Gas Furnace Silicon Nitride Ignitor Models

- Single and Two Stage Models
- Variable Speed Vent Models
- Variable Speed Blower Motor
- Test Procedures
- Direct Vent

Note: This publication is general in nature and is intended for INSTRUCTIONAL PURPOSES ONLY. It is not to be used for equipment selection, application, installation, or specific service procedures.

Contents

IFC Diagnostic Codes

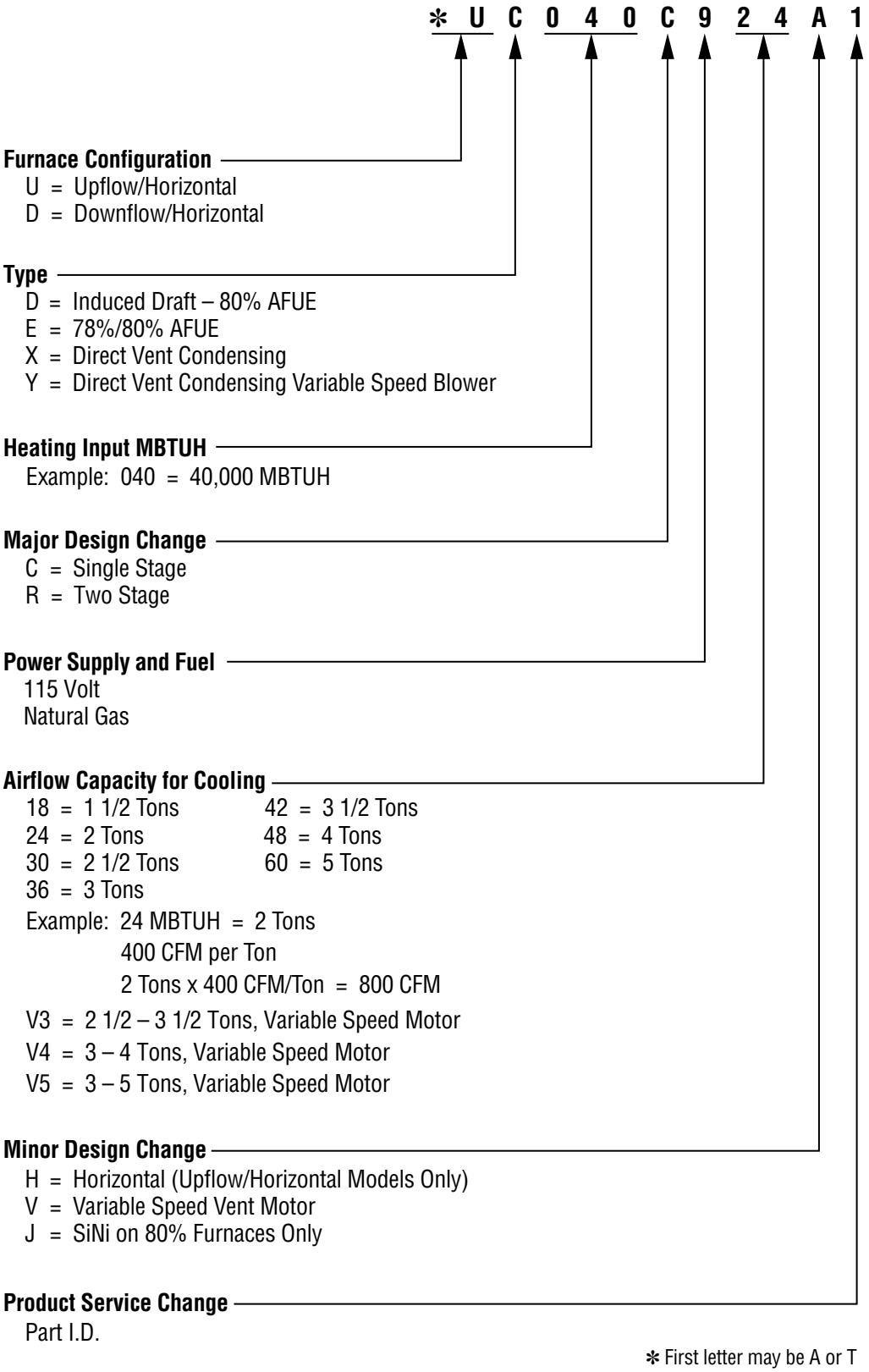
If 24 VAC "R – B" is less than 20 VAC or greater than 30 VAC, the control system will not function correctly.

Diagnostic Codes

LED Flash	Indicates
Slow Flash	Normal Stand By.
Fast Flash	Normal with a Call for Heat.
Continuous ON	Internal Fault in the IFC.
2 Flashes	System Lockout – No Flame. Total of three tries. Automatic reset in one hour.
3 Flashes	Pressure Switch Error. (Fault may be caused by a vent problem or a wiring connection in the switch circuit.) On two speed furnaces, if there is a high heat pressure switch fault, the IFC will not lock out. It will go back to low heat, cancel the three flash indication for ten minutes and again try high heat.
4 Flashes	Thermal Protection Device Open.
5 Flashes	Flame being sensed with Gas Valve De-energized (Stuck Open). Vent motor and indoor blower will be energized.
6 Flashes	No Ground or Power Leads to Furnace Reversed, or Line Voltage Too Low.
7 Flashes	20 VAC at Gas Valve with No Call for Heat or if No Flame is Present; Keep Vent Motor On.
8 Flashes	Low Flame Sense Signal.
9 Flashes	Ignitor Fault or Improper Ground or Low Voltage.

50A61-605 part #CNT02536 will only show the first seven flash codes.

Model Nomenclature

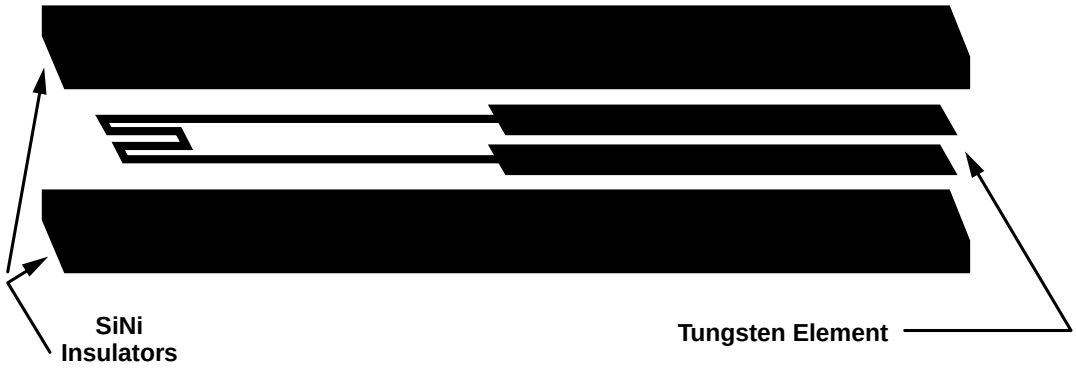


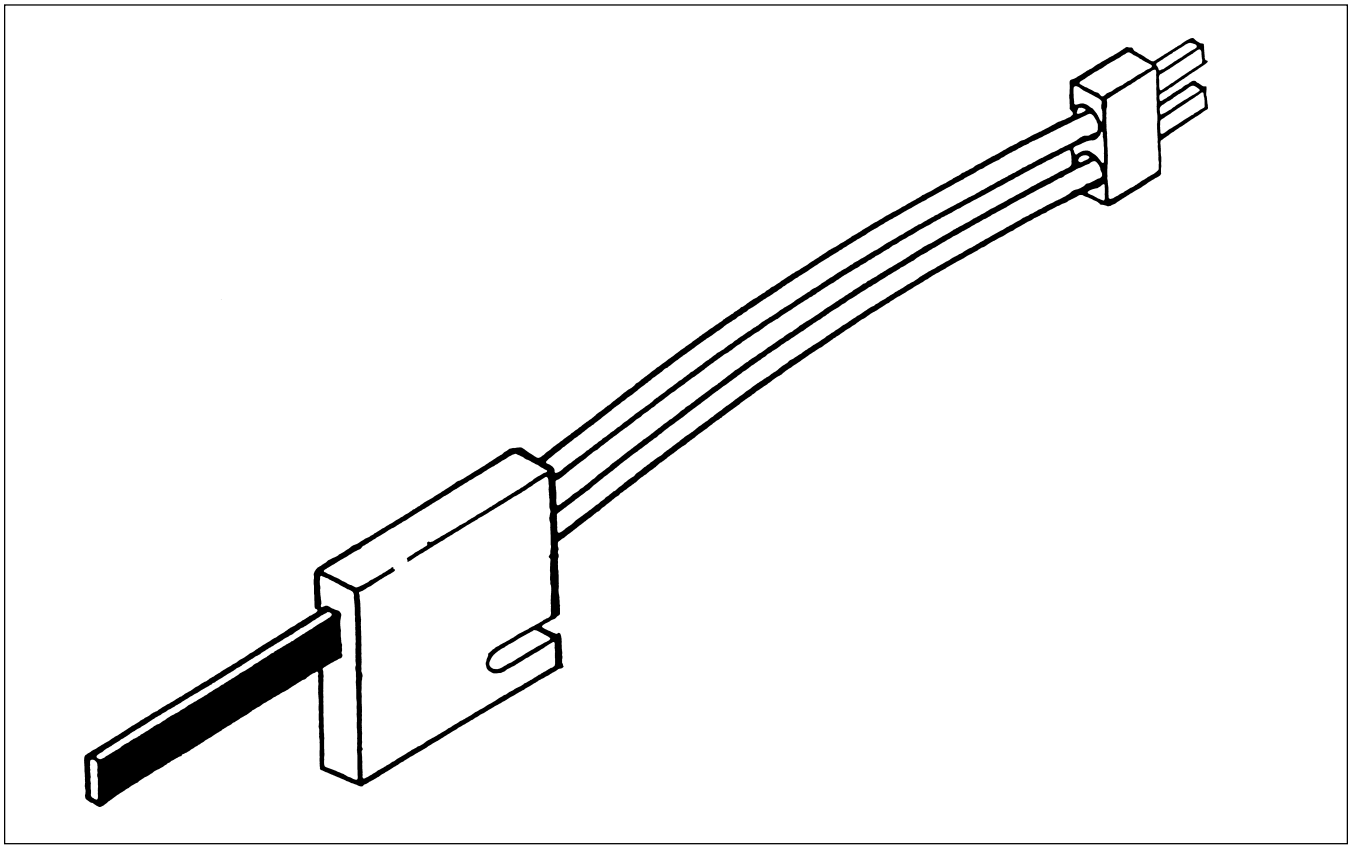
Silicon Nitride Ignitor

Abbreviation ➠ SiNi

Ignitor Composition:

1. Tungsten Paste Element
2. Silicon Nitride Ceramic Insulators





Part # IGN 0104 Silicon Nitride Ignitor

Silicon Nitride Ignitor

The ignitor used with this series of White-Rodgers controls is constructed of a tungsten heater element and silicon nitride ceramic insulators. The voltage rating of the ignitor is 80 volts R.M.S., which is less than the line voltage applied to the furnace; therefore, the control will reduce the number of cycles it supplies to the SiNi ignitor per second. The control checks the line voltage constantly and when a call for heat is received the control sets the number of cycles it is going to supply to the ignitor based on the line voltage it is reading. This reduced number of AC sine wave cycles per second reduces the effective voltage R.M.S. applied to the SiNi ignitor per second. If the line voltage is low, the number of cycles will go up, or if the line voltage is high, the number of cycles is reduced.

After each successful ignition, the number of AC sine wave cycles is reduced. The lower number of AC sine waves reduces the effective voltage applied to the ignitor. After each successful ignition attempt, the burner lights, then the number of cycles is reduced. During this learning program the number of cycles will become too low and the gas fails to ignite. A retry is initiated by the IFC and the number of AC sine wave cycles is raised slightly to increase the ignitor temperature.

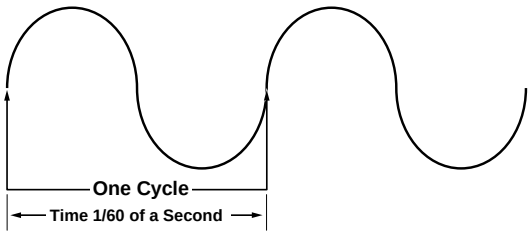
Once a successful ignition attempt occurs during a retry, that cycle count will be maintained for the next 255 calls of heat, or until another retry is called. The IFC repeats the learning process again after 255 calls for heat have been completed, or whenever power to the furnace is cycled off and then on again.

This learning process is employed to provide the most reliable ignition system possible. By lowering the ignitor temperature, you will get the longest possible service life from the rugged Silicon Nitride Ignitor. This control requires the correct polarity of the 120 V.A.C. wiring and a ground connection for proper operation. If the line voltage is low, or the line polarity is reversed, or the ground is not properly connected, the IFC control will lock out and cause the diagnostic status L.E.D. to flash six times for control #50A61-605 CNT2536 only. Controls #50A65-474 CNT2854 and #50V65-495 CNT2871 will flash six times if the line polarity is reversed and nine times if line voltage is low or ground is not properly connected or the ignitor is open.

The maximum voltage permitted between line neutral and ground is 10 volts; otherwise the IFC control will not be able to properly vary the number of AC sine wave cycles to the Silicon Nitride Ignitor.

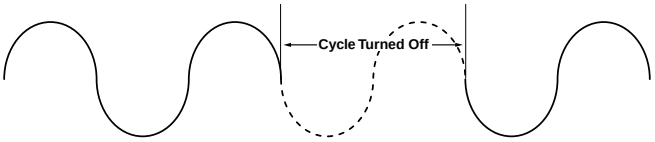
This ignitor can only be checked by ohming in a cold condition. A good ignitor reads 11 – 18 ohms. A bad ignitor will have a much higher resistance (impedance).

60 Hertz AC Sine Wave



Number of cycles per second affects the effective voltage or voltage R.M.S.

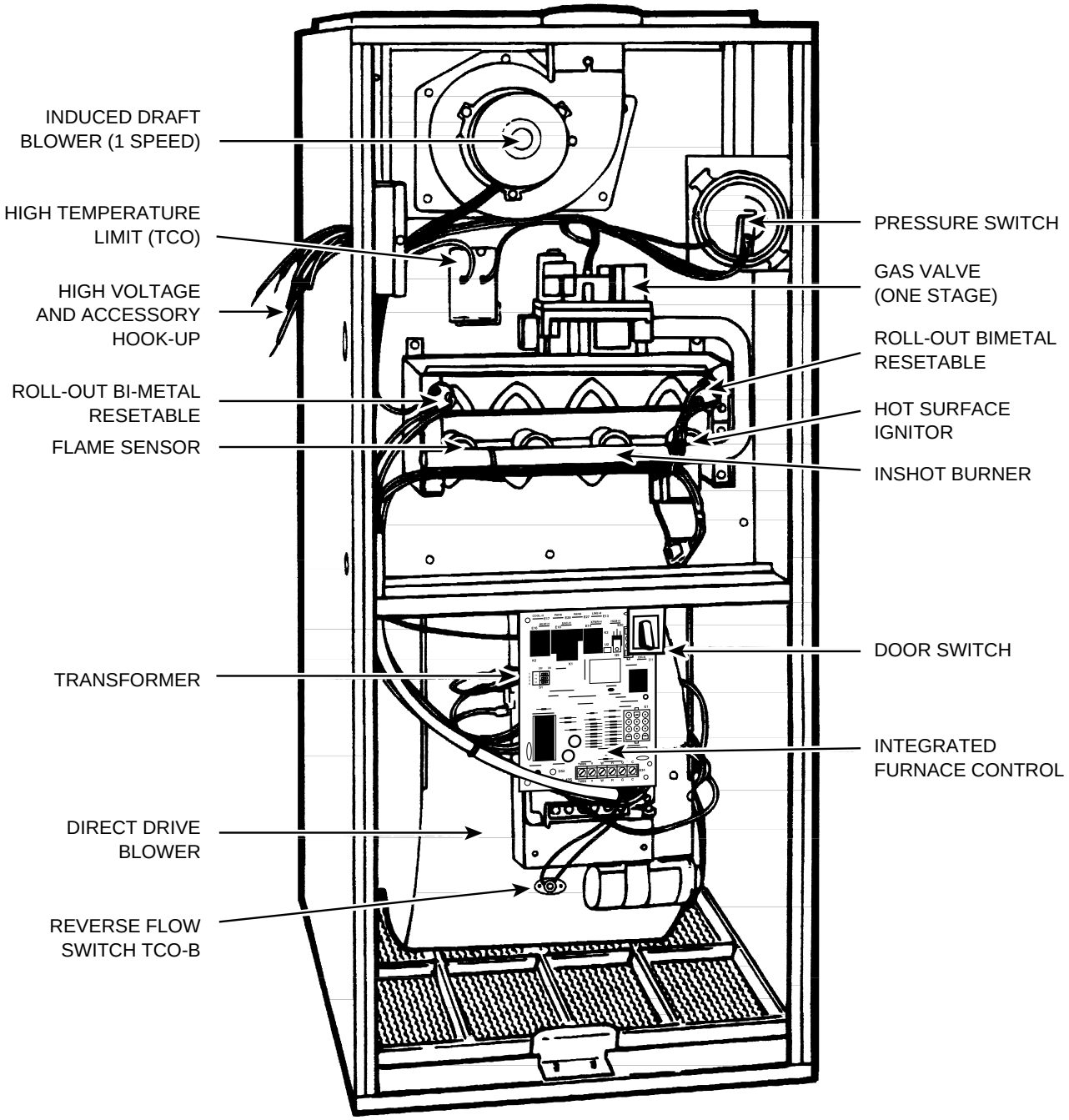
R.M.S. = Root – Mean – Square = The value assigned to an alternating current or voltage that results in the **same power dissipation** in a fixed resistance as **DC current** or **voltage of the same** numerical **value**.



One or more cycles are turned off by the I.F.C. control to control the R.M.S. voltage supplied to the silicon nitride ignitor.

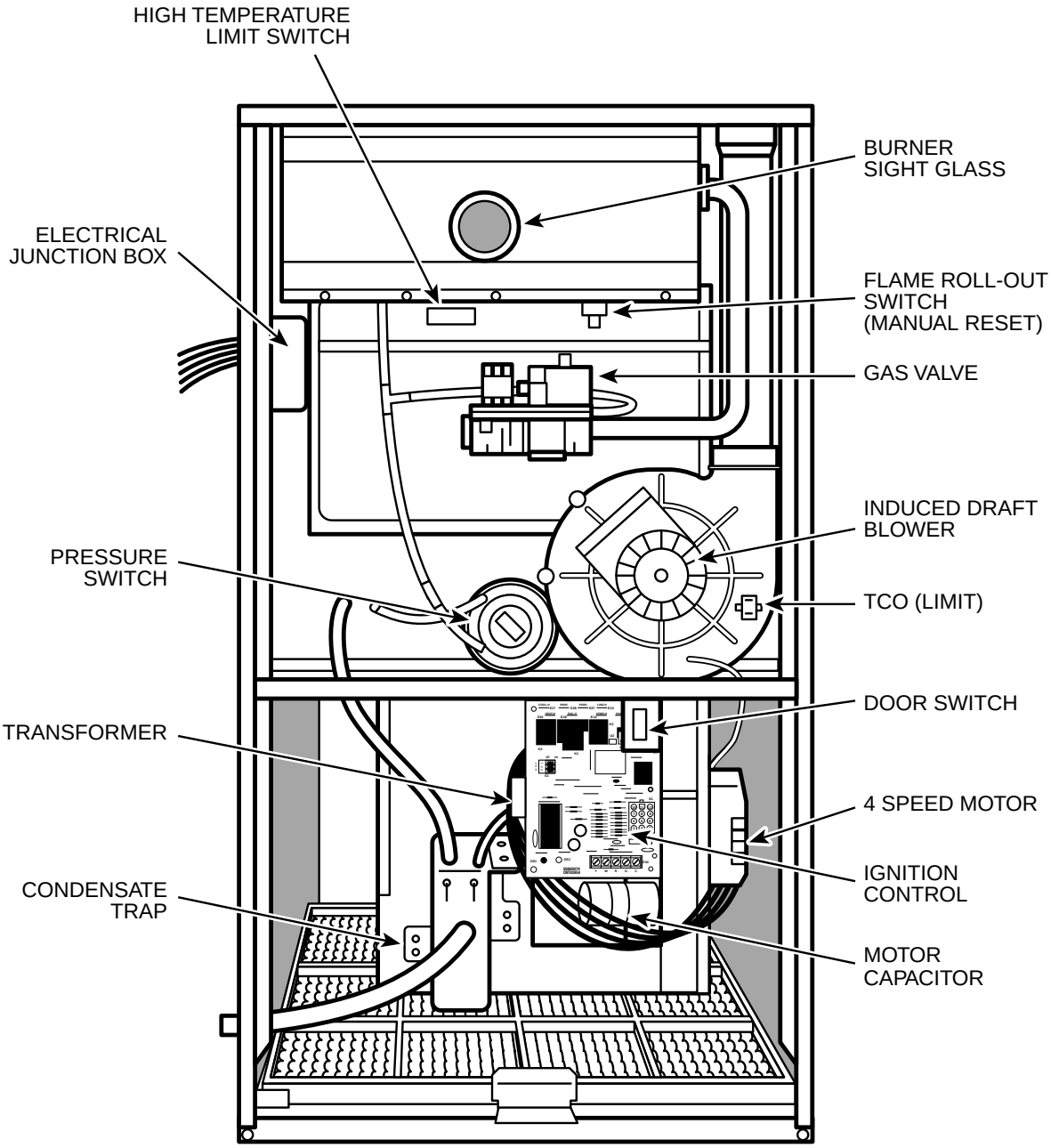
Component Identification

Single Stage 80% Upflow/Horizontal



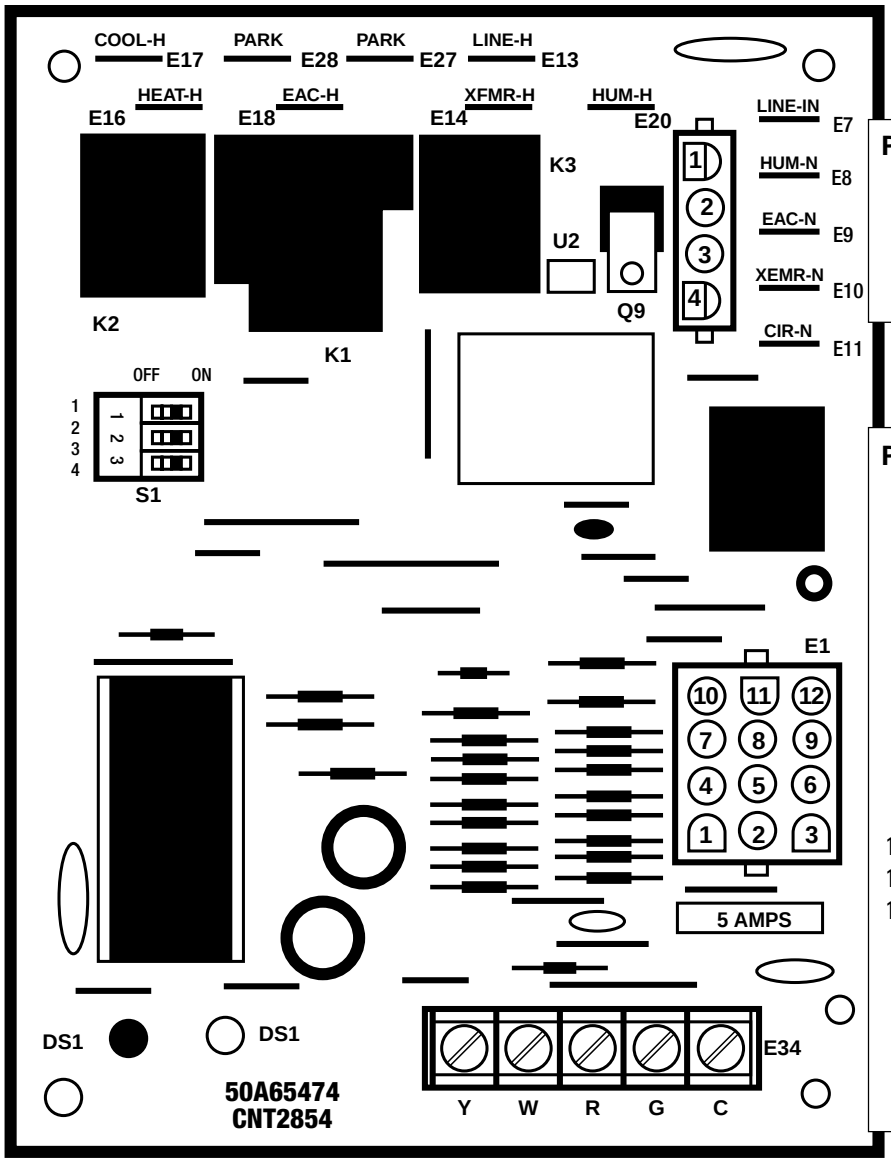
Component Identification

Single Stage 90% Upflow/Horizontal



Integrated Furnace Control CNT2854 – Superseded to CNT03076

Used on 80% and 90% Furnaces
Single Stage Heat – Silicon Nitride Hot Surface Ignitor
Single Speed Vent Motor and Standard Four Speed Blower



