates 120v motor

Code 41/44 Blower Motor

Troubleshooting with a Voltmeter



Yellow = input line (signal to blower motor)

Blue = output line (from the blower to the CPU)

Red = 12vdc power

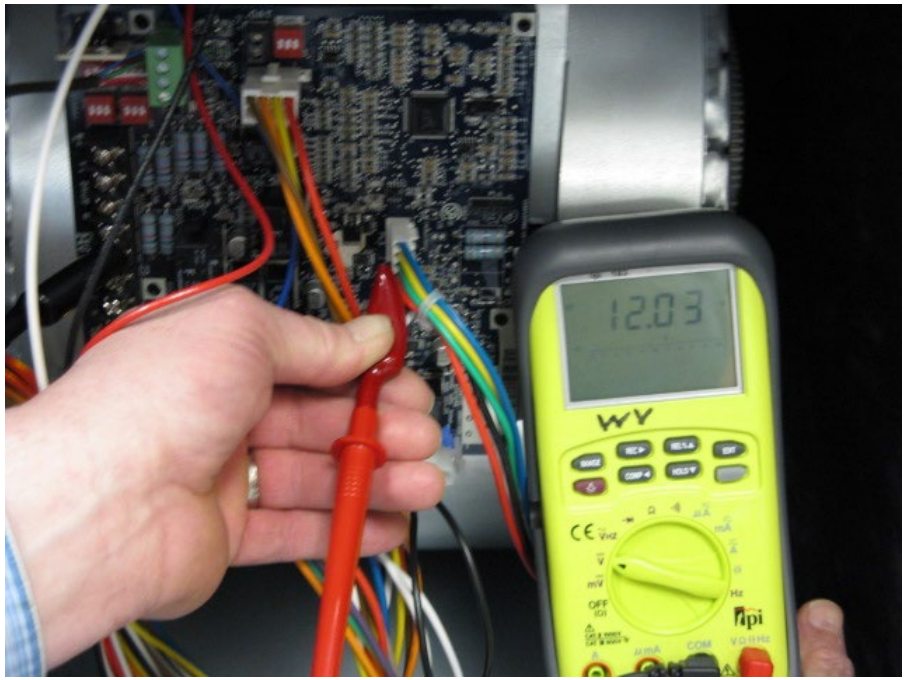
Green = Common

The Blower and CPU should always be communicating when power is applied to the unit

Code 41/44 Blower Motor

- Set meter to dc volts
- Will need either
  - Long skinny probes
  - Small open paper clip
  - Small section of stat wire – both ends stripped

Code 41/44 Blower Motor



- On Board check
- PL3-2 Green wire -
- PL3-1 Red wire +

- **To common on transformer**
  - PL3-1 Red Wire 12 vdc
  - PL3-2 Green 0 vdc*

- **Across PL3-1 to PL3-2**
  - 12 VDC

- 12 VDC present check PL13 plug on motor

Code 41/44 Blower Motor

Blower Motor Input Signal

- On Board check
- PL3-2 Green wire -
- PL3-3 Yellow wire +

- **To common on transformer**
  - PL3-3 Yellow Wire 5 vdc
  - PL3-2 Green 0 vdc*

- **Across PL3-3 to PL3-2**
  - 5 VDC

- Signal will fluctuate up to 1 vdc

Code 41/44 Blower Motor

Blower Motor Output Signal

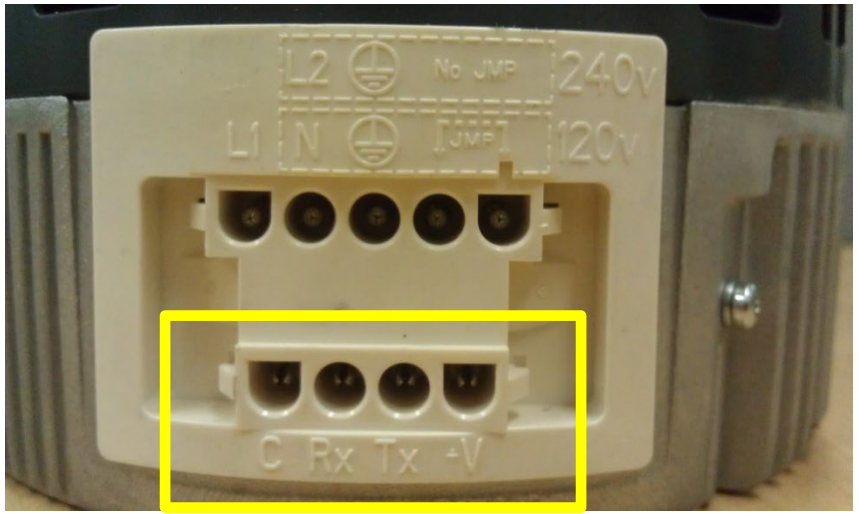
- On Board check
- PL3-2 Green wire -
- PL3-4 Blue wire +

- **To common on transformer**
  - PL3-4 Blue Wire 0-1 vdc
  - PL3-2 Green -0 vdc*

- **Across PL3-4 to PL3-2**
  - 0-1 VDC
- Signal will fluctuate should be near 0 vdc

Code 41/44 Blower Motor

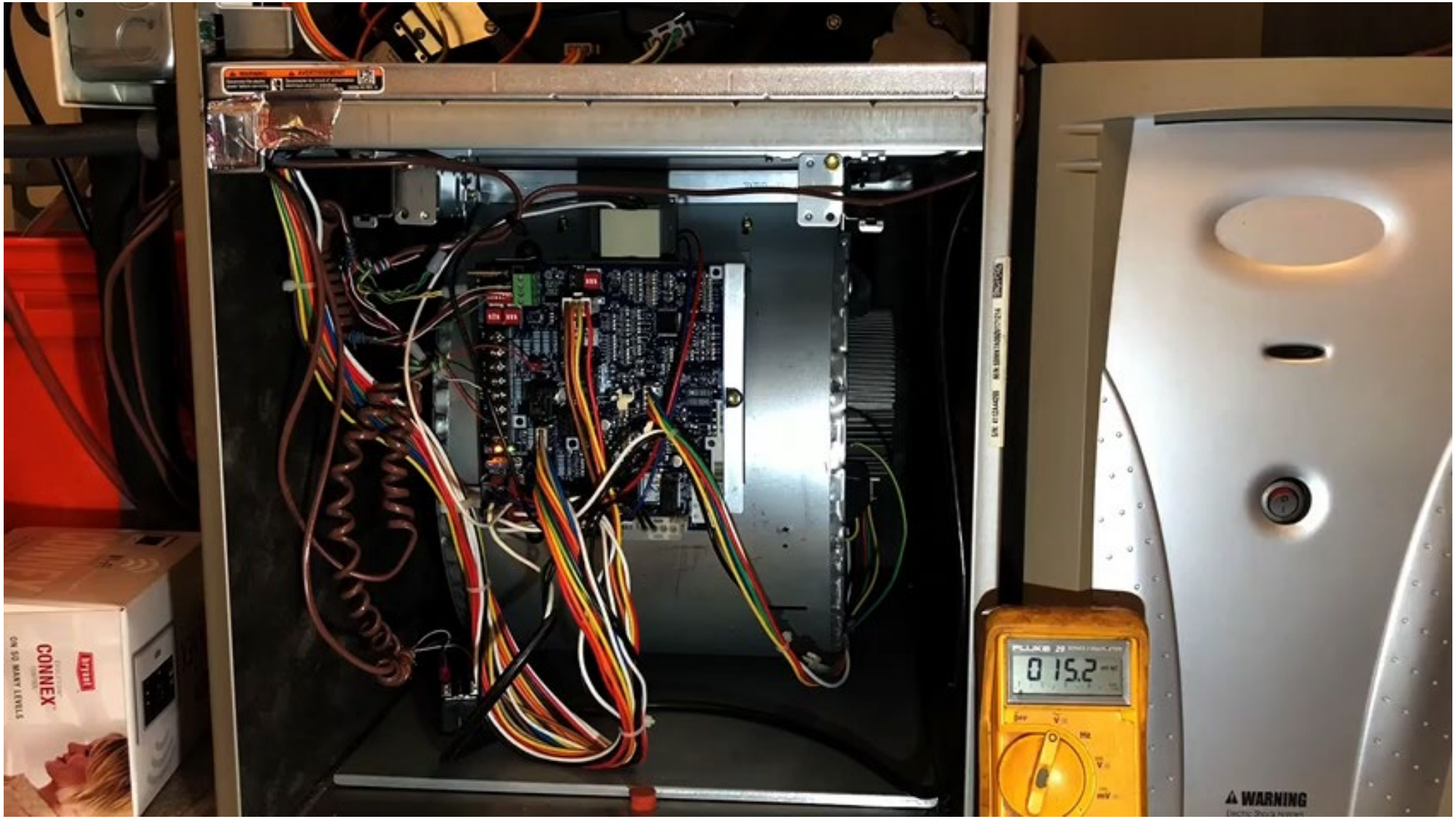
PL13



- To common on transformer
  - PL13-1 Red Wire 12 vdc
  - PL13-4 Green 0 vdc*
  - PL13-2 Yellow Wire 5 vdc
  - PL13-4 Green 0 vdc*
  - PL13-3 Blue Wire 0-1 vdc
  - PL13-4 Green -0 vdc*

Voltage fluctuations should be similar to PL3 measurements

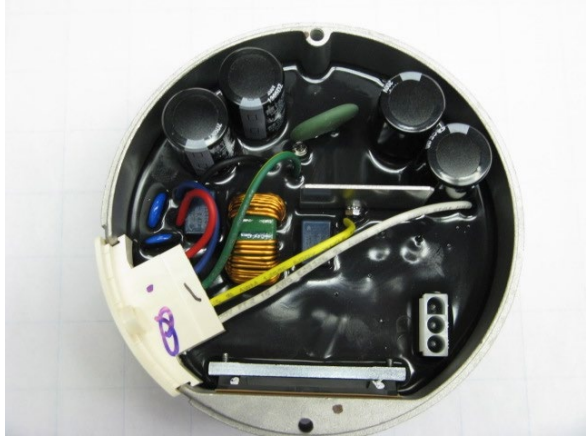
Code 41/44 Blower Motor



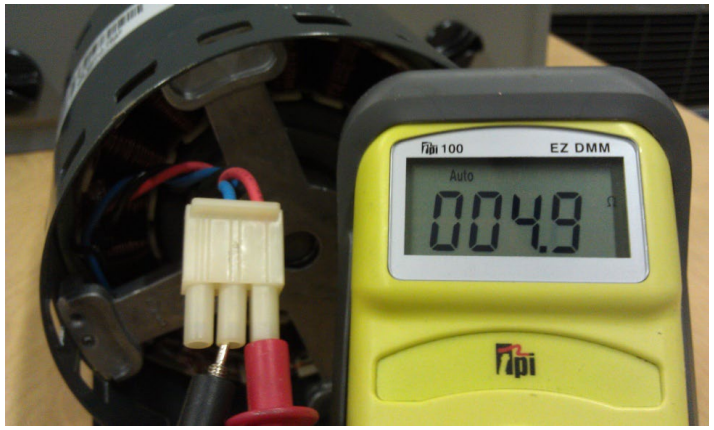
Code 41/44 Blower Motor

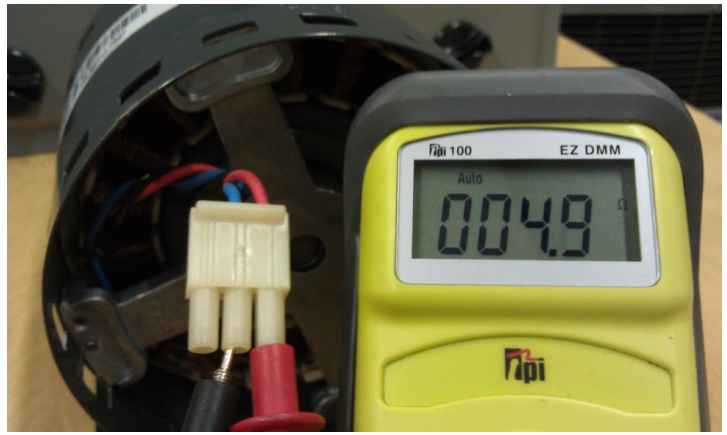
You have Line and Control voltage to the motor– but it does not run

- Separate the electronic control module from motor
- Warning power down 5 minutes prior to separating motor

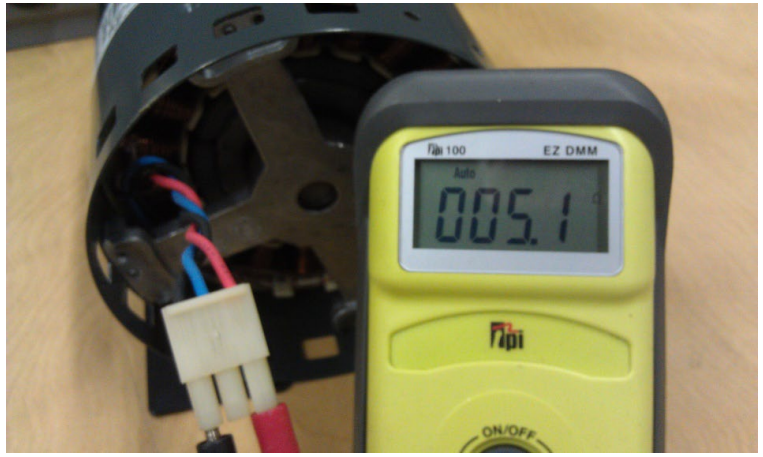


Code 41/44 Blower Motor





Resistance values less than 20 ohms

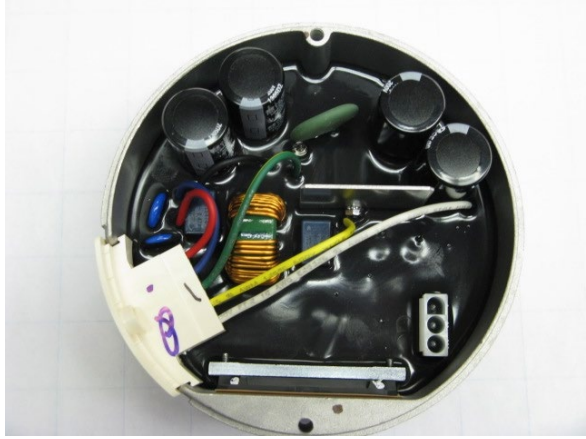


All windings equal plus or minus 10%

Code 41/44 Blower Motor

You have Line and Control voltage to the motor– but it does not run

- Separate the electronic control module from motor
- Warning power down 5 minutes prior to separating motor



Code 41/44 Blower Motor

PWM MOTOR TROUBLESHOOTING

- To discuss troubleshooting procedures for PWM blower motors
- To discuss basic PWM motor control operation
  - **If you have a question, ASK! - Your presenter is probably doing a poor job, not being very clear, and you are probably not the only one with the question.**

WARNINGS

⚠ WARNING

ELECTRICAL SHOCK, FIRE OR EXPLOSION HAZARD

Failure to follow safety warnings could result in dangerous operation, serious injury, death or property damage.

Improper servicing could result in dangerous operation, serious injury, death or property damage.

– Before servicing, disconnect all electrical power to furnace.

– When servicing controls, label all wires prior to disconnection. Reconnect wires correctly.

– Verify proper operation after servicing.

