

COPELAND

Integrated Furnace Controls

HSI Simulator Presentation



Course Agenda

Part One Furnace Control Operation

Part Two Understanding the Sequence
of Operation

Part Three Choosing the Correct Furnace Control

Part Four Troubleshooting Furnace Controls



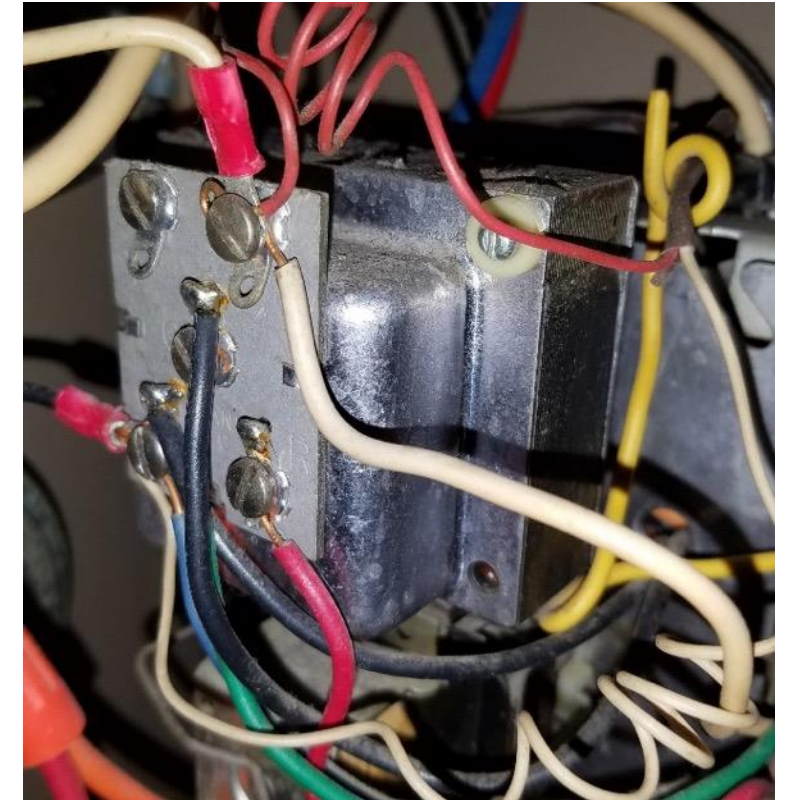


Furnace Control Operation

Part One

Furnace Operation

- The development of printed circuit boards has advanced the technology, control, and efficiency in the HVACR industry
- Mercury bulb thermostats, fan-limits, and other analog controls are switches that control loads—there is little to no communication between them
- Modern integrated furnace controls, or IFCs, are the circuit boards within the furnace that control every function in a specific timing sequence, and monitor vital safety circuits while communicating with auxiliary equipment

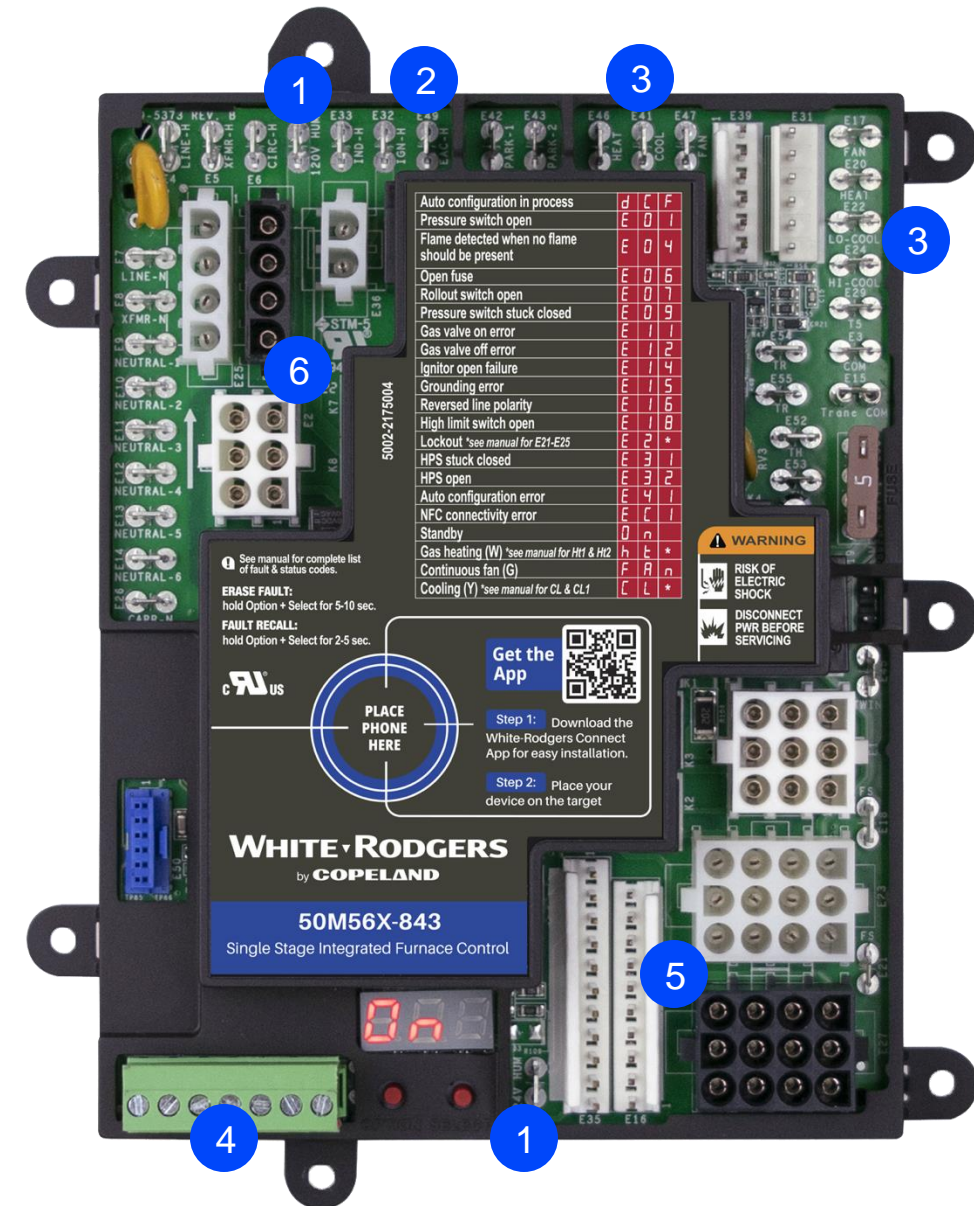


Furnace components and how they connect to an Ignition Control Board

White-Rodgers 50M56X-843

1. Humidifier
2. Electronic air cleaner
3. Blower motor:
 - PSC Fan, Cool, Heat speed taps
 - ECMx Fan, Cool, Heat speed taps
 - ECMx Motor Inline Connectors
4. Thermostat terminals
5. Main Harness Connectors (5 Options*)
 - I. Pressure switch
 - a. Proof of venting
 - b. Condensate
 - II. Limit Switches
 - a. Main air limit
 - b. Vent limit
 - c. Blower limit
 - d. Rollout
 - III. Flame sense
6. Inducer / Ignitor Connectors (4 Options*)

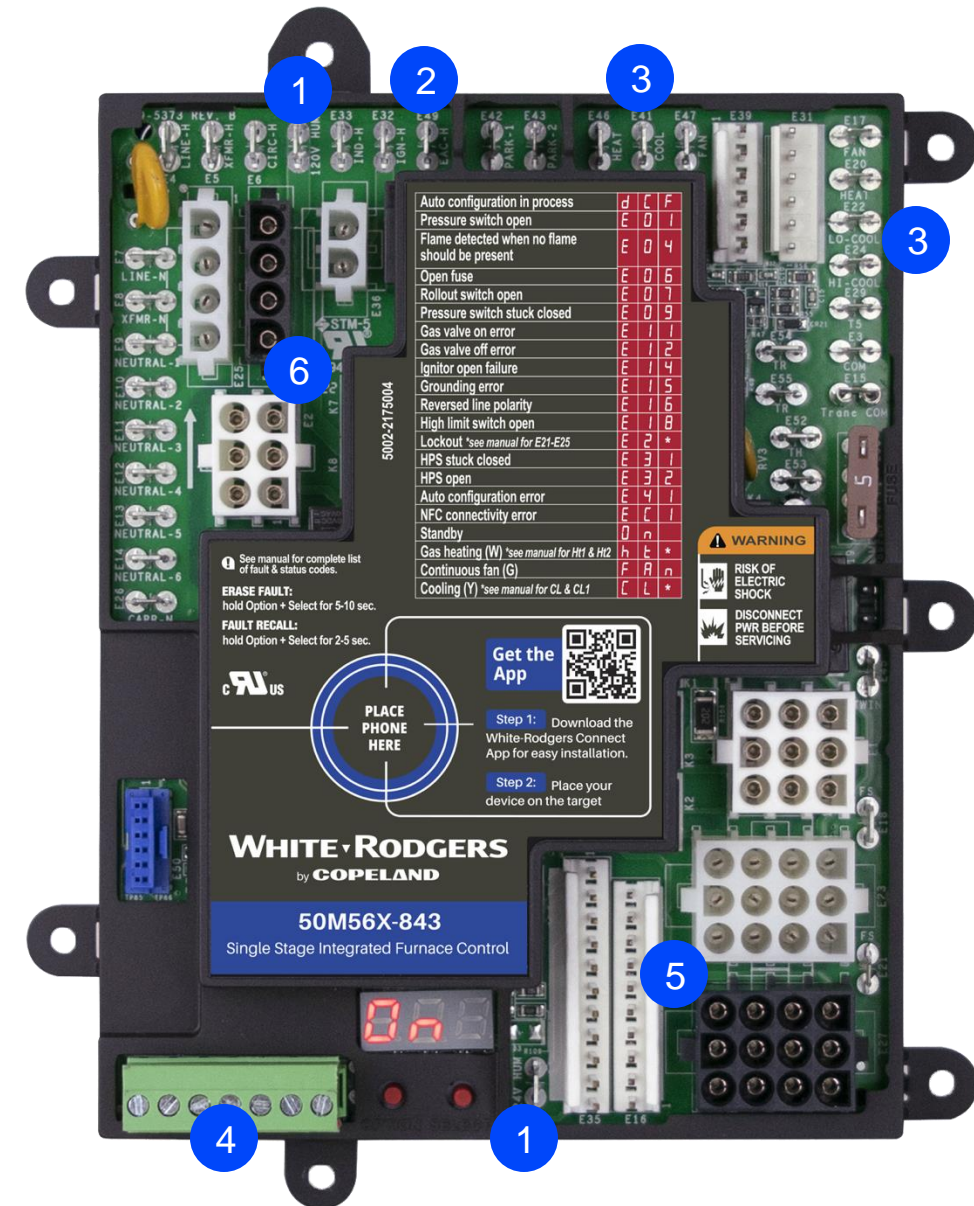
* Only 1 main harness and inducer / ignitor connector is utilized in a given application. Harness pinout configuration is determined by autoconfiguration process at startup, see instruction manual for additional details.



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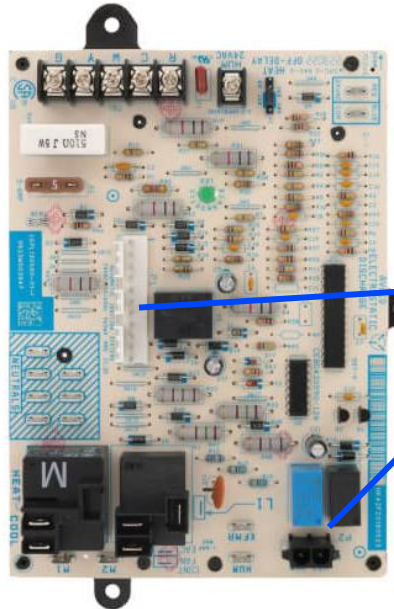
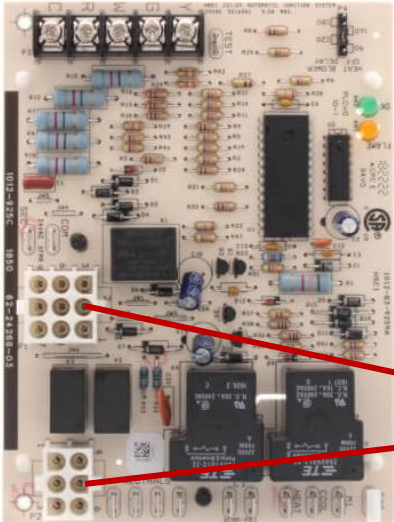
* Only 1 main harness and inducer / ignitor connector is utilized in a given application. Harness pinout configuration is determined by autoconfiguration process at startup, see instruction manual for additional details.



Universal Controls: Adaptors or multiple connectors used to connect to different OEM harnesses.

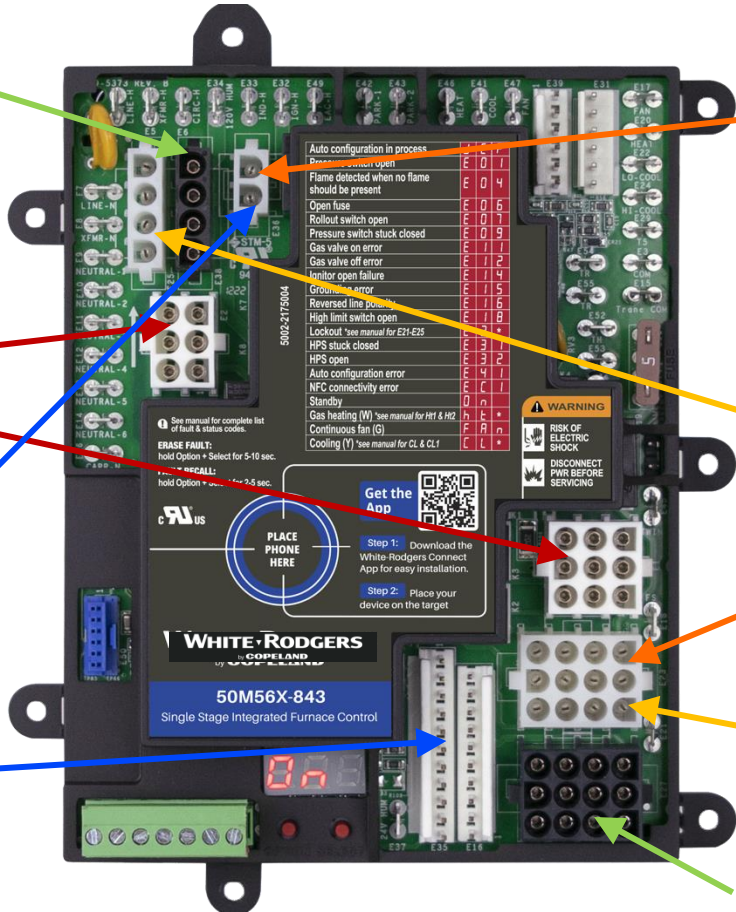
Rheem 62-24268-03

Carrier HK42FZ018



White-Rodgers 50M56X-843

Lennox/Allied



Lennox/Allied

Identify connector types on control being replaced and plug the OEM wiring harness directly on to 50M56X-843. Not every connector will be used.