Plug # E20

1. IND-H
2. IGN-H
3. IND-N
4. IGN-N

Plug # E1

PINS OUT
12 PIN CONNECTOR

1.	HLO	High Limit Output
2.	FP	Flame Probe
3.	TH	24V Hot
4.		Not Used
5.		Not Used
6.	TR	24V Return
7.	HLI	High Limit Input
8.	GND	Ground
9.	MV COM	Main Valve Common
10.	PS	Pressure Switch
11.		Not Used
12.	MV	Main Valve

4 PIN CONNECTOR

1.	IND	Inducer
2.	IGN	Ignitor
3.	IND-N	Inducer Neutral
4.	IGN-N	Ignitor Neutral

Electrical Rating:

Input: 25 VAC, 60 Hz.
XFMR Sec, Current: 450 MA
IGN Output: 120 VAC, 2.0 A
MV Output: 24 VAC, 1.5 A
Cir. Blower Output: 120 VAC, 14.5 FLA, 26.0 LRA
Trial for Ignition Period: 4 Seconds
Ignitor Activation Period: Not Declared
Prepurge: 0 Seconds
Postpurge: 5 Seconds
Retries: 2
Recycles: 10
Cir. Blower on Delay: Heat 45 Seconds
Cir. Blower on Delay: Cool 2 Seconds

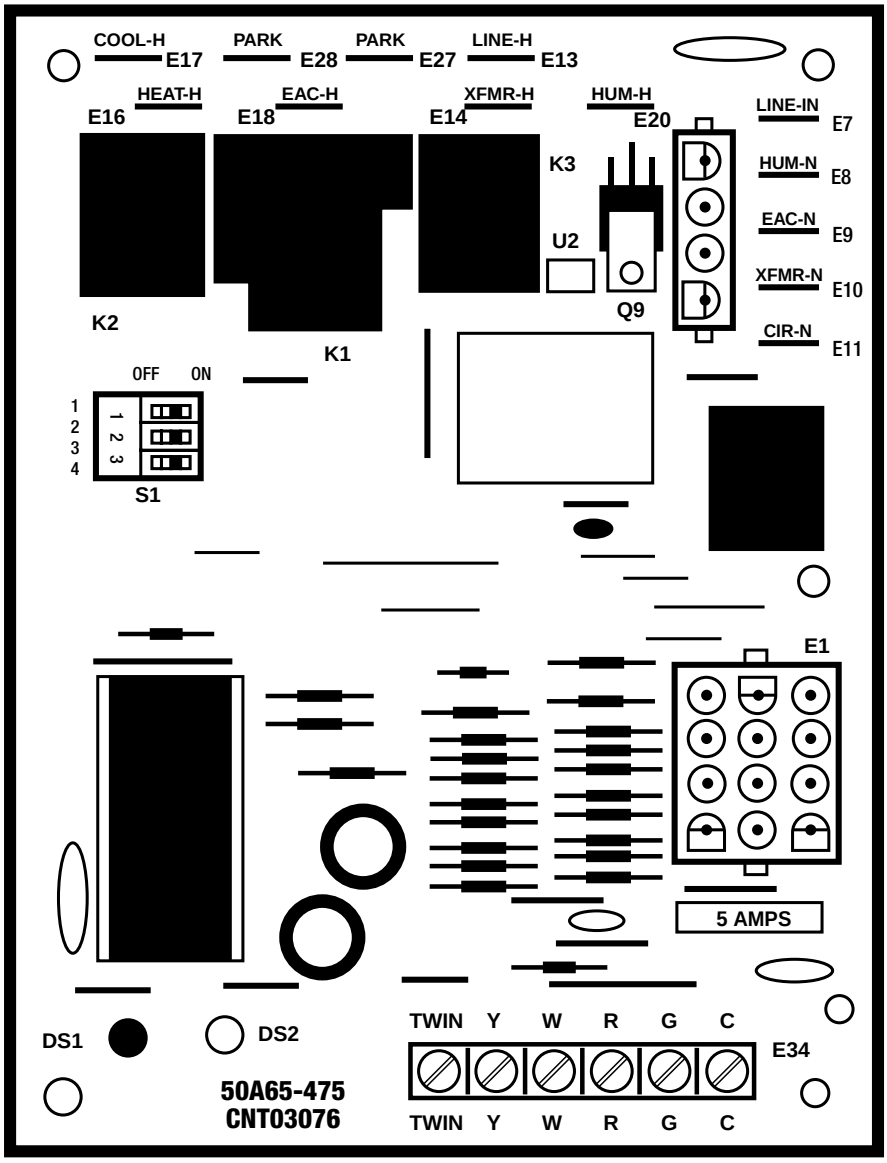
Cool "Off" Delay	
SW1	**Secs**
On	0*
Off	80

Heat "Off" Delay		
SW2	**SW3**	**Secs**
On	Off	60
On	On	100*
Off	On	140
Off	Off	180

* Factory Settings

Integrated Furnace Control – CNT03076

Used on 80% and 90% Furnaces
Single Stage Heat – Silicon Nitride Hot Surface Ignitor
Single Speed Vent Motor and Standard Four Speed Blower with Single Wire Twinning Feature



Single Stage 50A65-474 Sequence of Operation

White-Rodgers Integrated Furnace Controls 50A65-474 with Silicon Nitride Hot Surface Ignitor (SiNi HSI) – Part No. CNT02854, Superseded to CNT03076

When the disconnect ① is in the "ON" position, power is applied through the blower door interlock switch ⑥ to the control line voltage input terminal ⑧ and out of the control to the primary side of the control transformer "XFMR" ⑬. The low voltage side of the transformer supplies 24 volts to the control through terminals "TH" ⑲ and "TR" ⑱. Control terminal "R" ㉚ supplies 24 volts to the "R" terminal of the room thermostat.

Once power is applied, the control flashes the LED "ON" for one second and performs a self check routine. Following the normal system check, the control flashes the LED light once per second continuously (slow flash) while in stand-by.

On a call for heat, 24 volts are applied from the room thermostat's terminal "W" to the "W" terminal ㉚ on the control. The control checks and confirms normally closed contacts at the temperature cut out "TCO" ㉔, or the fuse link auxiliary limit (downflow and some upflow/horizontal models) ㉗, the flame roll-out switch ㉗ and normally open contacts of the safety pressure switch "PS" ㉔. With all safety and control switches in their proper position, the control will energize the induced draft motor ⑯ and flash the LED light two times per second continuously (fast flash) during a call for heat.

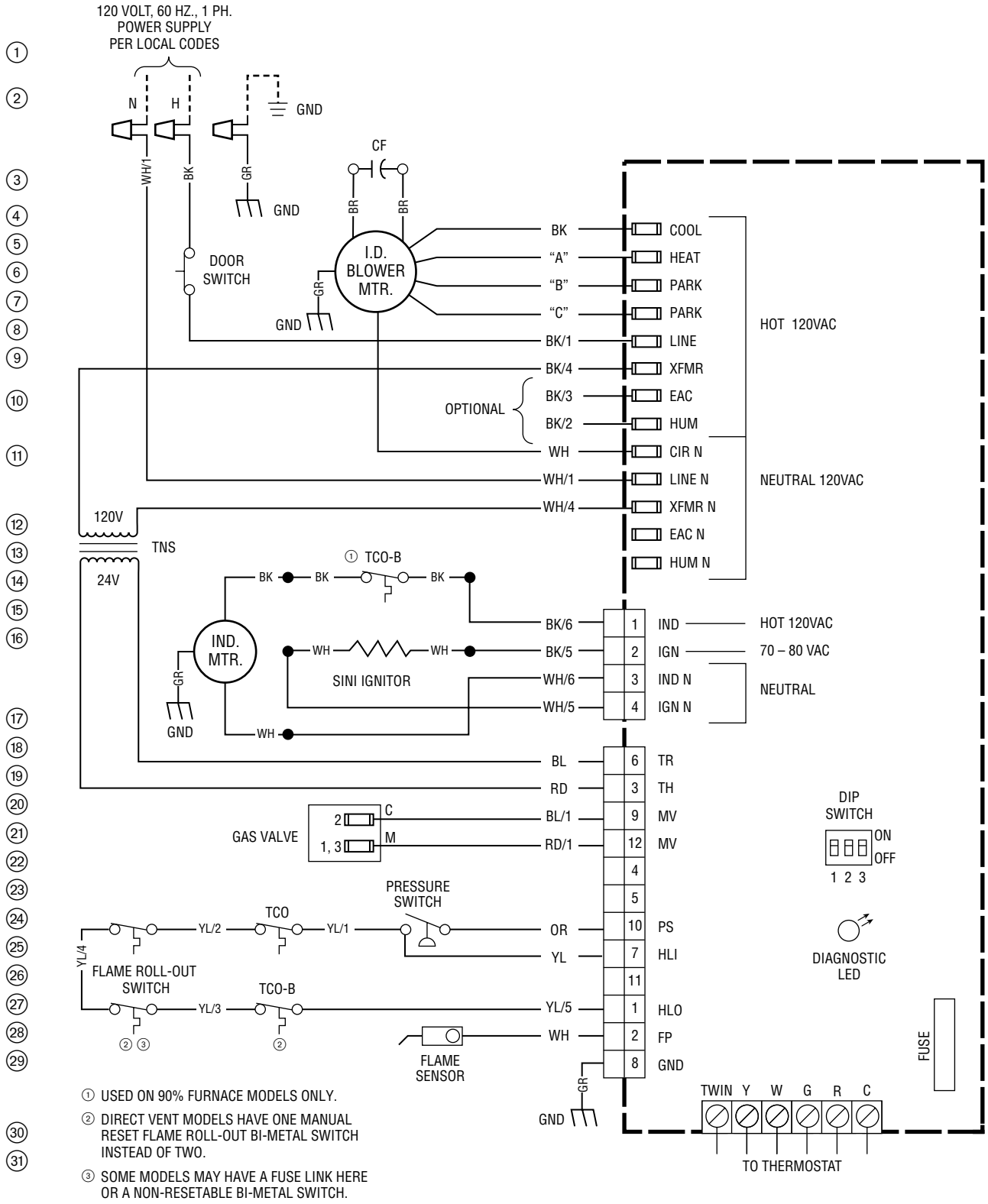
When the safety pressure switch "PS" ㉔ closes, the control begins the ignition sequence. The SiNi hot surface ignitor ⑯ is energized for several seconds (see page 11) allowing the thermal element to heat up. The control then switches on 24 volts to the gas valve "MV" terminal #1 ㉑. The redundant and main solenoids are energized allowing gas flow and main burner ignition. When flame current is detected by the control through its terminal "FP" ㉘, the 45 second indoor blower motor delay on timing begins. Flame failure response time is set for two seconds. After flame has been established for ten seconds, the flame failure response time is reset for 0.7 seconds. If flame current is not sensed by the control ㉘ within four seconds, the trial for ignition period, the redundant and main gas valve solenoids ㉑ are de-energized. The control will begin an interpurge cycle and may add additional AC sine wave cycles to the hot surface ignitor warm-up cycle (see SiNi HSI write up). The control energizes the gas valve ㉑ for the second attempt to establish main burner ignition. If flame current is not sensed by the control on the second retry within the trial for ignition period, the control will repeat the previous cycle one additional time before locking out.

At the end of the indoor blower delay on time, line voltage is applied at the controls terminal "HEAT" ⑤ energizing the indoor blower motor at heating fan speed, supplying warm air to the space.

When the thermostat is satisfied, the valve's redundant and main solenoids ㉑ are de-energized, extinguishing main burner flame. Once the control senses loss of flame current (0.7 sec.) ㉘, the induced draft motor ⑮ is de-energized after a five second post-purge cycle. The indoor blower motor delay off timing begins. At the completion of the fan delay off timing, the indoor blower motor ⑤ is de-energized and the cycle is complete.

Wiring Schematic

Single Stage 80% and 90%



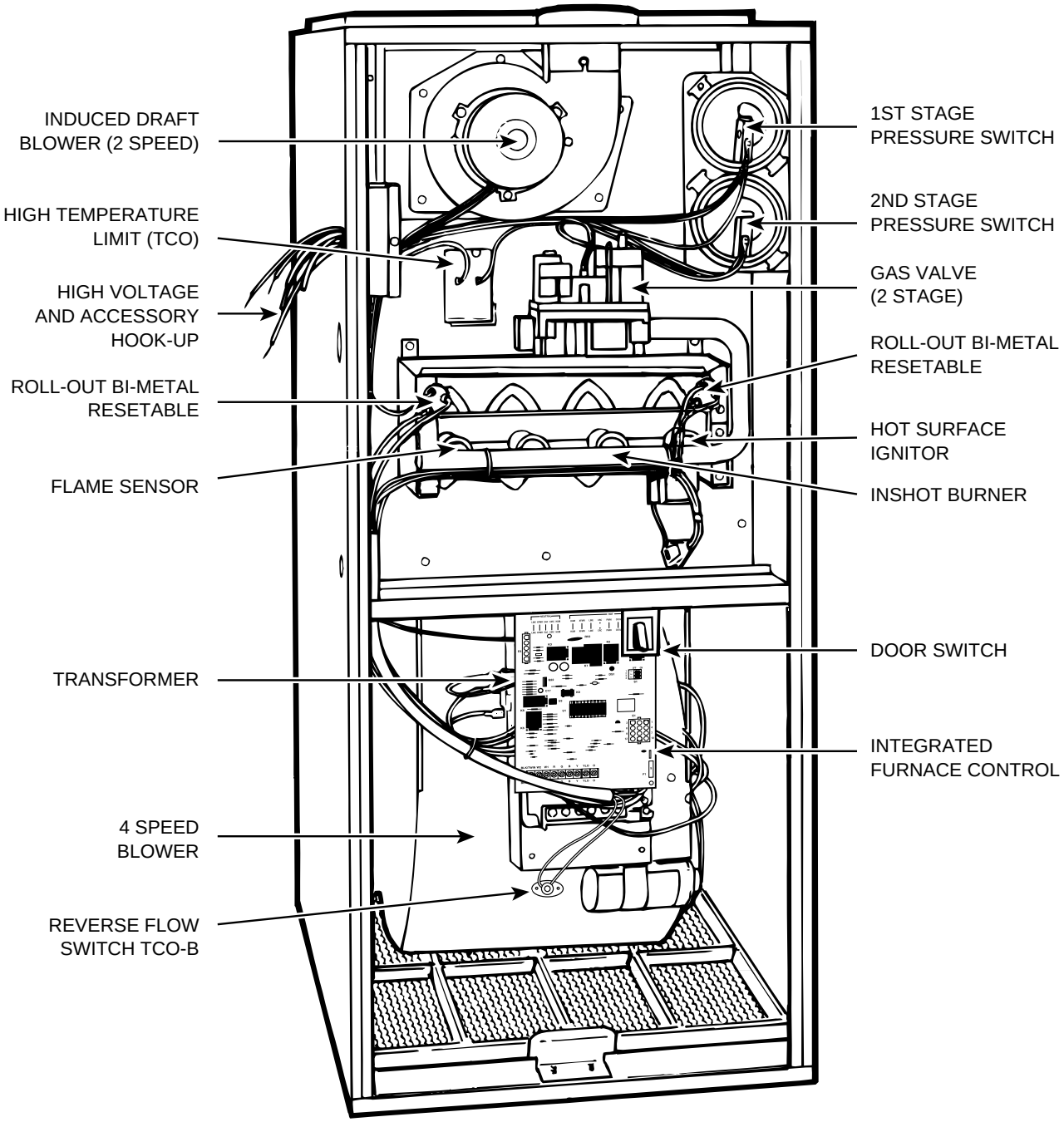
① USED ON 90% FURNACE MODELS ONLY.

② DIRECT VENT MODELS HAVE ONE MANUAL RESET FLAME ROLL-OUT BI-METAL SWITCH INSTEAD OF TWO.

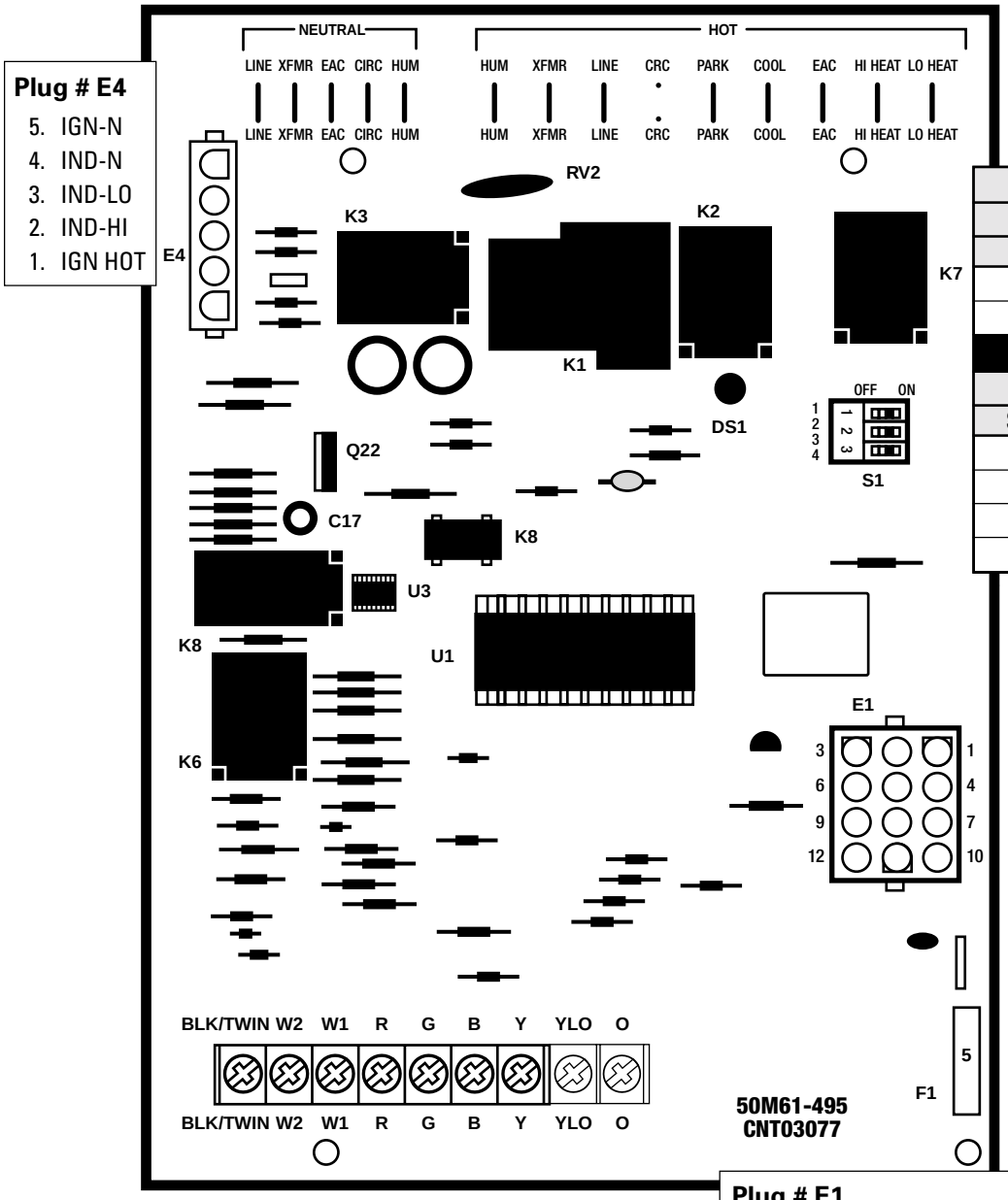
③ SOME MODELS MAY HAVE A FUSE LINK HERE OR A NON-RESETABLE BI-METAL SWITCH.

Component Identification

Two Stage 80% Upflow/Horizontal



Integrated Furnace Control – CNT03077



Plug # E4

5. IGN-N
4. IND-N
3. IND-LO
2. IND-HI
1. IGN HOT

DIP SWITCH (S1)		
Cool "Off" Delay		
SW1	**Secs**	
On*	80	
Off	0	
Heat "Off" Delay		
SW2	**SW3**	**Secs**
On	Off	60
On*	On	100
Off	On	140
Off	Off	180

Factory Settings

Plug # E1

PINS OUT
12 PIN CONNECTOR

1.	MVH	High Main Valve
2.	PS2	2nd Stage Pressure Switch
3.	FP	Flame Probe
4.	GND	Ground
5.	TH	24V Hot
6.	HLI	High Limit Input
7.	MVL	Low Main Valve
8.	MVCOM	Main Valve Common
9.	TR	24V Return
10.	GND	Ground
11.	HLO	High Limit Output
12.	PSI	1st Stage Pressure Switch

Two Stage 50M61-495 Sequence of Operation

White-Rodgers Integrated Furnace Control 50M61-495 Models

When the service disconnect ① is in the "ON" position, power is applied through the blower door interlock switch ⑥ to the controls line voltage input terminals ⑧ and out of the control to the primary side of the control transformer "XFMR" ⑰. The secondary side of the control transformer supplies 24 volts to the control through terminal "TH" and "TR" ⑳⑲. Control terminal "R" ㉚ supplies 24 volts to the "R" terminal of the room thermostat.