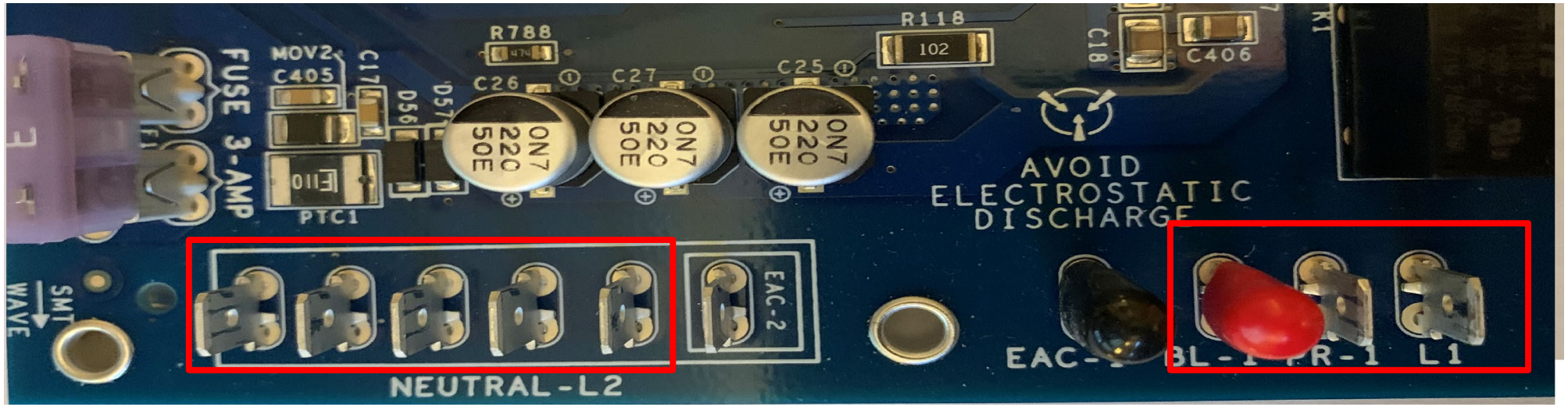
– Always reinstall access doors after completing service and maintenance.

Proper Personal Protective Equipment (PPE) should be utilized at all times

Caution should be used at all times when performing the procedures outlined in this presentation

Read and Follow all Warnings and cautions outlined in the Installation, Start-up Operating and Maintenance Instruction manual

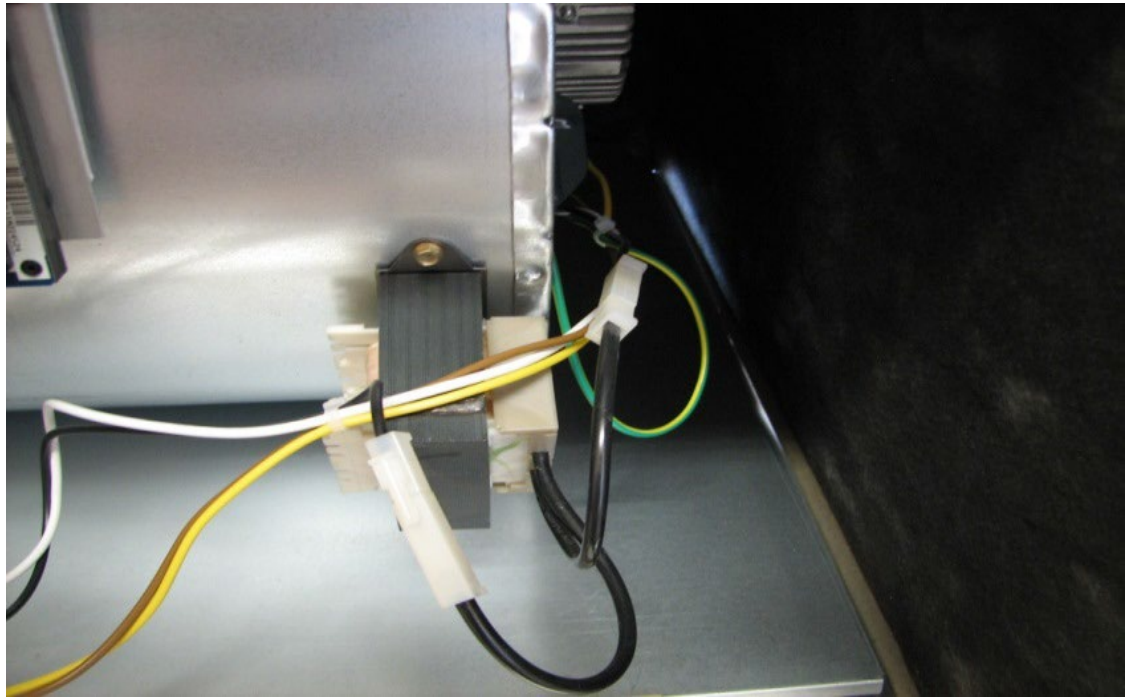
CHECKING LINE VOLTAGE



- Blower motor has 115 VAC applied to it anytime furnace is powered
- Manually close blower door switch.
- Verify 115 VAC power between L1 and Neutral L2 Wires
- (L1 and Neutral L2 removed for clarity)

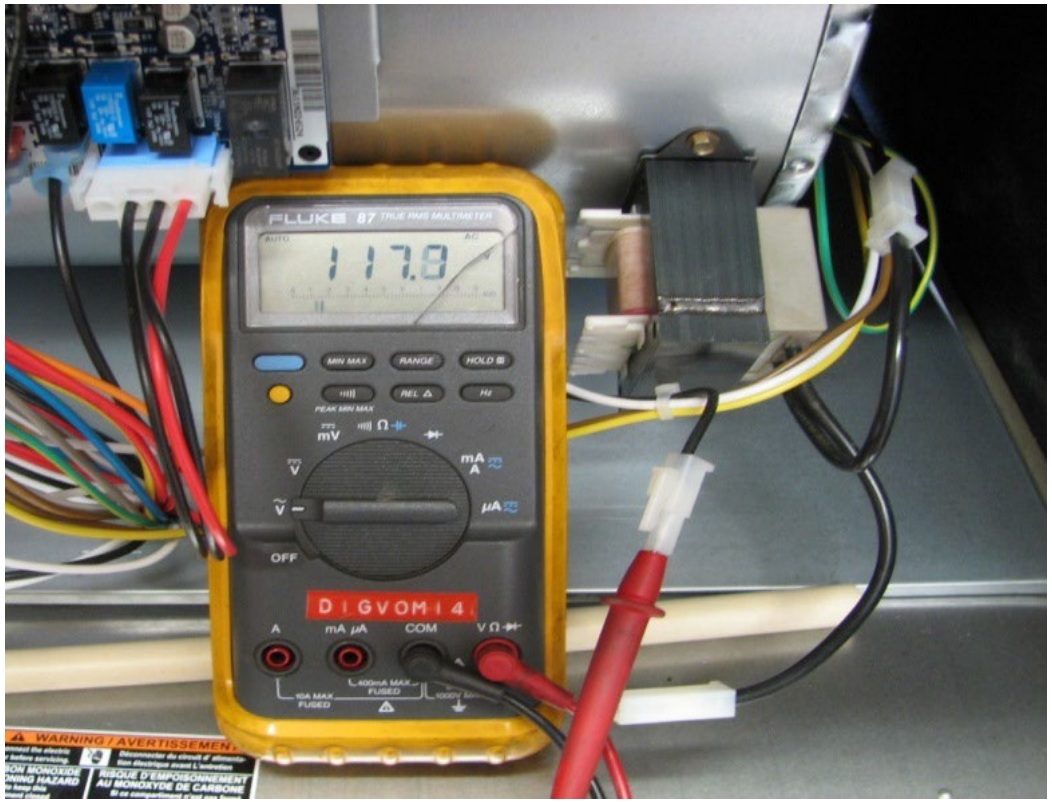
CHECKING LINE VOLTAGE - POWER CHOKE

- ¾ hp & 1 hp PWM blower motors have a power choke located on the blower housing
- Power chokes are used to filter line power and to reduce current draw of the motor
- Power choke may be bypassed for troubleshooting purposes



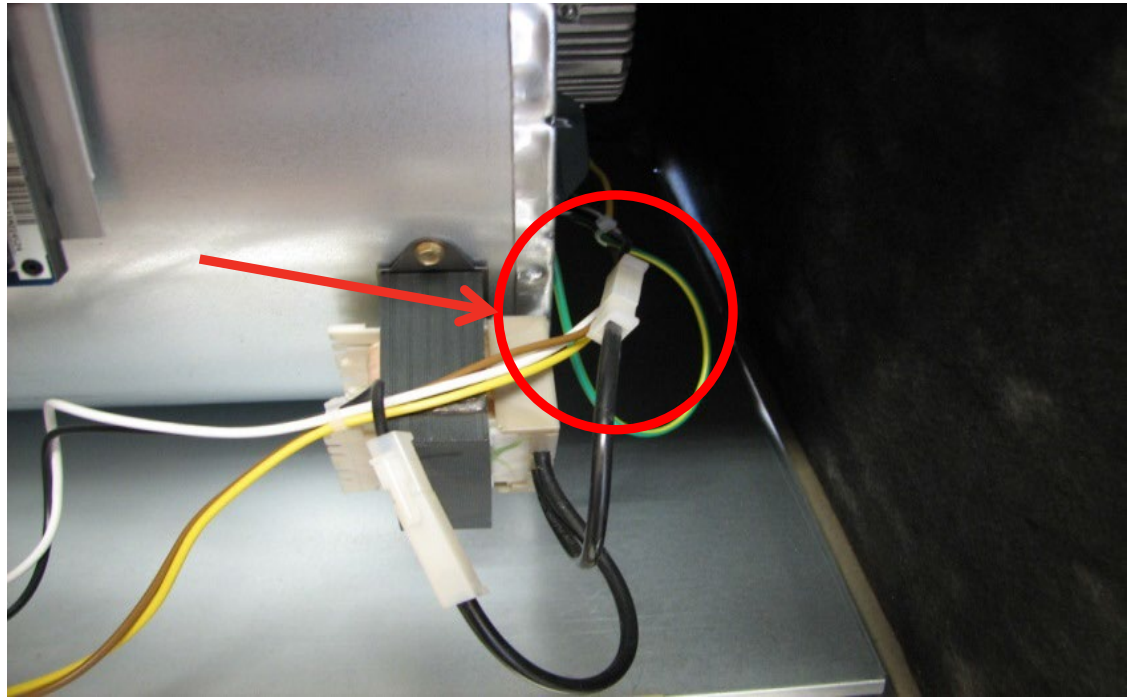
CHECKING LINE VOLTAGE - POWER CHOKE

- Open the blower door switch
- Disconnect L1 feed to power choke
- Insert meter probe into the L1 connector from the furnace control
- Manually close blower door switch and verify 115 VAC power
- Release blower door switch
- Reconnect L1 to power choke



CHECKING LINE VOLTAGE - POWER CHOKE

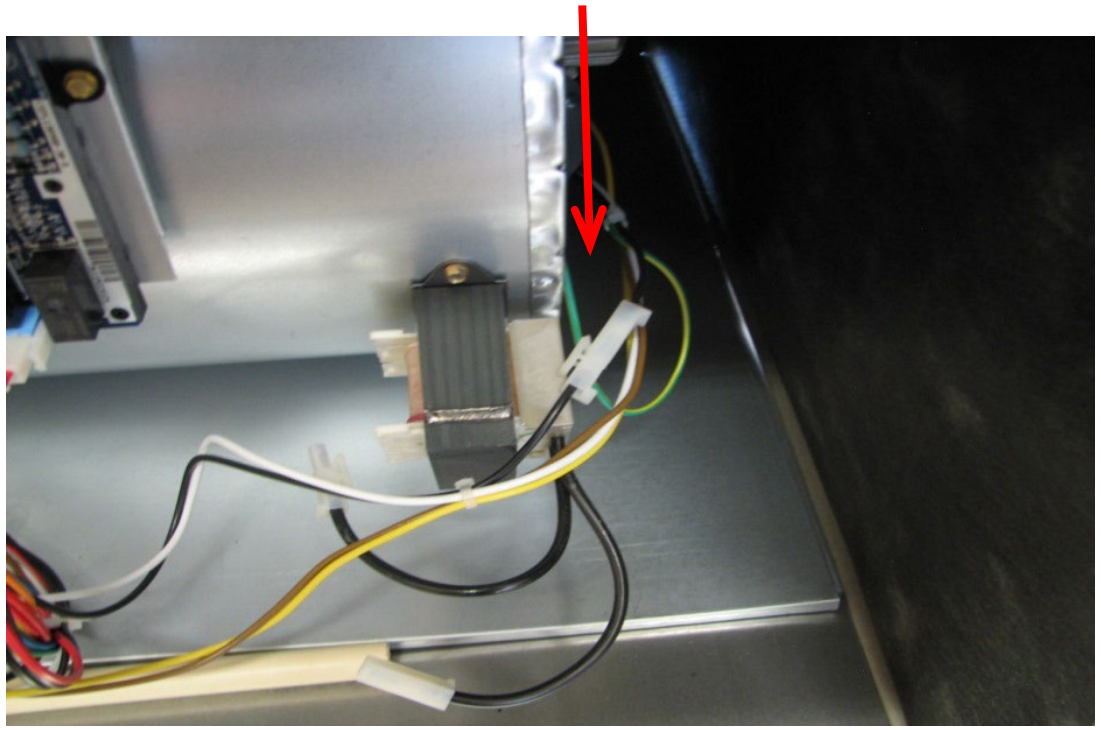
- Open the blower door switch
- Disconnect black lead between power choke and motor
- Insert meter lead into disconnected power choke lead
- Manually close blower door switch and verify 115 VAC power from power choke
- Release blower door switch
- Reconnect power choke leads



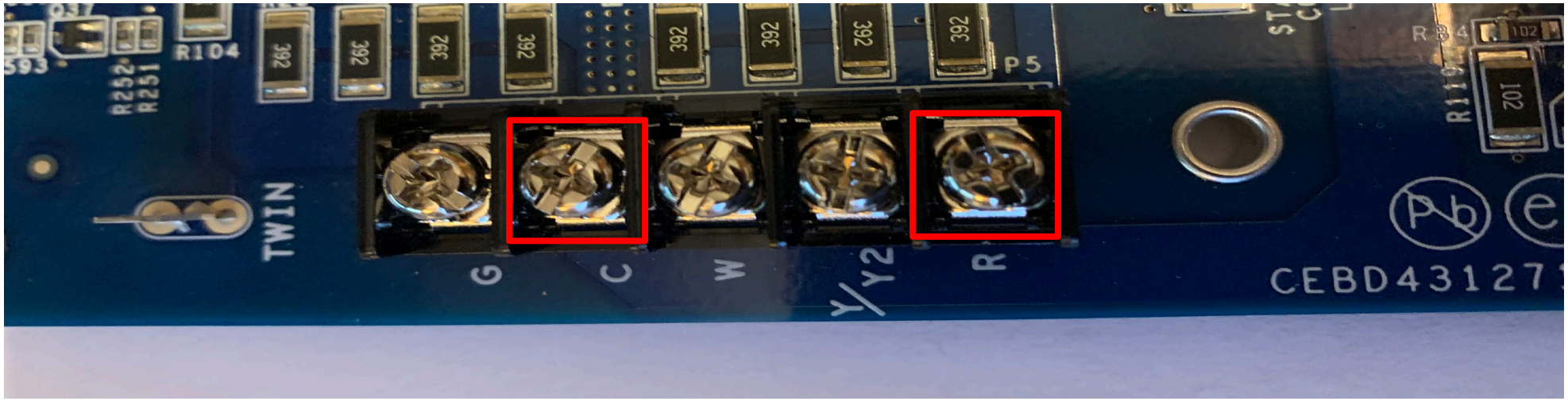
POWER CHOKE BYPASS-QUICK TEST

- Power choke may be temporarily bypassed for troubleshooting
- Open blower door switch
- Disconnect power choke between L1 harness and blower motor
- Connect L1 harness to blower motor harness
- Close blower door switch
- Continue with troubleshooting
- Remember to reconnect power choke when completed!