Goodman PCBBF145S

Trane CNT07941

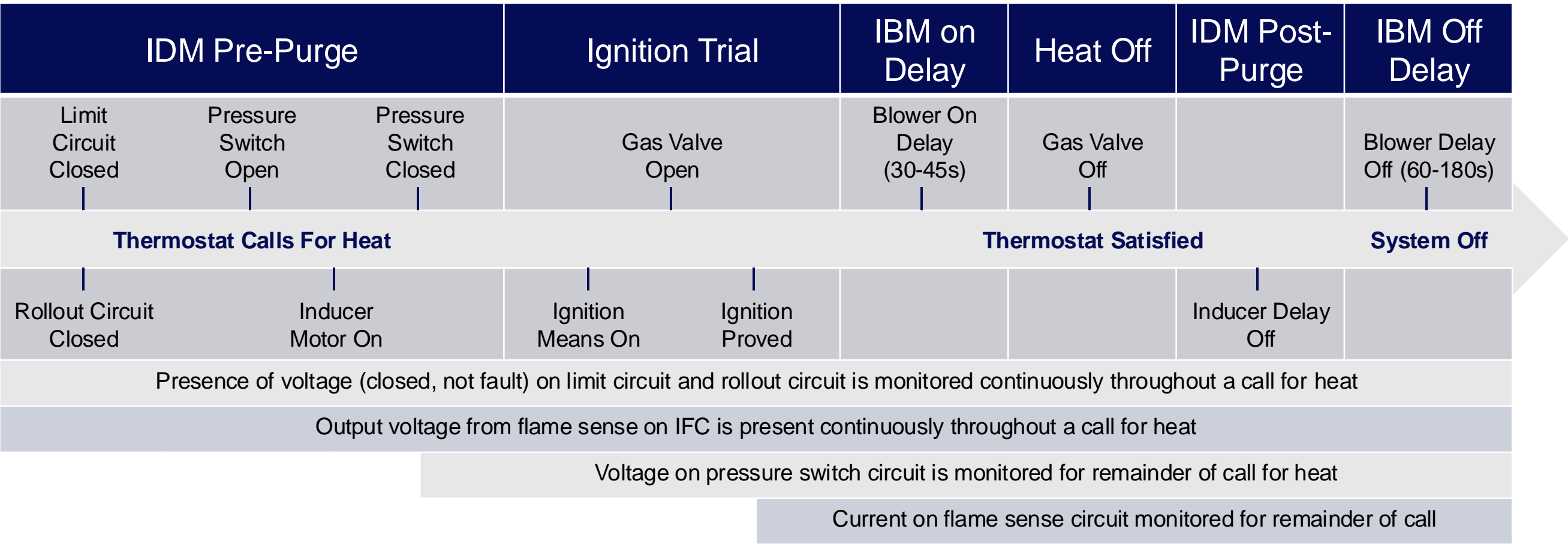


Understanding the Sequence of Operation

Part Two

Sequence of Operation

- The sequence of operation is the set of functions performed by the integrated furnace control
- Every IFC from every manufacturer follows the same sequence of operation
 - Variations occur depending on the different types and numbers of safety switches and the wiring of the switches themselves



Sequence of Operation

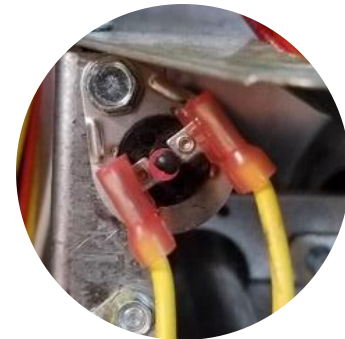
1. Thermostat calls for heat: The room temperature drops, causing the switch between R and W to close, sending 24V on W to the IFC
2. Safety check: IFC applies voltage to safety circuit(s)
 - Main air limit, vent limit, blower limit, and rollouts are all normally closed switches that open on a temperature rise
 - Voltage returning through these circuits proves these safeties
 - A fault in this circuit would result in the gas valve being deenergized while both the inducer motor and blower motor remain energized to deal with excess heat or combustible fumes
 - The limit circuit is continuously monitored throughout a call for heat



Component Call-Out: Limit Switches



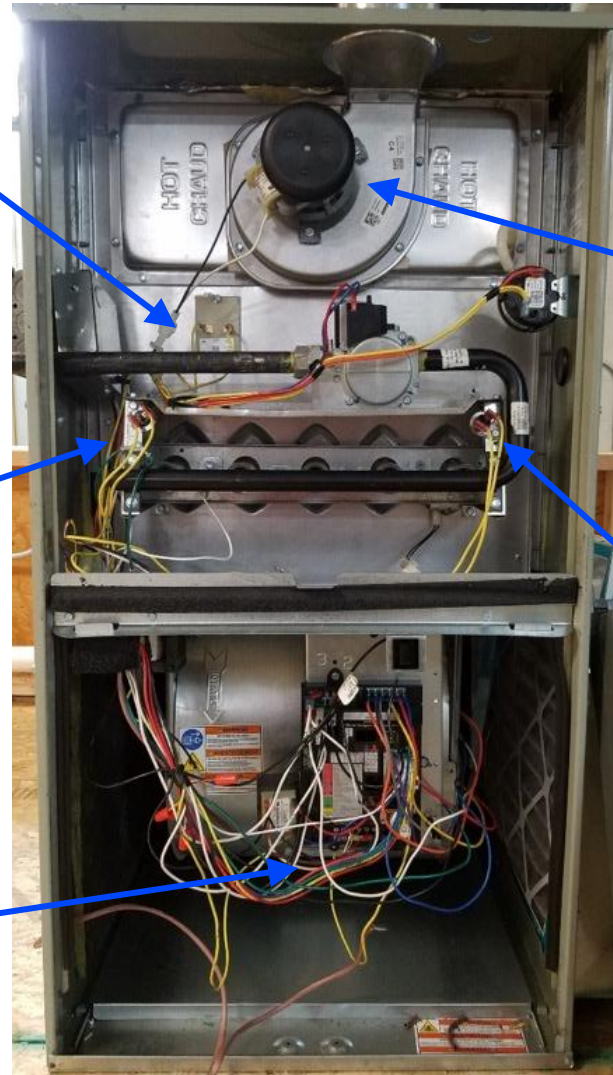
Main Air Limit



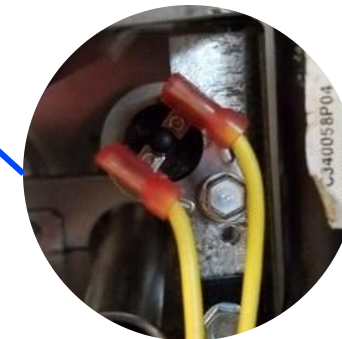
Rollout



Blower Limit



Vent Limit



Rollout

Sequence of Operation (Continued)

3. **Safety check:** IFC applies voltage to safety circuits

- The pressure switch is a normally open switch that closes under negative pressure in the heat exchanger
 - Voltage should not return through this circuit—the presence of voltage indicates the switch is stuck closed and would not shut down the system due to a lack of draft
 - A fault in this circuit, at this time, would halt the sequence of operation until the error has been corrected
 - Common causes: stuck or bypassed switch
- Flame rectification circuit should be open at this time, due to the lack of a flame to complete the circuit
 - Voltage should not return through this circuit—the presence of voltage indicates the circuit has a short-to-ground and would not be able to detect the presence or absence of a flame
 - A fault in this circuit would result in the sequence halting and energizing the inducer motor deal with combustible fumes



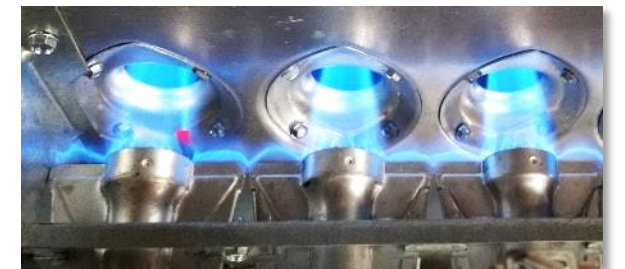
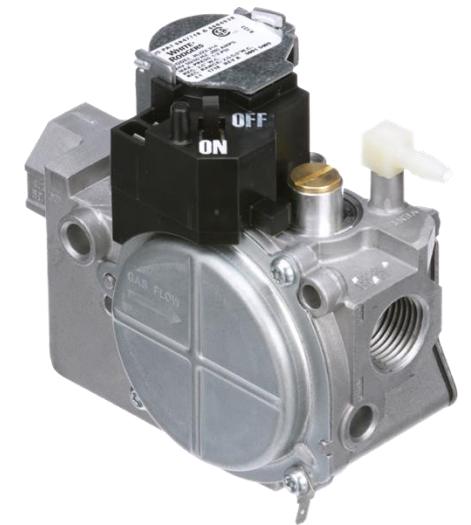
Sequence of Operation (Continued)

4. **Inducer motor energizes:** IFC applies 120V to draft inducer motor
 - Draft inducer comes to full speed and creates a negative pressure in the heat exchanger—ready to draw products of combustion
5. **Pressure switch closes:** Negative pressure in the heat exchanger closes the pressure switch, allowing voltage to return to IFC
 - A proven draft allows the ignition sequence to begin
 - A fault in this circuit would result in the sequence halting and energizing the inducer motor to deal with combustible fumes (interpurge)
 - The sequence of operation then starts over with a safety check and resumes
 - A set number of unsuccessful retries will be attempted before entering into a hard-lockout state
 - The IFC continually monitors the pressure switch circuit during a call for heat



Sequence of Operation (Continued)

6. **Ignitor energizes:** IFC applies voltage to hot surface ignitor (120V or 80V, depending on manufacturer) or energizes direct spark ignition coil
 - HSI has a brief delay time before progressing to next step to allow ignitor to come to full temperature (minimum 1,200°F)
7. **Gas valve energizes:** IFC sends 24V to gas valve solenoid
 - Solenoid valve opens and allows fuel to pass through the manifold, the spuds, and into the burners
 - Inducer motor draws the fuel vapors through the burners and across the path of the ignition source
8. **Burners ignite:** Fuel vapors contact the ignition source and combustion begins
 - Flame carries over from burner to burner via channels, igniting all remaining burners in sequence
 - Inducer motor draws the products of combustion through the heat exchanger and conveys them toward the flue



Ignition



Sequence of Operation (Continued)

- 9. Flame rod proves:** Flame completes the circuit between the flame rod (electrode) and the burner (ground)
- The high resistance of the flame and the difference in surface area between the flame rod and the burner partially rectifies the current and creates a low amperage DC signal
 - The IFC interprets the quality of the current (either a strong or weak flame signal as communicated by the IFC) and holds the gas valve open for the duration of the call for heat
 - If the current on the flame rectification circuit (measured in DC microamps or volts) is below the minimum required by the IFC, the flame is not sensed, and a fault occurs
 - Sequence of operation is halted for an interpurge and then retries for ignition
 - After multiple unsuccessful attempts, the IFC enters into a hard-lockout state
- 10. Blower motor energizes:** After a predetermined amount of time the heat exchanger warms up (30-45 seconds) and the blower motor begins to circulate air across the heat exchanger and through the conditioned space
- Improper airflow can cause the high limit to open and halt combustion



Sequence of Operation (Continued)

11. **Thermostat satisfies:** Normal furnace operation warms conditioned space to meet the thermostat setpoint and the switch between R and W opens
12. **Gas valve deenergizes:** With the loss of voltage on W, the IFC stops sending 24V to the gas valve
 - Main solenoid snaps shut and flames are extinguished
13. **Inducer motor deenergizes:** After a predetermined post purge, the inducer motor stops
14. **Blower motor deenergizes:** The blower off delay time (60-180 seconds) expires after the heat exchanger has been cooled and the blower motor shuts down
15. **Furnace waits in ready-state (stand-by) for the next call for heat**



HSI Simulator Breakout – In Practice

Observe the Sequence of Operation In Live Fire Mode



HSI Simulator Breakout – In Practice

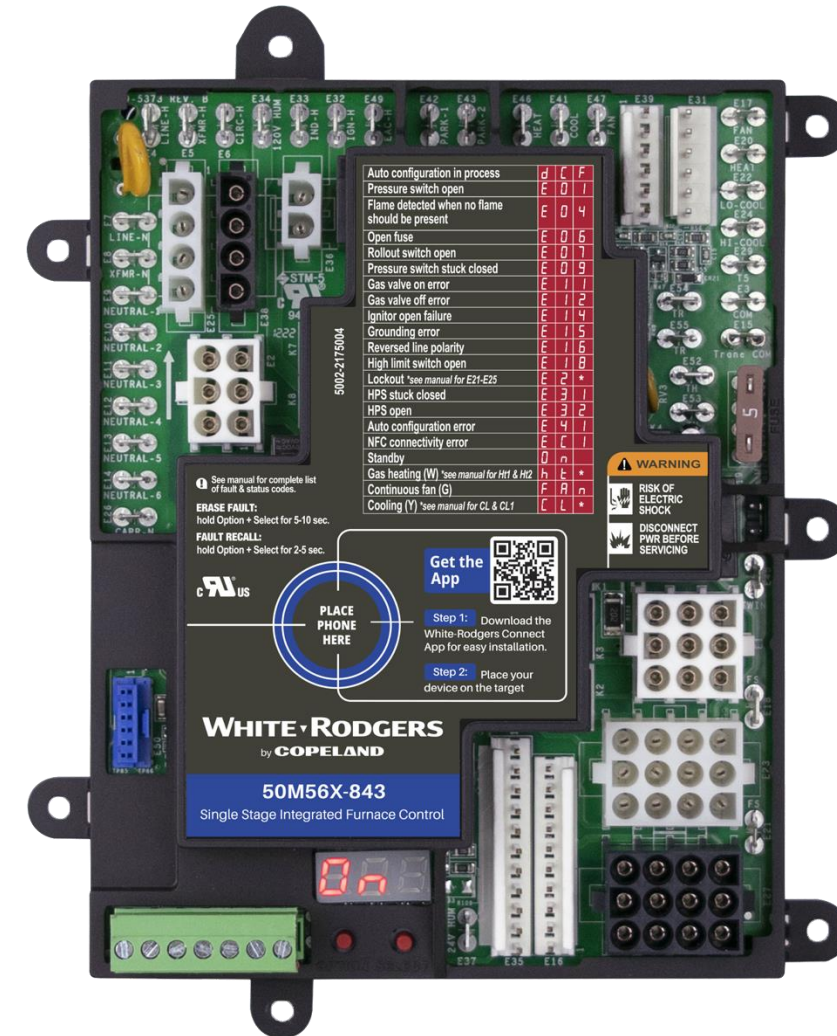
Observe the Sequence of Operation In LED Only Mode



Key Takeaways

The sequence of operation is the key to troubleshooting electrical faults in a furnace.

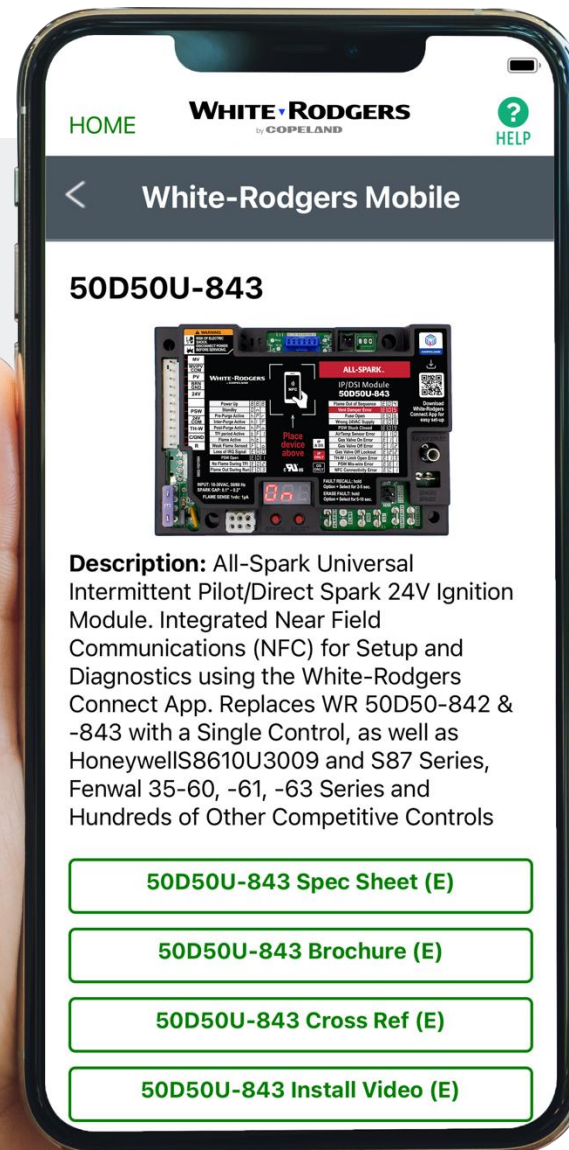
It determines when switches open and close, which circuits are active, and which loads are energized.



Comprehensive cross reference & product information

Find the right part while on the job.

Search by OEM, Competitor and White-Rodgers part numbers.



Your on-the-go resource for:

- Complete cross reference
- Product information and spec sheets
- Installation information and videos
- Wiring diagrams
- Select product by features
- Priority technical support

WR Mobile app

Search for “WR Mobile” in both Apple and Google Play Stores



Desktop version

Access the online version [HERE](#)



Choosing the Correct Furnace Control

Part Three

Furnace Control Failure

Two main causes for failure in an electronic circuit board:

Heat

- Controls are mounted too close to combustion surfaces
- Loose connections generate excessive heat

Moisture

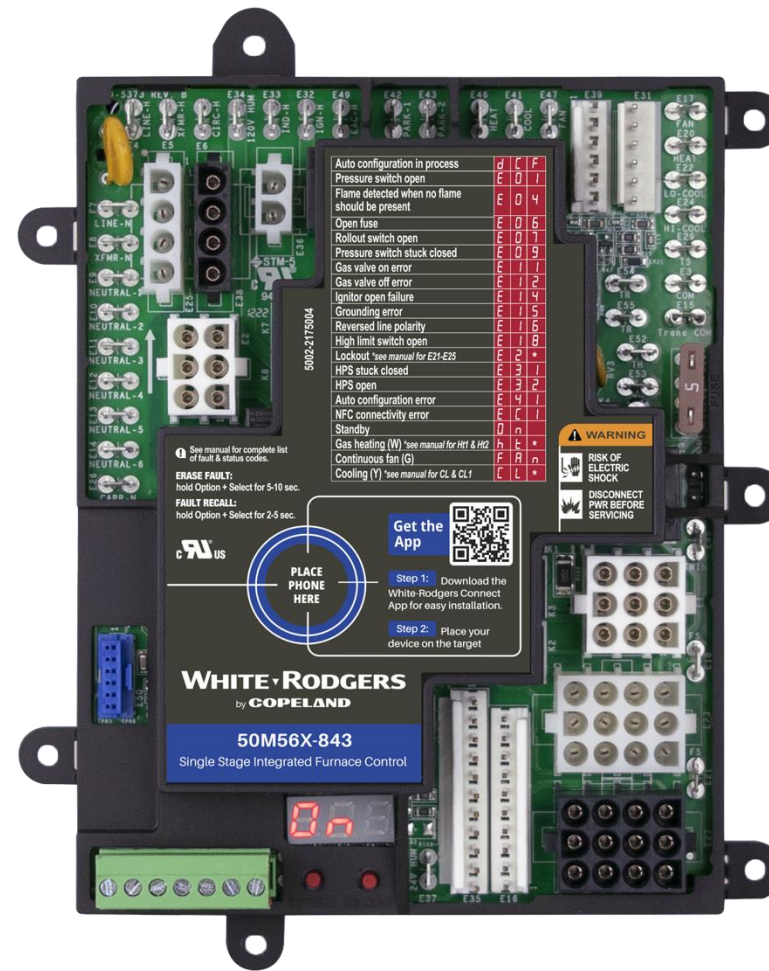
- Overflowing condensate from evaporator or condensing furnace
- Flooding