Once power is applied, the control flashes the LED light "ON" for one second and performs a self check routine. Following the normal system check, the control flashes the LED one time per second (slow flash) continuously while in stand-by.

On a call for heat, 24 volts are applied from the room thermostat's "W1" terminal to the "W1" terminal ㉛ on the control. The control checks and confirms normally closed contacts at the temperature cut out"TCO" ㉗, auxiliary limit (downflow and some upflow/horizontal models), the flame roll-out bi-metal control (two bi-metal controls are now used on downflow/horizontal models) ㉙ and normally open contacts at the safety pressure switch #1 ㉗. With all safety and control switches in their proper position, the control will energize the induced draft motor on high speed ⑫ and flash the LED two times per second continuously (fast flash) during a call for heat.

When safety pressure switch "#1" ㉗ closes, the control switches the induced draft motor to low speed ⑫ and begins the ignition sequence. The hot surface lignitor ⑫ is energized for several seconds (see note) allowing the thermal element to heat up. The control then switches 24 volts to its "MVL" and "MV COM" ㉕ terminals to terminals #1 ㉕ and #2 ㉔ on the gas valve. The redundant and main solenoids are energized allowing gas flow and main burner ignition. When flame current is sensed by the control through its "FP" ㉚ terminal, the 45 second indoor blower motor time delay "ON" begins. Flame failure response time is set for two seconds. After flame has been established for ten seconds, the flame failure response time is reset for 0.7 seconds. If flamed current is not sensed by the control within the trial for ignition period (see note), the main valve low and redundant gas valve solenoids ㉕㉑ are de-energized. The control will begin an interpurge cycle and adds additional seconds to the hot surface ignitor warm-up timing (see note). The control energizes the gas valve for the second attempt to establish main burner ignition. If again flame current is not sensed by the control within the trial for ignition period (see note), the control will repeat the previous cycle before locking out. At the end of the indoor blower motor delay "ON" timing, line voltage is applied at control terminal "HEAT LO" ⑥ energizing the indoor blower motor at low heat fan speed, supplying warm air to the space.

If the temperature in the space continues to fall, the thermostat second stage contacts "W2" close. 24 volts are switched from thermostat terminal "W2" to the "W2" terminal ㉛ on the control. A 30 second, 2nd stage recognition time delay begins. At the end of the 30 second delay, the induced draft motor is switched to high speed ⑫ causing pressure switch #2 ㉓ to close. When pressure switch #2 closes, 24 volts are switched from control terminal "MVH" ㉓ to the gas valve terminal #3 ㉓ energizing the second stage solenoid allowing increased gas flow to the burners. At the same time, the indoor blower motor is switched to high heat fan speed ⑦.

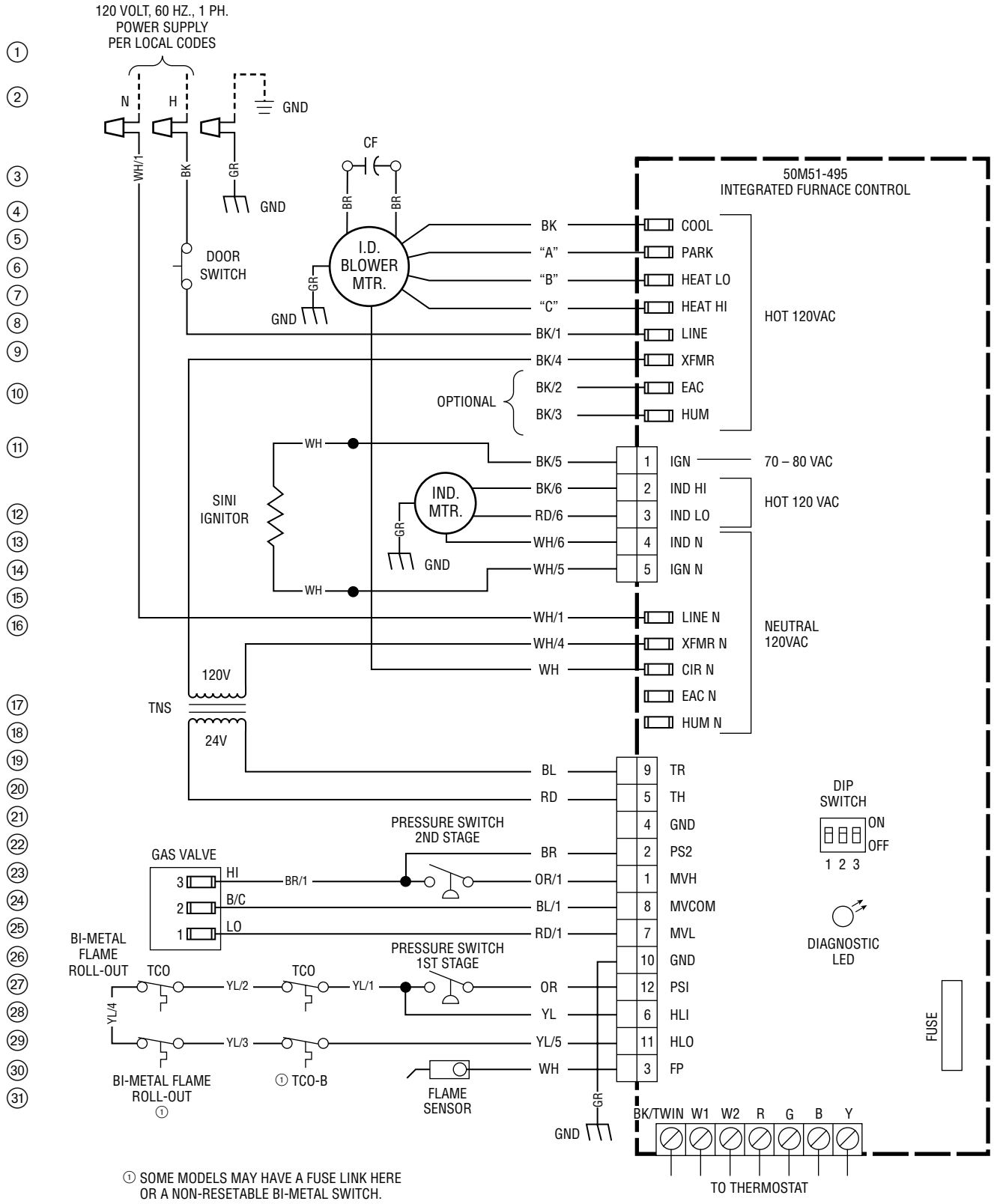
When second stage thermostat contacts "W2" satisfy, the induced draft motor is switched back to low speed ⑫ causing pressure switch #2 ㉓ to open, breaking the circuit to the second stage gas valve solenoid ㉓. Gas flow is reduced to the burners. The indoor blower motor will switch back to low heat fan speed after a 30 second delay ⑥.

When first stage thermostat contacts "W1" satisfy, the main valve low and the redundant gas valve solenoids ㉕ are de-energized extinguishing main burner flame. Once the control senses the loss of flame current (0.7 sec.) ㉚, the induced draft motor ⑫ is de-energized after a five second post-purge cycle. The indoor blower motor "OFF" timing begins. At the end of the indoor blower motor "OFF" timing, the indoor blower motor is de-energized and the cycle is complete.

Note: See Timing Chart for details or the Integrated Furnace Control Label.

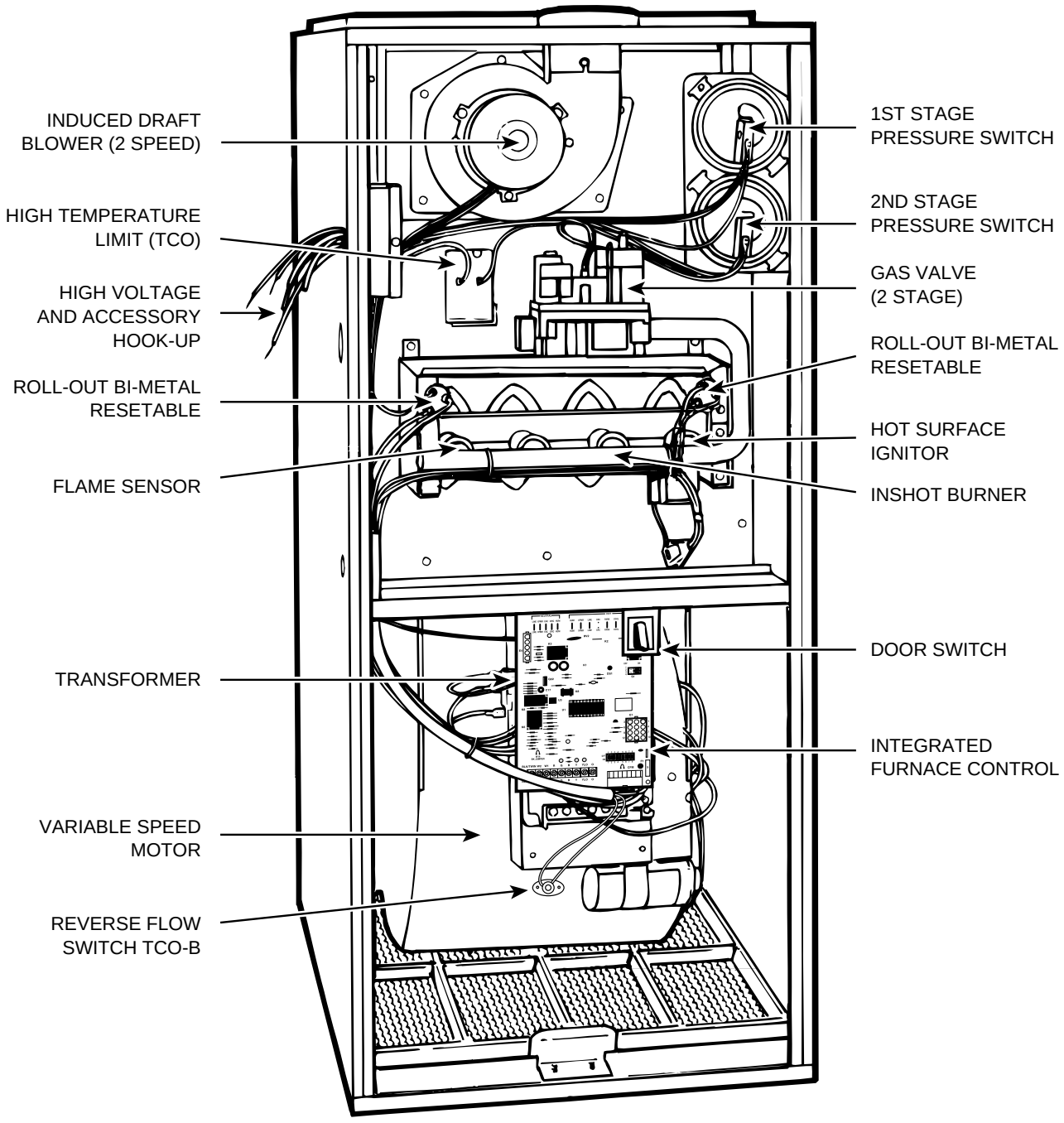
Wiring Schematic

Two Stage Heat (White-Rodgers 50M61-495 Series Integrated Furnace Control)

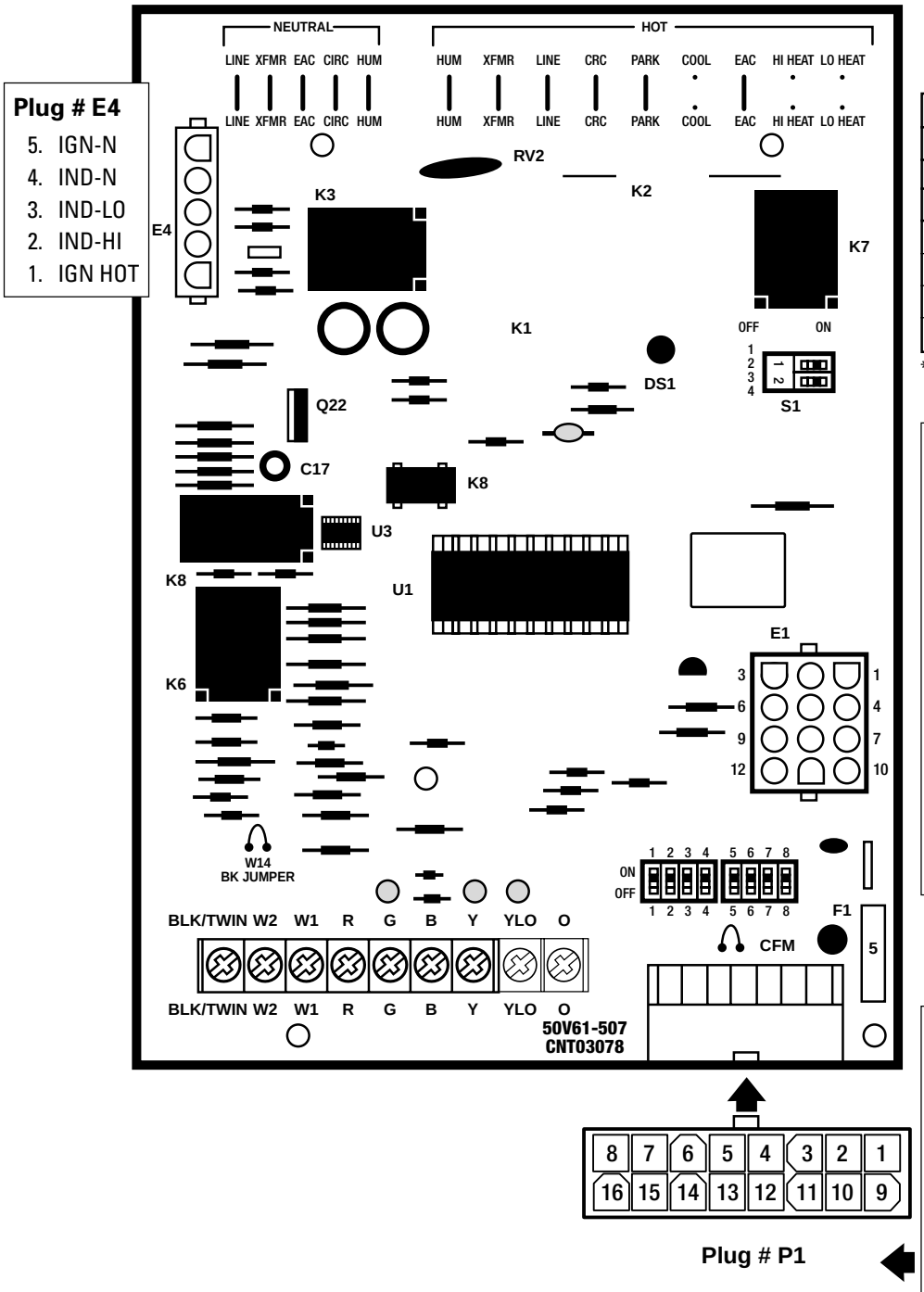


Component Identification

80% Two Stage/Two Speed Vent Motor and Variable Speed Indoor Motor



Integrated Furnace Control – CNT03078



Plug # E4

5. IGN-N
4. IND-N
3. IND-LO
2. IND-HI
1. IGN HOT

DIP SWITCH (S1)		
Heat "Off" Delay		
SW1	Secs	
SW2	SW3	Secs
On	Off	60
On*	On	100
Off	On	140
Off	Off	180

* Factory Settings

Plug # E1

PINS OUT
12 PIN CONNECTOR

1.	MVH	High Main Valve
2.	PS2	2nd Stage Pressure Switch
3.	FP	Flame Probe
4.	GND	Ground
5.	TH	24V Hot
6.	HLI	High Limit Input
7.	MVL	Low Main Valve
8.	MVCOM	Main Valve Common
9.	TR	24V Return
10.	GND	Ground
11.	HLO	High Limit Output
12.	PSI	1st Stage Pressure Switch

Plug # P1

16 PIN CONNECTOR

1. Earth Ground
2. Low Heat Speed Select Output
3. Earth Ground
4. Delay Dip Switch
5. Cool Dip Switch
6. YLO
7. Adjust Dip Switch
8. Earth Ground
9. "O" Input From Thermostat
10. BK Output
11. Heat Dip Switch
12. TH (24VDC)
13. High Heat Speed Select Output
14. Y
15. Enable Output
16. CFM LED

Two Stage Variable Speed Sequence of Operation

White-Rodgers 50V61 Series Integrated Furnace Control

When the service disconnect ① is in the "ON" position, power is applied through the blower door interlock switch ③ to the controls line voltage input terminals ⑥ and out of the control to the primary side of the control transformer ⑨, and from the "CIRC" ⑦ terminal to the ECM™ Fan Motor ③. The secondary side of the control transformer supplies 24 volts to the control through terminal "TH" and "TR" ⑫ ⑬. Control terminal "R" ㉕ supplies 24 volts to the "R" terminal of the room thermostat.

Once power is applied, the control flashes the LED light "ON" for one second and performs a self check routine. Following the normal system check, the control flashes the LED one time per second (slow flash) continuously while in stand-by.

On a call for heat, 24 volts is applied from the room thermostats "W1" terminal to the "W1" terminal ㉕ on the control. The control checks and confirms normally closed contacts at the temperature cut out "TCO" ㉑, auxillary limit (downflow and some upflow/horizontal models), the flame roll-out bi-metal control (two bi-metal controls are now used on downflow/horizontal models) ㉑ and normally open contacts at the safety pressure switch #1 ⑳. With all safety and control switches in their proper position, the control will energize the induced draft motor on high speed ⑨ and flash the LED two times per second continuously (fast flash) during a call for heat.

When safety pressure switch "#1" ⑳ closes, the control switches the induced draft motor to low speed ⑩ and begins the ignition sequence. The hot surface ignitor ⑨ is energized for several seconds allowing the thermal element to heat up. The control then switches 24 volts to its "MVL" ⑱ and "MV COM" ⑰ terminals to terminals #1 ⑱ and #2 ⑰ on the gas valve. The redundant and main solenoids are energized allowing gas flow and main burner ignition. When flame current is sensed by the control through its "FP" ㉔ terminal, the 45 second indoor blower motor time delay "ON" begins. Flame failure response time is set for two seconds. After flame has been established for ten seconds, the flame failure response time is reset for 0.7 seconds. If flamed current is not sensed by the control ㉔ within the trial for ignition period, the main valve low and redundant gas valve solenoids ⑱ are de-energized. The control will begin a 30 second interpurge cycle and adds additional seconds (see note) to the hot surface ignitor warm-up timing. The control energizes the gas valve for the second attempt to establish main burner ignition. If again flame current is not sensed by the control within the trial for ignition period (see note), the control will repeat the previous cycle before locking out. At the end of the indoor blower motor delay "ON" timing, the microprocessor will close the normally open **K3** relay contacts ㉗ completing a 24 volt signal circuit to pin #15 of the ECM™ motor, signaling it to turn on and run at the low heat blower speed, supplying warm air to the space. 24 volts W1 ㉕ terminal from the thermostat is also applied to the ECM™ motor harness pin #12 ㉖, which signals the ECM™ motor to run at the low heat speed setting.

If the temperature in the space continues to fall, the thermostat second stage contacts "W2" close. 24 volts are switched from thermostat terminal "W2" to the "W2" terminal ㉕ on the control. A 30 second, 2nd stage recognition time delay begins. At the end of the 30 second delay, the induced draft motor is switched to high speed ⑨ causing pressure switch #2 ⑲ to close. When pressure switch #2 closes, 24 volts is switched from control terminal "MVH" ⑲ to the gas valve terminal #3 ⑲ energizing the second stage solenoid, allowing increased gas flow to the burners. At the same time, the microprocessor closes the normally open **K1** relay contacts ㉗ completing a 24 volt signal circuit to pin #13 ㉘ of the ECM™2 motor signaling the indoor blower motor to run at the high heat blower speed.

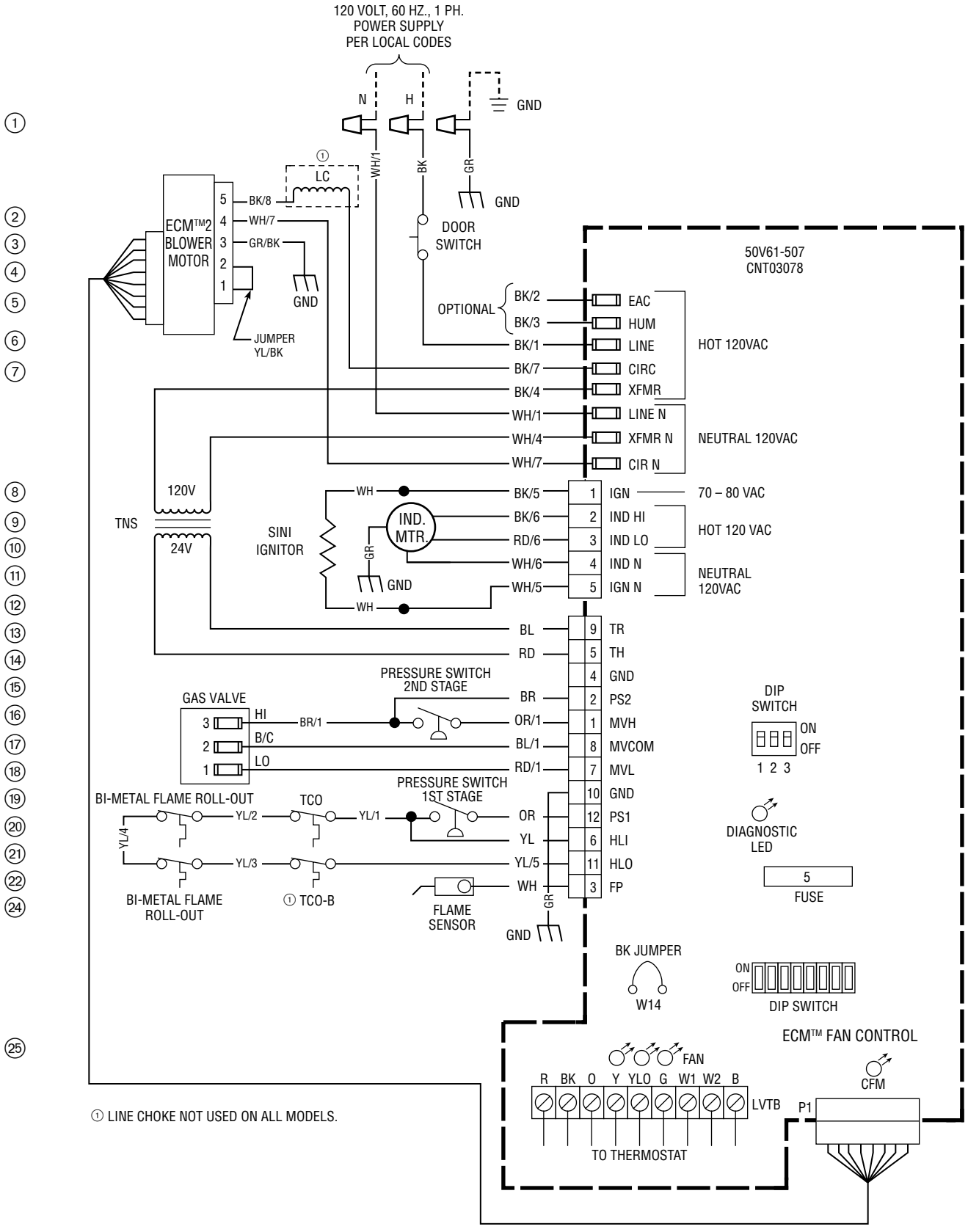
When second stage thermostat contacts "W2" satisfy, the induced draft motor is switched back to low speed ⑩ causing pressure switch #2 ⑯ to open, breaking the circuit to the second stage gas valve solenoid ⑯. Gas flow is reduced to the burners. The indoor ECM™ blower motor ④ will be switched back to the low heat fan speed after a 30 second delay.