L1 harness connected to blower motor



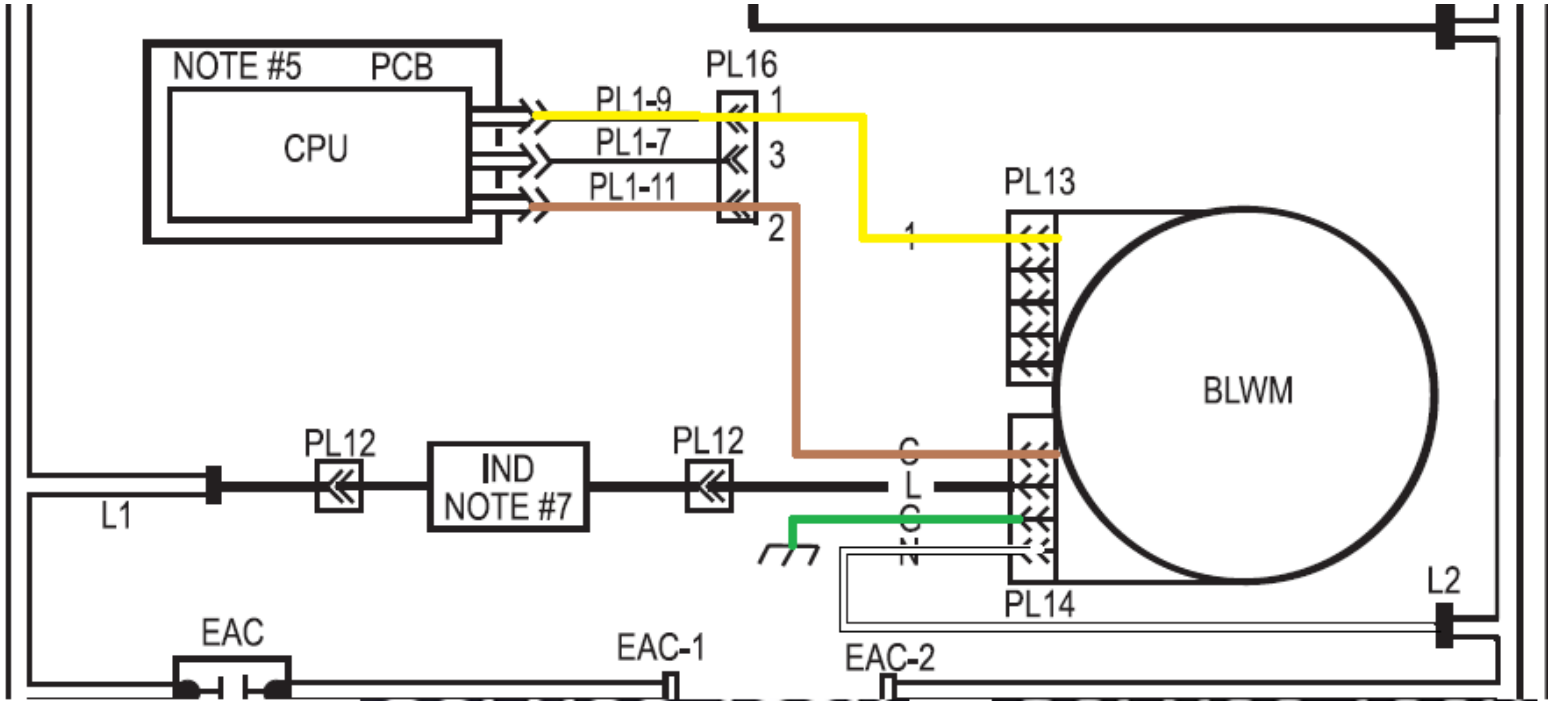
CHECKING FOR SECONDARY VOLTAGE



- Manually close blower door switch and verify 24 VAC between R and C at thermostat terminals of furnace control
- The PWM blower motor used in the current furnaces is controlled by ON/OFF switching of the DC voltage circuit (and resultant current) through the motor controller

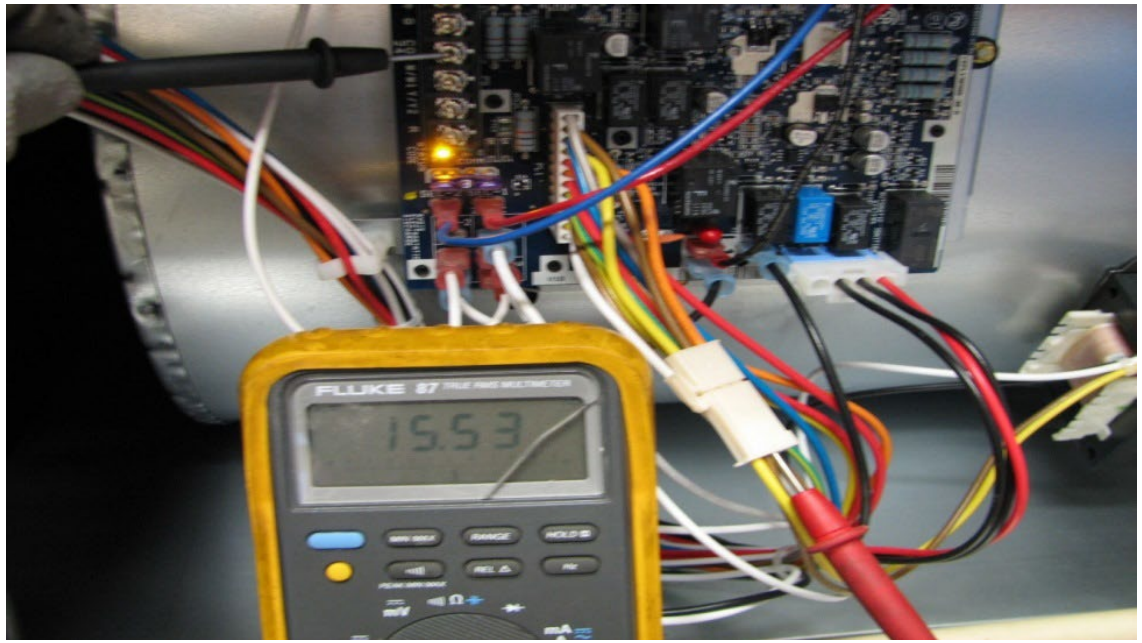
PWM MOTOR CIRCUIT

- Only two wires to the control motor speed
  - Brown wire feeds constant 15VDC to motor
  - Yellow wire feeds back FROM motor to the furnace control



CHECKING 15 VDC POWER TO BLOWER (BROWN)

- Verify all harnesses are connected
- and 115 VAC power is ON
- Close Blower door switch
- Set meter to volts DC (VDC)
- Insert (+) meter probe into the back of brown lead at PL16
- Touch other (-) meter probe to COM on furnace control
- Voltage from furnace control should be about 15 VDC at the brown wire
- Note: a reading of approximately 35V (or higher) indicates the green ground wire on the motor is disconnected - repair as needed.



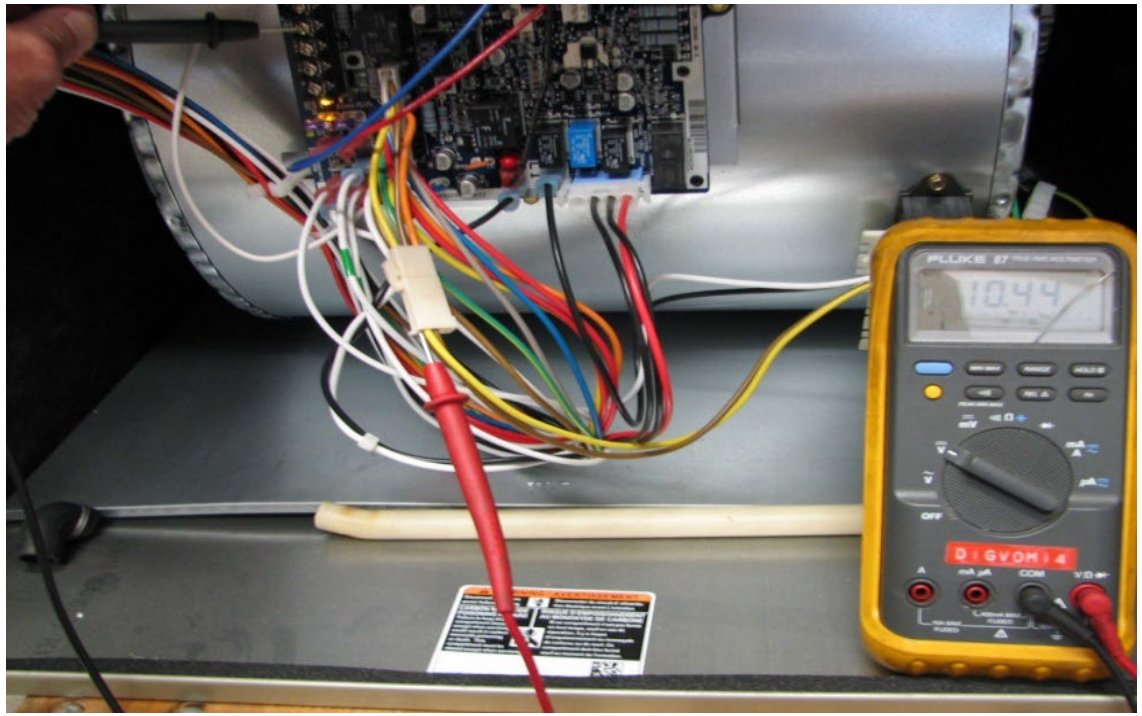
Note: All low voltage troubleshooting is done with PL13 at the blower motor and PL16 connected

CHECKING 15 VDC POWER TO BLOWER (BROWN)

- 15 VDC is nominal
- May be slightly higher or lower
  - Actual line voltage affects low voltage
  - Meter type affects reading
- If reading is unstable or scrolling
  - Check harness connectors and pins
  - Clean meter probes
  - Try a probe with a finer point to improve contact inside the connector

CHECKING MOTOR TORQUE CONTROL SIGNAL (YELLOW)

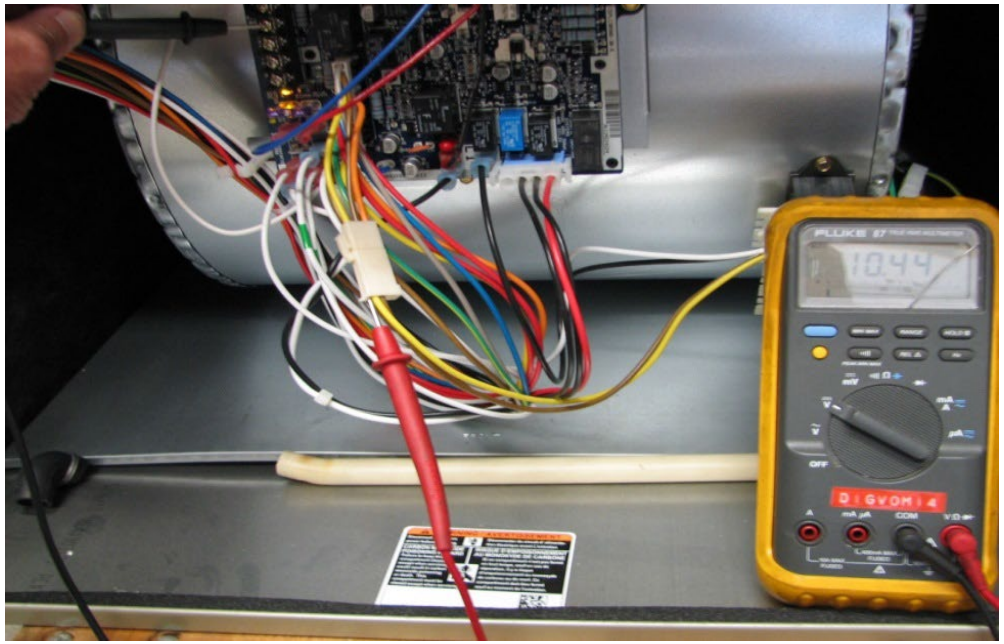
- 115 VAC power should be ON
- No call at the thermostat terminals (Remove R thermostat lead)
- Close Blower door switch
- With meter set to volts DC (VDC), insert + meter probe into the back of yellow lead of PL16
- Touch other (-) meter probe to COM on furnace control
- With no motor operation, voltage will be 10 to 15 VDC
  - Actual voltage will depend on meter being used and manufacturer of the motor



CHECKING MOTOR TORQUE CONTROL SIGNAL

- If voltage is 0 VDC or significantly below 10VDC

- Voltage for speed control is fed from the furnace control at the brown wire, through the motor circuitry, and back on the yellow wire.
- 0 VDC indicates a likely “no connection” issue with the harness connector plugs at either PL13 (Motor) or PL16 (Harness)
- Voltage significantly below 10VDC indicates partial connection of harness connectors, or a damaged motor controller
- Harness updates are being implemented to reduce likelihood of connector with yellow wire from being dislodged from motor

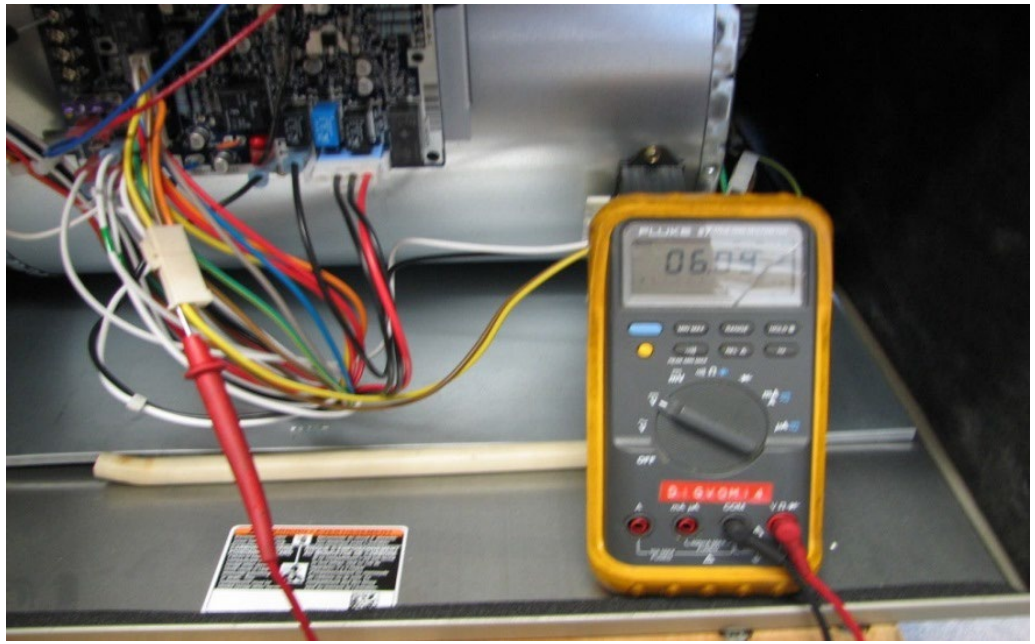


CHECKING MOTOR TORQUE CONTROL SIGNAL

- Initiate Component Self Test using Service Tech App or pushbuttons on control
- (+) Meter probe remains in the back of the yellow lead of PL16
- Touch other (-) meter probe to C on furnace control
- Initially, voltage will be about 10 to 15 VDC (blower off) as Component Self Test Starts

CHECKING MOTOR TORQUE CONTROL SIGNAL

- Voltage will remain constant on the yellow lead of PL16 Until Component Self Test starts the main blower
- After approximately 25 seconds
- After hot surface igniter turns off
- As blower starts, Voltage on PL16 will drop
- Nominal voltage on yellow lead of PL16 decreases to 5 to 8 VDC
  - Voltage is stable until blower shuts down
- Voltage will return to 10 to 15 VDC when blower turns off



MOTOR CONTROL VOLTAGES COMPONENT SELF TEST

1. Remove blower door.
2. Remove the wire from the thermostat “R” terminal from the control board or disconnect the communication connector from the control board
3. Initiate Component test from Service App or from push buttons

Function during Component Self Test	Start Time	End Time	Voltage	
	0 Sec	0 Sec	Yellow wire of PL16 to Com	Brown wire of PL16 to Com
Inducer starts in high speed and stays running	0 Sec	---	10 to 15VDC	15 VDC
Hot surface igniter turns on	10 Sec	25 Sec	10 to 15 VDC	15 VDC
Blower motor turns on at 50% PWM	25 Sec	35 Sec	5 to 8 VDC	15 VDC
Inducer turns off	---	45 Sec	10 to 15 VDC	15 VDC

Code 42 Inducer Motor Fault

Furnace with Modulating Valves
59MN7 / 987M

INDUCER MOTOR FAULT - This status code indicates the inducer has not started within 20 seconds after a call for heat, the inducer RPM is outside its valid range of operation, or the inducer RPM signal was lost for 5 seconds during operation.