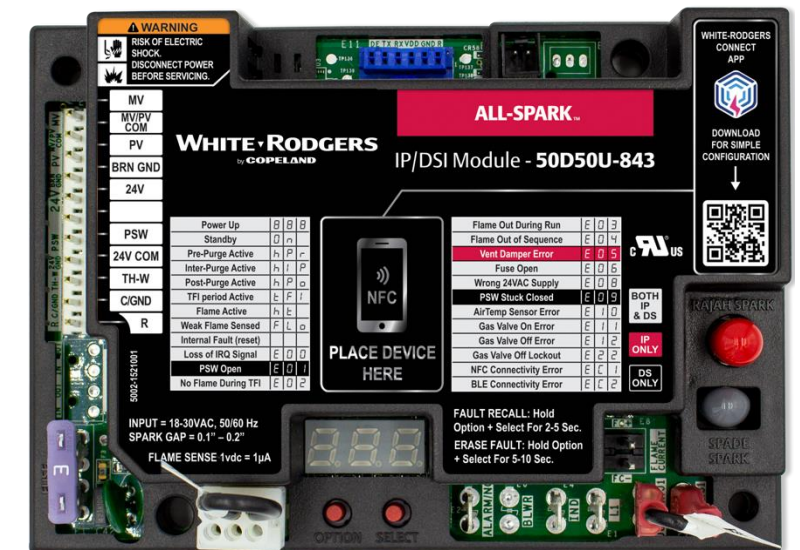
Choosing the Correct Furnace Control

The correct furnace control must match all four of the following characteristics

1. Logic
 - Integrated or non-integrated
2. Ignition source
 - Intermittent/proven pilot, hot surface ignitor, direct spark ignitor
3. Staging
 - Single stage, multi-stage, modulating
4. Blower type
 - PSC, ECMx, ECM



Integrated logic



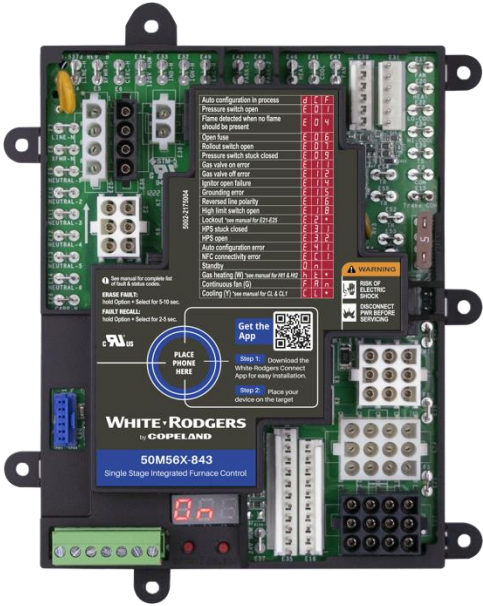
Non-integrated logic

1. Control Logic

Integrated logic

All functions of the furnace are driven and monitored by the control

- Safety checks
- Ignition and burner supervision
- Blower control
- Auxiliary components (air cleaning, humidification)



Integrated logic

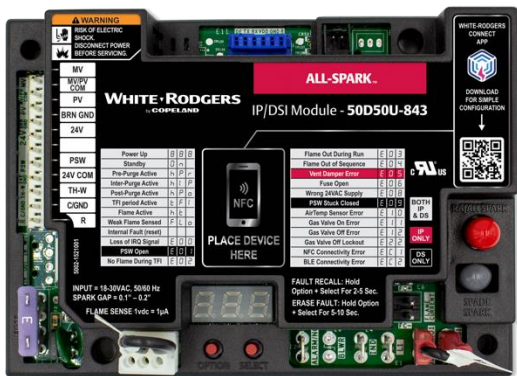
IDM Pre-Purge			Ignition Trial		IBM on Delay	Heat Off	IDM Post-Purge	IBM Off Delay
Limit Circuit Closed	Pressure Switch Open	Pressure Switch Closed	Gas Valve Open		Blower On Delay (30-45s)	Gas Valve Off		Blower Delay Off (60-180s)
Thermostat Calls For Heat					Thermostat Satisfied			System Off
Rollout Circuit Closed	Inducer Motor On	Ignition Means On		Ignition Proved			Inducer Delay Off	

1. Control Logic (Continued)

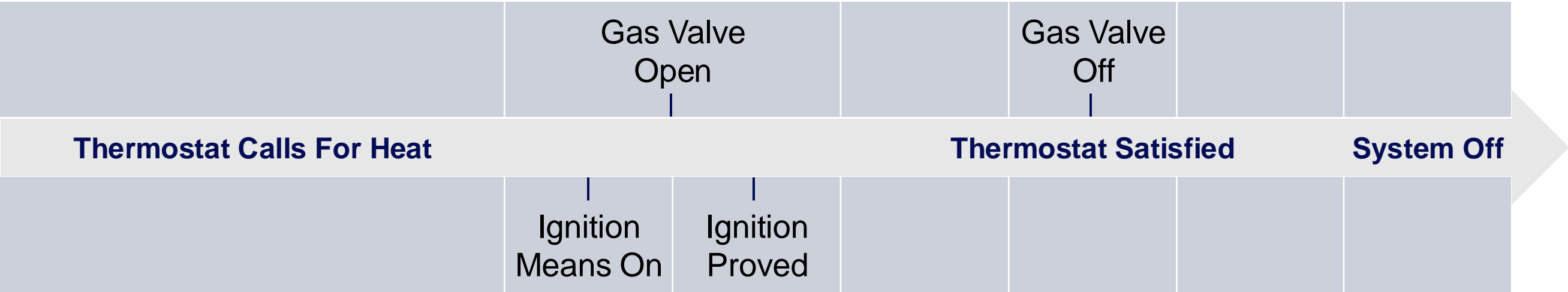
Non-Integrated logic

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Non-integrated logic



1. Control Logic (Continued)

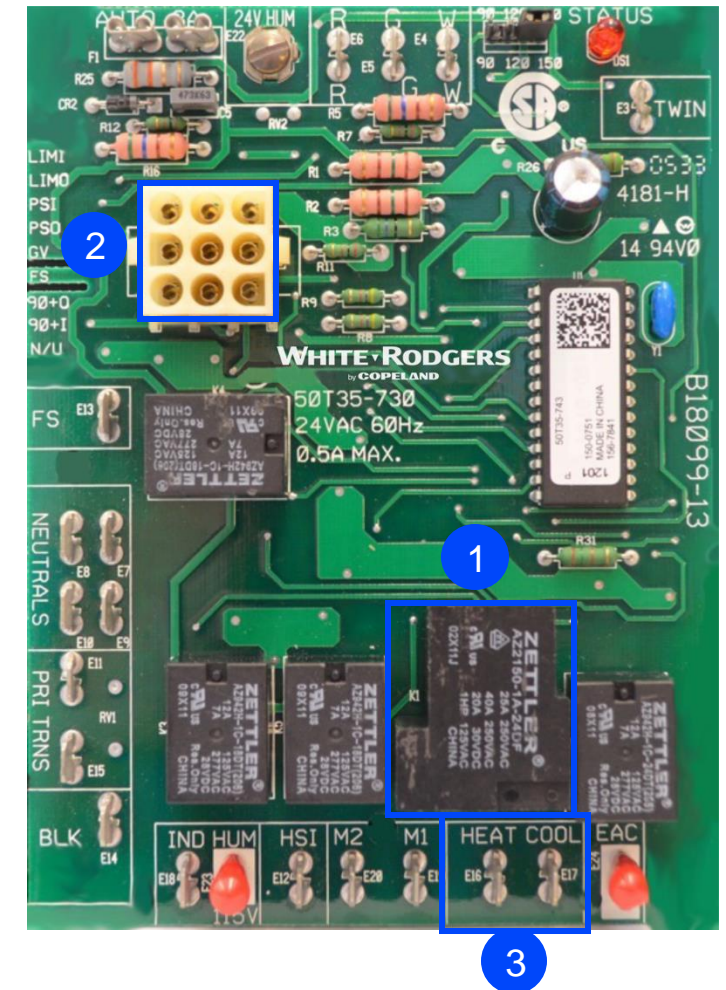
A visual inspection of the current circuit board will identify the type of control logic

Integrated:

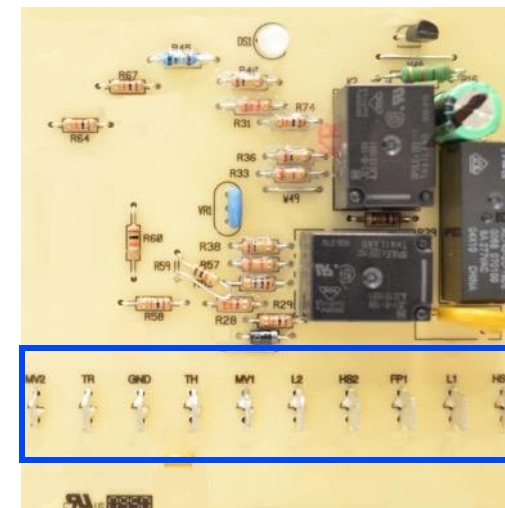
1. A board-mounted blower relay with high voltage blower terminals
2. Molex connector for safety circuits and control wiring bundle

Non-integrated

3. Terminals and relays only control gas valve, ignition, and flame proving



Ignition and burner supervision only



2. Ignition Source

Intermittent/Proven Pilot Ignition

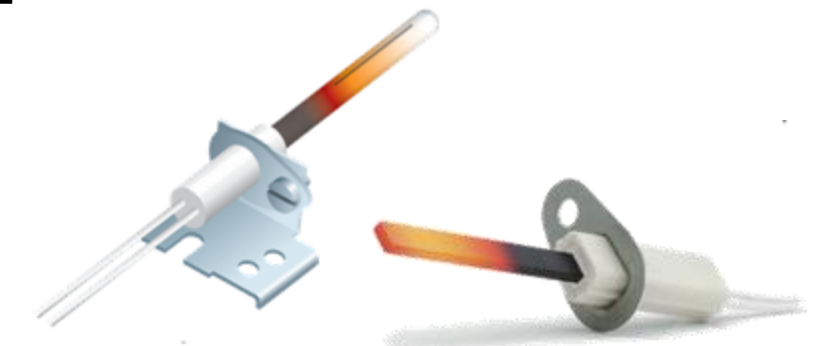
- A pilot tube extends from the gas valve to the pilot burner
- Pilot flame is not standing, but automatically lit during a call for heat
- A flame sensing circuit proves the pilot flame to keep pilot valve open and allow main valve to open



Intermittent/Proven pilot ignition

Hot Surface Ignition

- Direct burner ignition system
- Current passes through resistive strip, causing it to heat to a minimum of 1,200°F
- Gas valve opens and passes fuel across ignition source
- Burner flame is proven through sensing circuit and allows gas valve to stay open for duration of call



Hot surface ignition

2. Ignition Source (Continued)





Direct Spark Ignition

- Direct burner ignition system
- Spark electrode is located near combustion surface of burner
- High voltage pulses (in excess of 10,000V) cause a spark to bridge the 1/8" gap between the spark ignitor and the burner ground
- Gas valve opens and passes fuel across ignition source
- Electronic spark is hot enough to ignite the burner
- Burner flame is proven through sensing circuit and allows gas valve to stay open for duration of call



Direct spark ignition

2. Ignition Source (Continued)

Proven Pilot	Direct Spark	Hot Surface Ignition	
		120 VAC	80 VAC
			
A traditional pilot burner to ground, with a spark electrode and a flame sensor	A ground electrode, with a spark electrode and a flame sensor	A resistive element that heats up to ignition temperature and lights the gas with flame sensing (direct or indirect). Can be 120v or 80v AC.	

2. Ignition Source (Continued)

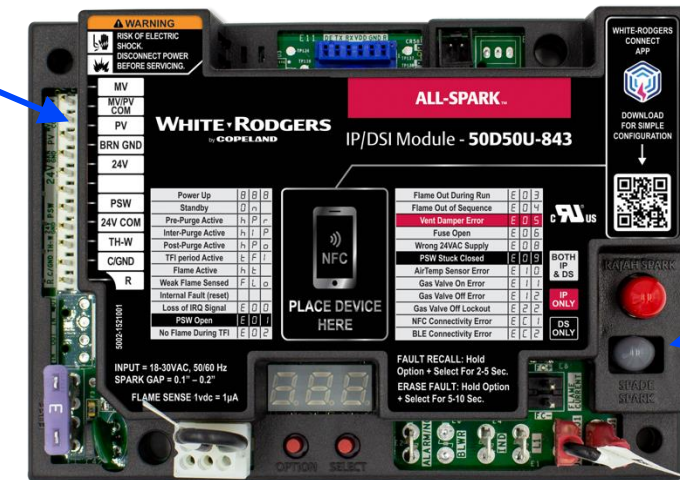
A visual inspection of the current circuit board will identify the ignition source.

PV is the Pilot Valve: Proven Pilot

HS1 or HS2: Hot Surface Ignition

No PV with Spark Ignitor terminal: Direct Spark

PV terminal



Spark ignitor terminal

Proven Pilot



Hot surface ignitor terminal

Hot Surface Ignition

3. Staging

Single stage

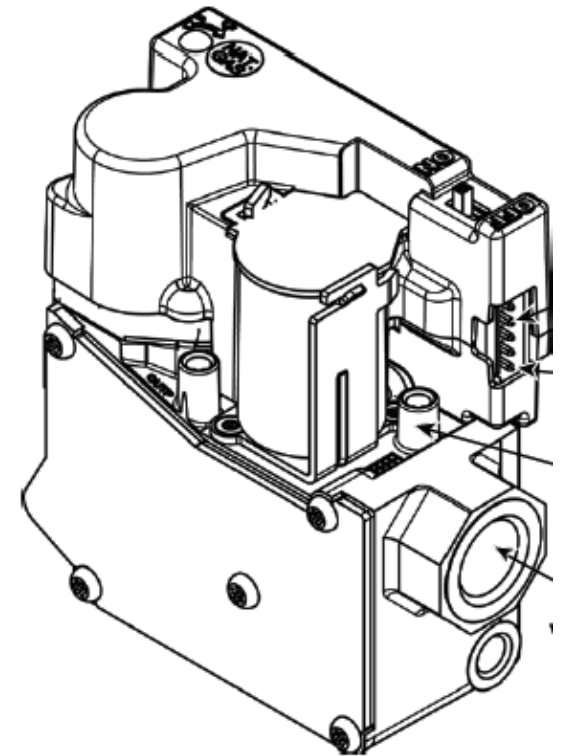
- System energizes at full capacity when there is a call for heating or cooling

Two-stage

- System has a high-fire and low-fire mode
- System runs at partial capacity to satisfy load on mild days, but at full capacity as the need increases
- Systems can have two-stage cooling capacities as well

Modulating/variable speed

- System automatically adjusts Btu output, inducer speed, and blower speed to maintain constant temperature and comfort

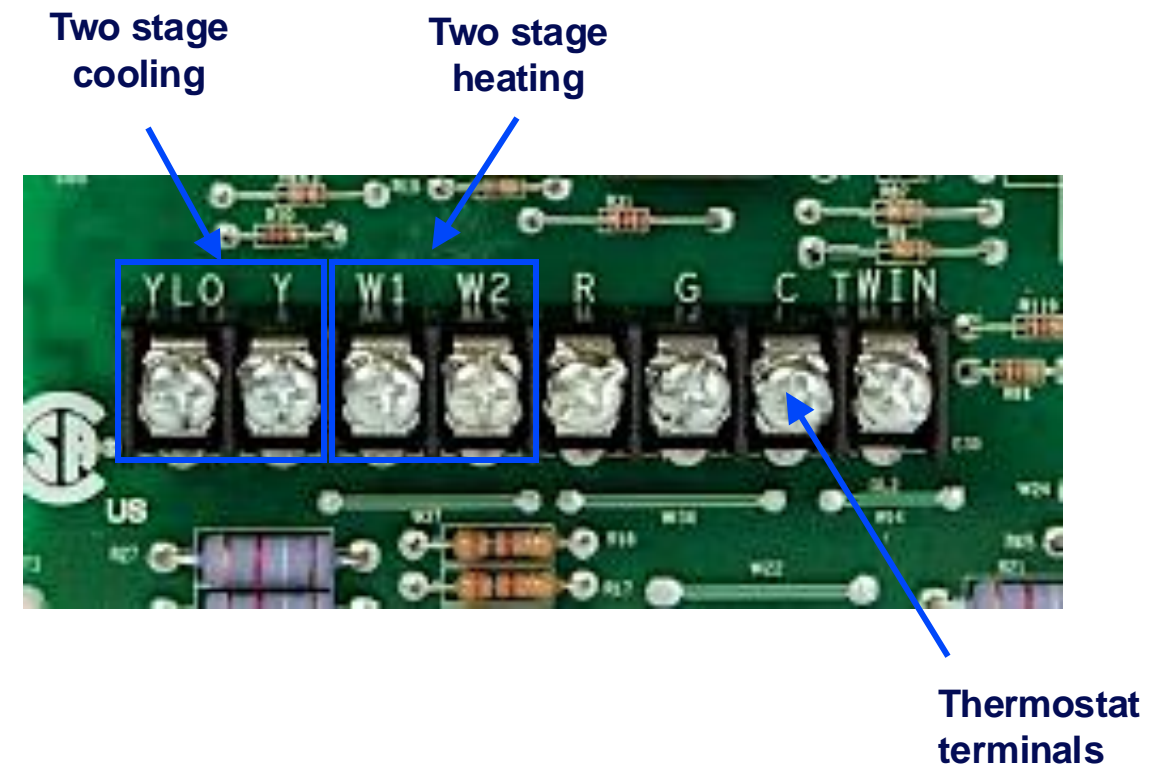


36J Modulating

3. Staging

A visual inspection of the current circuit board will identify the heating and cooling stages

- W and Y only: single stage
- W1, W2, and Y1, Y2: two staged
 - Multiple combinations of heating and cooling stages