When first stage thermostat contacts "W1" satisfy, the main valve low and the redundant gas valve solenoids ⑱ are de-energized extinguishing main burner flame. Once the control senses the loss of flame current (0.7 sec.) ㉔, the induced draft motor ⑨ is de-energized after a five second post-purge cycle. The indoor blower motor "OFF" timing begins. At the end of the indoor blower motor "OFF" timing, the indoor blower motor is de-energized and the cycle is complete.

Note: See Timing Chart for details or the Integrated Furnace Control Label.

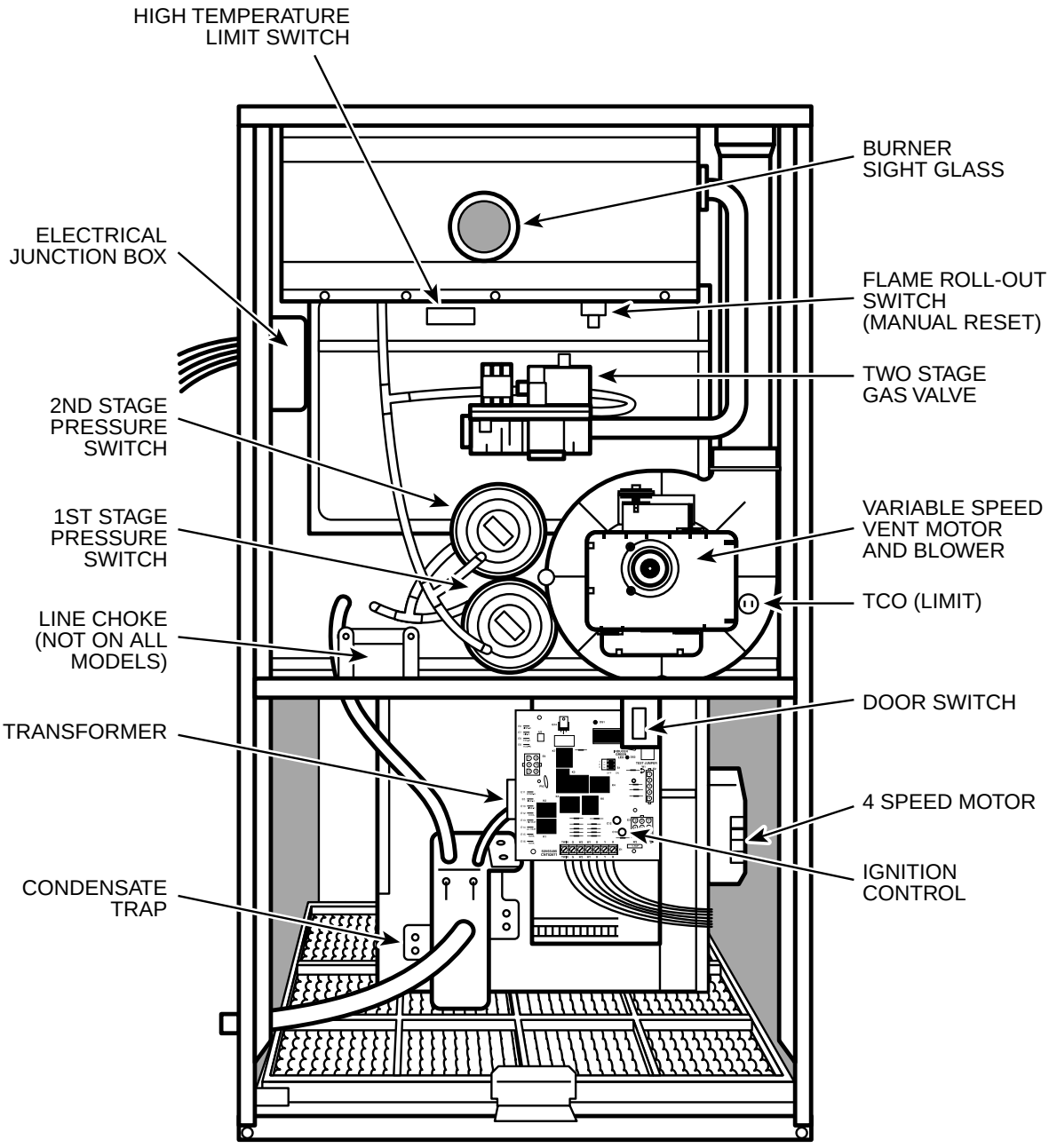
Wiring Schematic

Two Stage Variable Speed Indoor Blower



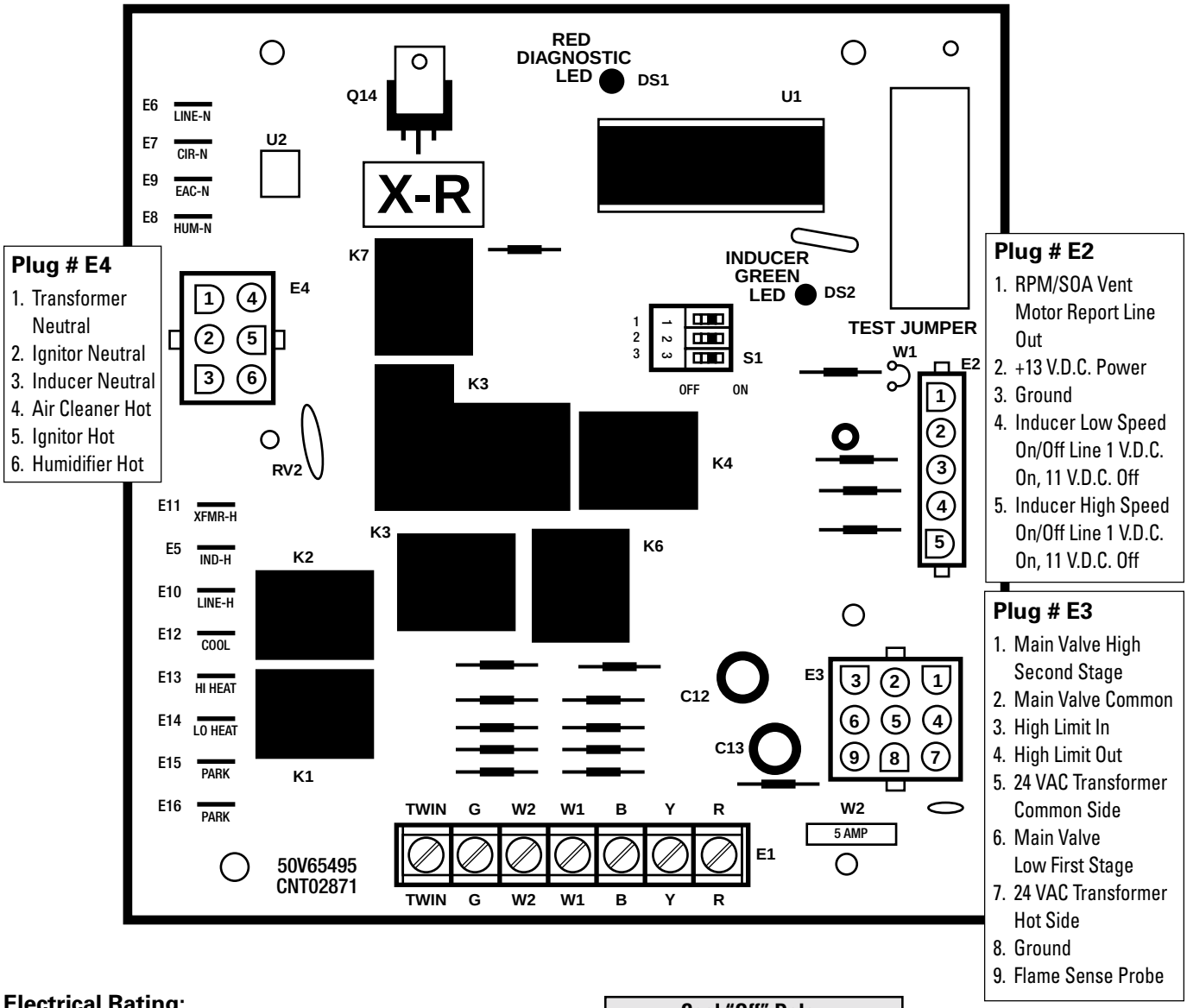
Component Identification

Two Stage 90% Variable Speed Vent Motor and 4 Speed Indoor Motor



Integrated Furnace Control – CNT2871

Two Stage Heat – Silicon Nitrate Surface Ignitor
Variable Speed Vent Motor and Standard Four Speed Blower



Plug # E4
1. Transformer Neutral
2. Ignitor Neutral
3. Inducer Neutral
4. Air Cleaner Hot
5. Ignitor Hot
6. Humidifier Hot

Plug # E2
1. RPM/SOA Vent Motor Report Line Out
2. +13 V.D.C. Power
3. Ground
4. Inducer Low Speed On/Off Line 1 V.D.C. On, 11 V.D.C. Off
5. Inducer High Speed On/Off Line 1 V.D.C. On, 11 V.D.C. Off

Plug # E3
1. Main Valve High Second Stage
2. Main Valve Common
3. High Limit In
4. High Limit Out
5. 24 VAC Transformer Common Side
6. Main Valve Low First Stage
7. 24 VAC Transformer Hot Side
8. Ground
9. Flame Sense Probe

Electrical Rating:

Input: 25 VAC, 60 Hz.
XFRMR Sec, Current: 500 MA
MV Output: 1.5 A @ 24 VAC
IGN Output: 2.0 A @ 120 VAC
Cir. Blower Output: 14.5 FLA, 25.0 LRA @ 120 VAC
Prepurge: 0 Seconds
Interpurge: 60 Seconds
Postpurge: 5 Seconds
Ignitor Warm-up: 20 Seconds
Trial for Ignition: 4 Seconds Maximum
Retries: 2
Recycle: 10
Cool On Delay: 2 Seconds
Heat On Delay: 45 Seconds

Cool "Off" Delay	
SW1	**Secs**
On	0*
Off	80

Heat "Off" Delay		
SW2	**SW3**	**Secs**
On	Off	60
On	On	100*
Off	On	140
Off	Off	180

* Factory Settings

Variable Speed Vent Motor

This microprocessor based variable speed motor ECM™ has an adaptive learning routine, which causes the motor to learn the optimum operating speed for low and high fire. The adaptive learning routine causes the motor to learn the lowest possible operating speed to ensure proper gas combustion at its maximum efficiency level.

The motor microprocessor works in conjunction with two pressure switches, one set for the correct low fire combustion air pressure and the other for high fire combustion air pressure. These switches are normally open.

How Does It Learn?

The adaptive learning routine begins on the initial call for heat, after power has cycled. On the initial call for heat, "W1" first stage, the motor ramps up to speed and checks the low pressure switch (LPS) input to verify that the switch is closed. After running for one minute, the motor ramps to its over-blow speed, which is 200 to 300 rpms higher, and runs at that speed for one minute, then begins to drop its speed until the LPS opens. When the LPS opens, the motor speed is increased slightly in steps until the LPS closes.

The motor will run at this speed for the next 150 calls for first stage heat, "W1". On a call for second stage heat, "W2," the motor ramps up to high speed and the high speed pressure switch (HPS) input is checked to verify the switch has closed.

After running for 90 seconds, the motor begins to drop its speed until the HPS opens. When the HPS opens, the motor speed is again increased slightly in steps until the HPS closes.The motor will run at this speed for the next 50 calls for second stage heat, "W2".

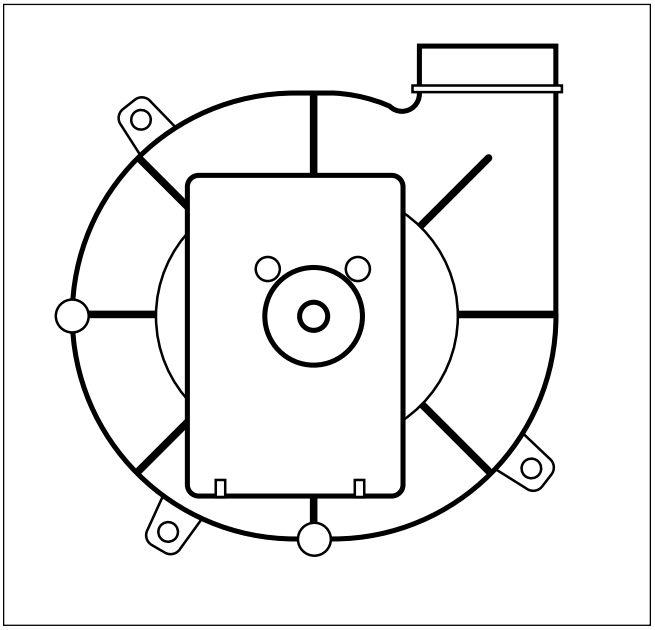
The learning process is repeated after the cycle count is completed for each stage. Both are learned after power is cycled.

The pressure switches are constantly monitored during the furnace operation. If a pressure switch opens during a run cycle, the motor speeds up to close the switch and maintains proper combustion air.

If during the second stage cycle the HPS opens for any reason, the motor will speed up gradually, every 3 to 4 seconds, attempting to close the HPS. The motor will continue to do this until it reaches its speed limit. If this occurs, the motor returns to Low Fire rpm for 10 minutes, at which time, the motor will attempt to close the HPS again. The IFC will continue this sequence as long as there is a call for "W2" heat and HPS does not close.

If LPS opens during a call for heat, the motor will speed up gradually, every 3 to 4 seconds, until Low Fire speed limit is reached. If the LPS is not closed during this process, the furnace will shut down and indicate a 3 flash fault. A recycle will occur in about 30 seconds.

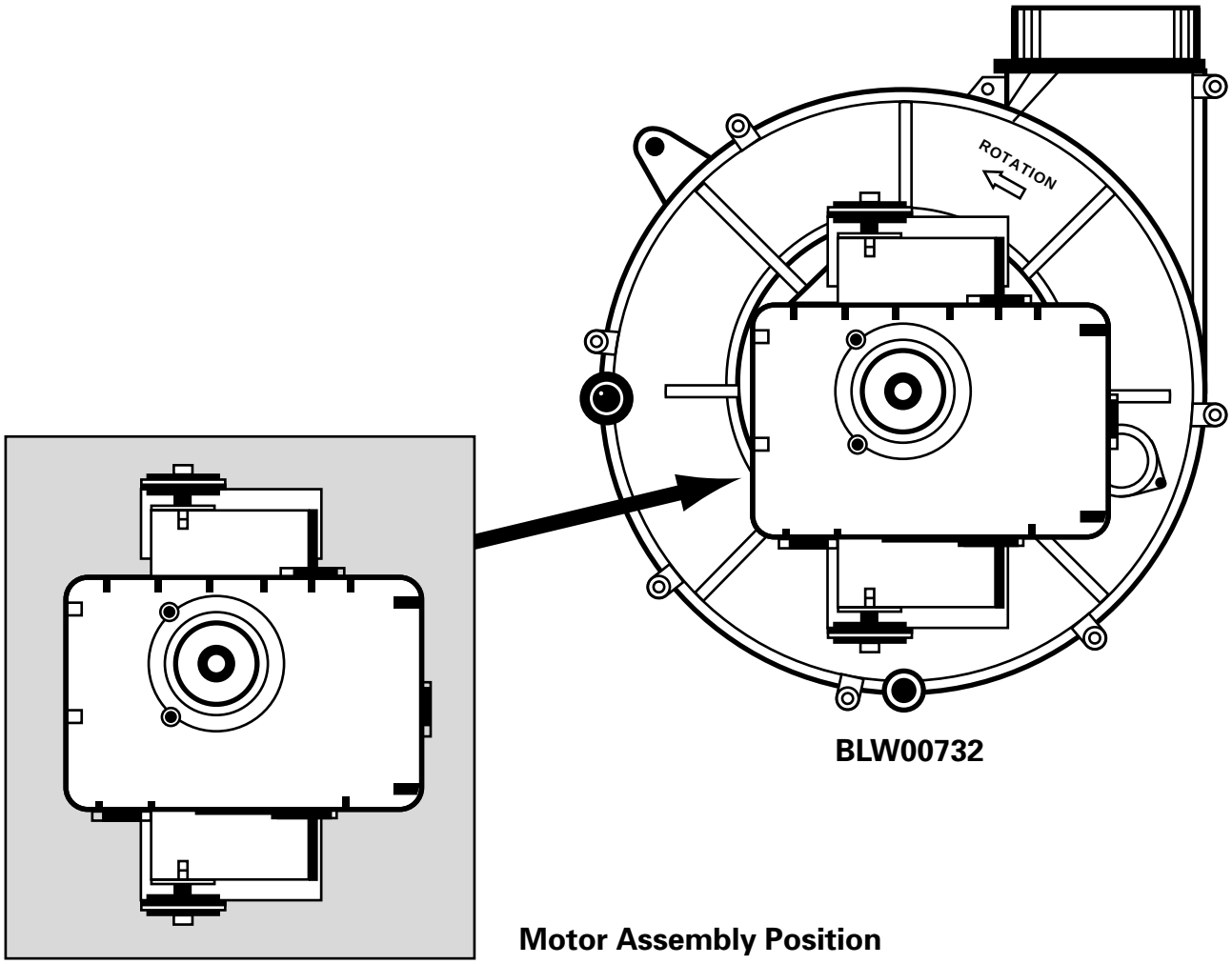
Motor speeds are primarily dependent on vent applications and combustion cycle restrictions.



Part # BLW00662 Variable Speed Vent Motor

Variable Speed Vent Motor

A new Inducer Motor Assembly has been introduced in the 90% furnace line using the variable speed inducer motors. This assembly features vibration isolators on each side of the motor to reduce vibration transmissions. As shown in the illustration, the motor is mounted horizontally with the isolators above and below the motor.



BLW00732

Motor Assembly Position

Note: If Vent Motor BLW00662 is being replaced by Vent Motor BLW0732, a harness kit (No. WIR02770) is required.

Two Stage 50V65 Sequence of Operation

White-Rodgers Integrated Furnace Control 50V65-495 Models – Part No. CNT02871

When the service disconnect ① is in the "ON" position, power is applied through the blower door interlock switch ③ to the controls line voltage input terminals ⑭ and out of the control to the primary side of the control transformer "XFMR" ⑩. The secondary side of the control transformer supplies 24 volts to the control through terminals "TH" and "TR" ㉔. Control terminal "R" ㉙ supplies 24 volts to the "R" terminal of the room thermostat.

Once power is applied, the control flashes the LED light "ON" for one second and performs a self check routine. Following the normal system check, the control flashes the LED one time per second (slow flash) continuously while in stand-by.

On a call for heat, 24 volts are applied from the room thermostat's "W1" terminal to the "W" terminal ㉙ on the control. The IFC control checks and confirms normally closed contacts at the temperature cut out "TCO" ⑱ auxiliary limit (downflow and some upflow/ horizontal models) ⑳, the flame roll-out switch ㉑, and checks the variable speed vent motor RPM/SOA ④ and ⑩ circuit for the proper "OFF" state signal (SOA = Safe Operating Area). With all safety and control switches in their proper position, the IFC control will call the variable speed vent motor for low speed operation ⑦ on the low speed line IND.LO Plug E10 pin #4 ⑪ and flash the RED LED light two times per second continuously (fast flash) during a call for heat.