Use Troubleshooting Guide to Troubleshoot fault. CEMA Training Web site

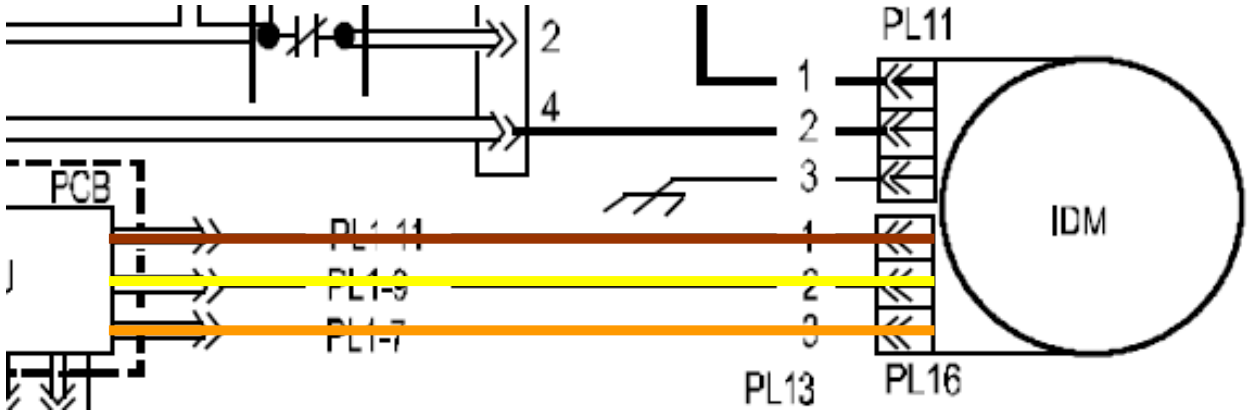
Code 42 Inducer Motor Fault

Fault Code 42 can be caused by 1 of 3 reasons:

1. Inducer has not started within 20 seconds
(or furnace control believes the inducer hasn't started)
2. RPM outside valid speed range
3. RPM signal is lost for 5 seconds during operation

Code 42 Inducer Motor Fault

- From the modulating furnace wiring diagram:



Brown -> Yellow = PWM line (signal to inducer motor)

Brown -> Orange = RPM Feedback (from inducer motor)

The Inducer and CPU should always be communicating when power is applied to the furnace

Code 42 Inducer Motor Fault

1. Let's say the inducer has not started within 20 seconds

(or the **I**ntegrated **F**urnace **C**ontrol believes the inducer hasn't started)

1 - Check Line voltage to Inducer

- Line voltage is always present between Black and White wires at inducer

2 – Check inducer PWM line

18.	Check the inducer PWM line. To do this disconnect 3-pin connector PL16 from the inducer motor or the inducer motor adapter harness (when used), and connect a DC voltmeter across terminals PL16-1 BROWN (+) and PL16-2 YELLOW (-). **Note:** The terminals can be permanently damaged if the voltmeter probe is jammed into the terminal end of the connector. Use caution when checking. Run COMPONENT TEST by turning setup switch SW1-6 ON. Does voltage across PL16-1 and PL16-2 change between states as shown below?	23	19	

Code 42 Inducer Motor Fault

1. Let's say the inducer has not started within 20 seconds

(We need to see if the IFC can tell the inducer to run)

- Modulating (59MN7, 987M)

  Brown -> Yellow = PWM line

  – No call to operate 2-5vdc
  – With a call to operate 9-13vdc

- Variable Speed(58MV[P,B,C], 355[M,A,C])

  Brown -> Yellow = PWM line

  – No call to operate 1-4vdc
  – With a call to operate 7-10vdc

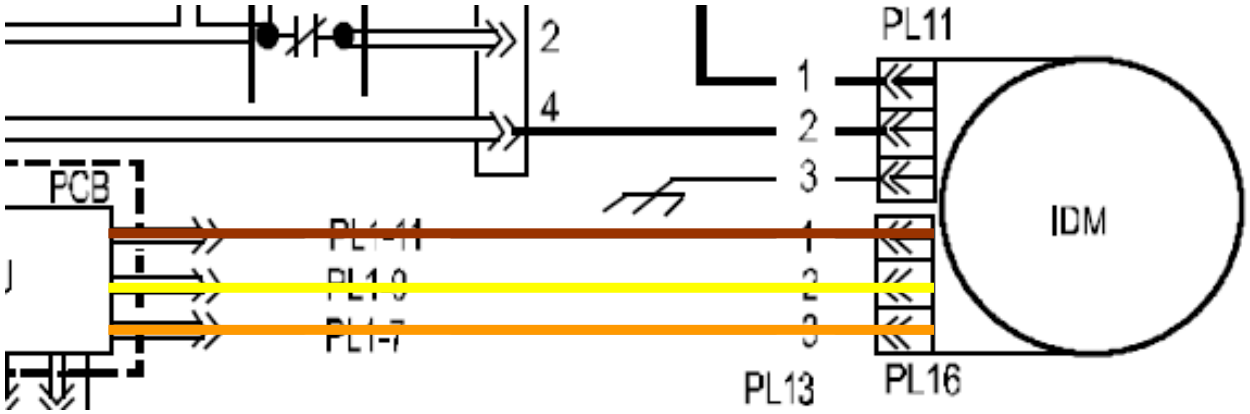
Voltages will vary by meter being used – LOOK FOR THE CHANGE !

Code 42 Inducer Motor Fault

1. Let's say the inducer has not started within 20 seconds

(We need to see if the IFC can tell the inducer to run)

- From the modulating furnace wiring diagram:



Brown -> Yellow = PWM line to the inducer

No call to operate	2-5vdc
With a call to operate	9-13vdc

Always check both ends of the harness for the same voltage

Code 42 Inducer Motor Fault

1. Let's say the inducer has started

(We need to see if the inducer is reporting back to the IFC)

- Modulating (59MN7, 987M)

Brown -> Orange = RPM Feedback

  - No call to operate 15-17vdc
  - With a call to operate 12-14vdc

- Variable Speed(58MV[P,B,C], 355[M,A,C])

Brown -> Orange = RPM Feedback

  - No call to operate 11.5-12.5vdc
  - With a call to operate 9.5-10.5vdc

Voltages will vary by meter being used – LOOK FOR THE CHANGE !

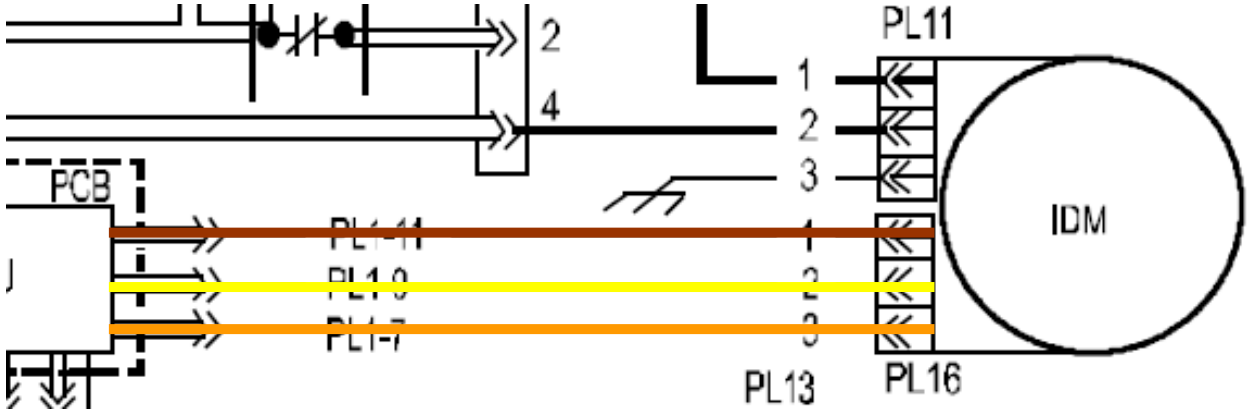
Always check both ends of the harness for the same voltage

Code 42 Inducer Motor Fault

Let's say the inducer has started

(We need to see if the inducer is reporting back to the IFC)

- From the modulating furnace wiring diagram:



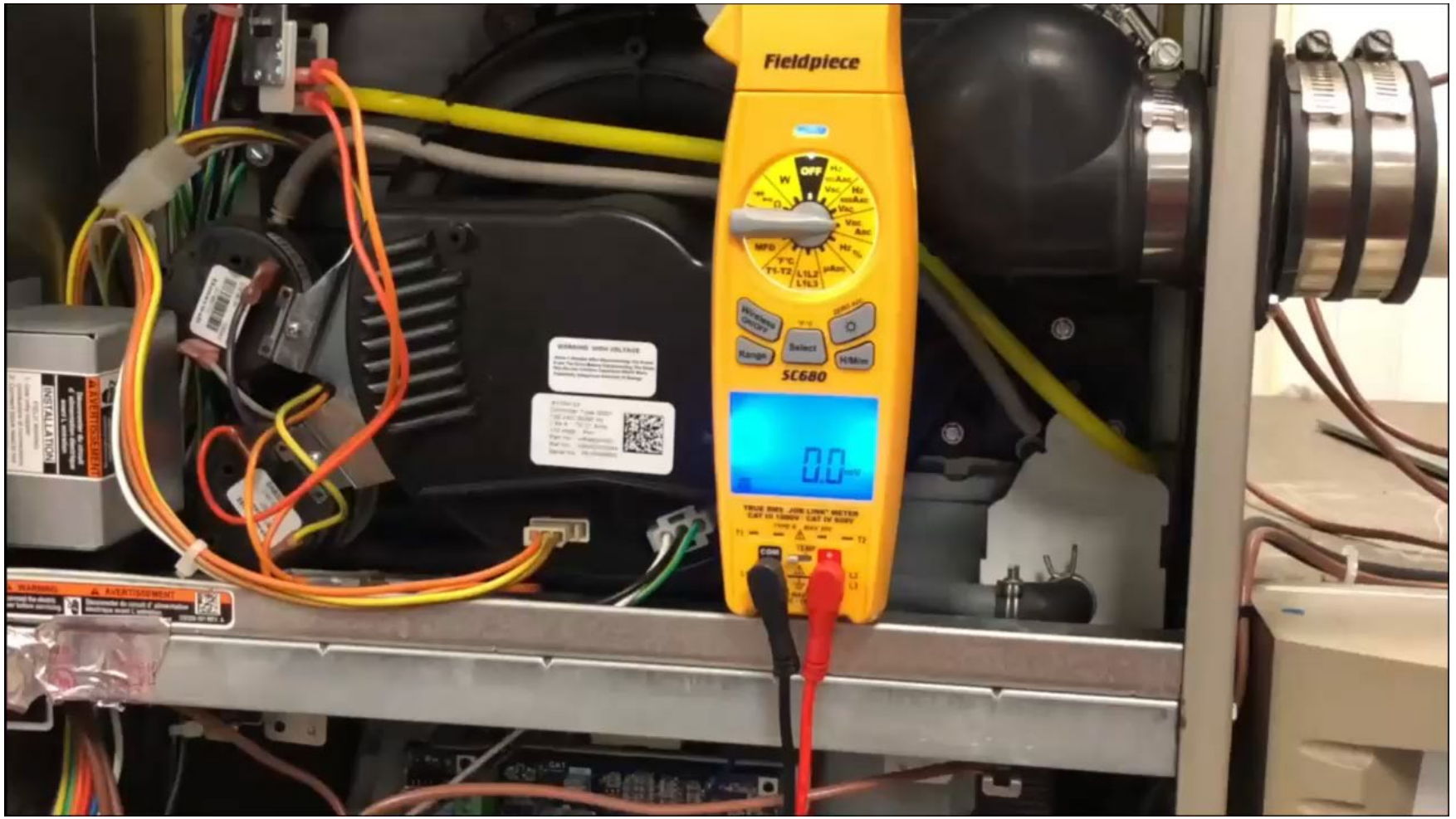
Brown -> Orange = RPM feedback line from the inducer to the CPU

With no call to operate 15-17 vdc

With a call to operate 12-14 vdc

Always check both ends of the harness for the same voltage

Code 42 Inducer Motor Fault



Code 42 Inducer Motor Fault

Let's say the Inducer starts and runs and communication is good

Remove accessories , hold door switch closed, and jumper R-W/W1.

27.	Does status code 42 flash within 20 seconds after a call for heat?	28	39	
28.	Turn power off and disconnect jumper from the R and W/W1 thermostat terminals.			29
29.	Disconnect collector box tube to pressure switch assembly.			30
30.	Turn power on and jumper the R and W/W1 thermostat terminals.			31

But why do we remove the pressure switch hose?

•If communication channel is correct, inducer will continue to ramp up for 45 seconds and furnace control will display a code 32 (Pr. Sw.)

•If communication channel is defective, fault 42 will still occur after 20 seconds (check RPM feedback and harness connections)

Code 42 Inducer Motor Fault

2. RPM outside valid speed range

Why did we remove the pressure switch hose?

- Allowable RPM varies by model and size
  - Motor are rated for 500 – 4800 RPM
  - Generally :
    - Allowable RPM range at medium pressure switch (modulating, step-mod) or low-pressure switch make (variable speed) will be from 1500 to 3000 RPM

If the LPS switch does close before 1500 RPM or can not be closed until over 3000 RPM code 42 is generated. By removing the pressure switch hose and generating a code 32 PS fault. We are verifying we need to inspect the venting, HX and installation. Reinstall the pressure switch hose.

Code 42 Inducer Motor Fault

2. RPM outside valid speed range

- Inducer RPM when pressure switch makes may be hard to determine
  - If User Interface is used, furnace may be locked into low, and RPM may be taken from the checkout screen

Code 42 Inducer Motor Fault

2. RPM outside valid speed range

- If inducer speed is **below** required range

1. Check pressure switch settings
   If pressure switch, make points are correct
2. Inspect vent system for grossly oversized pipe
3. Inspect for HX blockage

Note: turning on the low/med heat rise switch will increase inducer speed by 15 percent, and may be enough to bring inducer RPM into correct range

Code 42 Inducer Motor Fault

2. RPM outside valid speed range

- If inducer speed is **above** required range:

1. Check pressure switch settings
2. Inspect vent system for sags and correct pitch
3. Inspect for collector or coupling box leak
4. Inspect pressure switch hoses for cracks or leaks
5. Inspect for pressure switch hoses for obstruction
6. Inspect for slow drain, or defective condensate trap

Code 42 Inducer Motor Fault

3. RPM signal lost for 5 seconds during operation

- Self explanatory
  - Check all harness connections
  - Follow steps as spelled out in troubleshooting guide to check RPM feedback line

35.	Check the RPM feedback line. To do this connect a DC voltmeter across terminals PL16-1 BROWN (+) and PL16-3 ORANGE (-), then put setup switch SW1-6 for COMPONENT TEST in the ON position. Does the voltage across PL16-1 and PL16-3 change between states as shown below? - State 1 – OFF (15.0 – 17.0 vdc) - State 2 – MED (12.0 – 14.0 vdc)	36	25	

  - Again, voltages shown are not absolute, and may vary with different types of meters
    - Look for a change between states !