4. Blower Motor

PSC – Permanent split capacitor

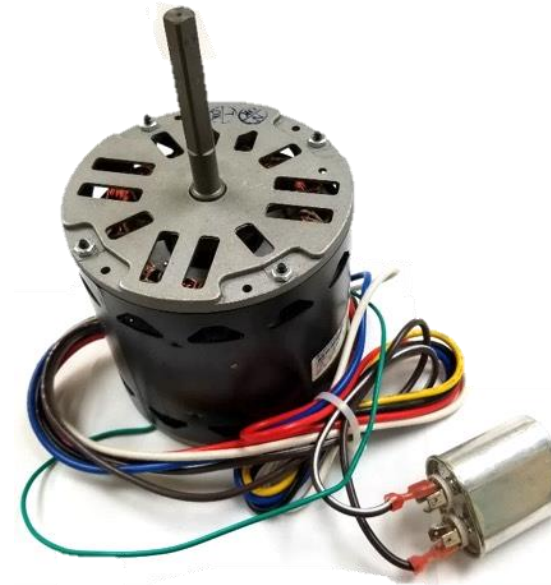
- Motor powered by integrated relays
- Each speed of motor connected to different high voltage terminal

ECMx – X-series, constant torque electronically commutated motor

- Motor powered by continuous high voltage connection
- Speeds controlled by individual low voltage terminals

ECM

- Variable speed, constant volume
- Speeds controlled by 16- or 4-pin connector



***PSC Blower Motor
with Run Capacitor***



***Electronically
Commutated Motor***



ECM 3.0



ECM 2.3



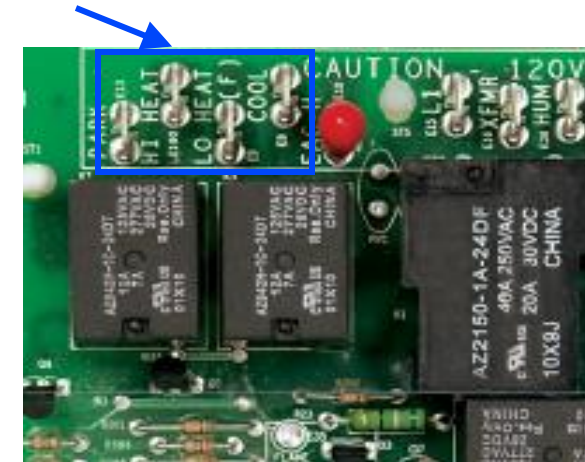
ECMx (X-13)

4. Blower Motor (Continued)

A visual inspection of the current circuit board will identify the blower motor type

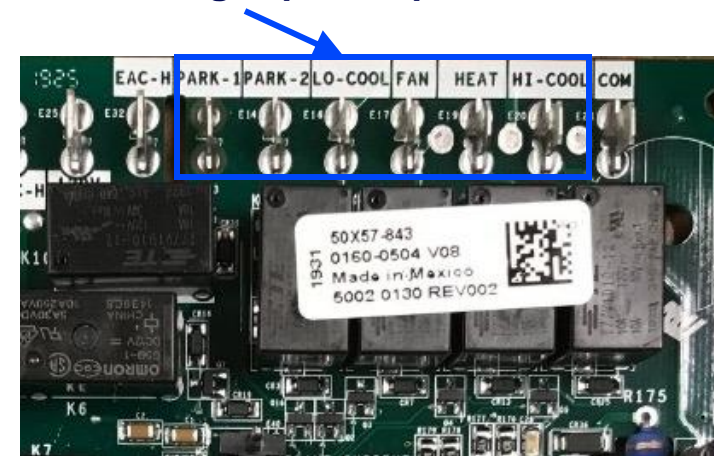
- High voltage speed taps: PSC
- Low voltage speed taps: ECMx
- 4- or 16-pin control connector: ECM

High voltage speed taps



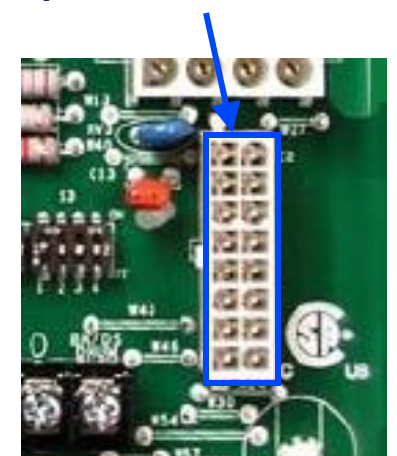
PSC

Low voltage speed taps



ECMx

16-pin control connector

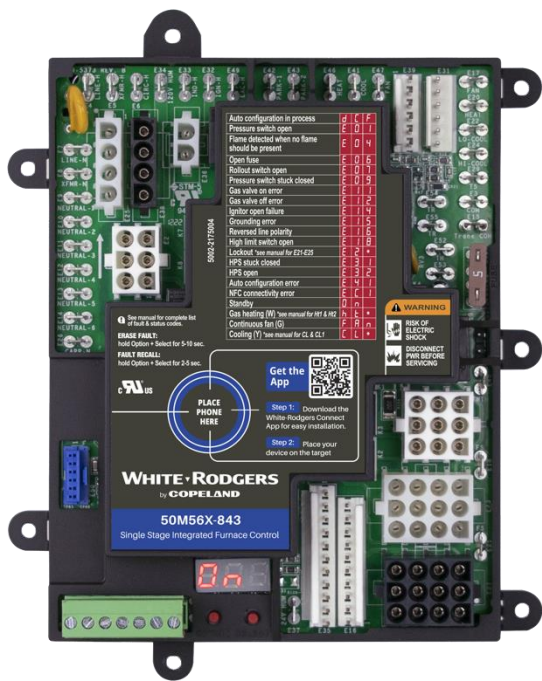


ECM

Choosing the Correct Furnace Control

Integrated Logic Control Family

Ignition Source	Blower Type	Heat Stages	White-Rodgers
HSI 120 VAC	PSC & ECMx	1	50M56X-843
HSI 120 VAC	PSC	2	21M51U-843
HSI 120 VAC	ECM	2	21V51U-843



50M56X-843

*Single-Stage Universal Integrated Furnace Control
for ECMx and PSC Blowers*



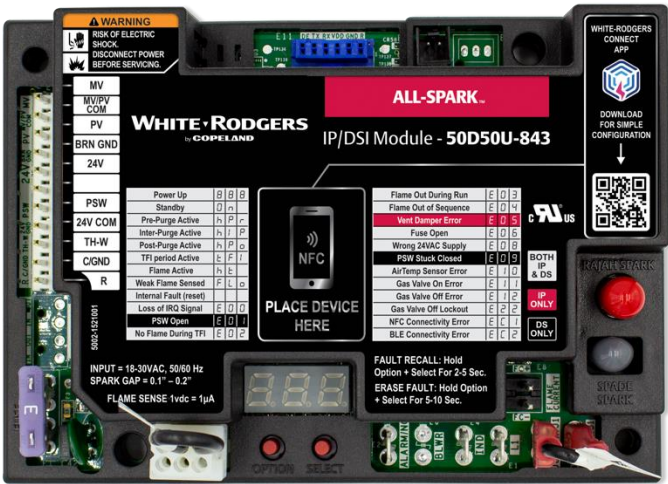
21M51U-843 / 21V51U-843

Multi-stage PSC / ECM

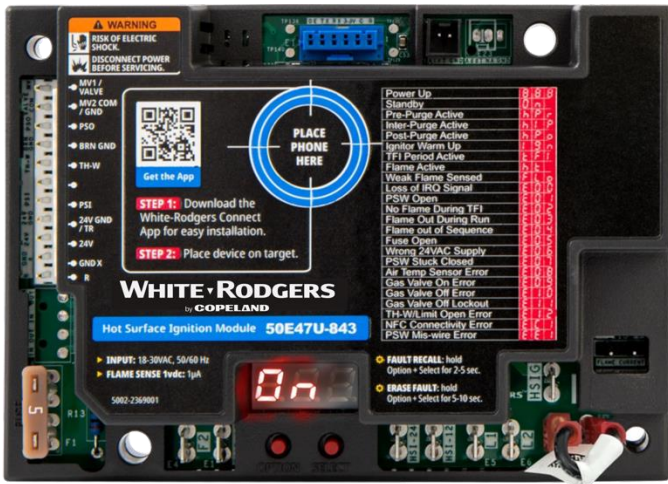
Choosing the Correct Furnace Control

Non-Integrated Logic Control Family

Ignition Source	Stages	White-Rodgers
Proven Pilot / Direct Spark	1	50D50U-843
HSI 24V, 120V, 240V	1	50E47U-843



50D50U-843
*All-Spark universal intermittent pilot/
direct spark 24V ignition module*



50E47U-843
Universal Hot Surface Ignition Module



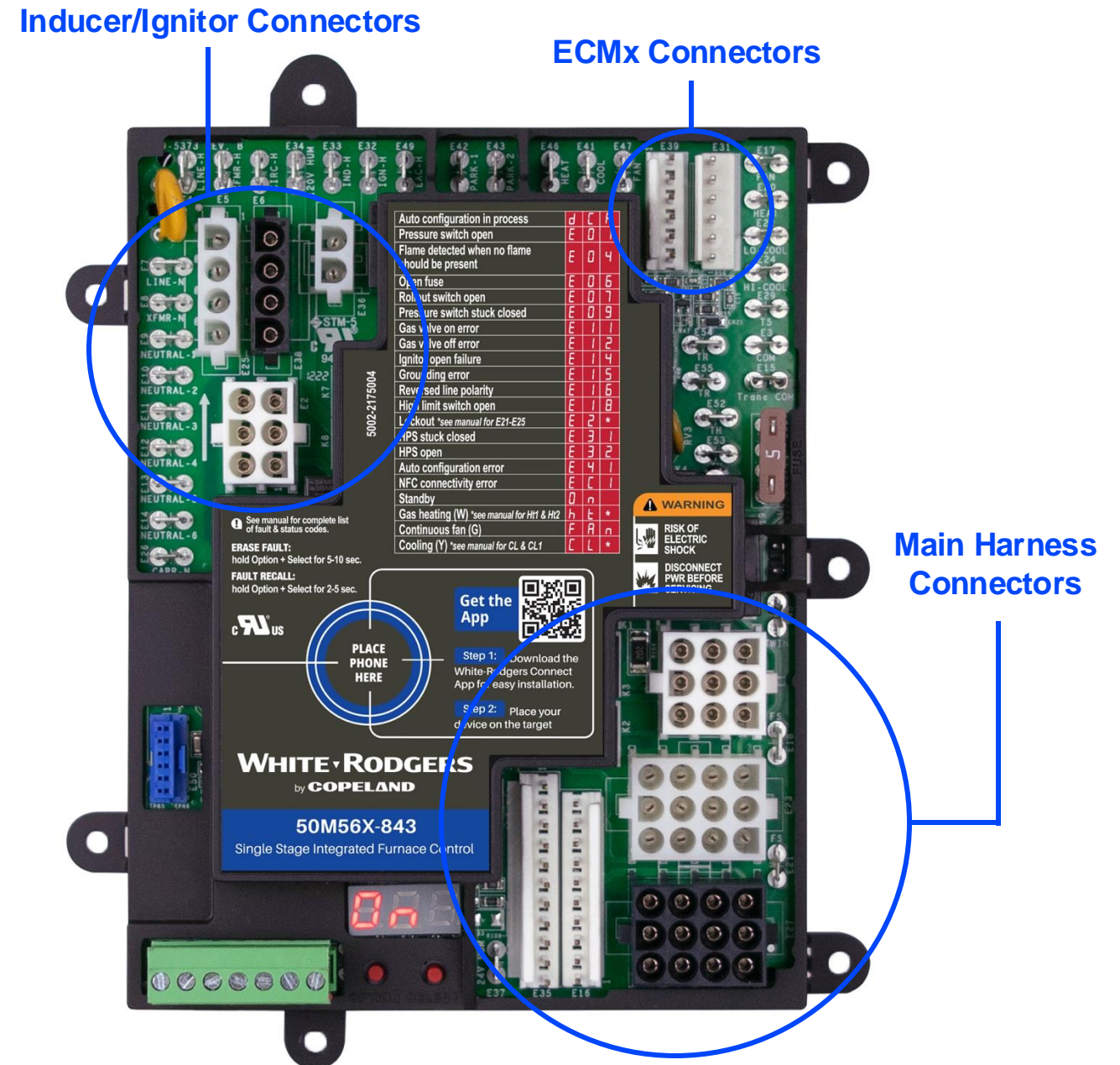
Single-Stage Universal Integrated Furnace Control 50M56X-843 for ECMx and PSC Blowers

Technical Overview

Onboard Major OEM Connectors

Simplifying Installation

- The 50M56X-843 has five main harness connectors, with both In-line and Molex plugs on the same control
- Four inducer/ignitor Molex connectors on-board
- Two ECMx connectors for Trane & Goodman direct plug-ins
- Direct OEM plug-in allows for a quick installation with multiple OEM brand controls, simplifying the process and eliminating the need for harness adapters

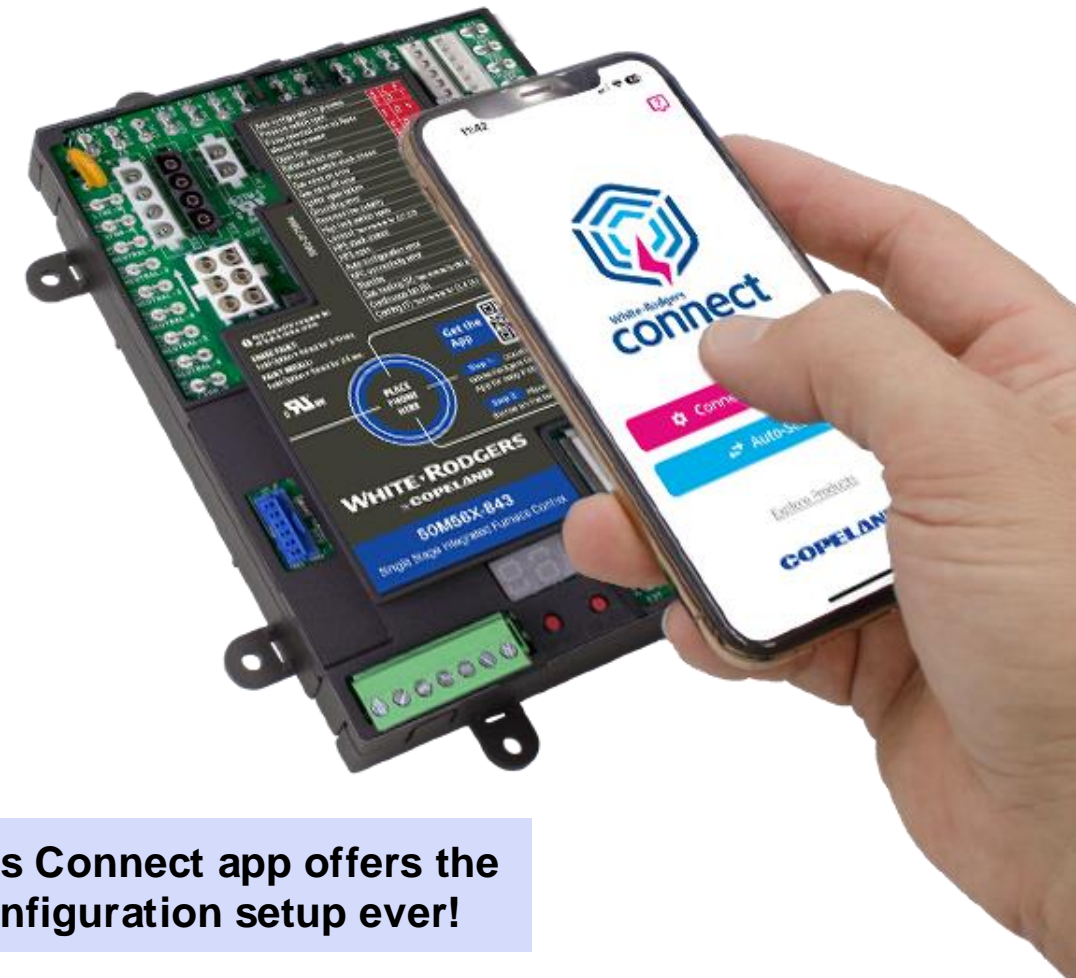


TECH TIP: During initial start-ups, the control will perform an auto-configuration sequence that takes approximately 30 seconds

Two Ways to Configure and Diagnose

The Upgraded Design Now Has On-board Programming That Allows for Configuration

Use the White-Rodgers Connect App and Do All the Programming From Your Smartphone



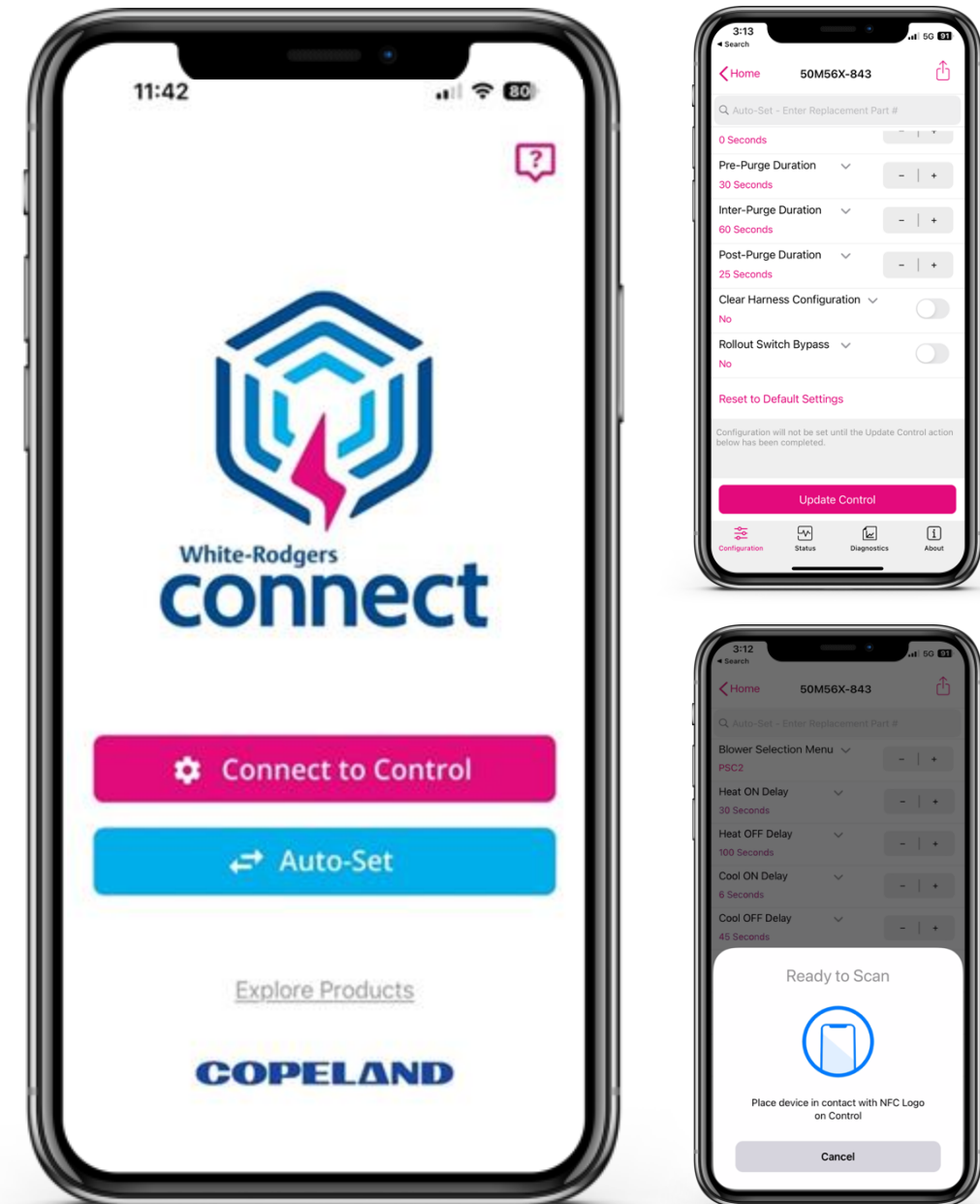
The White-Rodgers Connect app offers the fastest, easiest configuration setup ever!