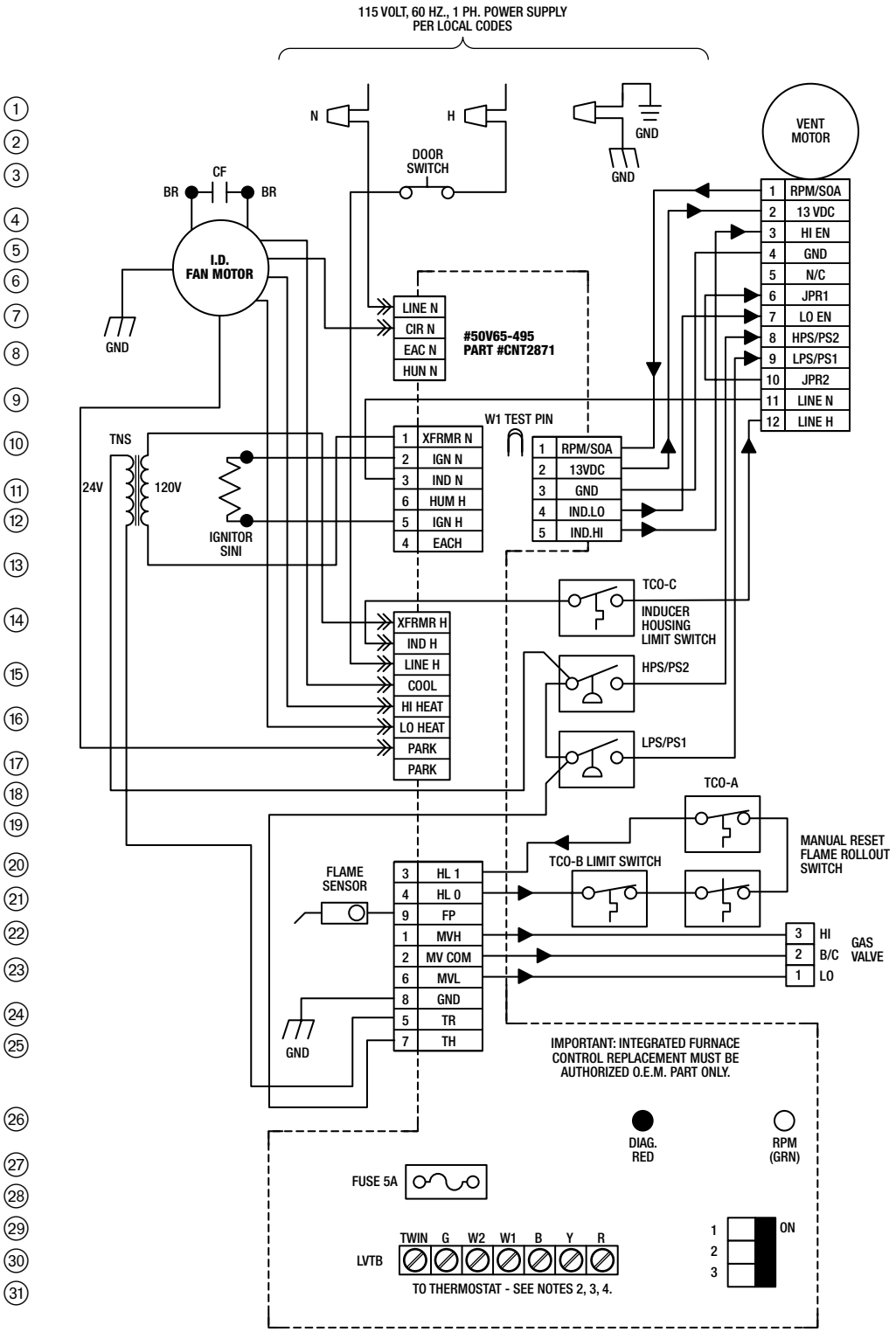
When the safety pressure switch LPS/PSI ⑰ closes, the variable speed vent motor reports this to the IFC on the RPM/SOA circuit ④ and ⑩. The SiNi hot surface ignitor ⑪ is energized for several seconds allowing the thermal element to heat up. The control then switches 24 volts to its "MVL" ㉓ terminal and pin #3 on the gas valve. The redundant and main solenoids are energized allowing gas flow and main burner ignition. When flame current is sensed by the control through its "FP" ㉒ terminal, the 45 second indoor blower motor time delay "ON" begins. Flame failure response time is set for two seconds. After flame has been established for ten seconds, the flame failure response time is reset for 0.7 seconds. If flame current is not sensed by the control within the trial for ignition period, the main valve low and redundant gas valve solenoids ㉓ are de-energized. The control will begin an interpurge cycle and add additional AC sine wave cycles to the hot surface ignitor warm-up timing cycle (see SiNi HSI write up). The control energizes the gas valve for the second attempt to establish main burner ignition. If again flame current is not sensed by the control within the trial for ignition period, the control will repeat the previous cycle one additional time before locking out. The control will automatically reset in one hour. At the end of the indoor blower motor delay "ON" timing, line voltage is applied at the control terminal "HEAT LO" ⑯ energizing the indoor blower motor at low heat fan speed, supplying warm air to the space.

If the temperature in the space continues to fall, the thermostat second stage contacts "W2" close. 24 volts are switched from the thermostat terminal "W2" to the "W2" terminal ㉙ on the control. A 30 second, 2nd stage recognition time delay begins. At the end of the 30 second delay, the IFC will call the variable speed vent motor for high speed operation ⑫ pin #5. The IFC switches 24V to the gas valve terminal pin #3 ㉒ energizing the second stage solenoid, allowing increased gas flow to the burners. At the same time, the indoor blower motor is switched to high heat fan speed ⑯.

When second stage thermostat contacts "W2" satisfy, the IFC will remove the high speed call from the variable speed vent motor IND.HI pin #5 ⑪. The pressure switch HPS/PS2 ⑮ opens and the variable speed vent motor reports this to the IFC on the RPM/SOA circuit ④ and ⑩. The IFC will turn off the 24 volts to the gas valve MVH pin #3 ㉒. Gas flow is reduced to the burners. The indoor blower motor will switch back to low heat fan speed after a 30 second delay.

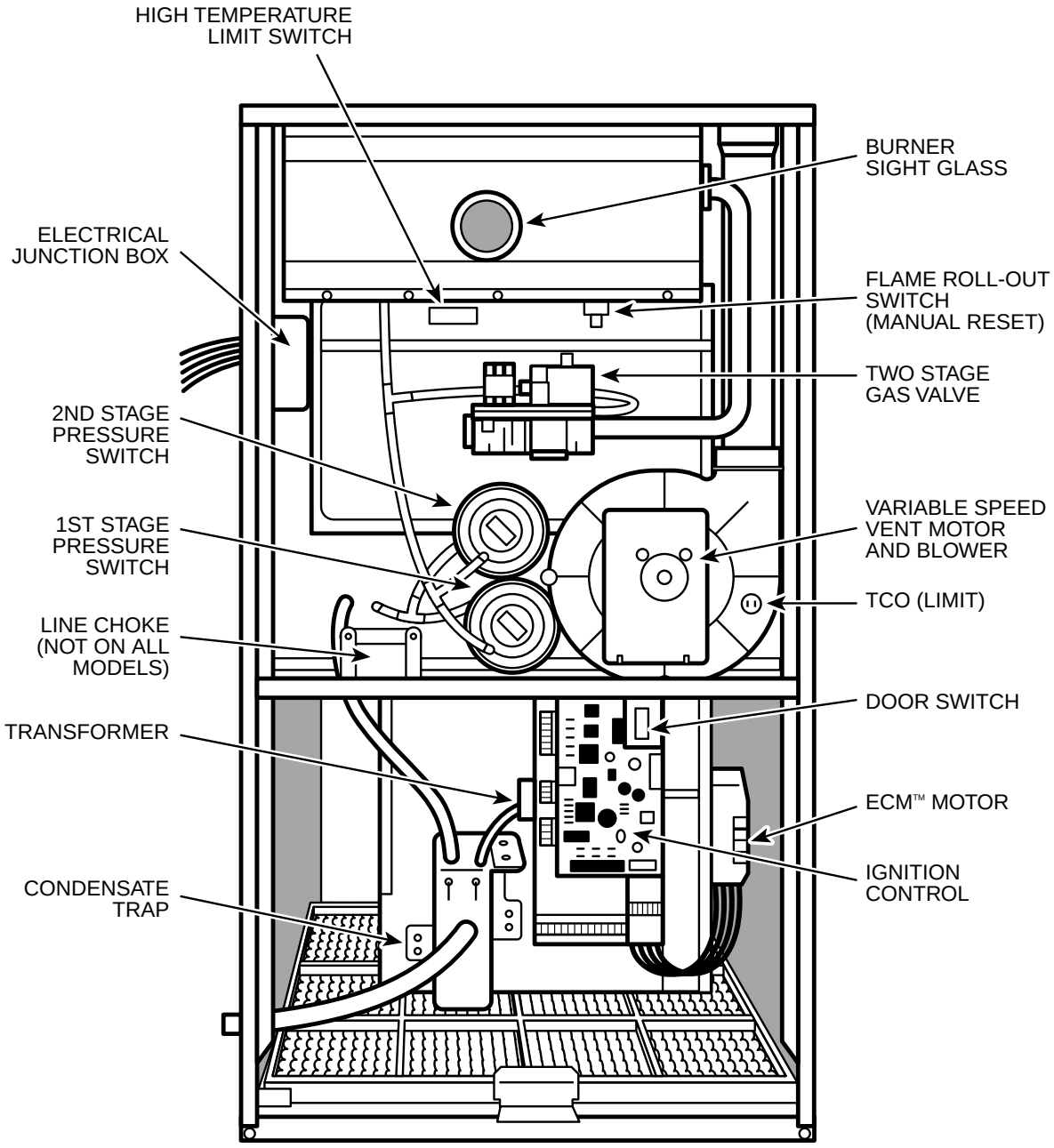
When first stage thermostat contacts "W1" satisfy, the main valve low and the redundant gas valve solenoids are de-energized extinguishing main burner flame. Once the control senses the loss of flame current (0.7 sec.) ㉒, the induced draft motor ② is de-energized after a five second postpurge cycle. The indoor blower motor "OFF" timing begins. At the end of the indoor blower motor "OFF" timing, the indoor blower motor is de-energized and the cycle is complete.

Two Stage Heat/Variable Speed Vent Motor/Std. Indoor Blower

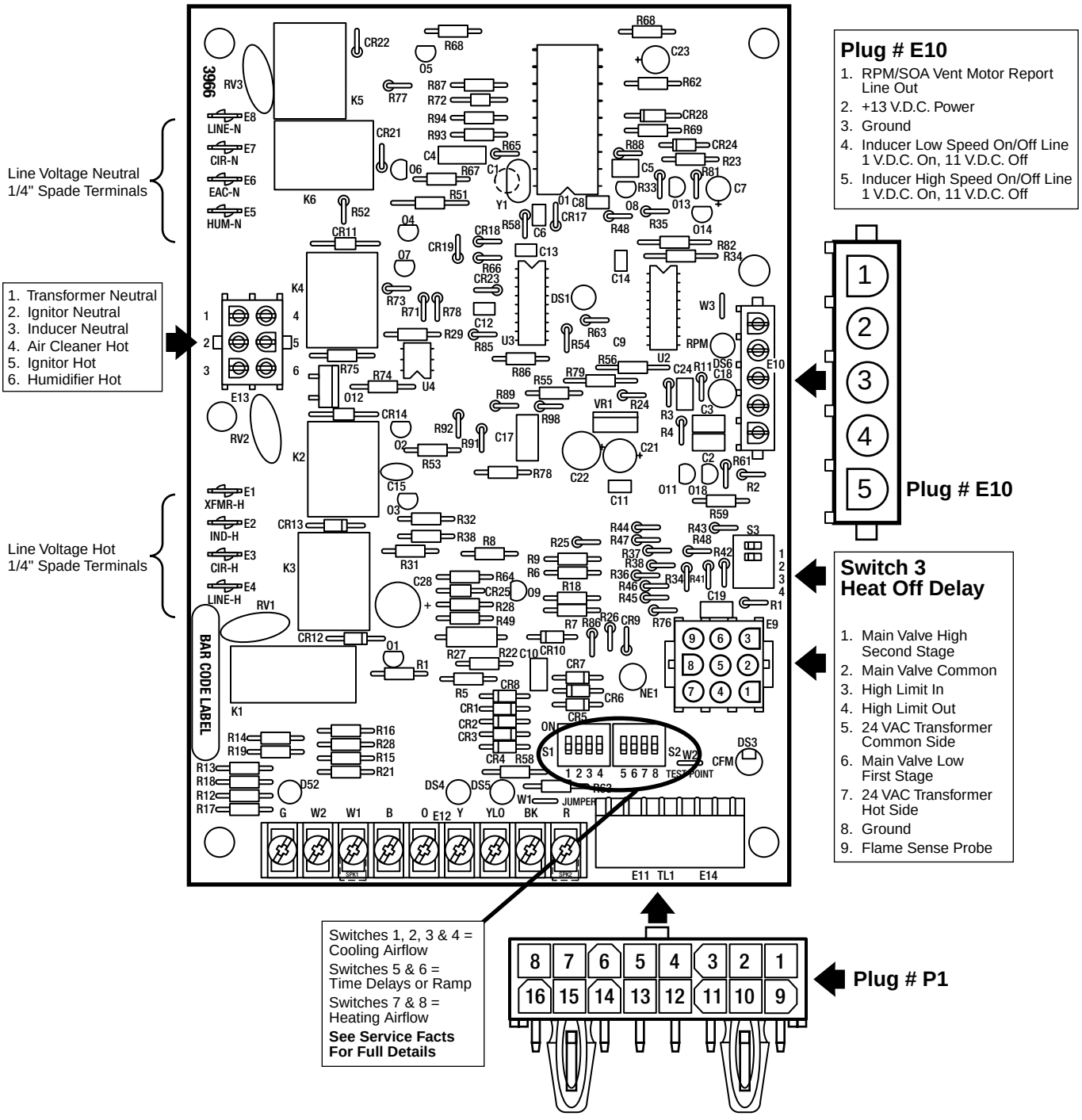


Component Identification

Two Stage 90% Variable Speed Vent Motor and Variable Speed Indoor Blower



Integrated Furnace Control – CNT02536



Two Stage 50A61 Sequence Of Operation

White-Rodgers Integrated Furnace Control 50A61-605 Model – Part No. CNT02536

When the service disconnect ① is in the "ON" position, power is applied through the blower door interlock switch ③ to the controls line voltage input terminal ⑮ and out of the control to the primary side of the control transformer "XFMR" ⑩. The secondary side of the control transformer supplies 24 volts to the control through terminals "TH" and "TR" ㉔. Control terminal "R" ㉙ supplies 24 volts to the "R" terminal of the room thermostat.

Once power is applied, the control flashes the LED light "ON" for one second and performs a self check routine. Following the normal system check, the control flashes the LED one time per second (slow flash) continuously while in stand-by.

On a call for heat, 24 volts are applied from the room thermostat's "W1" terminal to the "W1" terminal ㉙ on the IFC control. The IFC control checks and confirms normally closed contacts at the temperature cut out "TCO" ⑱, the auxiliary limit (downflow and some upflow/horizontal models) ⑳, the flame roll-out switch ⑳, and checks the variable speed vent motor RPM/SOA ④ and ⑩ circuit for the proper "OFF" state signal (SOA = Safe Operating Area). With all safety and control switches in their proper position, the IFC control will call the variable speed vent motor for low speed operation ④ on the low speed line IND.LO Plug E10 pin #4 ⑪ and flash the RED LED ⑨ two times per second continuously (fast flash) during a call for heat.

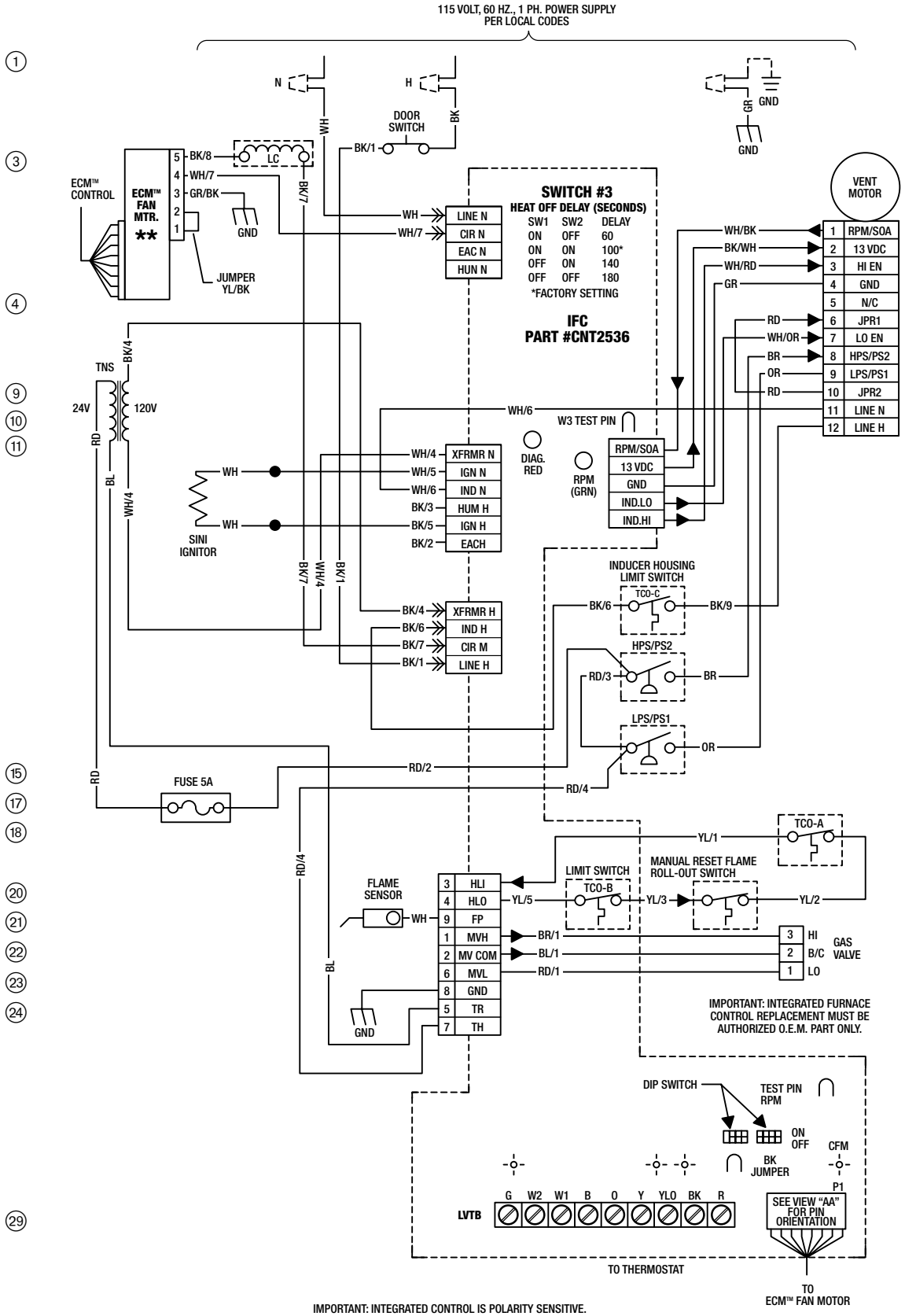
When the safety pressure switch LPS/PSI ⑰ closes, the variable speed vent motor reports this to the IFC on the RPM/SOA circuit ④ and ⑩. The SiNi hot surface ignitor ⑪ is energized for several seconds allowing the thermal element to heat up. The control then switches 24 volts to its "MVL" ㉓ terminal and pin #1 on the gas valve. The redundant and main solenoids are energized allowing gas flow and main burner ignition. When flame current is sensed by the control through its "FP" ㉑ terminal, the 45 second indoor blower motor time delay "ON" begins. Flame failure response time is set for two seconds. After flame has been established for ten seconds, the flame failure response time is reset for 0.7 seconds. If flame current is not sensed by the IFC control within the trial for ignition period, the main valve low and redundant gas valve solenoids ㉓ are de-energized. The control will begin an interpurge cycle and add additional AC sine wave cycles to the hot surface ignitor warm-up timing cycle (see SiNi HSI write up). The control energizes the gas valve for the second attempt to establish main burner ignition. If again flame current is not sensed by the control within the trial for ignition period, the control will repeat the previous cycle before locking out. The control will automatically reset in one hour. At the end of the indoor blower motor delay "ON" timing, the IFC control will apply 24 volts A.C. to Plug P1 pin #2 and 7 volts D.C. to pin #15. Pin #15 is the input command to the variable speed motor to turn on and pin #2 is the input command line to run at the low heat airflow, supplying warm air to the space.

If the temperature in the space continues to fall, the thermostat second stage contacts "W2" close. 24 volts are switched from the thermostat terminal "W2" to the "W2" terminal ㉙ on the IFC control. A 30 second, 2nd stage recognition time delay begins. At the end of the 30 second delay, the IFC control will call the variable speed vent motor for high speed operation ⑪ Plug E10 pin #5. The IFC switches 24V to the gas valve terminal #3 ㉒ energizing the second stage solenoid, allowing increased gas flow to the burners. At the same time the IFC control calls, the indoor blower motor for high heat fan speed ⑯ switches operation by applying 24 volts AC to Plug P1 pin #13, which is "W2" CFM.

When second stage thermostat contacts "W2" satisfy, the IFC will remove the high speed call from the variable speed vent motor IND.HI pin #5 ⑪. The pressure switch HPS/PS2 ⑮ opens and the variable speed vent motor reports this to the IFC control on the RPM/SOA circuit ④ and ⑩. The IFC control will turn off the 24 volts to the gas valve MVH pin #3 ㉒. Gas flow is reduced to the burners. The indoor blower motor will be switched back to low heat fan speed after a 30 second delay.

When first stage thermostat contacts "W1" satisfy, the main valve low and the redundant gas valve solenoids are de-energized extinguishing main burner flame. Once the control senses the loss of flame current (0.7 sec.), the variable speed vent motor ② is de-energized after a five second postpurge cycle. The indoor blower motor "OFF" timing begins. At the end of the indoor blower motor "OFF" timing, the indoor blower motor is de-energized and the cycle is complete.

Two Stage Variable Speed Vent Motor and Blower



Sequence of Operation

First Stage Heat

When the integrated furnace control, IFC, receives a call for first stage heat on "W1" the following will occur:

1. The IFC microcomputer runs a self-check routine.
2. The IFC checks the high limit switches, TCO-A, TCO-B, and the flame roll-out switch.
3. The IFC checks the variable speed vent motor RPM/SOA circuit for the proper "OFF" state signal (SOA = Safe Operating Area).
4. The IFC calls the variable speed vent motor for low speed operation on IND.LOW pin #4 circuit.
5. The variable speed vent motor ramps up in speed until it sees the low pressure switch, PS1, LPS/PS1, close. The variable speed vent motor reports this to the IFC on the RPM/SOA circuit.
6. Ignitor warm-up period begins. 20 seconds maximum time.
7. The gas valve is energized on low.
8. Trial for ignition period begins within four seconds.
9. Prove flame within two seconds.
10. Cycle off ignitor and start time count for the indoor blower.
11. Reset flame failure time to 0.7 seconds.
12. 45 seconds after flame is proved start the indoor blower.

Second Stage Heat

When the IFC control receives a call for second stage heat on "W2" and flame is present, the control will wait 30 seconds before sending a signal to the variable speed vent motor and the indoor blower for high speed operation.

1. The variable speed vent motor ramps up in speed until is sees the high pressure switch, HPS/PS2, close. Then the variable speed vent motor reports this to the IFC on the RPM/SOA circuit.
2. When the IFC sees the high speed vent motor signal, it energizes the gas valve on high.

Second Stage Satisfied, First Stage Still Calling

1. The IFC will remove the high speed signal to the variable speed vent motor and the indoor blower; the motors go to low speed operation.
2. The IFC de-energizes the high fire gas valve.

First Stage Satisfied

1. The IFC turns off the gas valve.
2. When the IFC sees no flame current, no flame, it starts the five second postpurge cycle and then turns off the variable speed vent motor.
3. The cool down cycle is started by the IFC. The cool down time can be changed; the factory setting is 100 seconds.

Call For First and Second Stage Together

There will be a 10 minute delay after low fire is established before the IFC will allow high fire operation.

White-Rodgers Self Diagnostic Features

The integrated furnace control tests for internal and external faults before allowing a heating sequence to begin. The external check includes all safety devices, making certain that they are in their proper normally open or normally closed position. If a fault is detected by the control, it will immediately enter into a fault mode and flash the LED light according to the fault detected (see LED Flash Rate table below). The control will remain in the fault mode until the problem is corrected. Once the fault is cleared, the control will start the heating sequence as long as the call for heat still exists.

The control has an expanded diagnostic feature that monitors system performance. If a fault is detected during operation, the control will de-energize the gas valve and flash the diagnostic LED according to the fault detected.