Code 45 – Control Circuitry Lockout

Possible Causes:

- Gas Valve Relay(GVR) Stuck Open
- Flame Sense Circuit Failure
- Software Check Error

Control will auto-reset after 1-hour lockout.

Fault may be cleared by cycling power to the board

If the status code repeats, replace board.

Carbon Monoxide--CO

- Result of unburned fuel
- Happens when any portion of a flame is reduced below ***1128 Degrees***
- Measured in ***ppm*** (parts per million)
- It's Odorless

Carbon Monoxide—CO (In The Home)

- **0-9 ppm -** These are considered normal levels within the home. If there are no smokers, however, investigation is recommended. These levels are measured above ambient levels in most cases, because the CO instrument has been zeroed in outdoor air.
- **10-35 ppm -** Advise occupants of the level, ask them about possible symptoms (slight headache, tiredness, dizziness, nausea, or flu-like symptoms). Check all unvented and vented appliances, including the furnace, water heater, and boiler. Check for other sources, including attached garages or small engine operation.
- **36-99 ppm -** Recommend fresh air; check for symptoms; ventilate the space, recommend medical attention.
- **100 ppm and higher -** Evacuate the home (including yourself) and contact emergency medical services. Do not attempt to ventilate the space. Short-term exposure to these levels can cause permanent physical damage.

Quoted from HVACR "The News"

Carbon Monoxide—CO (In The Stack)

Equipment levels (maximum), vented equipment. (CO readings must remain stable and are measured on an air-free basis.):

- 400 ppm stack ANSI Z 21.1. ***(This is the offical max via Government rating)***
- 100 ppm stack recommended.

Equipment levels (maximum), unvented equipment:

- 30-50 ppm stable.
- Less than 10 ppm recommended.

Quoted from HVACR "The News"

Heat Exchangers

HEAT EXCHANGER INSPECTION

- Several methodologies in the field as to how a Heat Exchanger inspection should be performed

- Improper or inadequate furnace heat exchanger inspection techniques can result in the mis-diagnosis of a heat exchanger failure when a failure has not occurred, or is not imminent

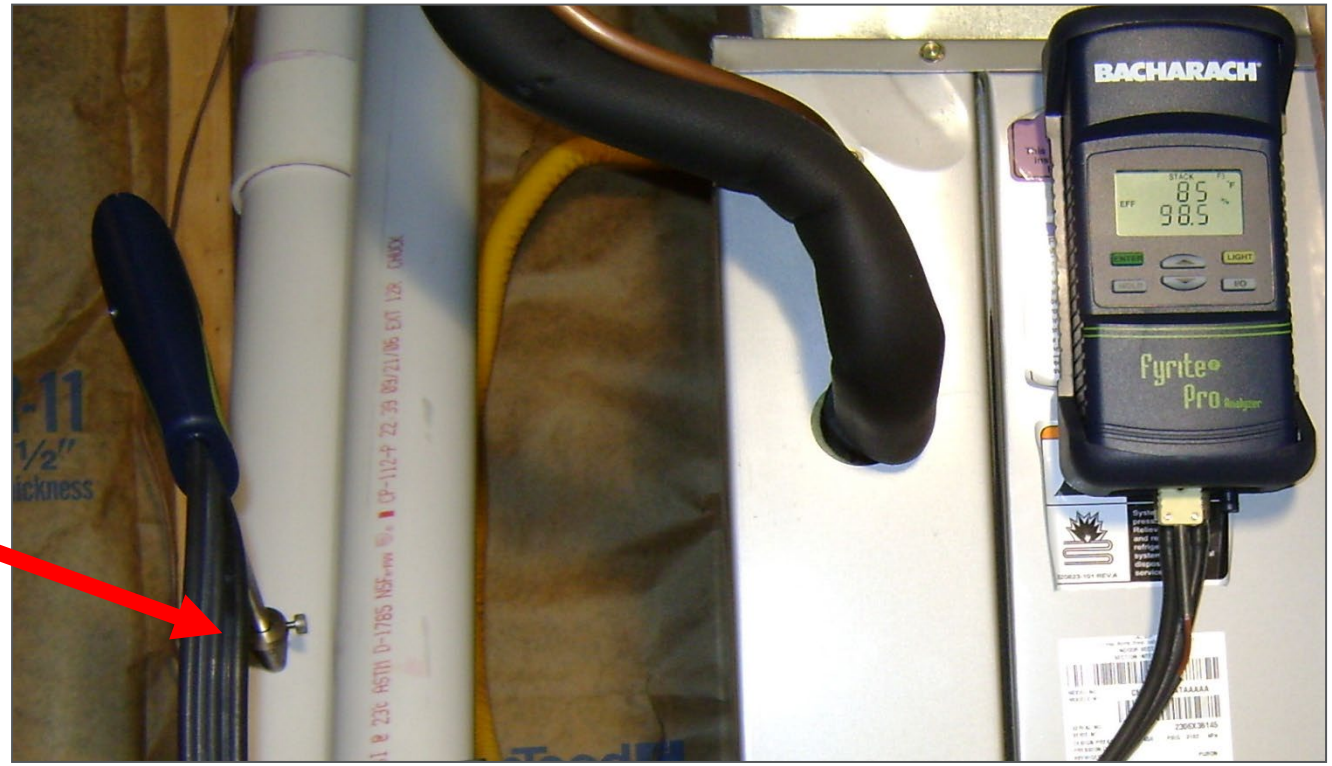
Official Carrier/Bryant/Payne Furnace Heat Exchanger Inspection Procedure

- This procedure should be used to correctly diagnose a heat exchanger failure in Carrier/Bryant/Payne furnaces
- This method is to be used once preliminary service and troubleshooting techniques indicate the heat exchanger is suspected to have failed
- This method may be used as a reference to verify the furnace is installed properly
- DSB09-0022

Setting Up Furnace for CO Reading

- Drill a small hole in the vent pipe approximately 12 inches from the inducer assembly outlet

Drill Hole 12” above Inducer Outlet



A WORD ABOUT COMBUSTION ANALYZERS

- Not all combustion analyzers are the same
- Different types and brands do different tests
- Choose an analyzer that can provide you with the most information
- Choose an analyzer that is easy for you to use

Examples of 2 analyzers-Same brand
Note: Other brands may be different

- Model “A”
- Measures:
  - Oxygen
  - Stack Temperature
  - Ambient Temperature
- Calculates:
  - Combustion Efficiency
  - Excess Air
  - Carbon Dioxide

- Model “B”
- Measures:
  - Oxygen
  - Stack Temperature
  - Ambient Temperature
  - Carbon Monoxide
- Calculates:
  - Combustion Efficiency
  - Excess Air
  - Carbon Dioxide
  - Carbon Monoxide (air free)
- Optional printer

MEASUREMENT RANGES

- Flue Gas O2 content
  - 0.0 to 20.9% O2
- Stack Temperature.
  - 0 to 999 °F (–18 to 537 °C)
- Ambient Temperature
  - 32 to 212 °F (0 to 100 °C)
- Flue Gas CO content (Model “B”)
  - 0 to 2,000 ppm CO

CALCULATION RANGES

- Combustion Efficiency
  - 0.1 to 99.9% This is not AFUE
- Flue Gas CO2 content
  - 0.0 to a fuel dependent maximum value in %
- Flue Gas CO Air-Free (Model “B”)
  - 0 to 9,999 ppm
- Excess Air
  - 0 to 400%

FUEL SELECTIONS

Natural Gas

Oil #2

LPG

Kerosene

- Note: Other meters may only test one type of fuel
- Typically, fuel must be selected before test is performed

HELPFUL TIPS

- Always refer to the instructions enclosed with your analyzer
- Try out your analyzer on a “test” furnace to see if you understand the instructions
- See if the company offers any training
- Download an electronic copy of the instructions if possible

BACKGROUND CO READING

- Gas fired appliances
- Fireplace operation
- Automobile operation in garage
- Negative Pressure condition could exist in the home
  - Exhaust fans
  - Natural draft fireplaces

BACKGROUND CO READING

An ambient measurement of CO does normally result from a cracked heat exchanger. More often than anything else, however, it is the result of auto exhaust from an attached garage or depressurization of the home, resulting in insufficient air for combustion.

If CO is detected, all possible sources should be checked, including but not limited to hot water tanks, gas ovens and stoves, the furnace, nonelectric space heaters, and vented or unvented appliances like gas logs.

Quoted from HVACR "The News"

FLAME PATTERN ISSUES

These conditions could indicate a possible:

- Split heat exchanger seam
- Open crack
- Heat exchanger deterioration/restriction
- Gasket material failure
- Physical separation of connected parts (primary, secondary heat exchanger, collector box, inducer assembly, etc.
- Chemical impurities in fuel supply

FLAME DISTURBANCE TROUBLESHOOTING

- Flame disturbance after the indoor blower motor comes on is a good indication that further heat exchanger inspection is required
  - Look for air leaks between primary HX cells and cell panel
  - Check for flame impingement on the cell panel
    - Does not always indicate a heat exchanger failure
    - Burner orifice misalignment should be checked
    - Air leakage around the hot surface ignitor—check gasket

If significant flame disturbance occurs after blower comes on that cannot be corrected by fixing air leaks, begin a physical inspection of the Heat Exchanger

Checking Heat Exchangers Using Combustion Analyzers

To test for cracks using a combustion analyzer, simply watch the **O_2/CO_2** readings and the **CO** reading when the blower comes on - usually several minutes after the burner(s) ignite.

Typically, the **O_2/CO_2** or **CO** readings will stabilize within 30 to 60 seconds after ignition. If a crack is present, when the blower energizes, air (at **20.9% Oxygen**) may be blown through the crack in sufficient quantities to raise the **O_2** reading on the combustion analyzer.

Advantages of Using This Method

- It test's the HX under actual operating conditions
- It may provide additional information as to how dangerous a crack is.
  - For example, if a crack is visually observed and a combustion test finds that when the blower comes on the **CO** reading rises above **200 ppm**, a dangerous situation exists and there is documentation that the unit needs to be immediately condemned and taken out of operation
  - ***It is the technician's responsibility to enforce this***
  - ***Do NOT leave unit operational until repairs or replacement have taken place***
- It can be easily done during the normal course of a service call where combustion testing is performed.

Checking Combustion with a Combustion Analyzer

Top 4 Mistakes in Combustion Testing

- Furnace is Over/Under Fired
- Furnace Temp Rise Incorrect
- Burner Alignment
- Furnace Not Operating At Steady State

VERIFYING BURNER ALIGNMENT

Impingement occurs when the flame hits an object that has sufficient mass or can transfer enough heat from the flame to cause low-flame temperatures and incomplete combustion. This can be something as simple as a screw poking into the flame from the heat exchanger, or as major as a warped cell***. Burners should always be carefully removed and reinserted to ensure proper placement and alignment.***

Product Updates

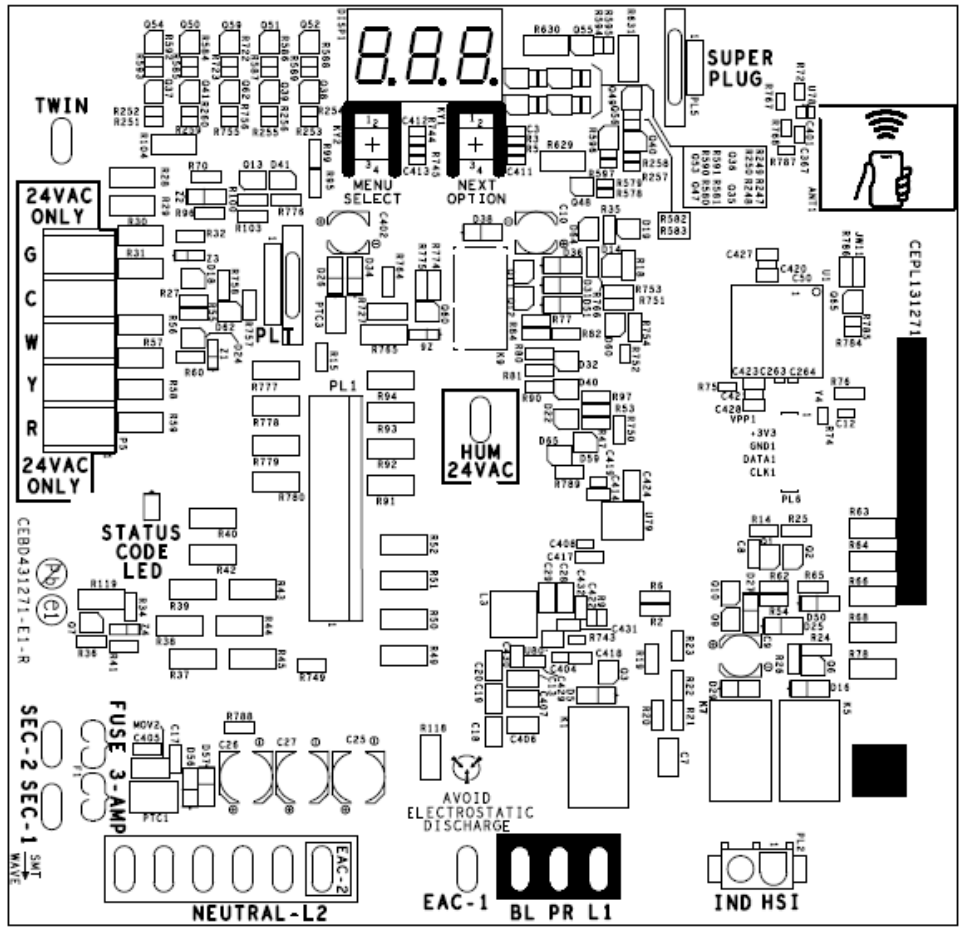
ENTRY TIER FURNACE CONTROL

Rating plate QR and bar codes

- QR Code
  - link to page in HVACPartners
  - Training video
  - Registration
  - App link
- 2D Bar Code
  - Contains unit serial number