Quick Configuration & Diagnostics with the White-Rodgers Connect App

- App provides simple configuration without power prior to installation
- No login or username required
- Configure with preloaded OEM settings or customize module configurations
- Diagnose fault codes and troubleshoot confidently
- View status and details about the module

Near-field Communication (NFC) creates an interface between the control and your mobile device with the White-Rodgers Connect app. Just place your mobile device on the control to enable a connection.

Once downloaded, the White-Rodgers Connect app does not require cellular/Wi-Fi service to use.



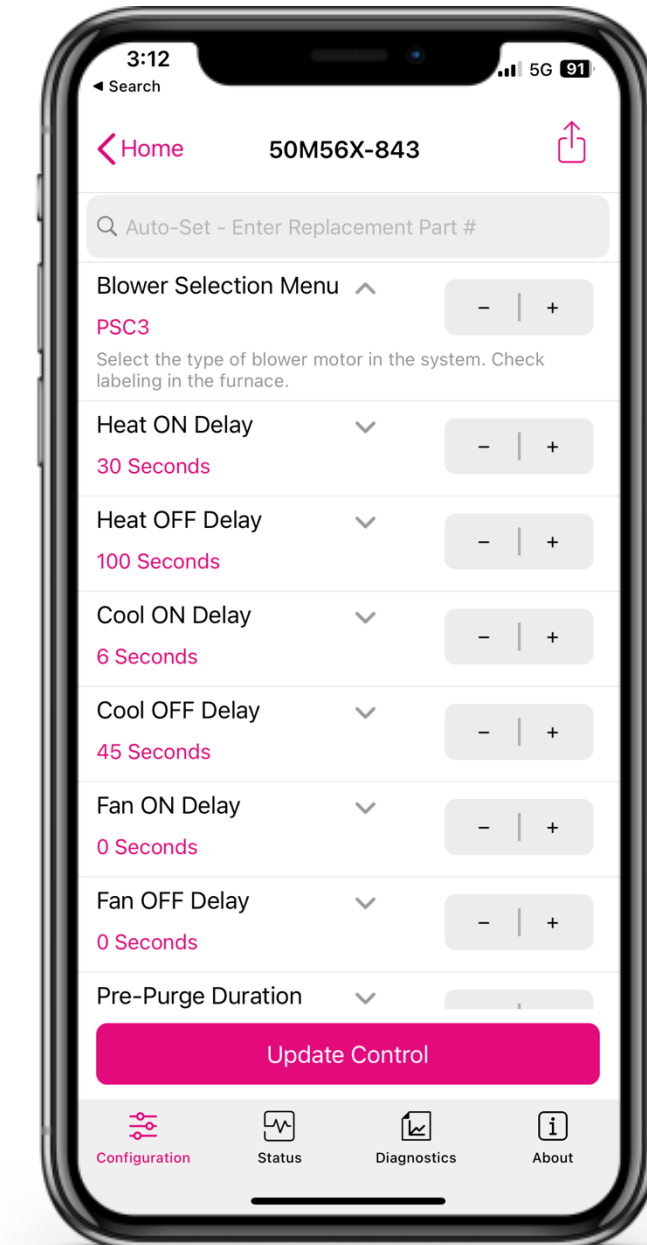
WR Connect Auto-set Feature

White-Rodgers Connect App

Configure with Auto-set

Type the replacement part number into the Configuration tab of the White-Rodgers Connect app to automatically configure the 50M56X-843 universal control to the original default settings for the replacement part number.

This can be completed without power to the control and before installation.



Enter replacement part number to automatically configure the All-Spark.

Intermittent Pilot Setting

Fully Customizable Configuration Programming in App

Both ignition and blower options are shown in the 50M56X-843 Configuration Settings

Quick Configuration Setup!

Blower Type

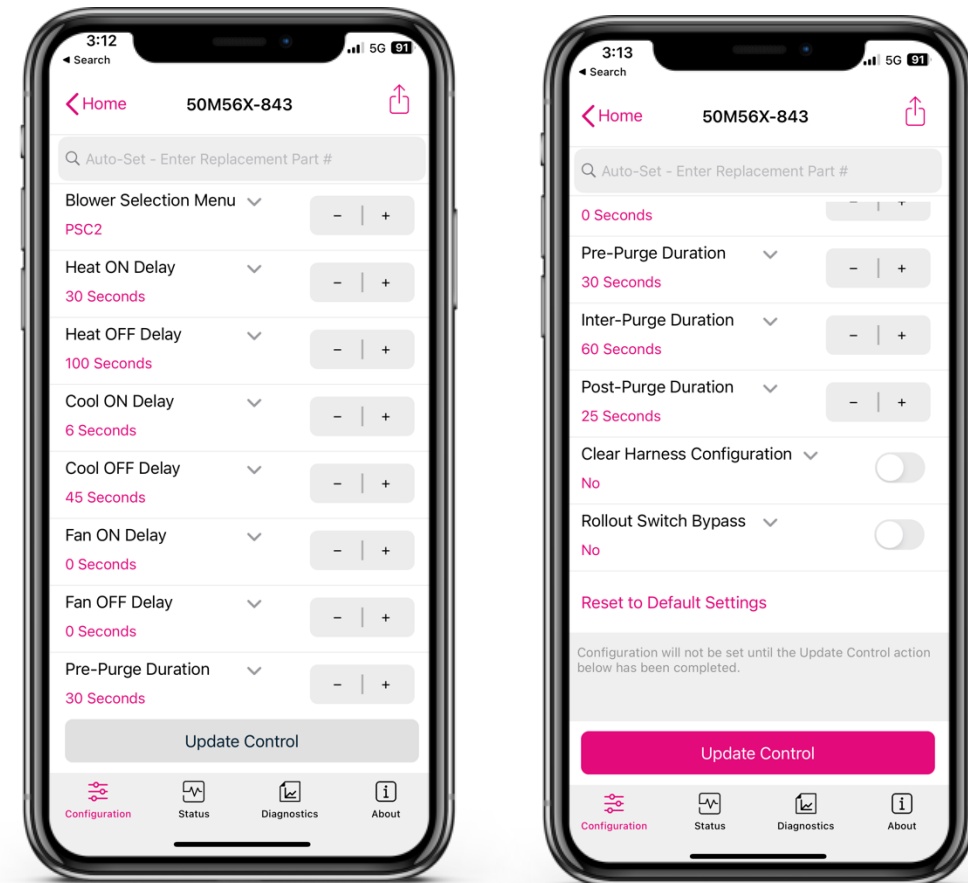
- Select between PSC & ECMx blowers with multiple speed options

Blower Timings

- Adjust blower heat on & off time
- Adjust blower cool on & off time
- Adjust blower fan on & off time

Inducer Purge Timings

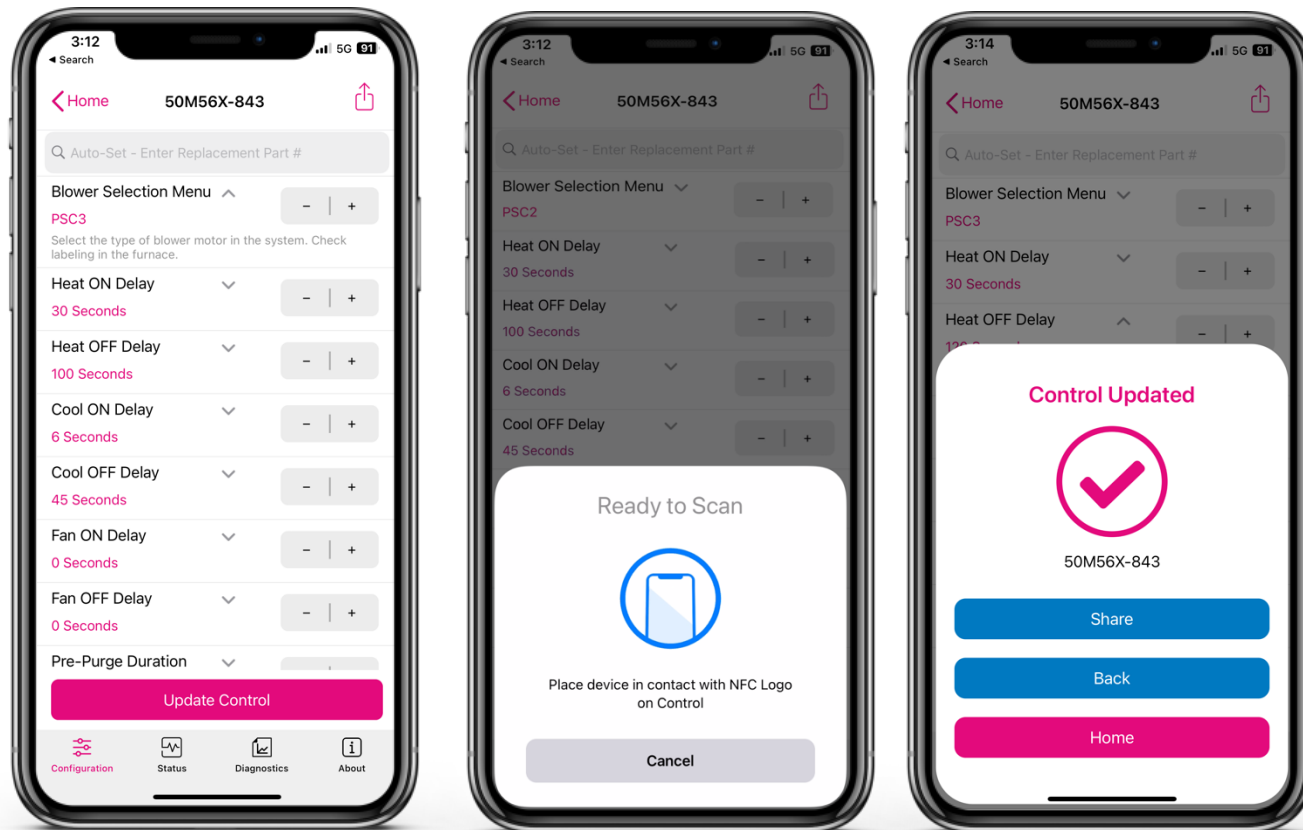
- Comes set at default for most cross-reference SKU's. Available for timing adjustments if needed.



Configuration

Update Configuration Settings from the App

White-Rodgers Connect



Tap

Update

Share

Easy to Update

- After making configuration changes, tap “Update Control” and hold your smartphone over the module again
- Once the new configuration is uploaded, a confirmation will display
- The settings for the control have been updated. You can then share a .txt file via an email or by texting. This .txt file can be printed or stored electronically in a customer's records at the installation company's office.

It takes 5± seconds to update when holding your phone steady over the module.

Additional App Features

White-Rodgers Connect

The app displays all the information shown on the 7-segment display and more!

Status

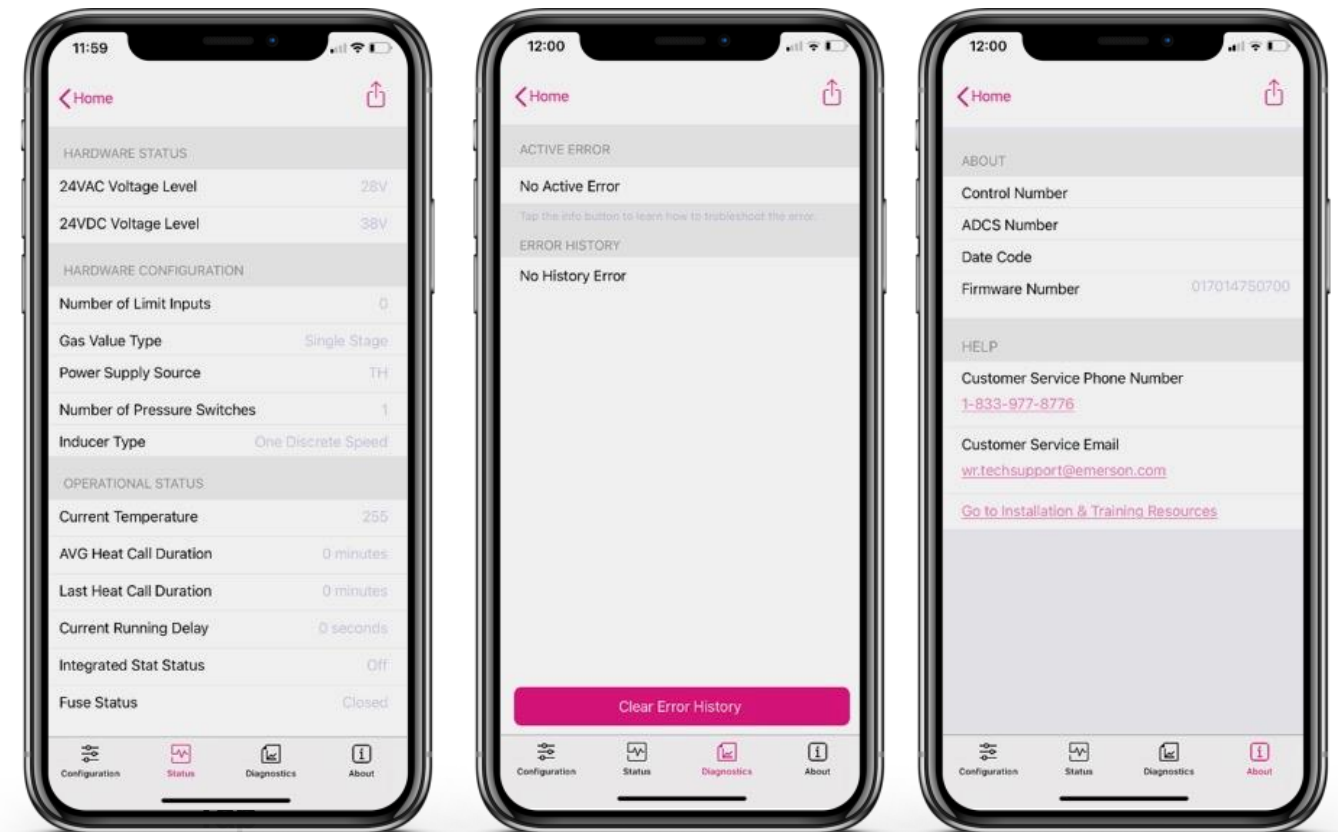
- See what is going on with voltage, configuration and operation

Diagnostics

- Look up current active errors as well as the last five errors that have occurred in the last 14 days
- View troubleshooting tips

About

- Get module-specific information, including the date code and the operating firmware



Status

Diagnostics

About

Understanding Near-field Communication



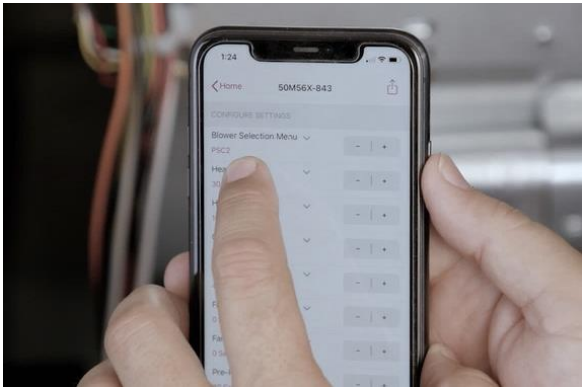
NFC

To connect to your NFC enabled control tap, connect to control. Place the NFC region of your mobile device on the NFC marking of your White-Rodgers control.