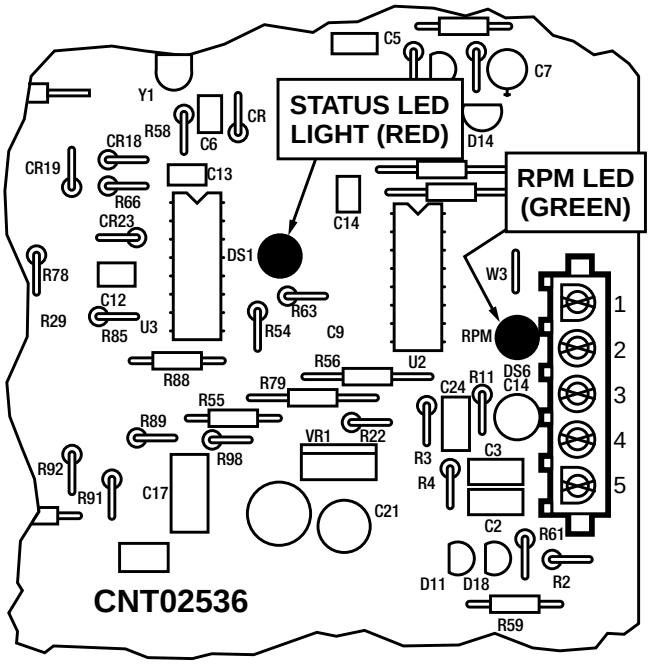
The control will automatically reset a lock-out due to loss of flame in one hour.

LED Flash Rates

Normal Operation

- The LED will flash for one second at power up.
- The LED will flash "FAST", 1/4 second "ON" and 1/4 second "OFF", during a call for heat.
- The LED will flash "SLOW", 1/4 second "ON" and 3/4 second "OFF", with system in stand-by (power on).

Note: The LED will flash "ON" for approximately 1/4 second, then "OFF" for approximately 1/4 second. The pause between groups of flashes is approximately two seconds.



Fault Diagnostic

LED Flash	Indicates
Slow Flash	Normal Stand By.
Fast Flash	Normal with a Call for Heat.
Continuous ON	Internal Fault in the IFC.
2 Flashes	System Lockout – No Flame. Total of three tries. Automatic reset in one hour.
3 Flashes	Pressure Switch Error. (Fault may be caused by a vent problem or a wiring connection in the switch circuit.) On two speed furnaces, if there is a high heat pressure switch fault, the IFC will not lock out. It will go back to low heat, cancel the three flash indication for ten minutes and again try high heat.
4 Flashes	Thermal Protection Device Open.
5 Flashes	Flame Being Sensed with Gas Valve De-energized (Stuck Open). Vent Motor and Indoor Blower will be Energized.
6 Flashes	No Ground or Power Leads to Furnace Reversed, or Line Voltage Too Low.
7 Flashes	20 VAC at Gas Valve with No Call for Heat or if No Flame is Present; Keep Vent Motor On.
8 Flashes	Low Flame Sense Signal.
9 Flashes	Ignitor Fault or Improper Ground or Low Voltage.

50A61-605 part #CNT02536 will only show the first seven flash codes.

Ignition Control Flash Codes

White-Rodgers No. Part Number		**50A65-475** CNT03076	**50A65-474** CNT02854	**50M61-495** CNT03077	**50V61-507** CNT03078	**50V65-495** CNT02871	**50A61-605** CNT02536
Fault (in bold type) Control Action							
Improper Flame							
Inducer	ON	X	X	X	X	X	X
Indoor Blower	ON	X	X	X	X	X	X
Internal Lockout							
Inducer	ON	X	X	X	X	X	X
Indoor Blower	ON	X	X	X	X	X	X
Humidifier	ON	X	X	X	X	X	
Humidifier	OFF						X
Air Cleaner	ON	X	X	X	X	X	X
External Lockout							
Inducer	OFF	X	X	X	X	X	X
Indoor Blower	ON	X	X	X	X	X	X
Humidifier	OFF	X	X	X	X	X	X
Air Cleaner	ON	X	X	X	X	X	X
Path to Internal Lockout							
Gas Valve Relay							
Contact Fail	YES	X	X	X	X	X	X
Gas Valve Relay							
Driver Fail	YES	X	X	X	X	X	X
Fault Code Flash							
1 thru 7 Flashes							X
1 thru 9 Flashes		X	X	X	X	X	

See Table on the previous page for Fault Code Flash meanings.

NOTE: One failure mode, which has been found, is due to the failure of an adequate ground. In adjusting the RMS voltage to the SiNi ignitor, the control must use the ground as a reference. If the ground is incomplete, there will be no proper point to adjust the turn on and off of the triac in the control. The control will increase the voltage to the ignitor to the point of encouraging an ignitor failure. Check for a proper ground by reading between the IFC "Line N" terminal and the IFC low voltage terminal "B or C". A reading of two volts or less is OK. If the reading is greater, correct the ground circuit. Re-test.

Application of a capacitor to reduce line noise. A 30 mfd capacitor may be applied to the incoming line between terminals "Line N" and "Line H" to reduce or eliminate the effects of line noise. This has been observed in applications involving generators. The capacitor must be rated for use with A.C. power and a voltage rating above 200 volts. Not required after code date 113.

Measuring Variable Speed Vent Motor RPM

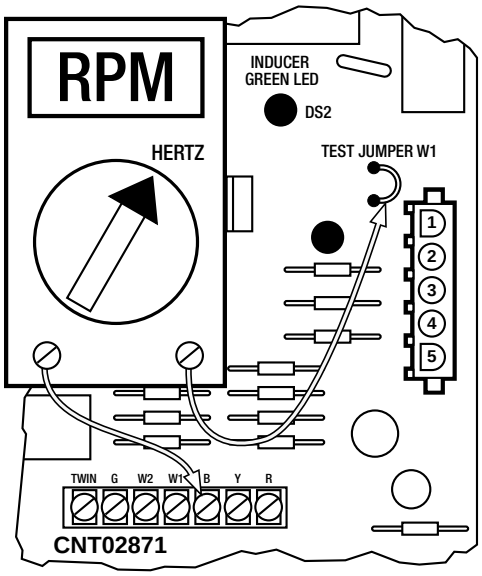
Tools Required:

- A Meter That Can Read Hertz

Connect the Meter as Follows:

Control 50V65-495

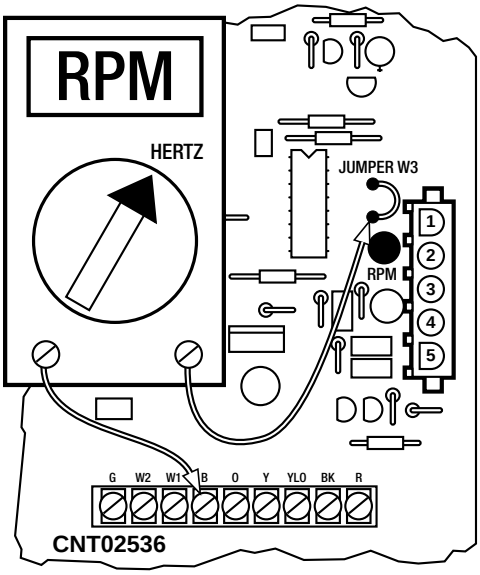
CNT02871



Connect meter to test jumper W1 and B.

Control 50A61-605

CNT02536



Connect meter to test jumper W3 and B.

Meter RPM x 30 = Vent Motor RPM

Low Speed RPM Range ..... 1500 RPM Min. – 4400 RPM Max.

High Speed RPM Range ..... 2300 RPM Min. – 5300 RPM Max.

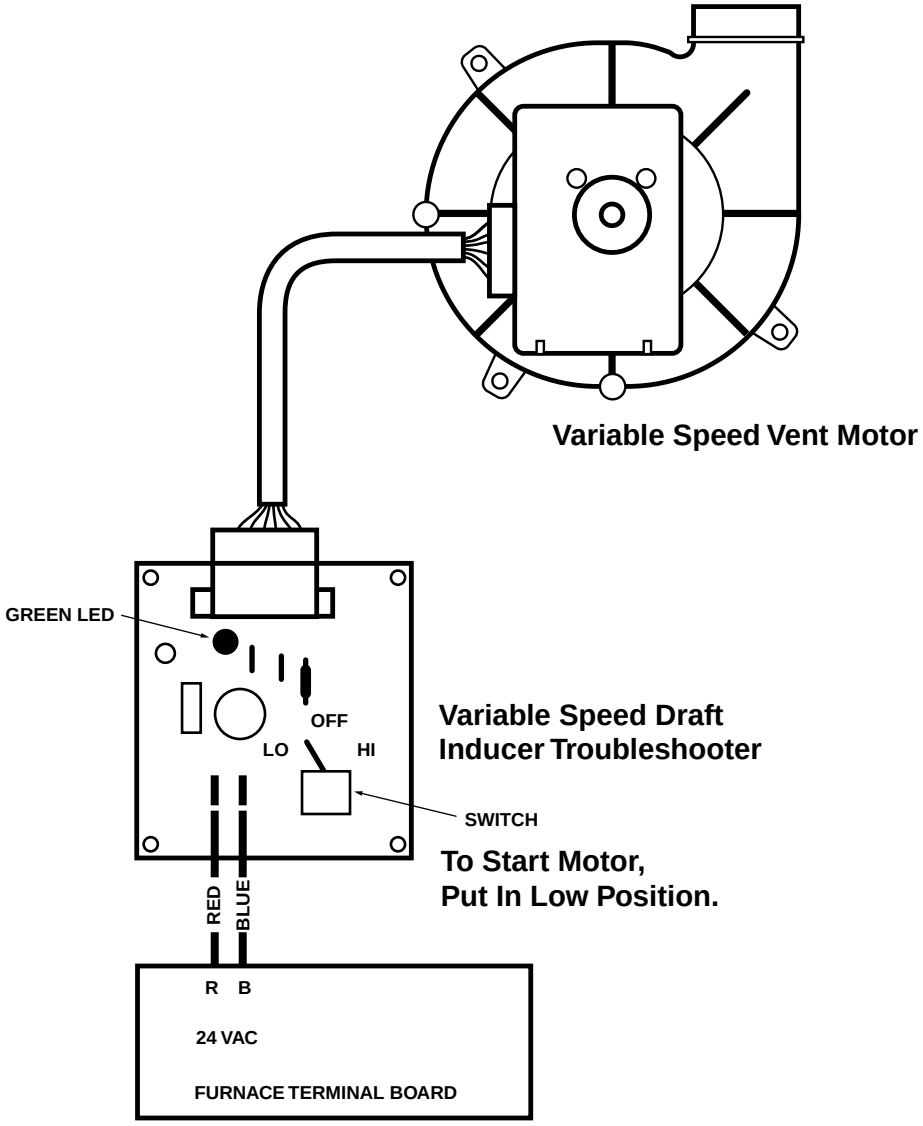
Variable Speed Vent Motor Models

The ECM™ motor has an output circuit used to report the motor's R.P.M. and pressure switch fault codes to the White-Rodgers' IFC. The White-Rodgers' IFC has a green LED labeled RPM to indicate proper operation and faults when detected.

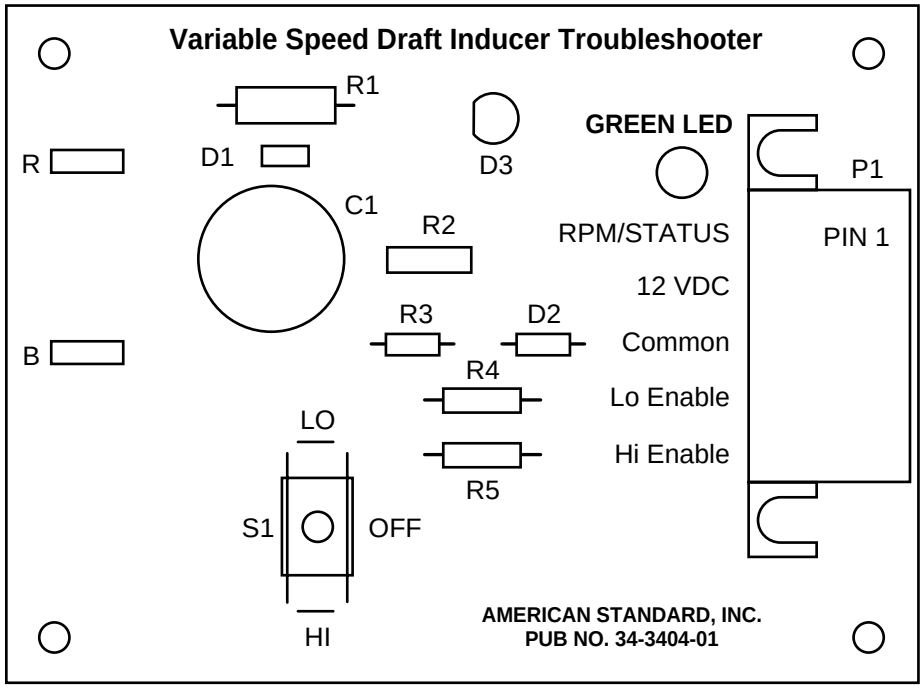
Red Status LED	Green IFC RPM LED	Fault
Out	Out	No Power
Slow Flash, No Call for Heat	Slow Bright Flash	No Call For Motor Operation, Motor OK
Slow Flash or Fast Flash	Out	No Power to Motor or Motor Defective
Fast Flash, Call For Heat	Dimly Pulsed	No Fault Present During Low or High Speed Operation
3 Flashes	On*	Fault with High Pressure Switch Circuit or Vent System
3 Flashes	Off or Slow Bright Flash	Fault with Low Pressure Switch Circuit or Vent System

*LED will be on only when the IFC is calling for High Speed operation. The IFC will cycle the Vent Motor and Gas Valve to low if a High Speed Pressure Switch Fault occurs.

Diagnosing the V/S Vent Motor with the V/S Troubleshooter



Diagnosing the V/S Vent Motor with the V/S Troubleshooter



Check diagnostic RED LED on the Integrated Furnace Control (IFC) for a fault before removing the furnace blower door on downflow models. With no Variable Speed Vent Motor operation, the IFC diagnostic RED LED will be flashing three times.

1. Turn power off to furnace.
2. Unplug the Variable Speed Vent Motor harness plug # E10 from the IFC and plug the harness into the Variable Speed Troubleshooter.
3. Remove the field wiring from the "R" terminal on the furnace Low Voltage Terminal Board (LVTB). Connect a wire from the "R" terminal of the furnace LVTB to the "R" terminal of the Variable Speed Troubleshooter. Connect another wire from the "B" terminal of the furnace LVTB to the "B" terminal of the Variable Speed Troubleshooter.

Caution

Do not reverse these wires; the Variable Speed Motor may start but will not test out correctly. Repower the furnace. 24 VAC must be present at the furnace LVTB terminals "R" and "B" for this test procedure.

4. With the Variable Speed Troubleshooter switch in the "OFF" position, does the GREEN LED on the Variable Speed Troubleshooter blink on and off brightly?

   YES: Go to Step #5.

   NO: Go to Step #8A.

5. Turn the Variable Speed Troubleshooter switch to the LOW position. Does the Variable Speed Vent Motor start?

   YES: Go to Step #6.

   NO: Go to Step #9.

6. Does the Variable Speed Troubleshooter GREEN RPM/Status LED come on dimly?

   YES: Go to Step #7.

   NO: Place a jumper across the low pressure switch; the troubleshooter GREEN LED should come on. If the GREEN LED does not come on, check for 24 VAC to the low pressure switch, out of the low pressure switch and on to the Variable Speed Motor Plug pin #9. If 24 VAC is not present at the Variable Speed Vent Motor Plug pin #9, repair as needed. If voltage is present at pin #9 and the GREEN LED does not come on, replace the Variable Speed Vent Motor.

7. Turn the Variable Speed Troubleshooter switch to the HIGH position quickly. Too long a delay at the "OFF" position will cause the motor to stop. Does the Variable Speed Vent Motor go to high speed operation?

YES: No fault with Variable Speed Vent Motor or the high pressure switch HPS/PS2. If the furnace will not cycle the Vent Motor, replace the IFC control.

NO: Unhook the brown wire from the high pressure switch HPS/PS2 and check motor again for high speed operation. If motor RPM now goes up, the high pressure switch HPS was closed. Repair as needed or replace the high pressure switch HPS/PS2. If the motor will not go to high speed and high pressure switch HPS/PS2 is OK, replace the Variable Speed Motor.

8A. Is there 10 – 13 VDC between pins #2 and #3 at the troubleshooter plug?

YES: Go to Step #8B.

NO: Unplug the Variable Speed Vent Motor from the Troubleshooter. Check for voltage between pins #2 and #3 again. The voltage should read between 10 – 16 VDC. If voltage is not present but goes low or to zero VDC when the Variable Speed Vent Motor is again plugged into the Troubleshooter, replace the Variable Speed Vent Motor. If the correct D.C. voltage is not present when the Variable Speed Vent Motor is unplugged from the Troubleshooter, check for the 24 VAC to it. If the 24 VAC is present at the Troubleshooter but no D.C. voltage is present, repair or replace the Troubleshooter.

8B. Is there 120 VAC line voltage present between pin #11 white wire and pin #12 black wire at the Variable Speed Vent Motor plug?

YES: Check the Variable Speed Vent Motor red jumper wire connecting pin #6 and pin #10 together. If a fault is found with this jumper, repair or replace as needed and re-check the Variable Speed Vent Motor, if the red jumper is OK and the correct voltage was read during checks 8A and 8B. If the Variable Speed Vent Motor will not run, replace it.

NO: Check for 120 VAC at the IFC terminals which supply power to the Variable Speed Vent Motor. If the line voltage is present, check the Variable Speed Vent Motor housing limit switch and the furnace wiring.

9. Remove the orange wire from the low pressure switch LPS/PS1. Will the Variable Speed Vent Motor now start on low speed?

YES: Fault is with the low pressure switch LPS/PS1. This switch is normally open and it is closed. Repair or replace switch as needed.

NO: Go back to Step #8A.

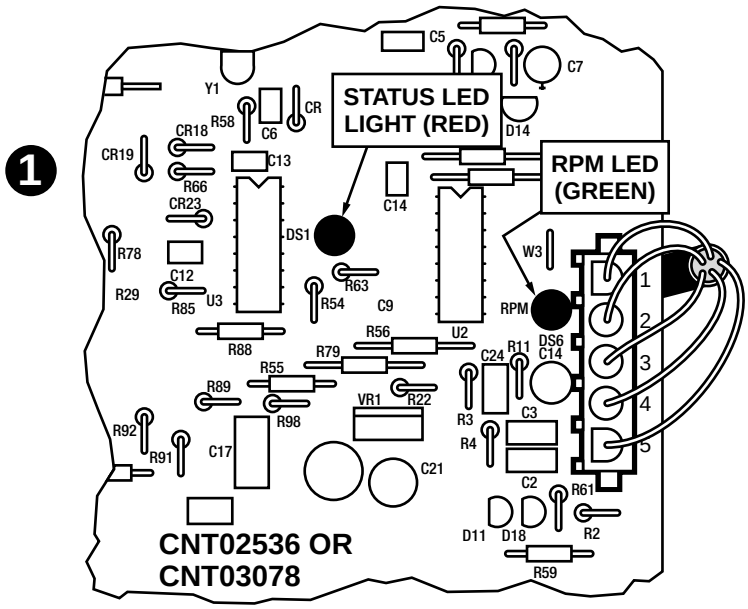
Diagnosing the V/S Vent Motor/Manual Method

DO NOT UNPLUG MOTOR FOR THESE TESTS.

1. Is there a slow flash (Heartbeat) on the green LED on the IFC Board?

YES: Go to Step #3.

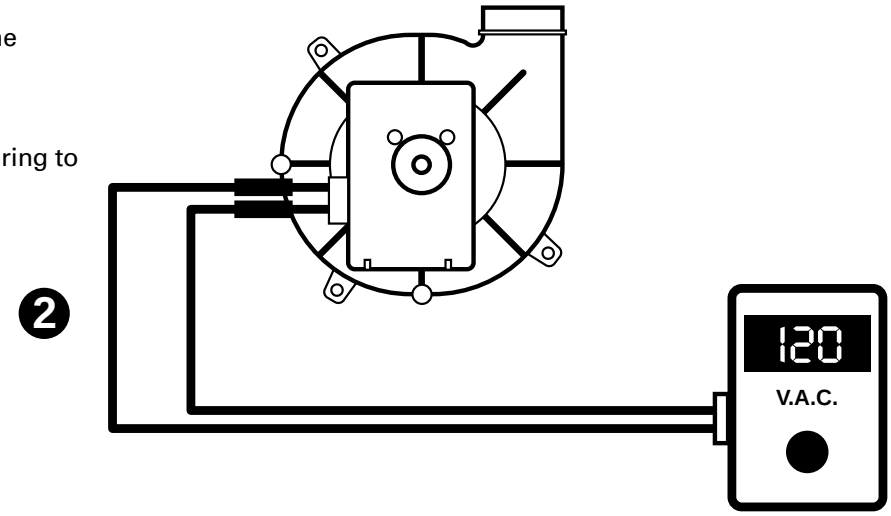
NO: Go to Step #2.



2. Is 120 VAC present, measured at the motor leads?

YES: Go to Step #3.

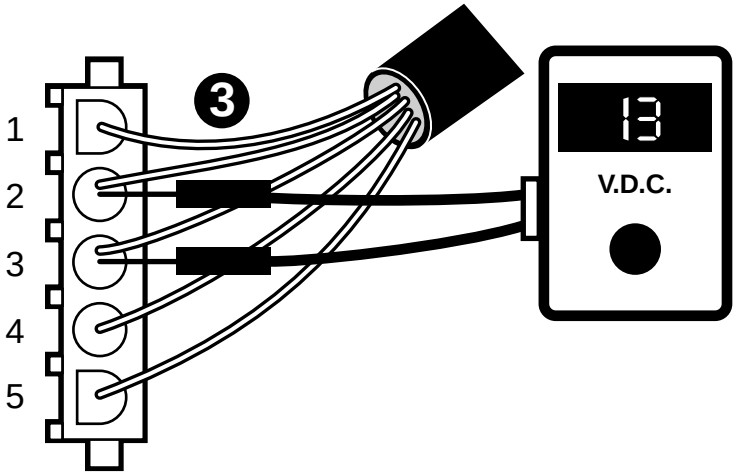
NO: Repair high voltage wiring to the motor.



3. Is 13 VDC present, when measured between pin #2 and pin #3?

YES: Go to Step #4.

NO: Replace the White-Rodgers IFC Board.



IN ALL REMAINING STEPS, THE PINS ARE ON PLUG E10, NEAR THE EDGE OF THE IFC BOARD. There is a built-in delay on all functions. Wait several seconds to see the result of any action.