ENTRY TIER FURNACE CONTROL

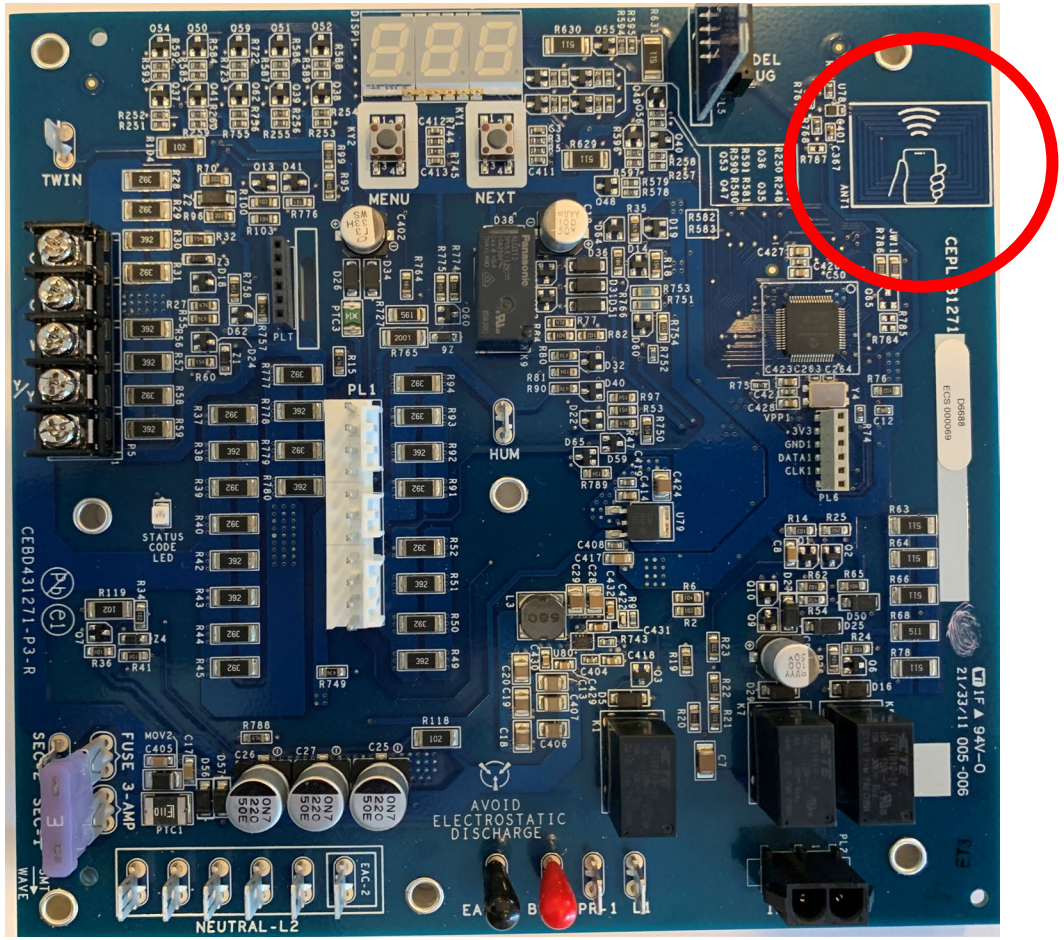
Increased flexibility



- New control for all entry tier units to better align with 2023 cooling products
- Will convert blower motors to PWM driven units – 18speeds
  - Greatly increased airflow selections for all modes of operation
  - Reduced motor stocking
- Will utilize Near-Field communication or pushbuttons to allow for adjustments
- Service controls will be blank
  - Requires Service app or Super Plug to load run “recipe” into control
- First production planned May 2022

FURNACE CONTROL

Near Field Communication

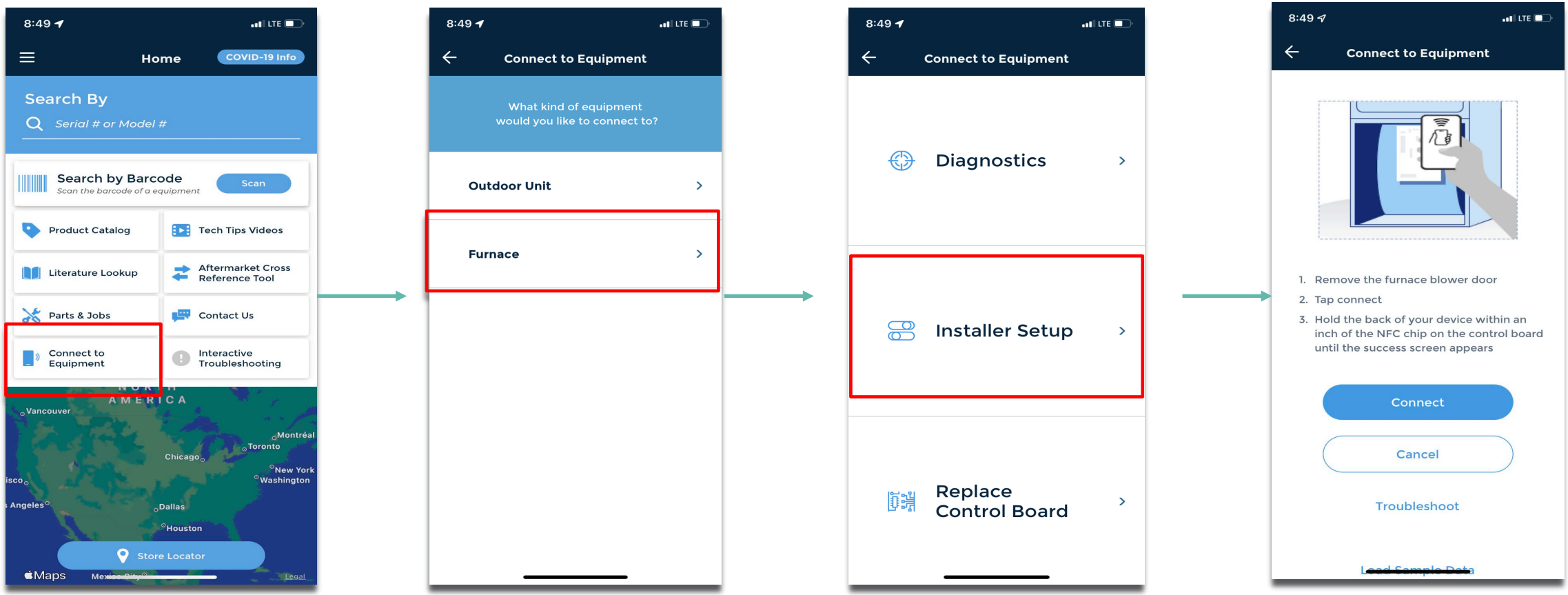


- Near Field Communication allows two devices placed within a few centimeters of one another to exchange information
- Used by Apple Pay and other contactless payment systems
- Installer recipe and user settings can be read, adjusted, and loaded into furnace control without switches or contact with the furnace control
- Non-powered, so information can be exchanged with furnace power in OFF state
- Allows for information transfer from existing control to new control easily
- Allows for runtime data
  - Fault code history
  - Runtime cycles/hours

FURNACE CONTROL

2023 Entry – Mid Tier Furnace App Integration

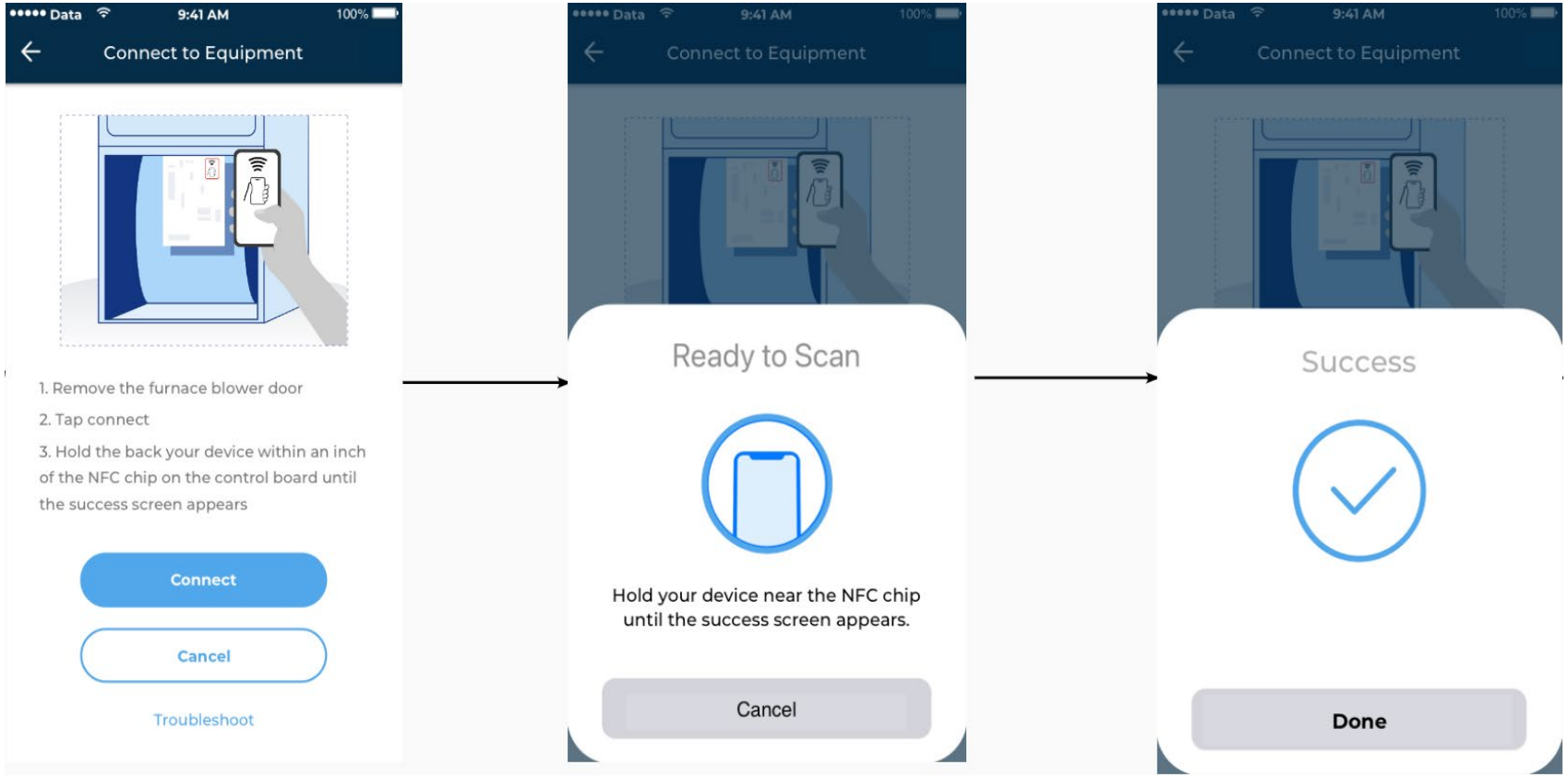
Utilizing existing Service Tech App featuring patent-pending Near Field Communication (NFC)



FURNACE CONTROL

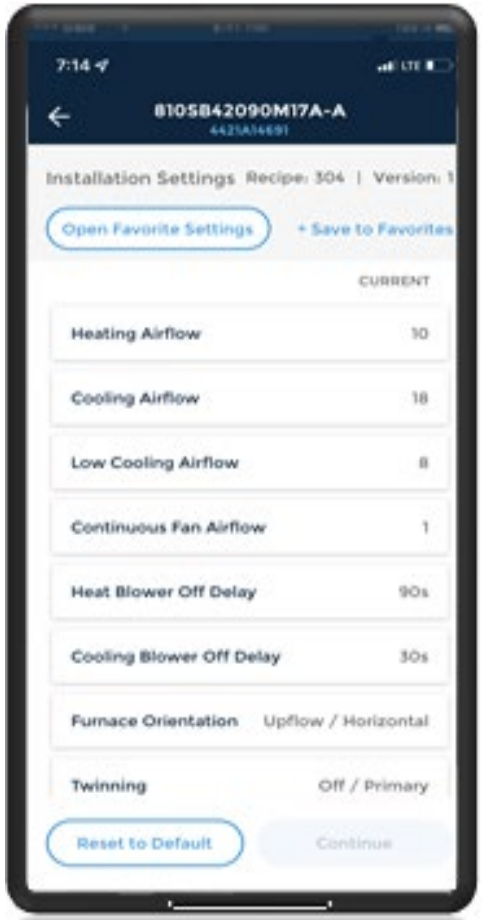
2023 Entry - MidTier Furnace App Integration

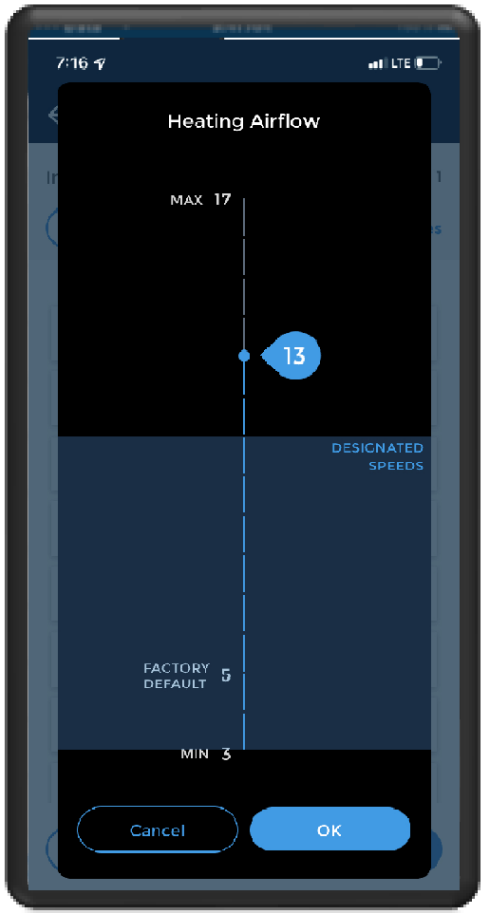
Utilizing existing Service Tech App featuring patent-pending Near Field Communication (NFC)