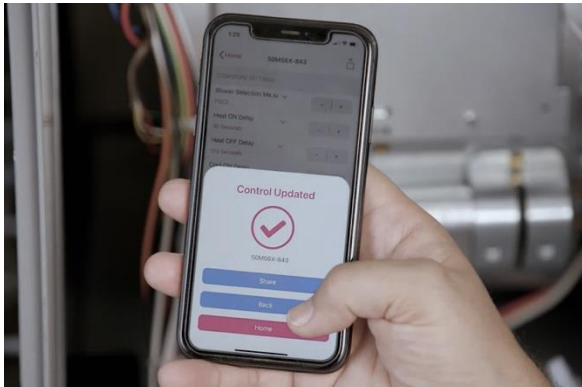
Connecting

Keep your device in contact with the NFC marking until a check mark appears and the app transitions to the configuration tab. You can then move your device away from the control.




Configuring

The text in pink shows your control settings. This text will change as you make modifications to each setting. If you tap on the name of a parameter, the app will display a description about each one for some controls.



Updating

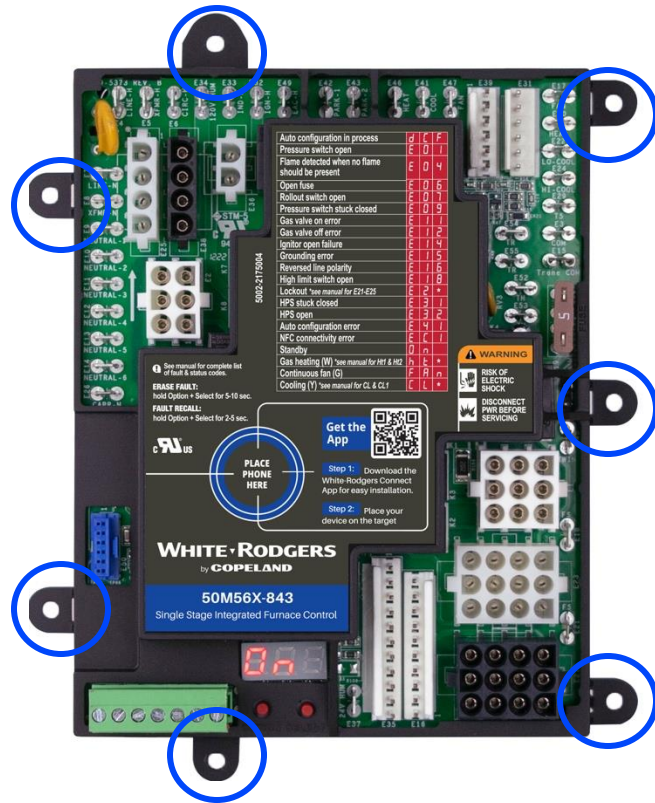
Once you've chosen your desired settings, tap update control. Place the NFC region of your device on the NFC marking of your White-Rodgers control, keep your device in contact with the NFC marking until a checkmark appears.

 **TECH TIP:** On select White-Rodgers controls, the auto set feature allows you to enter the replacement part number to automatically configure the White-Rodgers control to the replacement parts original settings.

Three Easy-to-Install Mounting Options

Seven Mounting Tabs

4 ½" self-tapping screws are supplied for multiple mounting options.



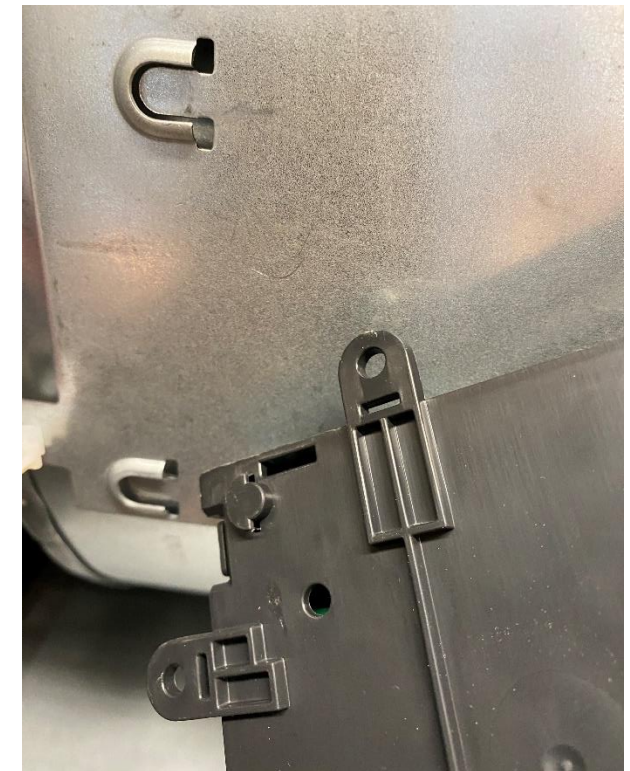
Five Standoff Holes

White-Rodgers' molded tray base provides space between the board and the unit mounting plate. Five standoffs are included for snap-in mounting.



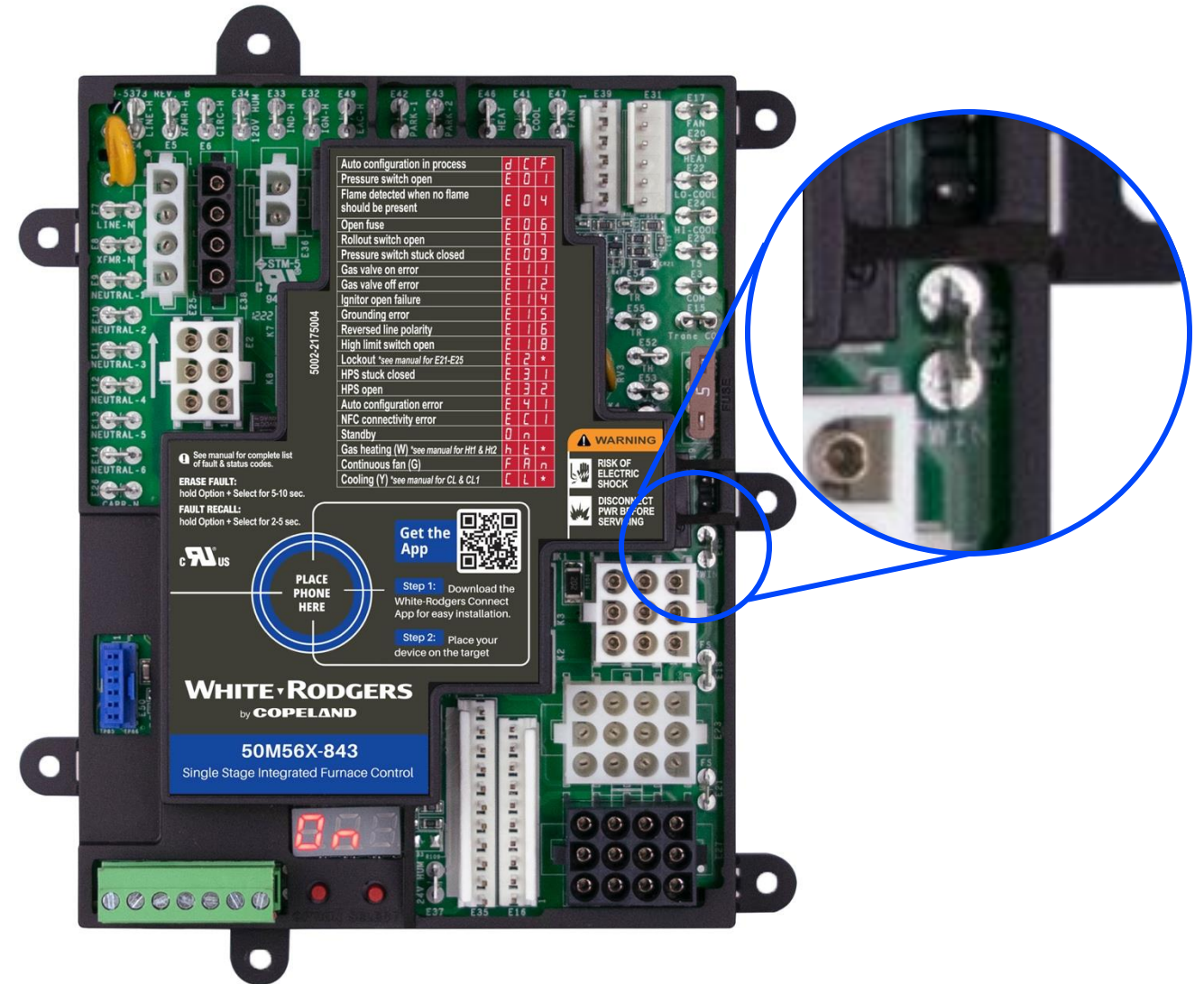
Two-slot Slide-in Tabs

Utilize existing slots by using slide-in tabs molded into the tray.



Twinning Feature

- Two 50M56X-843 controls can be connected to operate simultaneously.
- Twinning requires a connection of the twin terminal on both boards using an 18ga wire.
- The board with the thermostat connection will fully function, including the LED indicator and DIP switch settings. The twinned board will operate simultaneously as determined by the wired board unless “W” or “Y” are powered to it.



Easy On-board Setup Configuration

Configure Using the Option & Select Buttons

- After the system is powered on, the display will read ON when in standby mode. To enter setup, press the “Option” button.
- Refer to the installation instructions on page 2 for details on how to navigate the "Option" and "Select" buttons.



Match blower timer settings to the old control being replaced.

INSTALLATION

Table 1: Configuration Menu Options

				*Factory Default Setting
No.	Option Menu Item	Option Display	Selections Menu	Description / Notes
1	Active Fault Menu	Err	"Exx"	Cycles through up to 4 active errors. XX=2 digit Fault Code ex. E01
2	Firmware Version	Cr	"rXX"	Displays Firmware Version Number
3	Display Selected Harness Configuration	dSH	"Hxx"	Displays Harness / Connector (Auto) Configuration ex. H23
4	Reset to Factory	rSt	no*, yES	Resets configurations to factory defaults
5	Clear Harness Configuration	CHC	no*, yES	Clears Harness / Connector auto configuration data from memory
6	Blower Motor Type Selection	bLr	PS2*, PS3, EC2, EC3, EC4, EC5, EC9	Select according to OEM motor type either: PSC-2 & 3 speed, or ECMx 2, 3, 4, 5 or 9 speed
7	Pre-purge	PrE	15, 30*	Duration (Seconds)
8	Inter-purge	Int	15, 30, 45, 60*	Duration (Seconds)
9	Post purge	PSt	5, 10, 15, 25*, 30, 90	Duration (Seconds)
10	Constant Fan Speed ECMx	Fsd	Fxx (xx: Blower Speed Number) Default – F01	Fan Speed Setting for ECMx Blower Connectors (6-Pins)
11	1st Stage Cool Speed ECMx	CS1	Fxx (xx: Blower Speed Number) Default – F04	Low Cool Setting for ECMx Blower Connectors (6-Pins)
12	2nd Stage Cool Speed ECMx	CS2	Fxx (xx: Blower Speed Number) Default – F05	High Cool Speed Setting for ECMx Blower Connectors (6-Pins)
13	Heat Speed ECMx	Hsd	Fxx (xx: Blower Speed Number) Default – F01	Heat Speed Setting for ECMx Blower Connectors (6-Pins)
14	Fan On Delay	Fnd	0*, 2, 5	Duration (Seconds)
15	Fan Off Delay	FFd	0*, 2, 60, 90, 120, 180	Duration (Seconds)
16	Cool On Delay	Cnd	0, 2, 3, 5, 6*	Duration (Seconds)
17	Cool Off Delay	CFd	0, 2, 3, 5, 45*, 60, 80, 90	Duration (Seconds)
18	Heat On Delay	Hnd	15, 20, 22, 25, 30*, 40, 45, 60, 66	Duration (Seconds)
19	Heat Off Delay	HFd	60, 90, 100*, 120, 135, 140, 150, 160, 180, 225	Duration (Seconds)
20	Automatic Heat Staging (Hybrid Only)	AHS	OFF, 05, AUT*	Staging Time for Goodman Hybrid System – See Application Notes pg. 5
21	Rollout Input Bypass	rOb	no*, yES	Bypass Rollout Input – See Applications Notes pg. 6
22	Self-Test Mode	StE	no*, yES	Initiates Self-Test Mode

Action	Module Status	Button Press
Enter Configuration Menu	In Standby Mode	OPTION
Advance 1 Option Menu Item	In Configuration Menu	OPTION
Enter Selections Menu Level	At Options Menu Level	SELECT
Advance 1 Selection Item	At Selections Menu Level	OPTION
Confirm Selection	On Chosen Selection	SELECT
Exit Configuration Menu	On No. 22 in Configuration Menu	OPTION

Universal Applications

80V Ignitor Controls

80V ignition systems that must be upgraded to 120V by replacing the OEM ignitor with the included HotRod™ ignitor. See the installation instructions on page 5 or verify with WR Mobile for cross-reference numbers that apply.



Blower Type Selection

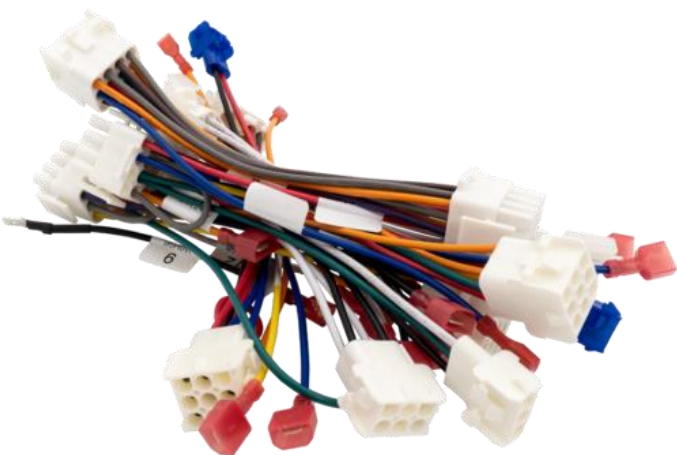
With the 50M56X-843 able to replace both PSC & ECMx blowers, configuration must be set to the type of motor as well as the quantity of speeds.

The Configuration Menu setting #6 (bLr) must be set to match the equipment's blower.

bLr	PS2*, PS3, EC2, EC3, EC4, EC5, EC9
Select according to OEM motor type either: PSC -2 & 3 speed, or ECMx 2, 3, 4, 5 or 9 speed	

Replacing Existing Universal Controls

When replacing a failed Resideo/Honeywell H9200U1000, ICM ICM2812-KIT & ICM-2812, or White-Rodgers 50M56U-843 & 50X57-843, identify and remove any wiring adapter harness between OEM furnace wiring and the failed universal control prior to installing a 50M56X-843.



Special Case Applications

Goodman Hybrid 2-Stage

A unique system known as the “Goodman Hybrid” system is a furnace with a two-stage gas valve paired with a single-speed inducer motor and a single stage blower.

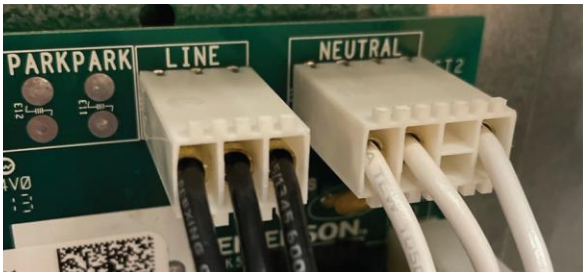
50M56X-843 is able to operate these unique applications with the following cross-reference controls:

Goodman Controls	
PCB00109	PCBBF109
PCBBF109S	PCBBF122
PCBBF122S	PCBBF132
PCBF132S	

OEM Wiring Connectors

Some OEM furnaces, for example Trane and American Standard have a plastic connector housing that groups together line and neutral spade terminals.

When found, remove the block and install the supplied quick-connect spade terminals.



Roll-Out Configuration

Certain Trane, American Standard, and York (including York P3UR/PCLU) furnaces do not have an individually monitored rollout switch in their main harness wiring configuration.

No shunt or jumper required.

The Configuration Menu setting #21 (rOb) to (yES) will digitally bypass the rollout input.



Flame Sensor Kit

If the 1994 or earlier Rheem/Ruud control being replaced has two green lights (no amber light) and a date code of 3294 or earlier, a Flame Sensor Kit, RHEEM part number 62-24044-71, required (not available through White-Rodgers).