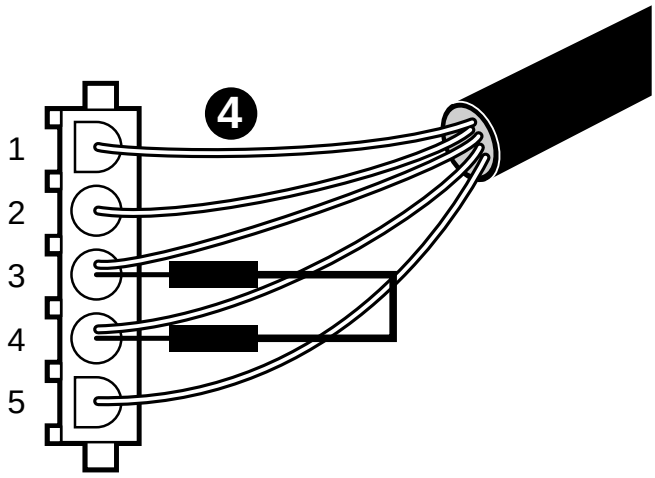
Diagnosing the V/S Vent Motor/Manual Method

4. Jumper pin #4 to pin #3 (B common)

Does the vent motor start and go through the learning curve?

YES: Go to Step #5.

NO: Remove the orange wire from the LPS pressure switch and repeat Step #4. If the motor still fails to start, replace the motor. Don't forget to replace the orange lead. If the motor starts, this may indicate that the LPS pressure switch is stuck closed. Check and replace, if necessary.

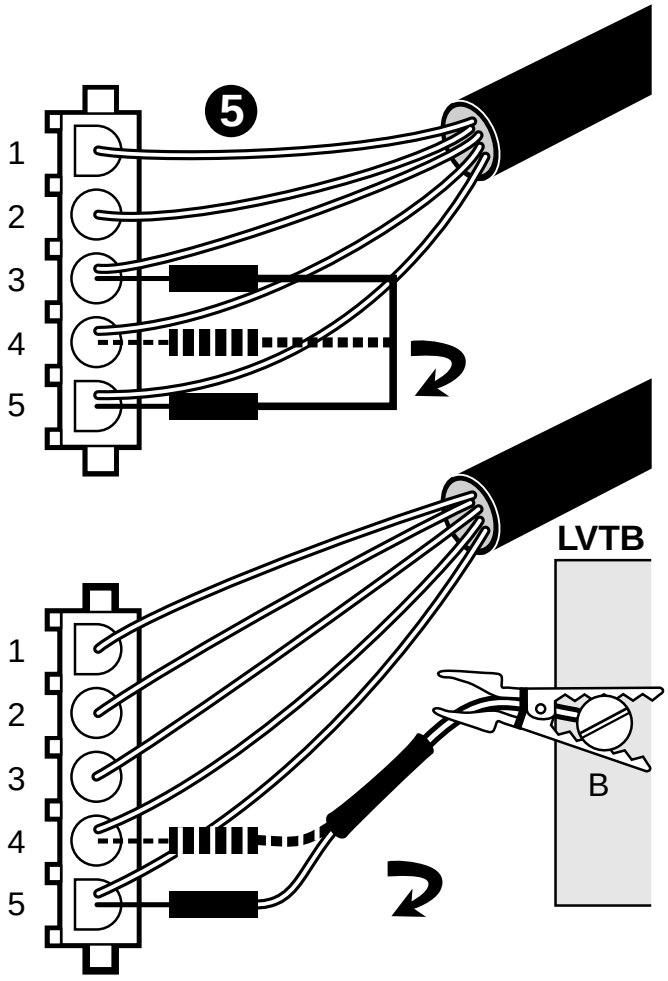


5. After the LPS pressure switch has closed, opened, and closed (learning curve), quickly remove one end of the jumper from pin #4 and move it to pin #5, keeping the other end of the jumper on pin #3 (B common). The motor must remain spinning. If it stops, repeat Step #4 and Step #5.

Does the motor go on high speed?

YES: Replace the White-Rodgers IFC board.

NO: Before replacing the motor, remove the brown wire from the HPS pressure switch and repeat the test in Steps #4 and #5. If it still does not go to high speed, replace the motor. Don't forget to replace the brown lead. If the motor starts, this may indicate that the HPS pressure switch is stuck closed. Check and replace, if necessary.



Both Tests 4 and 5 may use another connection which may be easier to reach.

The pin #3 signal (B common) is also found on B at the LVTB.

ECM™ 2 Variable Speed Furnace Motor Quick Check

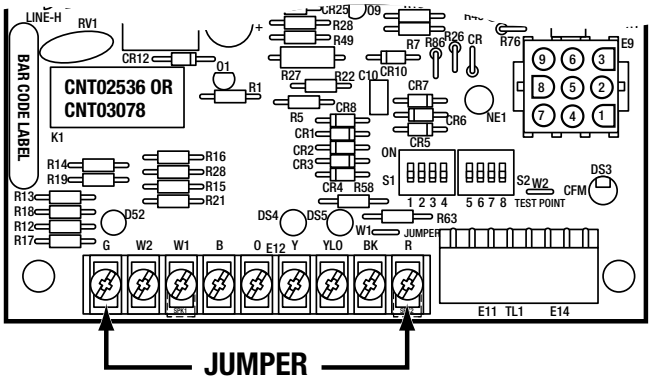
Blower Motor Will Not Run

1. Jumper 24 Volt A.C. "R" terminal to "G" terminal on the Motor Control Board.

Does motor run?

NO: Go to Step #2.

YES: Motor runs; check thermostat and thermostat wire.

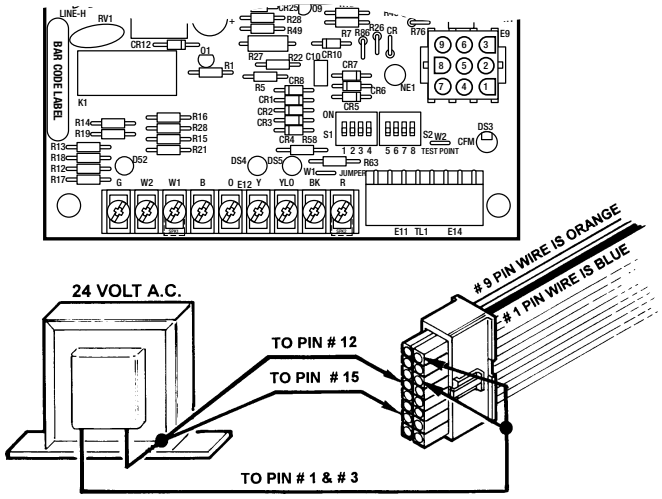


2. Unplug 16 wire low voltage harness from the motor control board. Jumper 24 Volts A.C. to pins #12 and #15 and common pins #1 and #3.

Does the motor run?

NO: Go to Step #3.

YES: Go to Step #4.



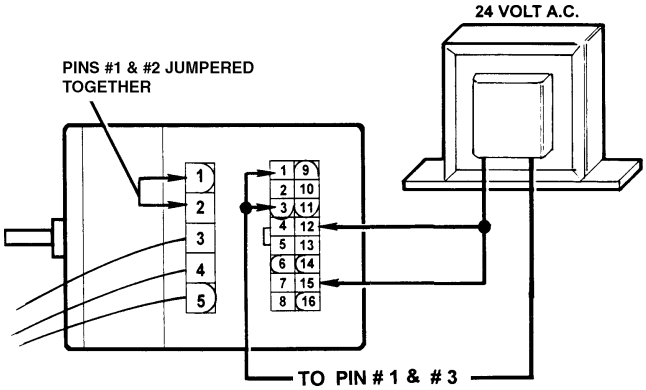
3. Unplug 16 wire low voltage harness from the motor. Jumper 24 Volts A.C. to motor low voltage plug pins #12 and #15 and common pins #1 and #3.

Note: Test plug can be made from a good harness to simplify this check.

Does motor run?

NO: Go to Step #4.

YES: Fault is in the 16 wire low voltage harness. Repair or replace it.

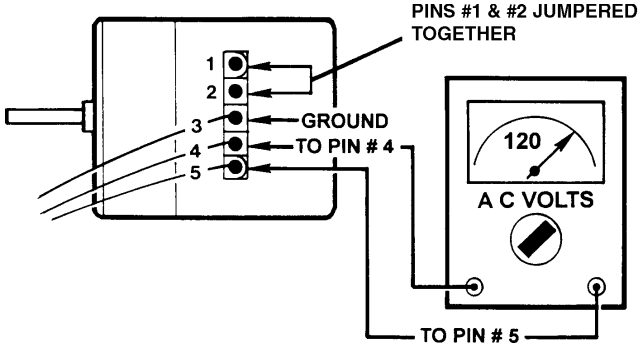


4. Is the line voltage to the motor high voltage power plug pin #4 and pin #5 correct?

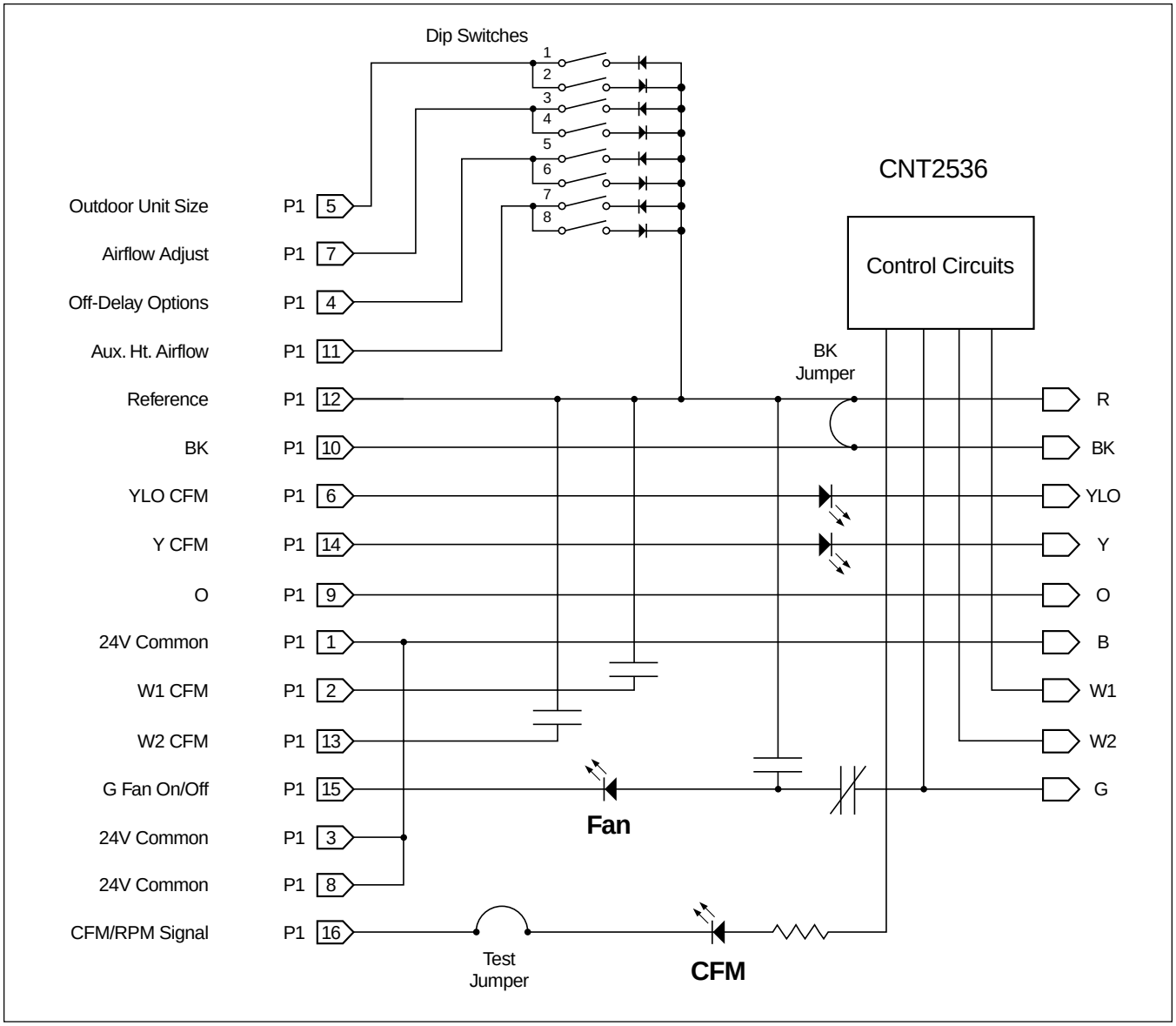
Furnace ECM™2 motor correct voltage is 120 Volts A.C. and there must be a jumper wire in this plug between pins #1 and #2.

NO: Correct line voltage fault.

YES: Line voltage correct and motor will not run. Replace motor.



V-Squared Furnace Motor – Control Board Schematic



Caution: When testing the variable speed blower motor on furnaces that use a White-Rodgers Control No. 50A61-605, Part No. CNT02536, using the ECM™2 troubleshooting board, Pub. No. 34-3403-1, LED'S "W1" and "W2" will not come on when called for in the test procedure. This no light condition is not a fault with the motor, motor harness or White-Rodgers Control. The White-Rodgers Control contains normally open relays in these circuits and will not close until flame is detected and is on for 45 seconds in low fire. High fire must be obtained before "W2" relay will close.

If correct airflow can not be obtained in low heat operation, check for 24 volts A.C. between pins #1 and #2. If voltage is present 45 seconds after flame is detected, fault is in the motor harness or the motors module. Check for 24 Volts A.C. at motor end of harness.

If correct airflow can not be obtained in high heat operation, burner on high fire, check for 24 Volts A.C. between pins #1 and #13. If voltage is present, fault is with the motor harness or the motors module. Check for 24 Volts A.C. at motor end of harness.

Vent Length Table for Variable Speed Vent Motor Models Only

Altitude	Maximum Total Equivalent Length in Feet for Vent and Inlet Air (See Notes)		
0 – 7,000 Feet	**2 Inch Pipe**	**2.5 Inch Pipe**	**3 Inch Pipe**
✻UX/✻DX or ✻UY/✻DY060R9V3V	200	200	200
✻UX/✻DX or ✻UY/✻DY080R9V3V	50	120	200
✻UX/✻DX or ✻UY/✻DY100R9V4V	Not Allowed	60	200
✻UX/✻DX or ✻UY/✻DY120R9V5V	Not Allowed	Not Allowed	200
7,000 – 9,500 Feet	**2 Inch Pipe**	**2.5 Inch Pipe**	**3 Inch Pipe**
✻UX/✻DX or ✻UY/✻DY060R9V3V	100	100	100
✻UX/✻DX or ✻UY/✻DY080R9V3V	25	60	100
✻UX/✻DX or ✻UY/✻DY100R9V4V	Not Allowed	30	100
✻UX/✻DX or ✻UY/✻DY120R9V5V	Not Allowed	Not Allowed	100
9,500 – 12,000 Feet	**2 Inch Pipe**	**2.5 Inch Pipe**	**3 Inch Pipe**
✻UX/✻DX or ✻UY/✻DY060R9V3V	50	50	50
✻UX/✻DX or ✻UY/✻DY080R9V3V	Not Allowed	30	50
✻UX/✻DX or ✻UY/✻DY100R9V4V	Not Allowed	Not Allowed	50
✻UX/✻DX or ✻UY/✻DY120R9V5V	Not Allowed	Not Allowed	50

Notes:

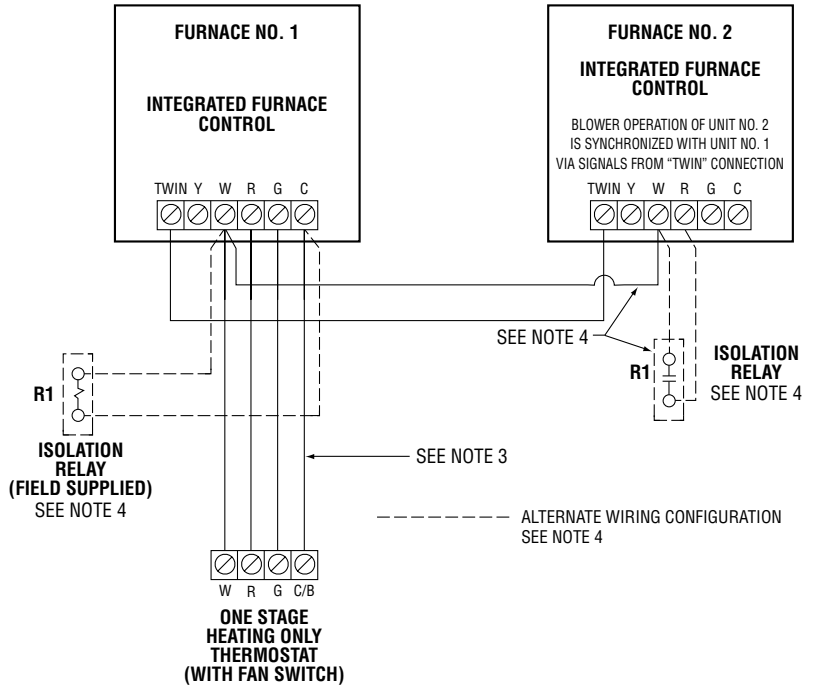
✻ First letter of models may be an "A" or "T".

1. Minimum vent length for all models: 3' horizontal and vertical.
2. DO NOT MIX PIPE DIAMETERS IN THE SAME LENGTH OF PIPE OUTSIDE THE FURNACE CABINET (except adapters at the top of the furnace).
3. MAXIMUM PIPE LENGTHS MUST NOT BE EXCEEDED! THE LENGTH SHOWN IS NOT A COMBINED TOTAL, IT IS THE MAXIMUM LENGTH OF EACH (vent or inlet air pipes).
4. One SHORT radius 90 elbow is equivalent to 10' of 3" pipe and one LONG radius elbow is equivalent to 6' of 3" pipe. One 90 elbow is equivalent to 7.5' of 2-1/2" pipe and 5' of 2" pipe. Two 45 elbows equal one 90 elbow.
5. The termination tee or bend must be included in the total number of elbows. If the BAYVENT100A termination kit is used, the equivalent length of pipe is 5 feet.
6. Pipe adapters are field supplied (except 120).
7. Low temperature icing on vent inlet or termination may cause pressure switch problems.

See Installation Manuals of Other 90% Furnaces with Standard Vent Motor for Their Vent Length Tables.

Single Wire Twinning – For Models with Twin Terminals

Twinning Connection Diagram for Twinning One Stage Furnaces with Single Wire Twinning Feature One Stage Heating Only Thermostat



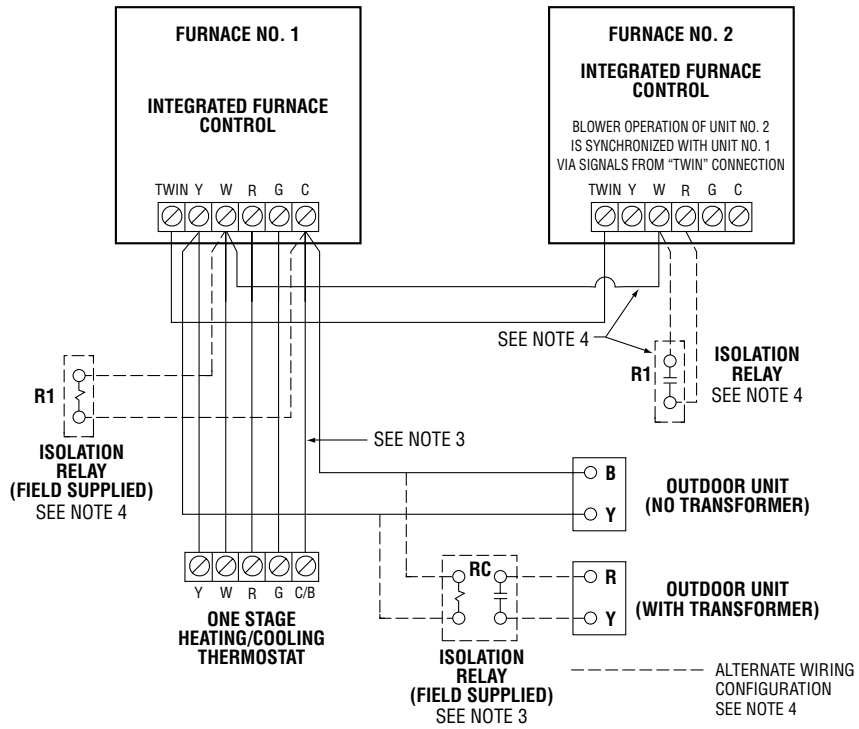
NOTES:

1. BOTH FURNACES MUST BE POWERED FROM THE SAME 115V. LEG OF CIRCUIT PANEL.
2. INSURE 24V. FURNACE TRANSFORMERS ARE IN PHASE. PRIOR TO COMPLETING CONNECTIONS, CHECK VOLTAGE BETWEEN "R" TERMINALS OF EACH FURNACE. IF VOLTAGE IS GREATER THAN 10V., REVERSE THE "BL" AND "RD" SECONDARY LEADS ON ONE OF THE FURNACE TRANSFORMERS.
3. CONNECTION MAY BE REQUIRED FOR ELECTRONIC THERMOSTAT.
4. IF CURRENT EXCEEDS THERMOSTAT CURRENT RATING, USE ISOLATION RELAYS "RI" AS SHOWN. (DO NOT CONNECT "W" TO "W.") ISOLATION RELAY NOT NEEDED IF THE THERMOSTAT CONTACTS ARE RATED AT 1.0A. OR ABOVE.

Twinning requires that two furnaces with the same configuration, capacity and airflow must be used. They shall have common returns with equal pressure drops or ducts with equivalent lengths and sizes.

From Dwg. 21B341422 Rev. 1

Twinning Connection Diagram for Twinning One Stage Furnaces with Single Wire Twinning Feature One Stage Heating/One Stage Cooling Thermostat



NOTES:

1. BOTH FURNACES MUST BE POWERED FROM THE SAME 115V. LEG OF CIRCUIT PANEL.
2. INSURE 24V. FURNACE TRANSFORMERS ARE IN PHASE. PRIOR TO COMPLETING CONNECTIONS, CHECK VOLTAGE BETWEEN "R" TERMINALS OF EACH FURNACE. IF VOLTAGE IS GREATER THAN 10V., REVERSE THE "BL" AND "RD" SECONDARY LEADS ON ONE OF THE FURNACE TRANSFORMERS.
3. IF OUTDOOR UNIT HAS A 24V. TRANSFORMER, AN ISOLATION RELAY MUST BE INSTALLED. (FIELD SUPPLIED – USE PILOT DUTY RELAY "RC", SUCH AS RLY0975.) SEE ALTERNATE CONNECTION.
4. IF CURRENT EXCEEDS THERMOSTAT CURRENT RATING, USE ISOLATION RELAYS "RI" AS SHOWN. (DO NOT CONNECT "W" TO "W.") ISOLATION RELAY NOT NEEDED IF THE THERMOSTAT CONTACTS ARE RATED AT 1.0A. OR ABOVE.
5. CONNECTION MAY BE REQUIRED FOR ELECTRONIC THERMOSTATS.