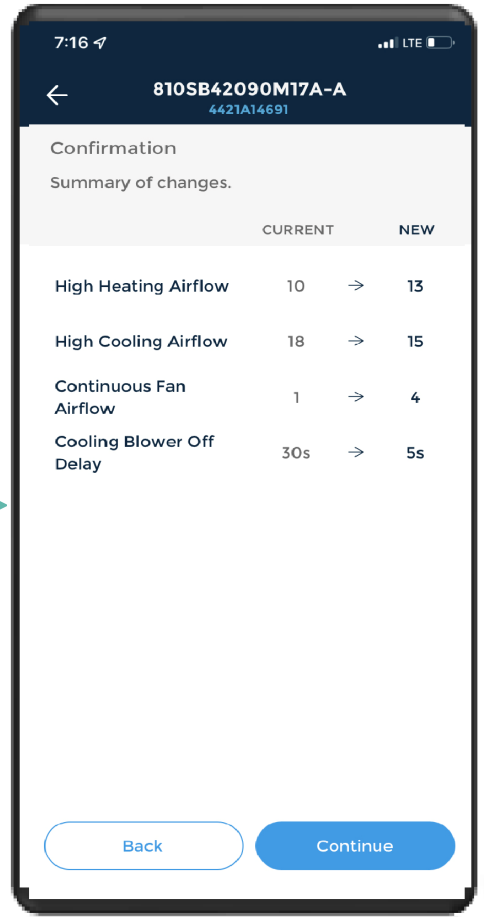


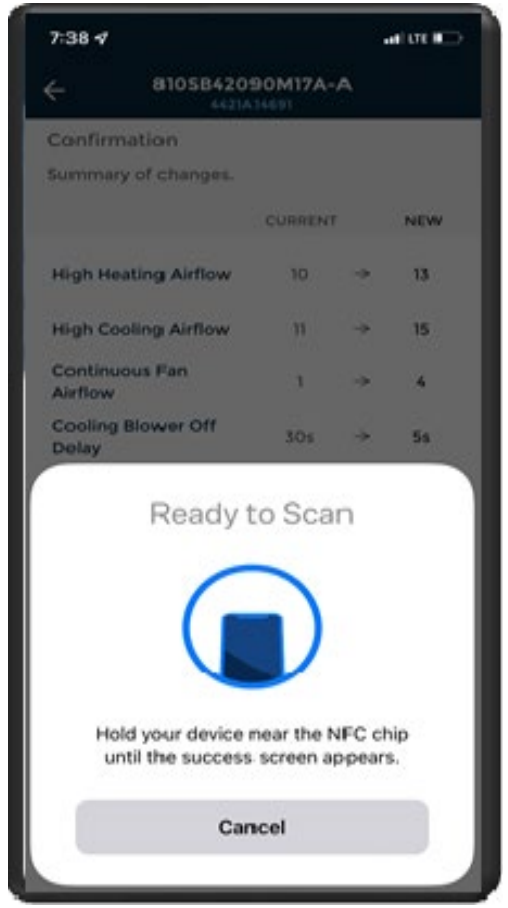
FURNACE CONTROL

Entry – MidTier Furnace App Set Up





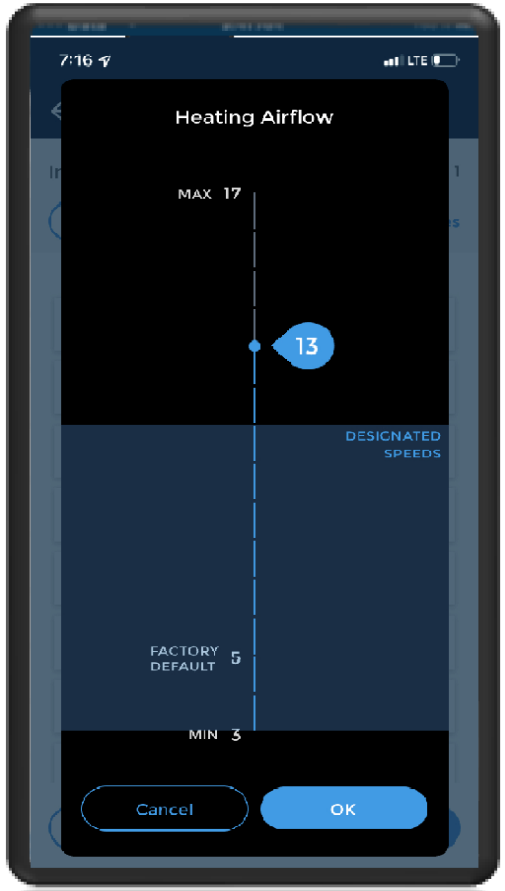




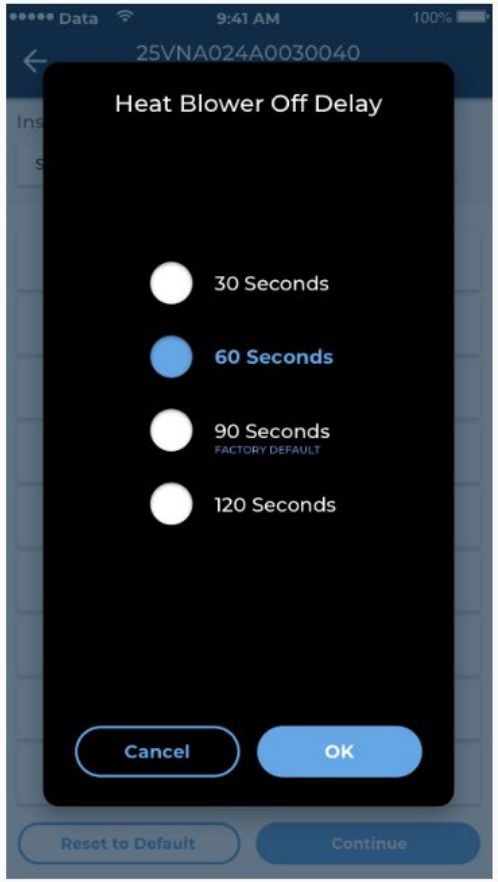
FURNACE CONTROL

App Screen Examples

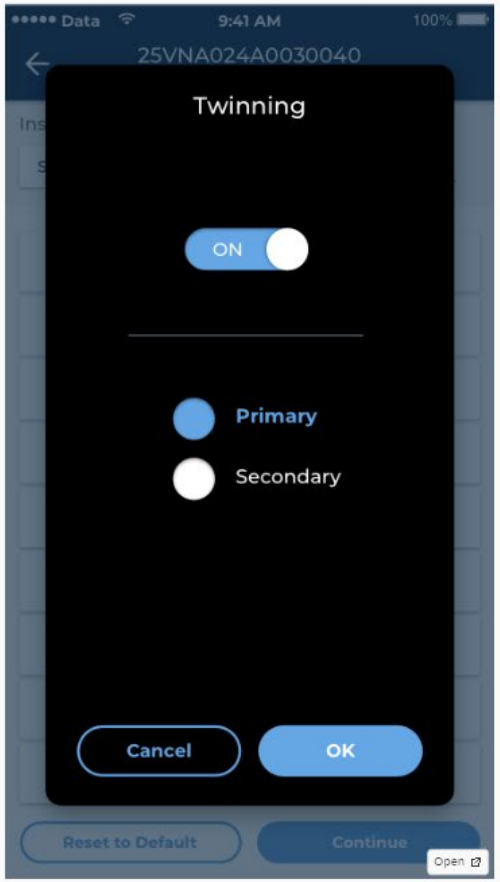
Slider Type



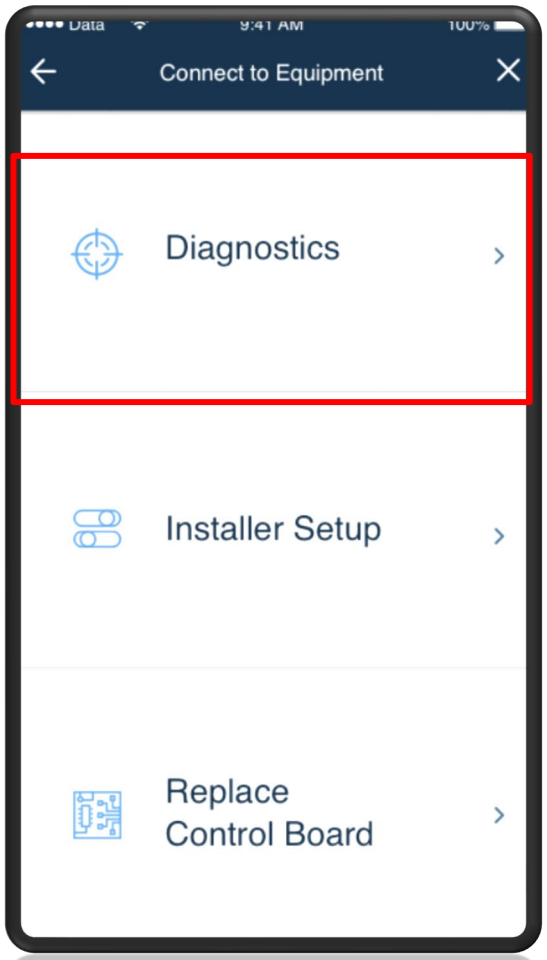
Choice Type

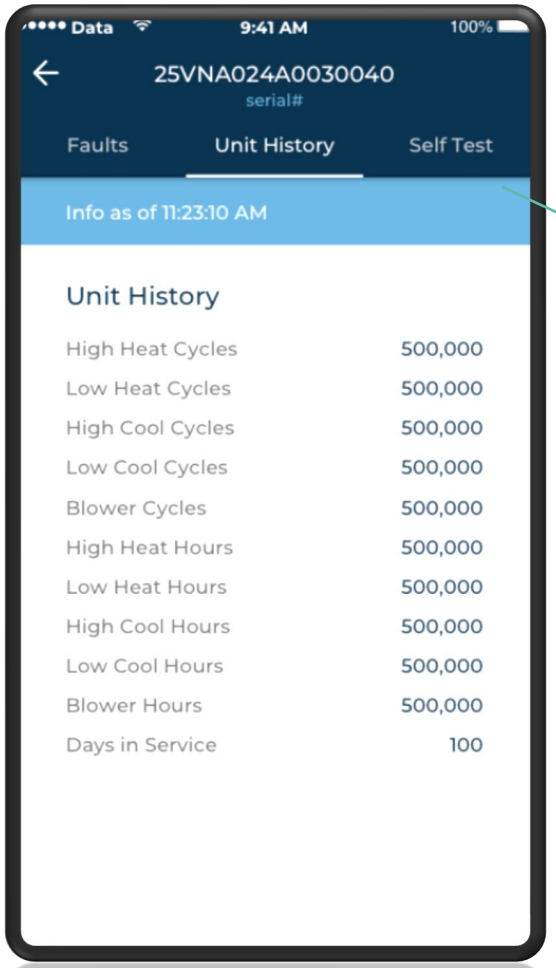


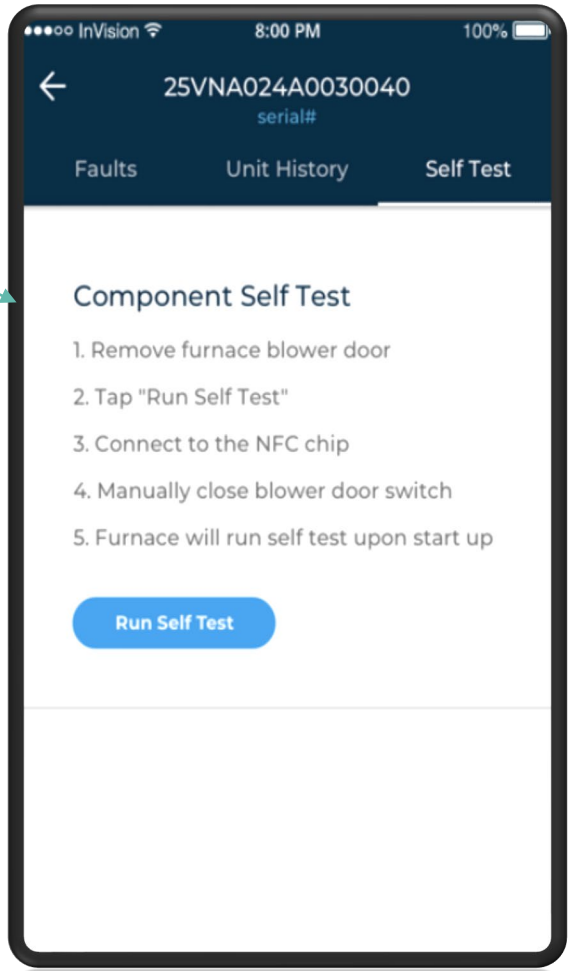
On/Off + Choice Type



2023 FURNACE APP DIAGNOSTICS



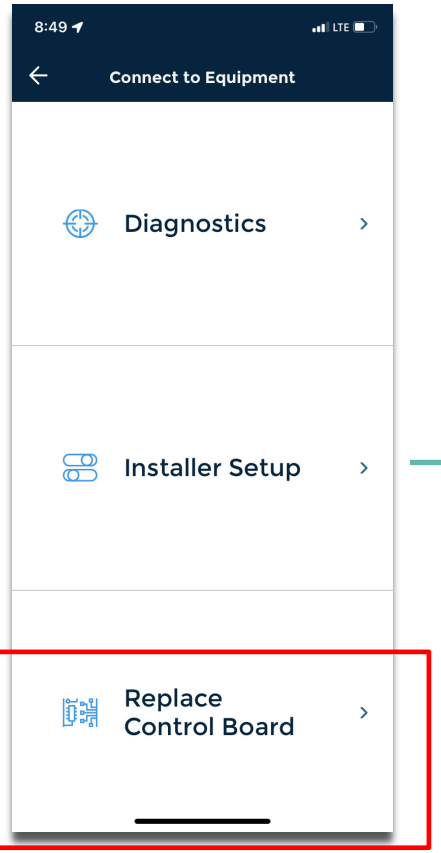


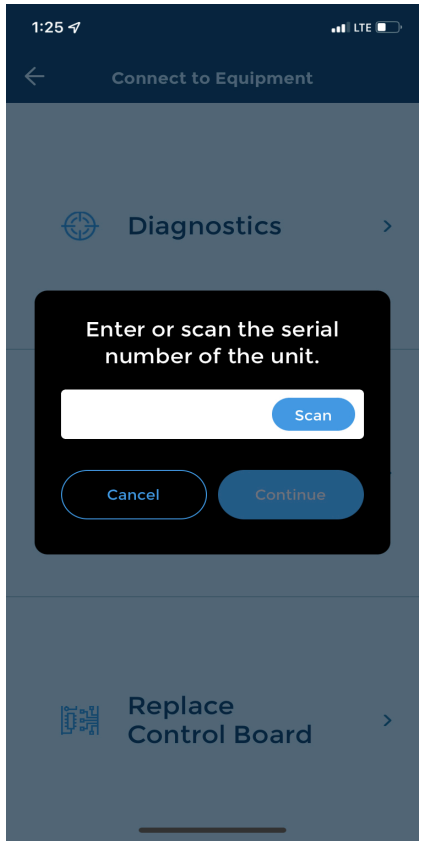


FURNACE CONTROL

2023 Furnace App Integration

Utilizing existing Service Tech App featuring patent-pending Near Field Communication (NFC)



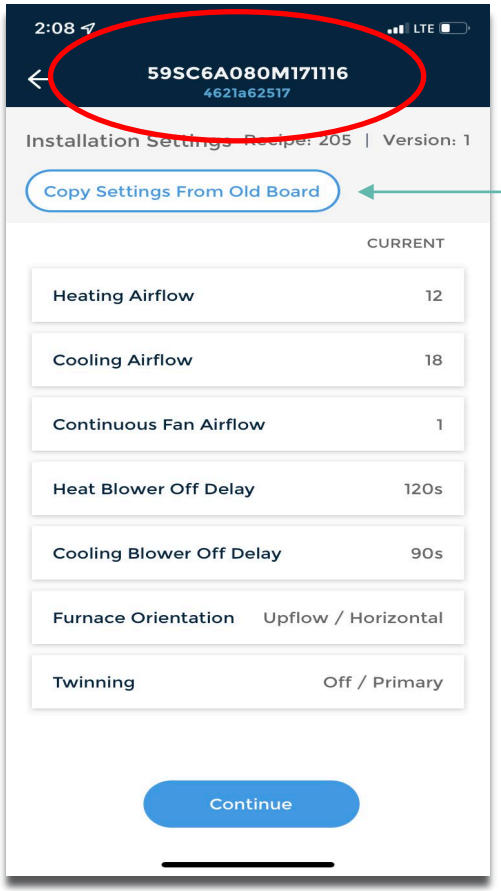


- Unit serial can be scanned or entered manually
- Scan or Manual entry will do a model look up for that serial #
- Model and serial number will be transferred into the new furnace control