Get Flame Current Reading Without Meter

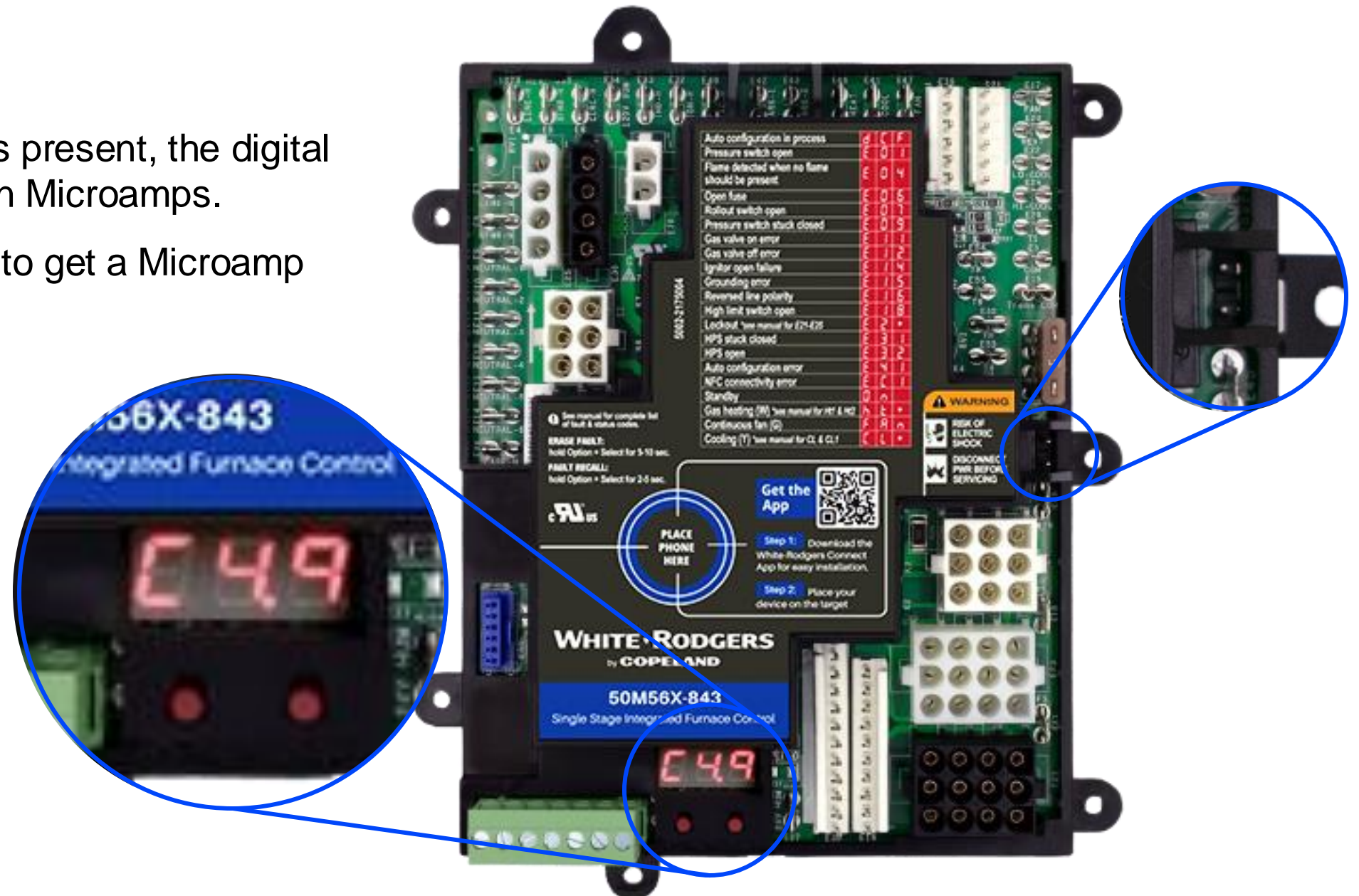
NEW On-Board Read-out

During a call for heat when a flame is present, the digital display will display the flame sense in Microamps.

No more needing to pull out a meter to get a Microamp reading—just look at the display!

Standard Test Pins Also Available

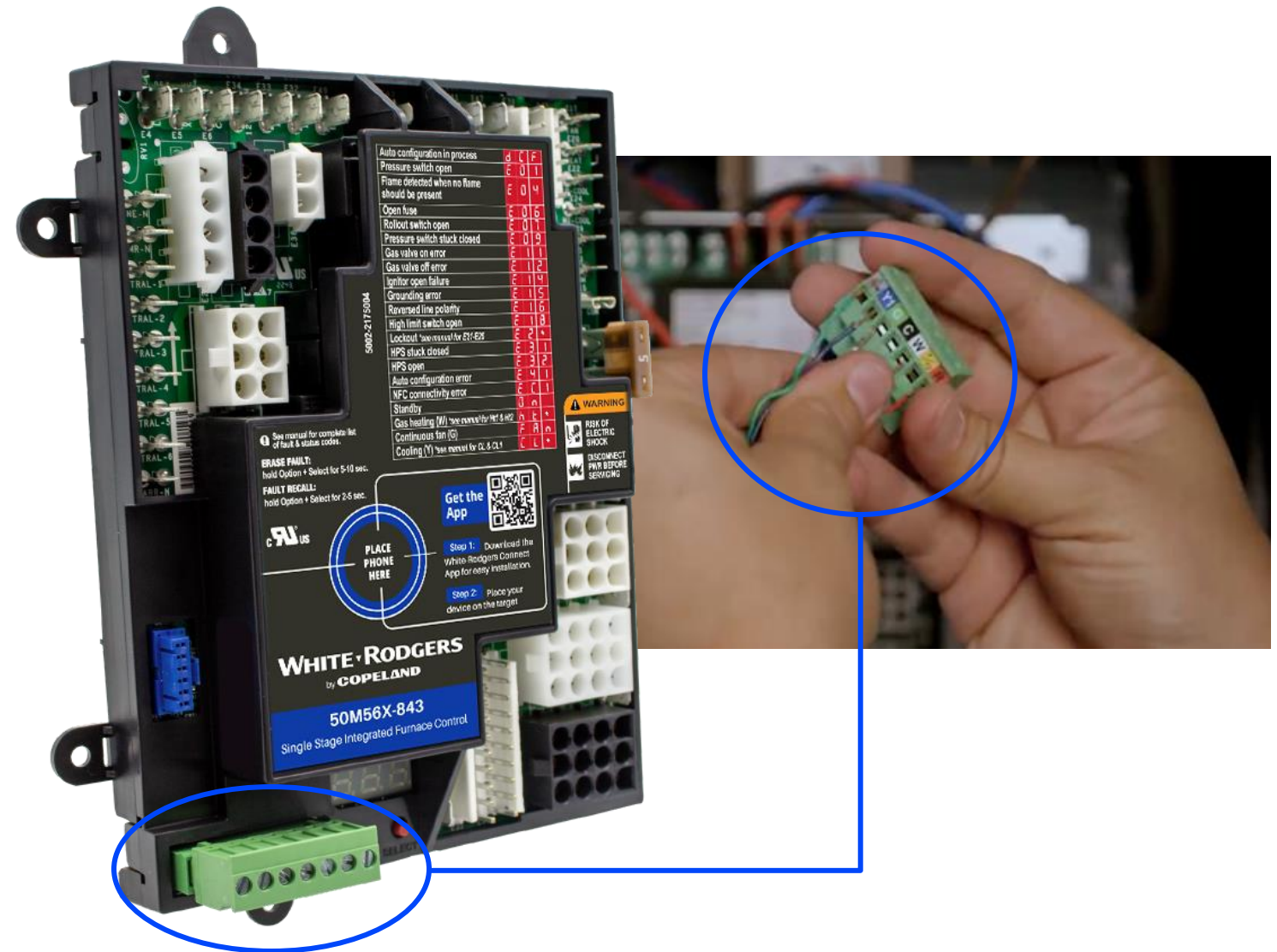
Two pins can be found on the right edge of the control board.



Thermostat Wiring Made Easy

Lift-off Thermostat Connector Block, Including Dehumidification

- Connect thermostat wiring away from the board
- No more getting into the furnace to get the wiring connected—just connect it out front, verify wires are secure in the block, then plug in!
- When the dehumidification terminal on the block is used, the control will slow the blower down during cooling for increased humidity removal.

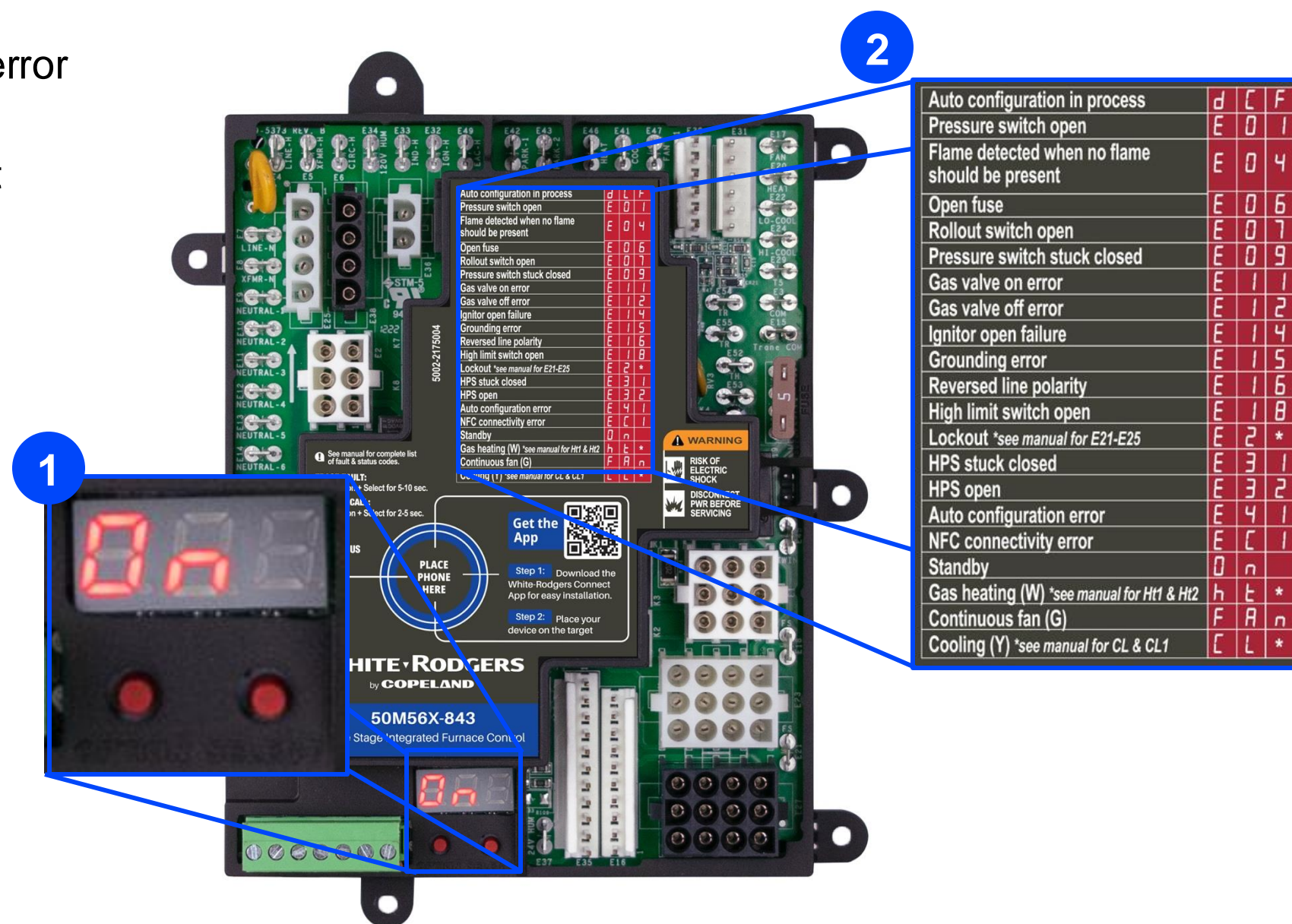
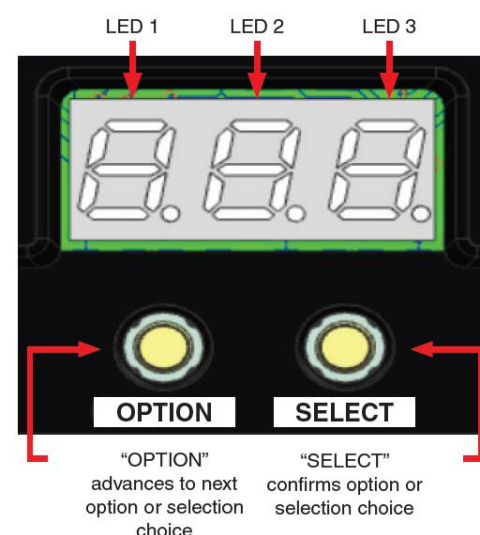


Onboard Status & Fault Codes for Troubleshooting

1. Easy-to-see digital display shows fault/error conditions
2. Troubleshooting is simplified with a fault code/status label on the control cover

The Option & Select Buttons Allow For:

- Menu configuration
- Recall of the last five faults
- Fault code erasure



Universal Integrated Furnace Controls Competitive Comparison

White-Rodgers Has More Features

Feature	Resideo / Honeywell S9200u1000	lcm lcm2812-kit	White-rodgers 50m56x-843
Stages / Blower Types	1 - PSC Only	1 - PSC Only	1 - PSC & Ecmx
Mobile App, NFC, BLE*	No	No	Yes – WR Connect
Harnesses	8	11	None – OEM Harness Detected
Cross-references	200+	150+	550+
Ignitor Voltage Serviced	120V Only	120V Only	80v & 120v
Includes Universal Ignitor	No	No	Yes
Configuration Options	Limited - 4 Dipswitches	Limited - 2 Dipswitches	Unlimited App Or Push Buttons
LED Displays	Tri-color LED Light	Red LED Light	Digital LED Display
Rollout Accessory	Difficult Wire Jumper	Difficult Wire Jumper	Not Required
Flame Current Test	No	No	Digital Readout Or Test Pins
Full Cover W/ Fault Code Label	No - Tray Only	Yes	Yes
Fault Recall & Clearing	Jump R & D Terminals	Push Button	WR App / Push Buttons
Status & Diagnostics	Count LED Flashes	Count LED Flashes	Read On Display Or App
Humidifier Output	120V Only	120V Only	24V Or 120V
2 nd Stage Cooling & Dehumidification	No	No	Yes



Troubleshooting Furnace Controls

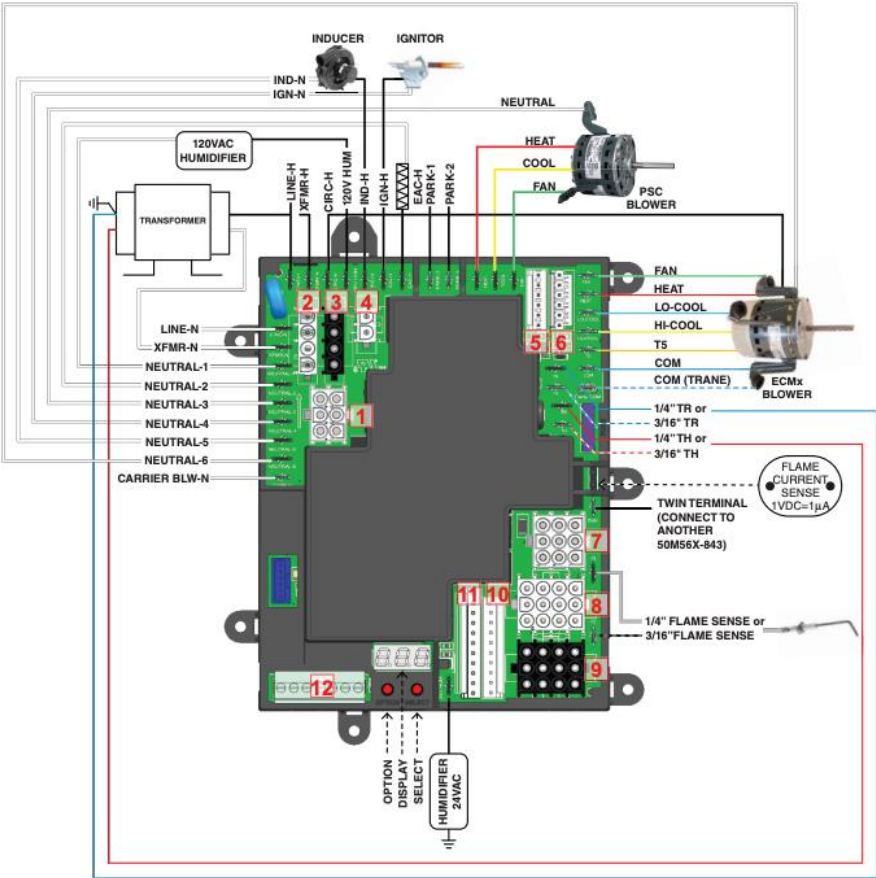
Technical Overview

Troubleshooting Integrated Furnace Controls

The two most common causes for failures in IFC boards are water damage and heat - either from combustion or from electrical overcurrent

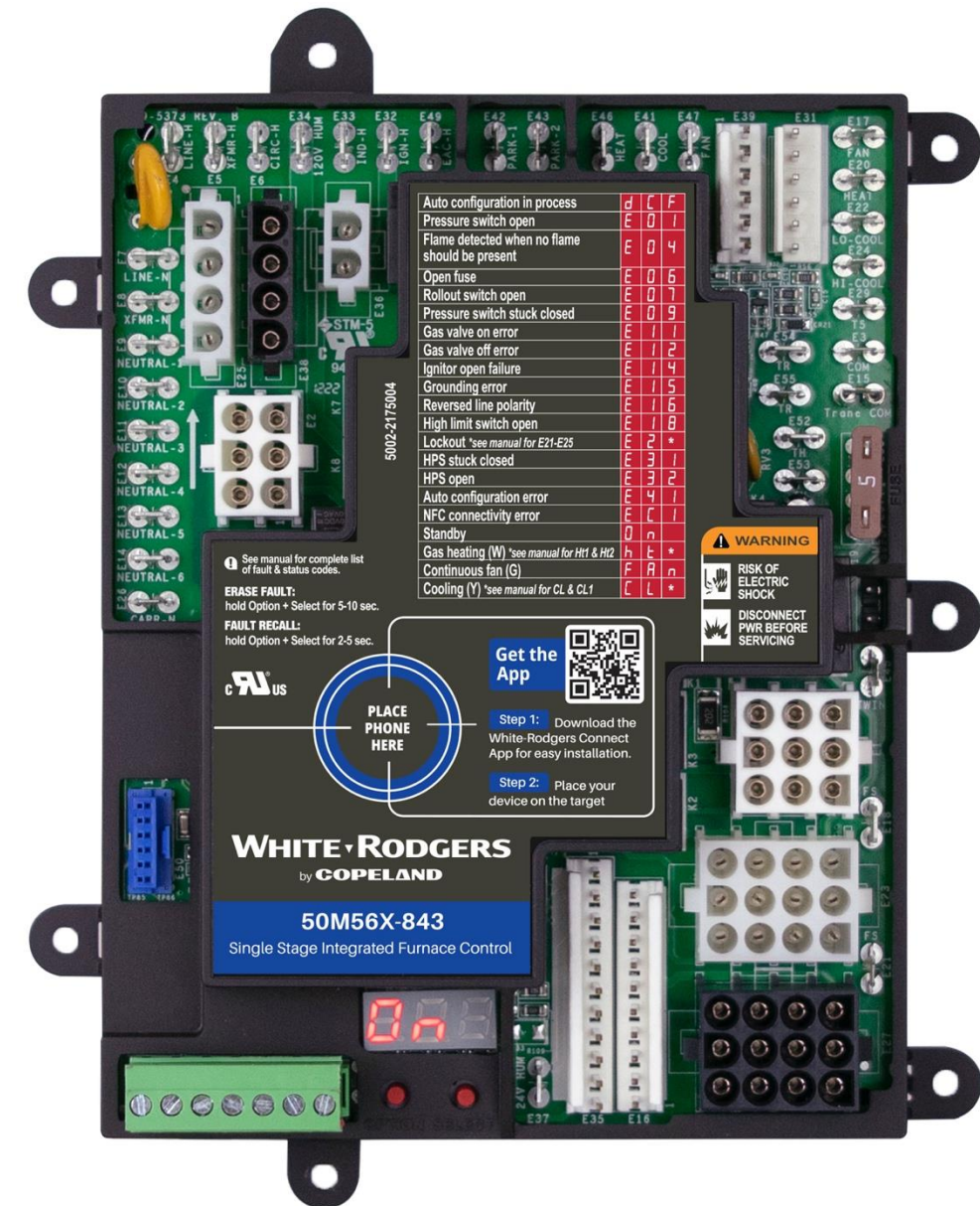
The three greatest tools for diagnosing IFC failures are knowing the sequence of operation, interpreting the wiring diagram, and using your multimeter.