From Dwg. 21B341423 Rev. 1

Manifold Pressure Settings

The 40" gas furnaces are shipped from the factory for use with natural gas. Conversion to propane requires a change in the main burner orifices. The two stage gas valve, 36E96 type 227, used in the ✻UX/✻DX or ✻UY/✻DY-R furnace is a dual purpose valve and does not require a regulator spring change for LP conversion.

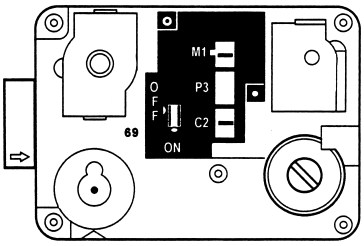
NOTE: It is necessary to adjust the "HI" fire setting to maximum rate (turn adjustment screw clockwise until it bottoms) before setting the "LO" propane fire rate, otherwise the "LO" fire rate of 4.0 – 4.5" W.C. cannot be set above the 3.5" W.C. natural gas "HI" fire setting.

✻ First letter of models may be an "A" or "T".

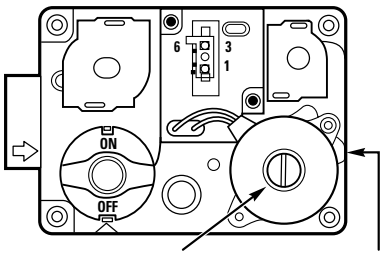
Main Burner Orifice Drill Size	Type Fuel	Final Manifold Pressure Setting	
		First Stage	Second Stage
45	NATURAL	1.4 – 1.7" W.C.	3.0 – 3.7" W.C.
56	PROPANE	4.0 – 4.5" W.C.	10.5 – 11.0" W.C.

Valve	Models	Supplier	Opening Characteristics	Factory Outlet Pressure Settings	Propane Convertible	Gas Valve	LP Kit
1	36E22-209	White-Rodgers	Single Fast	3.0 – 3.5 in W.C.	Yes	VAL06377	KIT03831 or BAYLPKT210A
2	36E96-227	White-Rodgers	Two Stage	1.4 – 1.7 in W.C. 3.0 – 3.5 in W.C. See Note②	Yes	VAL04420	Dual Purpose Valve Operates on Natural or Propane
3	36E54-201	White-Rodgers	Two Stage	1.4 – 1.7 in W.C. 3.0 – 3.5 in W.C. See Note②	Yes	VAL06376	Dual Purpose Valve Operates on Natural or Propane
4	36F22-209	White-Rodgers	Fast①	3.0 – 3.5 in W.C.	Yes	VAL06969	KIT03831 or BAYLPKT210A
4	36F22-205	White-Rodgers	Slow①	3.0 – 3.5 in W.C.	Yes	VAL06968	KIT03831 or BAYLPKT210A

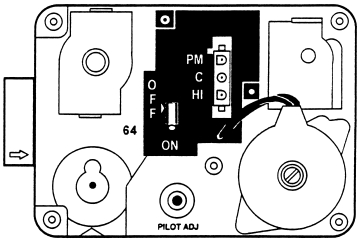
1. Single Stage with Toggle VAL06377



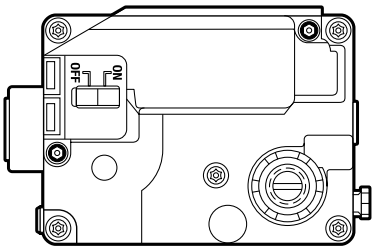
2. Two Stage VAL04420



3. Two Stage with Toggle VAL06376



4. Toggle VAL06968 and VAL06969



① Has toggle switch safety shut off.

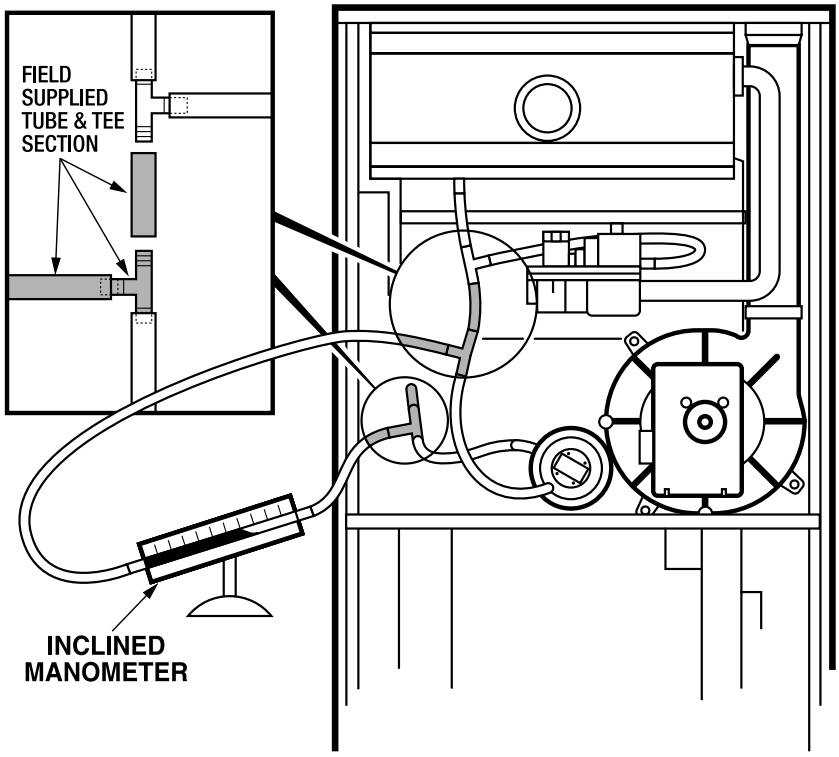
② Remove the slotted screw on top of the gas valve for First Stage (LO) manifold pressure adjustment. Remove slotted screw on outlet side for Second Stage (HI) adjustment. Turn the adjustment nut clockwise to increase the gas flow rate, and out to decrease the gas flow using a 3/32" hex wrench.

Furnace Pressure Switch Settings

Models	Closing Pressure In W.C.	Opening Pressure In W.C.	Factory Number	Replacement Number	High Altitude Kit	Closing Pressure In W.C.	Opening Pressure In W.C.	Factory Number	Replacement Part
✻UD-C-A, B, C, D/✻DD-C, A, B	–0.65	–0.5 ± .05	C340071P01	SWT01255	BAYHALT220	–0.56	–0.41 ±04	C340071P03	SWT01579
✻UD-C-H/✻DD-C-C②	–0.65	–0.5 ± .05	C340773P01	SWT01741	BAYHALT238	–0.56	–0.41 ± .04	C340773P03	SWT01830
✻UD-R-A, B/✻DD-R-A, B	HI –0.65	–0.5 ± .05	C340071P01	SWT01255	BAYHALT215	HI –0.56	–0.41 ± .04	C340071P03	SWT01579
	LO –0.31	–0.17 ± .03	C340191P02	SWT01373	③	LO –0.31	–0.14 ± .03	C340191P04	SWT01580
✻UD-R-H/✻DD-R-C②	HI –0.65	–0.5 ± .05	C340773P01	SWT01741	BAYHALT239	HI –0.56	–0.41 ± .04	C340773P03	SWT01830
	LO –0.31	–0.17 ± .03	C340789P02	SWT01760	③	LO –0.31	–0.14 ± .03	C340789P04	N/A
✻UE-A-A, B/✻DE-A-A, B	–0.65	–0.5 ± .05	C330610P01	SWT01600	BAYHALT224	–0.56	–0.41 ± .04	C330610P03	N/A
✻UE-A-H, K/✻DE-A-C, K②	–0.65	–0.5 ± .05	C340773P01	SWT01741	BAYHALT238	–0.56	–0.41 ± .04	C340773P03	SWT01830
✻UJ-A	–0.65	–0.5 ± .05	C330610P01	SWT01600	BAYHALT224	–0.56	–0.41 ± .04	C330610P03	N/A
FUA/FCA-A-A	–0.65	–0.5 ± .05	C340071P01	SWT01255	BAYHALT220	–0.56	–0.41 ± .04	C340071P03	SWT01579
FUA/FCA-A-B, C	–0.65	–0.5 ± .05	C330610P01	SWT01600	BAYHALT224	–0.56	–0.41 ± .04	C330610P03	N/A
FUA/FCA-A-D, E	–0.65	–0.5 ± .05	C340773P01	SWT01741	BAYHALT238	–0.56	–0.41 ± .04	C340773P03	SWT01830
✻UC/✻DC040C	–1.55	–1.40 ± .04	C340450P04	SWT01633	BAYHALT228	–1.27	–1.09 ± .04	C340450P08	N/A
✻UC/✻DC060C	–1.27	–1.04 ± .04	C340450P01	SWT01630	BAYHALT226	–1.02	–0.86 ± .04	C340450P06	N/A
✻UC/✻DC080, 120C	–1.51	–1.39 ± .04	C340450P03	SWT01632	BAYHALT225	–1.27	–1.04 ± .04	C340450P01	SWT01630
✻DC100C948	–1.64	–1.46 ± .04	C340450P02	SWT01631	BAYHALT228	–1.27	–1.09 ± .04	C340450P08	N/A
✻UC100C948	–1.55	–1.40 ± .04	C340450P04	SWT01633	BAYHALT225	–1.27	–1.04 ± .04	C340450P01	SWT01630
✻UC100C960	–1.41	–1.23 ± .04	C340450P09	SWT01776	BAYHALT240	–1.16	–1.00 ± .04	C340450P10	N/A
✻UX/✻DX040C, ✻UX100C960	–1.44	–1.29 ± .04	C340545P21	SWT01669	BAYHALT230	–1.21	–1.06 ± .04	C340545P05	N/A
✻UX060C	–1.09	–0.94 ± .04	C340545P22	SWT01670	BAYHALT231	–0.92	–0.77 ± .04	C340545P06	N/A
✻DX060C	–1.13	–0.98 ± .04	C340545P32	SWT01838	BAYHALT241	–0.97	–0.82 ± .04	C340545P13	N/A
✻UX080C942	–1.30	–1.15 ± .04	C340545P23	SWT01671	BAYHALT232	–1.09	–0.94 ± .04	C340545P02	SWT01670
✻UX100C948 ✻UX/✻DX120C960	–1.55	–1.40 ± .04	C340545P24	SWT01672	BAYHALT233	–1.30	–1.15 ± .04	C340545P03	SWT01671
✻DX080C942	–1.52	–1.37 ± .04	C340545P29	SWT01702	BAYHALT233	–1.30	–1.15 ± .04	C340545P03	SWT01671
✻DX100C948	–1.55	–1.40 ± .04	C340545P24	SWT01672	BAYHALT234	–1.44	–1.29 ± .04	C340545P01	SWT01669
✻UX/✻DX or ✻UY/✻DY060R9V3VO	LO – 0.88	–0.66 ± .05	C341096P41	SWT02003	BAYHALT245	–0.74	–0.52 ± .05	C341096P46	—
	HI – 1.60	–1.38 ± .07	C341096P43	SWT02005	BAYHALT245	–1.34	–1.16 ± .06	C341096P48	—
✻UX/✻DX or ✻UY/✻DY080, 100R9V-VO	LO – 1.25	–1.03 ± .06	C341096P42	SWT02004	BAYHALT246	–1.05	–0.83 ± .05	C341096P47	—
	HI – 2.29	–2.03 ± .10	C341096P44	SWT02006	BAYHALT246	–1.76	–1.58 ± .08	C341096P49	—
✻UX/DX or ✻UY/✻DY120R9V-VO	LO – 1.25	–1.03 ± .06	C341096P42	SWT02004	BAYHALT247	–1.05	–0.83 ± .05	C341096P47	—
	HI – 2.10	–1.88 ± .09	C341096P45	SWT02007	BAYHALT247	–1.88	–1.70 ± .04	C341096P50	—
✻UY/✻DY060, 080H① ✻DY120R①	LO –1.09	–0.94 ± .04	C340545P02	SWT01670	BAYHALT235	LO –0.92	–0.77 ± .04	C340545P06	SWT01862
	HI –1.76	–1.59 ± .05	C340545P08	SWT01699	③	HI –1.44	–1.29 ± .04	C340545P01	SWT01669
✻UY100R①	LO –1.30	–1.15 ± .04	C340545P03	SWT01671	BAYHALT236	LO –1.09	–0.94 ± .04	C340545P02	SWT01670
	HI –1.76	–1.59 ± .05	C340545P08	SWT01699	③	HI –1.44	–1.25 ± .04	C340545P01	SWT01698
✻DY100R①	LO –1.30	–1.15 ± .04	C340545P03	SWT01671	BAYHALT237	LO –0.92	–0.77 ± .04	C340545P26	N/A
	HI –1.94	–1.75 ± .06	C340545P11	SWT01710	③	HI –1.63	–1.44 ± .04	C340545P27	N/A
✻UY120R①	LO –1.09	–0.94 ± .04	C340545P02	SWT01670	BAYHALT242	LO –0.92	–0.77 ± .04	C340545P06	SWT01862
	HI –1.63	–1.48 ± .04	C340545P07	SWT01698	③	HI –1.30	–1.15 ± .04	C340545P03	SWT01671

① The pressure switches for the ✻UX/✻DX/✻UY/✻DY furnaces are differential switches.
② The mounting method for 80+ furnace pressure switches changed with the introduction of the upflow/horizontal models in the 1st quarter of 1996. Those changes are reflected in this table.
③ These kits contain both pressure switches.
Note: Switches listed on this page by model number are the latest switch listed as of 3/18/98 and may not have the same set point as the original factory installed switch. Check T.S.B for the latest changes.
✻ First letter of models may be an "A" or "T."

Direct Vent Pressure Switch Connections



Direct Vent Manifold Pressure Check

The 40" Direct Vent furnaces (single and two stage) reference the burner box inlet static to provide proper gas valve regulation. The burner box static pressure varies with the different inlet vent pipe lengths and ambient air conditions. Therefore, the gas valve regulator must be able to reference the box pressure to maintain a constant manifold setting. The gas valve vent port has a barbed hose fitting which connects with a “tee” fitting to the burner box and combustion air switches.

When setting or checking the gas valve outlet manifold pressure, the manometer must be connected to both the gas valve outlet pressure tap and the burner box pressure hose (see figures below).

Note: The final manifold pressure will be higher than the reading indicates if the burner box hose is not connected. The actual manifold pressure will be off by the same amount as the burner box static pressure.

Example: 3.50" W.C. gas valve outlet pressure tap reading.

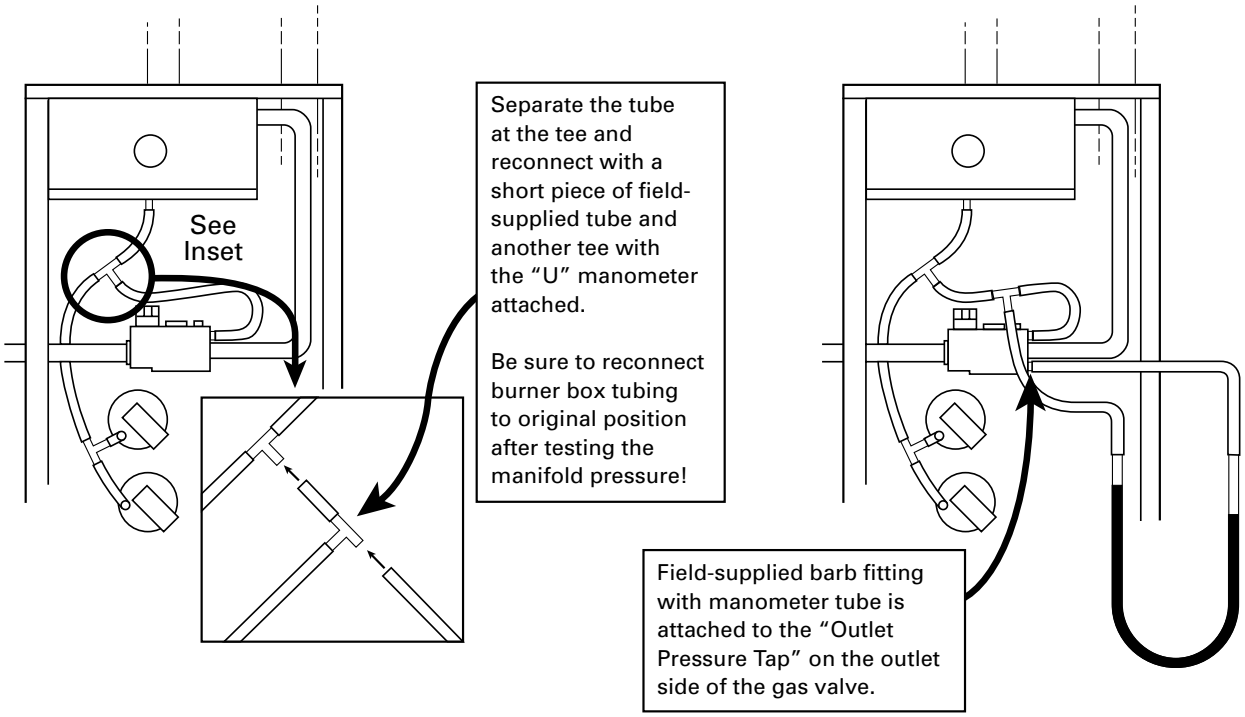
–.15" W.C. burner box inlet pressure hose not connected.

3.65" W.C. actual manifold pressure instead of desired 3.5" W.C.

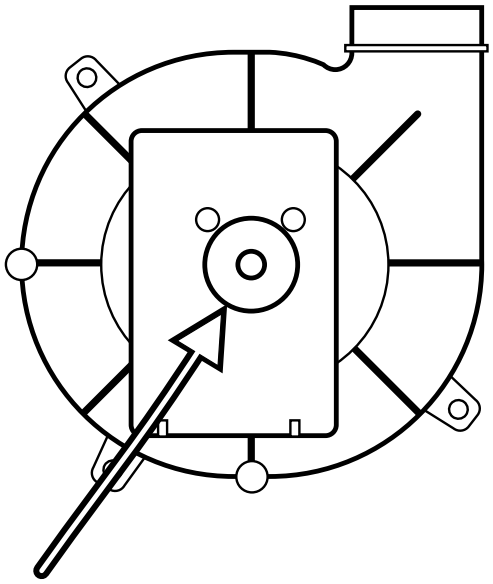
The burner box pressure hose does not have to be connected to set the outlet manifold pressure if the burner box front cover is removed.

Direct Vent Manifold Pressure Check

Correct Method of Checking Direct Vent Manifold Pressure with Burner Box Referenced

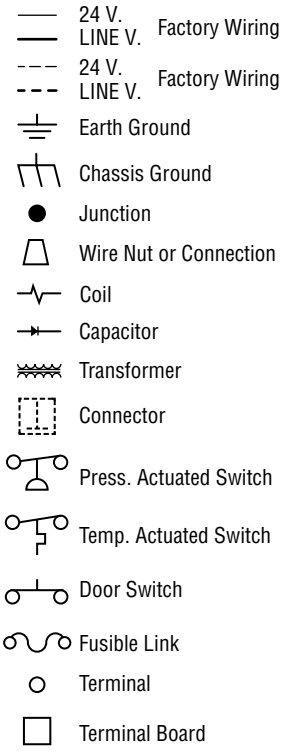


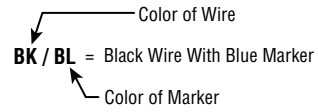
Cleaning the Air Inducer Stirring Fan



This opening is for the Inducer Controller Air Stirring Fan which circulates air over the inducer control board. The Fan and opening should be cleaned annually. Shut the power off to the furnace. Use a vacuum cleaner to pick up any lint or dust which may have accumulated in the opening. Then brush the Fan and opening lightly with a soft brush while using the vacuum to pick up any loosened lint or dust.

Legend – System Wiring





BK Black **OR** Orange **YL** Yellow
BL Blue **RD** Red **GR** Green
BR Brown **WH** White **PR** Purple

GV Gas Valve
CF Fan Capacitor
Gnd Ground
L Line
LVTB Low Voltage Terminal Board
MTR Motor
N Neutral
TCO High Temperature Limit Switch
TNS Transformer
NO Normally Open
NC Normally Closed
COM Common
GM Gas Valve Main
HLO High Limit Output
GE Gas Valve E.Q.S.O.
ROI Roll-Out Input
PO Pressure Switch No.
GC Gas Valve Common
FSO Flame Sensor Output
GR Gas Valve Redundant
PC Press. Switch Nc
PCOM Press. Switch Com
FSI Flame Sensor Input
TR 24V AC Trans. Com Side
TH 24V AC Trans. Hot Side
R Redundant
M Main
EQSO Electrical Quick Shut Off
◆◆ Thermally Protected Internally

Terminal		
Number	**Type**	**System Component Connection**
W		low voltage thermostat W terminal first stage heat
W		low voltage thermostat W terminal second stage heat
G	captive	low voltage thermostat G terminal indoor fan
R	screw	low voltage thermostat R terminal 24 VAC Hot
Y		low voltage thermostat Y terminal compressor contactor
B/C		24 VAC COMMON side of compressor contactor coil
MV		gas valve (both gas valve solenoids are connected in parallel)
MVL		gas valve first stage heat
MVH		gas valve second stage heat
MVCOM		gas valve COMMON
TR	12-pin	24V AC transformer (low voltage COMMON SIDE)
TH	connector	24V AC transformer (low voltage HOT SIDE)
PS	and	pressure switch INPUT
PS2	harness	pressure switch 2 INPUT
FP		flame sensor probe
PS1		pressure switch INPUT
HLI		high limit INPUT
HLO		high limit OUTPUT
GND		MUST BE RELIABLY GROUNDED TO CHASSIS
50A50 Only		
IND	4-pin	inducer motor HOT side
IGN	connector	ignitor HOT side
IND N	and	inducer motor NEUTRAL side
IGN N	harness	ignitor NEUTRAL side
50A51 Only		
IND LO	5-pin	inducer motor HOT side low speed
IND HI	connector	inducer motor HOT side high speed
IND N	and	inducer motor NEUTRAL side
IGN	harness	ignitor HOT side
IGN N		ignitor NEUTRAL side
COOL		indoor blower COOL SPEED terminal
PARK		unused indoor blower terminal
HEAT		indoor blower HEAT SPEED terminal
HEAT LO		indoor blower low HEAT SPEED terminal
HEAT HI		indoor blower high HEAT SPEED terminal
LINE		input voltage (120V AC) HOT SIDE
XFMR	spade	24V AC transformer line voltage HOT SIDE
EAC		air cleaner HOT SIDE
HUM		humidifier HOT side
CIR N		indoor blower NEUTRAL terminal
LINE N		input voltage (120V AC) NEUTRAL SIDE
XFMR		24V AC transformer line voltage
XFMR N		24V AC transformer line voltage NEUTRAL SIDE