FURNACE CONTROL

2023 Furnace App Integration

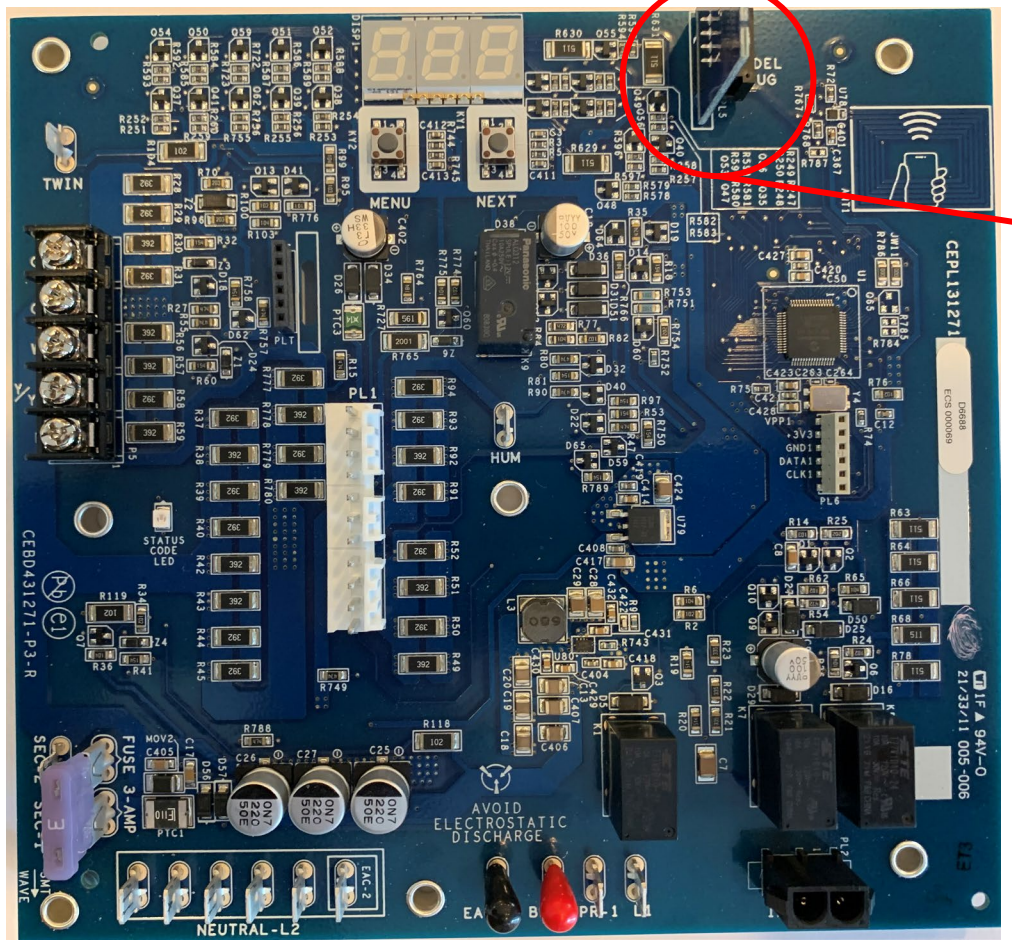
Utilizing existing Service Tech App featuring patent-pending Near Field Communication (NFC)



- Shows Model, serial, and recipe for that model
- Shows Default settings for the specific model
- Will allow the default setting for the model to be used
- Or will allow adjustment settings to be copied over from faulty control

FURNACE CONTROL

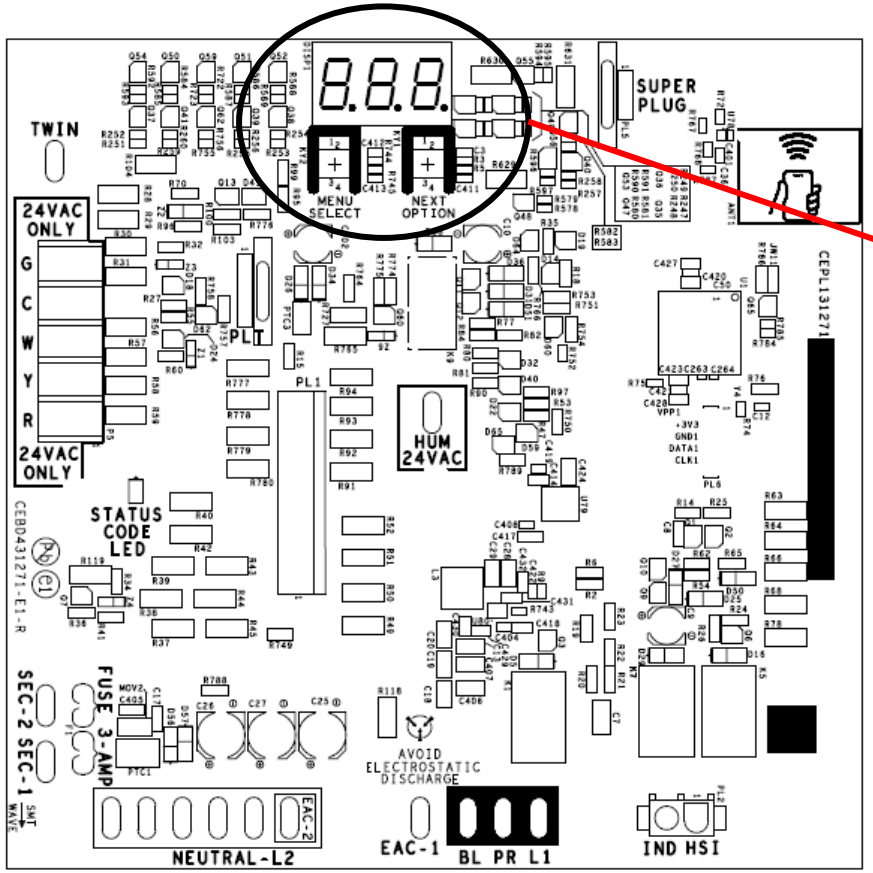
App Alternates - Super Plug

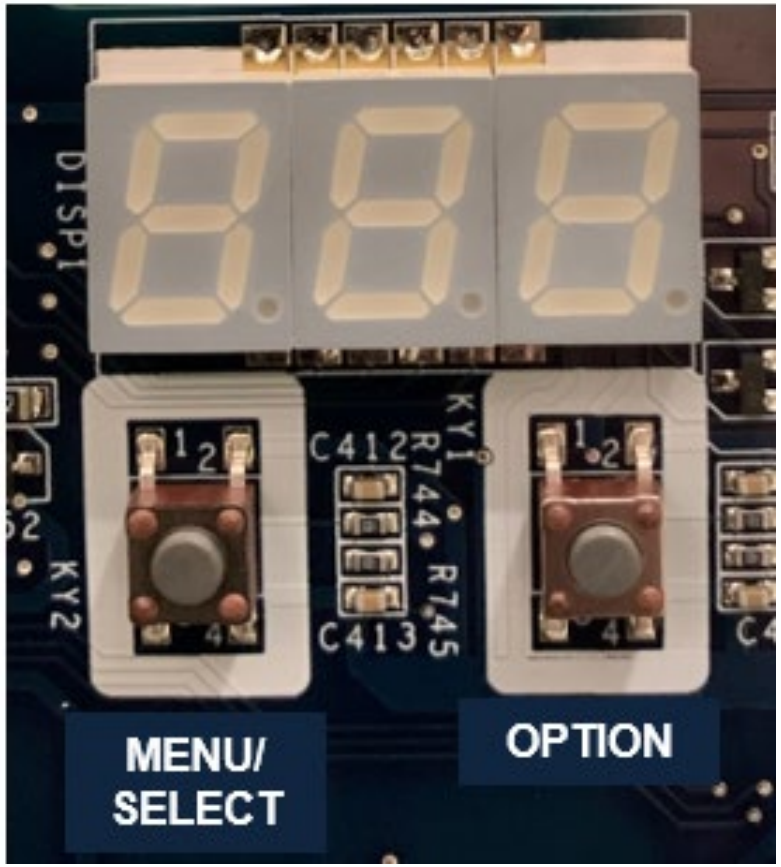


- Service controls do NOT contain run parameters
- Super plug is an alternate method of loading “run recipe” into furnace control
- Not in place while furnace is operating
  - Power up while plug is in place will automatically initiate programming mode, but will revert to run mode after 2 minutes
- All standard entry-tier model recipes will be contained on one Super Plug

FURNACE CONTROL

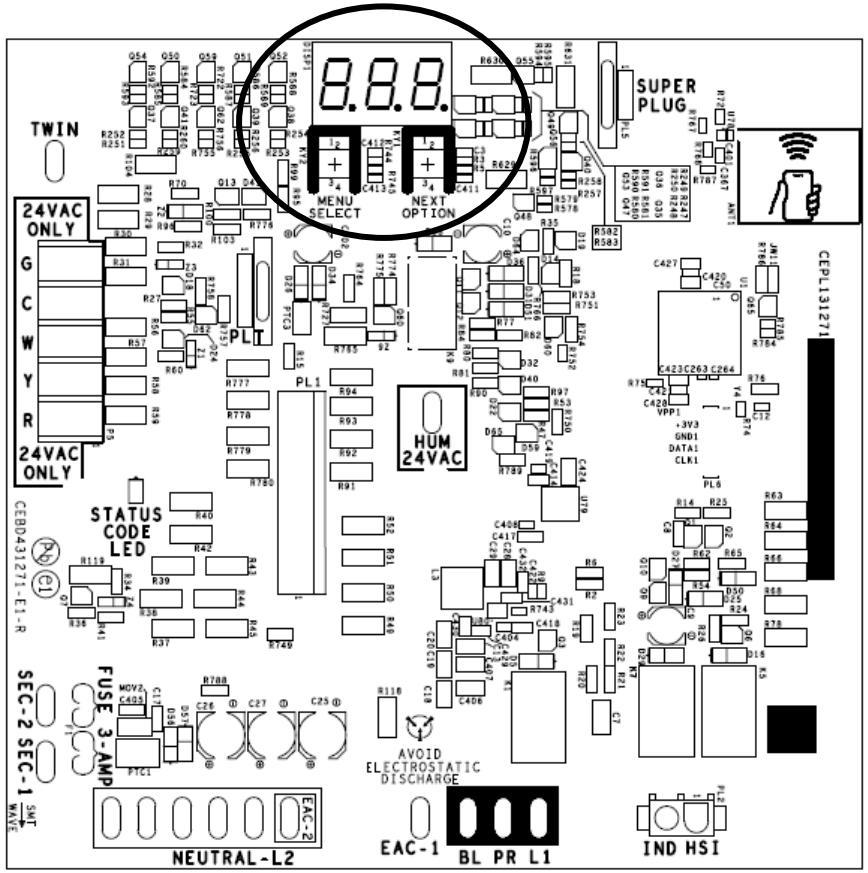
App Alternate - Pushbuttons and 7 segment Display





FURNACE CONTROL

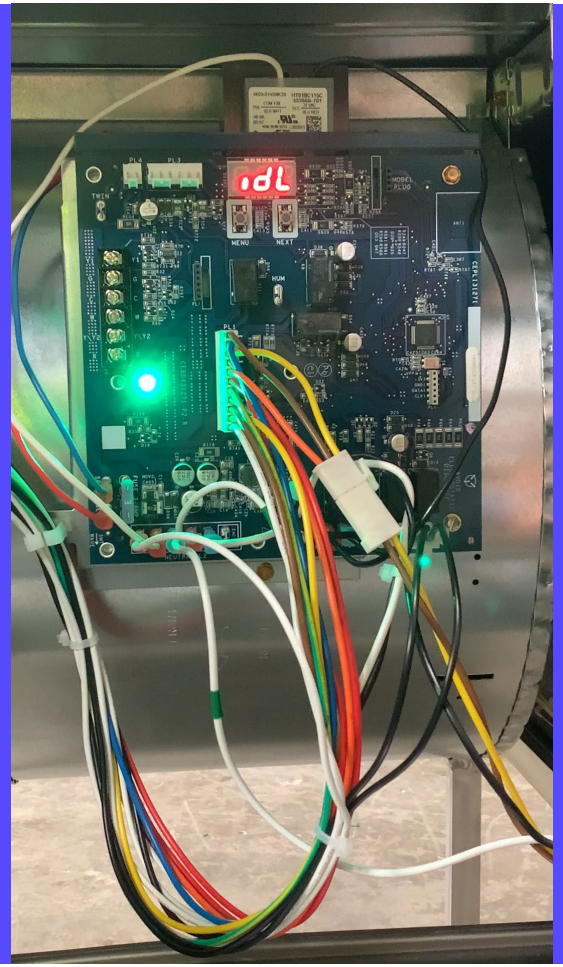
App Alternate Pushbuttons and 7 segment Display

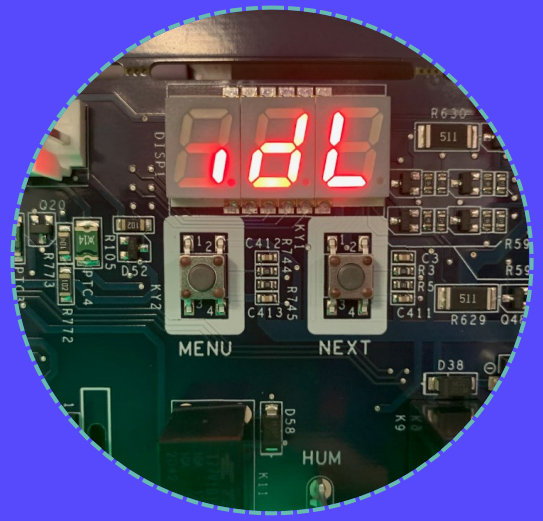


- Allows for manual selection for recipe load on new “blank” furnace controls
- Allows for manual adjustment of run parameters
  - Heating, cooling, and cont. fan speeds
  - Heating cooling off delays
  - Orientation
  - Twinning
- Used to initiate component self test
- 3 number display allows for more defined fault codes
  - Like NGIP, fault codes will have a base code and index allowing more concise troubleshooting

FURNACE CONTROL

APP ALTERNATE PUSHBUTTONS ,7 SEGMENT DISPLAY





3-digit 7 segment display w/ 2 push buttons

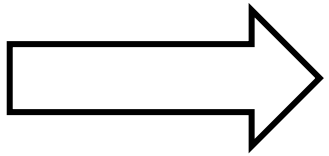
- Setup Options
- Fault Code Communication

Main Menu		
Display	**7-Segment Visual**	**Function**
FLt	FLt	Fault History Retrieval Menu
Ht	Ht	Heating Blower Speed Index
CL	CL	Cooling Blower Speed Index
CFn	CFn	Continuous Fan Blower Speed Index
Hod	Hod	Heating Blower Off Delay
Cod	Cod	Cooling Blower Off Delay
dir	di r	Direction; Unit Orientation Menu
CFn	CFn	Continuous Fan Blower Speed Index
tnn	t nn	Twinning Furnace Select
inF	i nF	Startup Information (Software Version)
Ct	Ct	Component Test
rSt	r St	Reset to Default Settings

FURNACE CONTROL

FAULT CODE IMPROVEMENTS

59SC2D	Description
11	No Previous Code
12	Blower on after power up
13	Limit circuit lockout
14	Ignition lockout
21	Gas heating lockout
22	Abnormal Flame-proving signal
23	Pressure switch did not open
24	Secondary voltage fuse is open
31	HPS pressure switch did not close or reopened
32	LPS pressure switch did not close
33	Limit circuit fault
34	Ignition proving failure
45	Control circuit lockout



Future Fault Codes

Major status code	Minor status code	Functional status code
Show "rF" on 7 Segment Display	N/A	L1 Polarity Fault
12	1	W on at power up
13	1	Limit Lockout
14	1	Ignition Lockout for 4 consecutive ignition tries
	2	Flame rollout algo lockout
21	1	Gas valve fault
22	1	False Flame
23	1	Stuck Main Pressure switch
	2	Stuck Secondary Pressure switch (condensing)
24	1	Fuse fault
25	1	No recipe info in local tag chip
	2	Corrupted recipe info in local tag chip
	3	Twinned units do not have same recipe number
	4	Primary recipe invalid, using secondary recipe to operate.
	5	Installer settings corrupted, using default installer settings.
	6	Incompatible Recipe
	7	Incompatible Recipe - Condensing
27	1	No recipe info in model plug
	2	Corrupted recipe info in model plug
	3	Failed to copy recipe from super model plug.
31	1	Open main pressure switch (in series with gas valve voltage) on non-condensing
	2	Open secondary pressure switch on A90 models
	3	Secondary PS Lockout mode, is in a 3 hr lockout
32	1	Open main pressure switch (A90 models)
33	1	Limit Fault
34	1	Ignition fault - four consecutive tries or before blower on-delay
	2	Ignition fault before on-delay
	3	Ignition fault after on-delay
	4	Ignition fault - any Self Healing mode
45	1	Control failure – Flame circuit fault, memory mismatch or sequence error
	2	Control failure – Gas valve relay will not close
	3	Control Failure – EEPROM Memory issue

THANK YOU!
QUESTIONS & QUIZ