IDM Pre-Purge			Ignition Trial	IBM on Delay	Heat Off	IDM Post-Purge	IBM Off Delay
Limit Circuit Closed	Pressure Switch Open	Pressure Switch Closed	Gas Valve Open	Blower On Delay (30-45s)	Gas Valve Off		Blower Delay Off (60-180s)
Thermostat Calls For Heat			Thermostat Satisfied			System Off	
Rollout Circuit Closed	Inducer Motor On		Ignition Means On	Ignition Proved		Inducer Delay Off	



Troubleshooting Questions

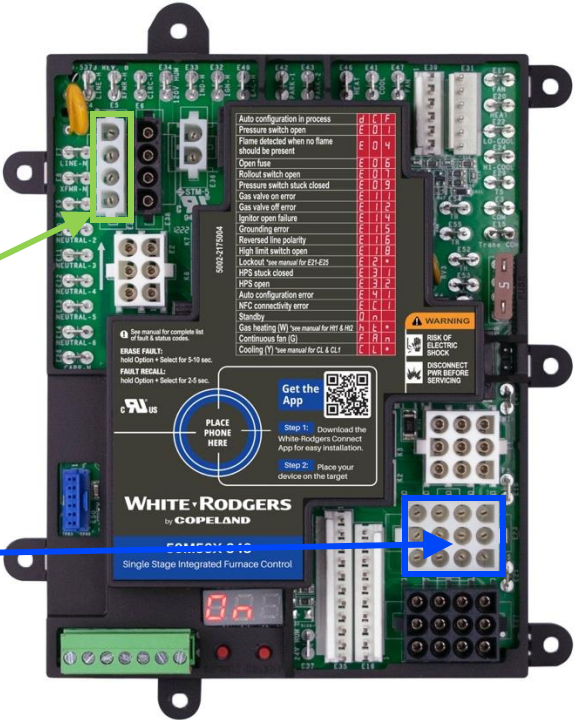
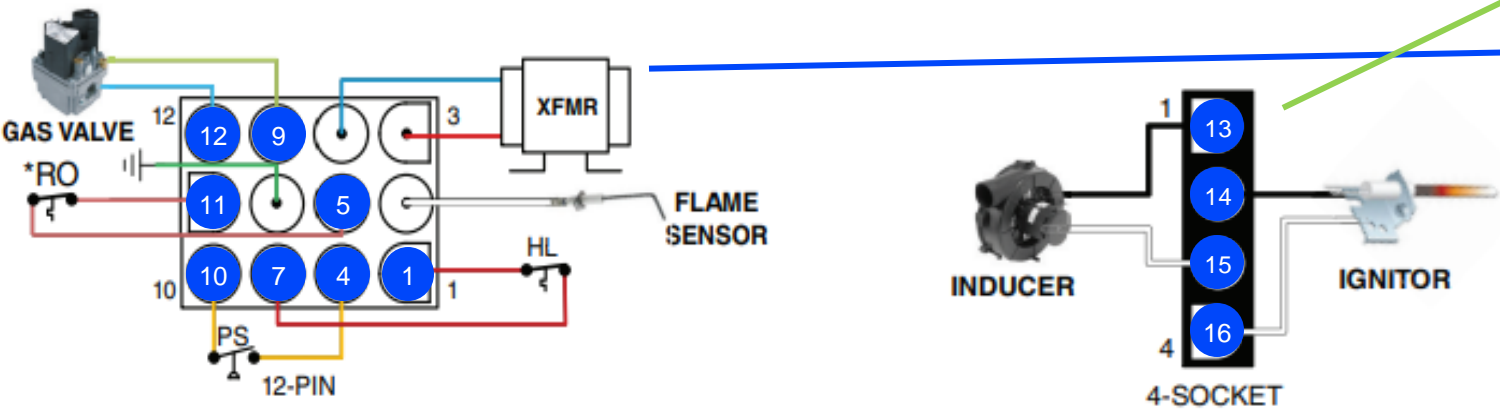
- At what step in the sequence of operation does the control fail?
 - Every step in the sequence of operation results in energized circuits activating relays that energize new circuits
- Which switches should be closed and passing power?
- Where should voltage be supplied? And what voltage should it be?
- Are any control or load wires grounded?
 - A disconnected lead can easily touch the frame of the furnace and create a short-to-ground
 - Foil backing from insulation can also ground wires



Sequencing and Troubleshooting

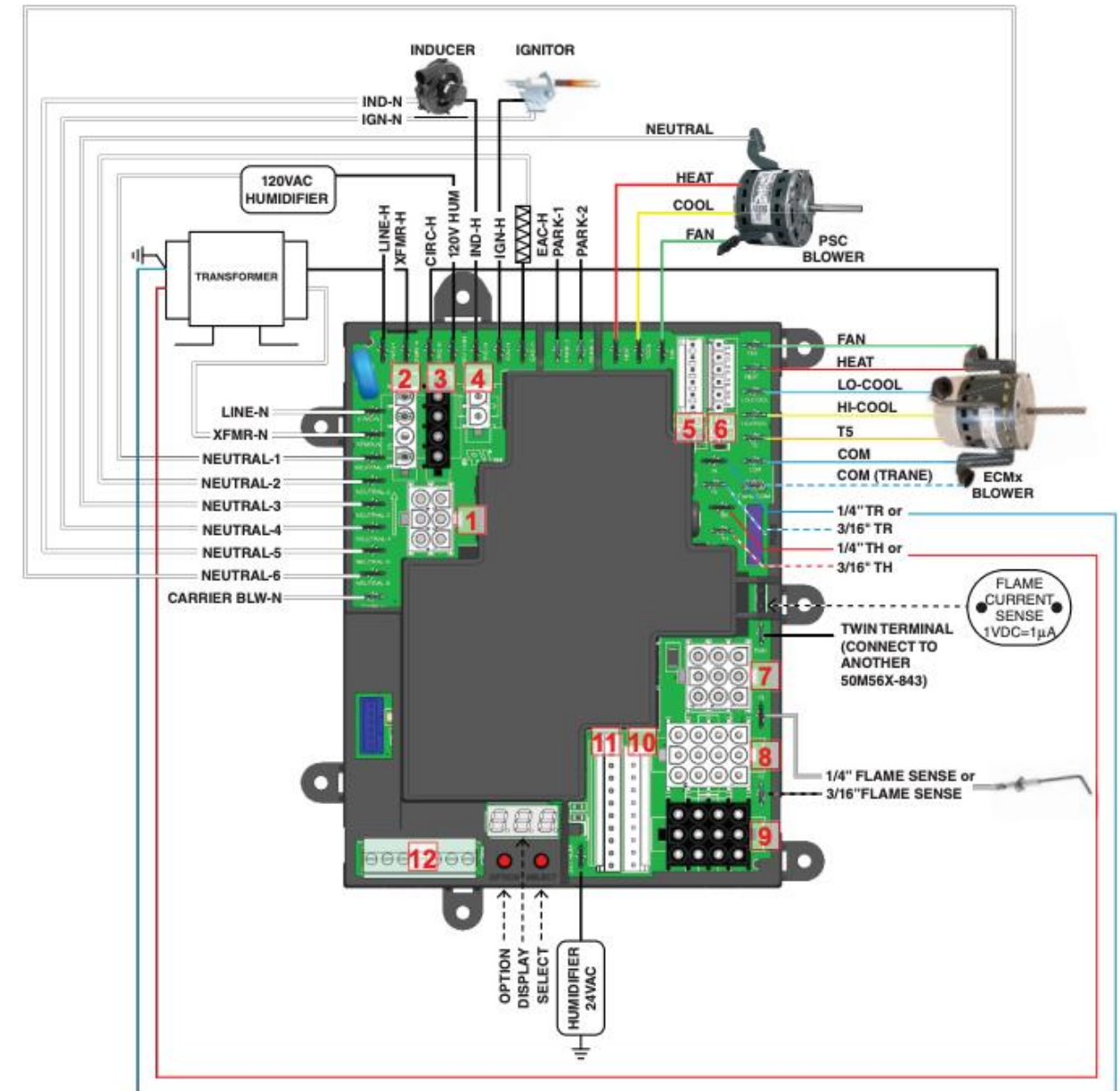
Every pin and terminal on the IFC is associated with a step in the sequence of operation.

IDM Pre-Purge	Ignition Trial	IBM on Delay	Heat Off	IDM Post-Purge	IBM Off Delay
Limit Circuit Closed Pressure Switch Open Pressure Switch Closed	Gas Valve Open	Blower On Delay (30-45s)	Gas Valve Off		Blower Delay Off (60-180s)
1 7 4 10 4 10 0.0V 24V 0.0V	7 8 24V				
Thermostat Calls For Heat			Thermostat Satisfied		System Off
5 11 13 15 0.0V 120V	14 16 14 16 120V 0V				
Rollout Circuit Closed Inducer Motor On	Ignition Means On Ignition Proved			Inducer Delay Off	



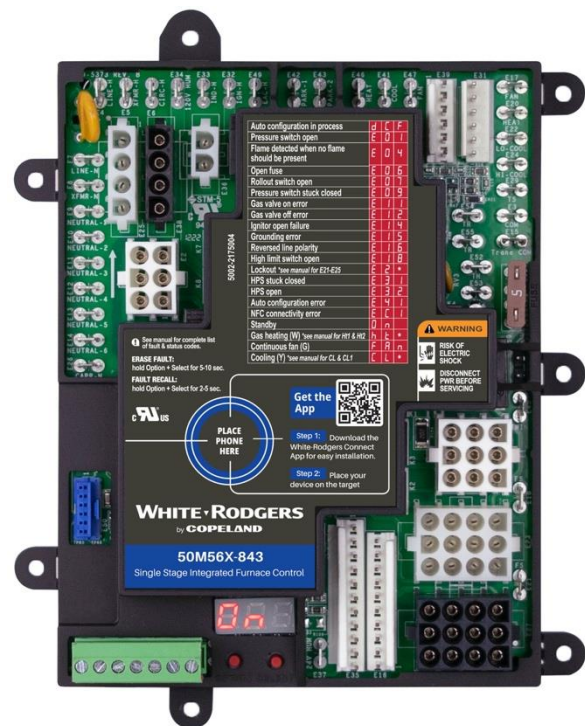
Wiring Diagram

- Discovering where each circuit and load connects to the IFC allows for testing and isolation
- The status code LED provides troubleshooting assistance
- Fault code retrieval
 - When the control is in Standby mode (no call for heat or cool), press the fault recall button for approximately 2 to 5 seconds or until the diagnostic LED turns off
 - Up to 5 fault codes are stored



Evaluating Fault Codes

- The 50M56X-843 displays error codes on the digital display with guides on the product label as well as the instruction sheet.
- For quick and easy diagnostics view error codes in the White-Rodgers Connect app which also displays troubleshooting tips.



Operation	Module Status	Action	Duration of Action	LED Display	Extra Notes
Fault Code Recall	Standby	Hold OPTION and SELECT together	2-5 sec.	F L E after 2 sec.	<ul style="list-style-type: none">• A maximum of 5 error codes are stored in the sequence they occur• Press OPTION button < 1 second to advance to next fault code• When OPTION button is pressed after last error code, LEDs return to current status of unit• E n o will be displayed if there are no error codes stored
Fault Code Reset	Standby	Hold OPTION and SELECT together	5-10 sec.	Alternates between C L r and F L E after 5 sec.	<ul style="list-style-type: none">• Once both OPTION and SELECT are released after holding them together for 5-10 seconds, the LEDs will flash C L r 3 times to indicate the error codes have been erased, module will then return to current status• Error codes are stored in the module's memory for up to 14 days

Note: Thermostat calls are ignored when module is in Error Code Recall or Reset modes

TROUBLESHOOTING

Table 2: 7-Segment Display Codes

Condition	LED 1	LED 2	LED 3	Comment/Troubleshoot Step
Line Frequency Error / Internal Fault	E	0	0	Verify 60 Hz line frequency, Replace control
Pressure Switch Open	E	0	1	Check pressure switch, inducer, and flue
Flame Detected When no Flame Should be Present	E	0	4	Check gas valve for proper operation, check gas valve and safety limit wiring
Open Fuse	E	0	6	Locate & repair 24V fault, replace fuse
Rollout Switch Open	E	0	7	Check for rollout condition or failed switch
Pressure Switch Stuck Closed	E	0	9	Replace failed pressure switch
Gas Valve On Error	E	1	1	Check gas valve operation and wiring
Gas Valve Off Error	E	1	2	Check gas valve operation and wiring
Ignitor Relay Fault	E	1	3	Internal ignitor relay failure, replace control
Ignitor Open Failure	E	1	4	Replace failed ignitor
Grounding Error	E	1	5	Check control & furnace ground connections
Reversed Line Polarity	E	1	6	Hot and neutral wires are reversed
Twinning Error	E	1	7	Validate twin configuration for both units
High Limit Switch Open	E	1	8	Check for open/failed HL & any aux switches
Lockout - Retries Exceeded	E	2	1	Lockout after unsuccessful trial for ignition
Lockout - Gas Valve Off	E	2	2	Gas valve relay internal error, replace control
Lockout - Recycles Exceeded	E	2	3	Lockout after failed relight due to flame loss
Lockout - Pressure Switch Open	E	2	4	Lockout due to open pressure switch
Lockout - HPS Open	E	2	5	Lockout for Housing P.S. on condensing units
HPS Stuck Closed	E	3	1	Housing P.S. stuck closed - condensing units
HPS Open	E	3	2	Housing P.S. not closing - condensing units
Auto Configuration Error	E	4	1	See Automatic Configuration Process Notes
NFC Connectivity Error	E	C	1	NFC comm error, power cycle control & retry
Continuous Fan (G)	F	A	n	Active call for constant fan
Standby	0	n		Ready to access menus or respond to calls
Control Power Up	B	B	B	Displayed at initial power up
Blower on After Power up	b	0	n	Cool down after power loss with active call
Gas Heat (W) Present before pre-purge or during error conditions	h	t	P	Gas heat call active before inducer pre purge or with error conditions that prevent ignition
Gas Heat (W) with Pre-Purge Active	h	P	r	Gas heat call active during pre-purge period
Gas Heat (W) with Inter-Purge Active	h	I	P	Gas heat call active during inter-purge period
Gas Heat (W) with Post-Purge Active	h	P	o	Gas heat call active during post-purge period
Gas Heat (W) Ignitor Warm-up Period Active	i	9	n	Gas heat call active during ignitor warm-up period
Gas Heat (W) Trial for Ignition Period Active	t	F	i	Gas heat call active during trial for ignition period
Gas Heat (W) after flame is active	h	t		Gas heat call with flame present
Single Stage Gas Heat Active (W)	h	t	1	1 st stage gas heating – Goodman Hybrid only
Goodman Hybrid Only - 2nd Stage Gas Heat (Autostage)	h	t	2	2 nd stage gas heating – Goodman Hybrid only, 2 nd stage timing based on AHS menu setting
Single / High Stage Cooling (Y/Y2)	C	L		Call for high cooling with 1 or 2 stage AC/HP
Low Stage Cooling (Y1)	C	L	1	Call for low cooling – For 2 stage AC/HP only
Low Flame Current Sense	F	L	o	Check Flame Quality, Clean/Replace Flame Sensor
Auto Configuration in Progress	d	C	F	Allow 30 seconds for the control to configure

HSI Simulator Breakout

Limit Circuit Fault



HSI Simulator Breakout

Rollout Circuit Fault



HSI Simulator Breakout

Pressure Switch Fault



HSI Simulator Breakout

Flame Sense Fault



HSI Simulator Breakout

Weak Flame Signal



HSI Simulator Breakout

High Voltage Failures



HSI Simulator Breakout

Low Voltage Failures



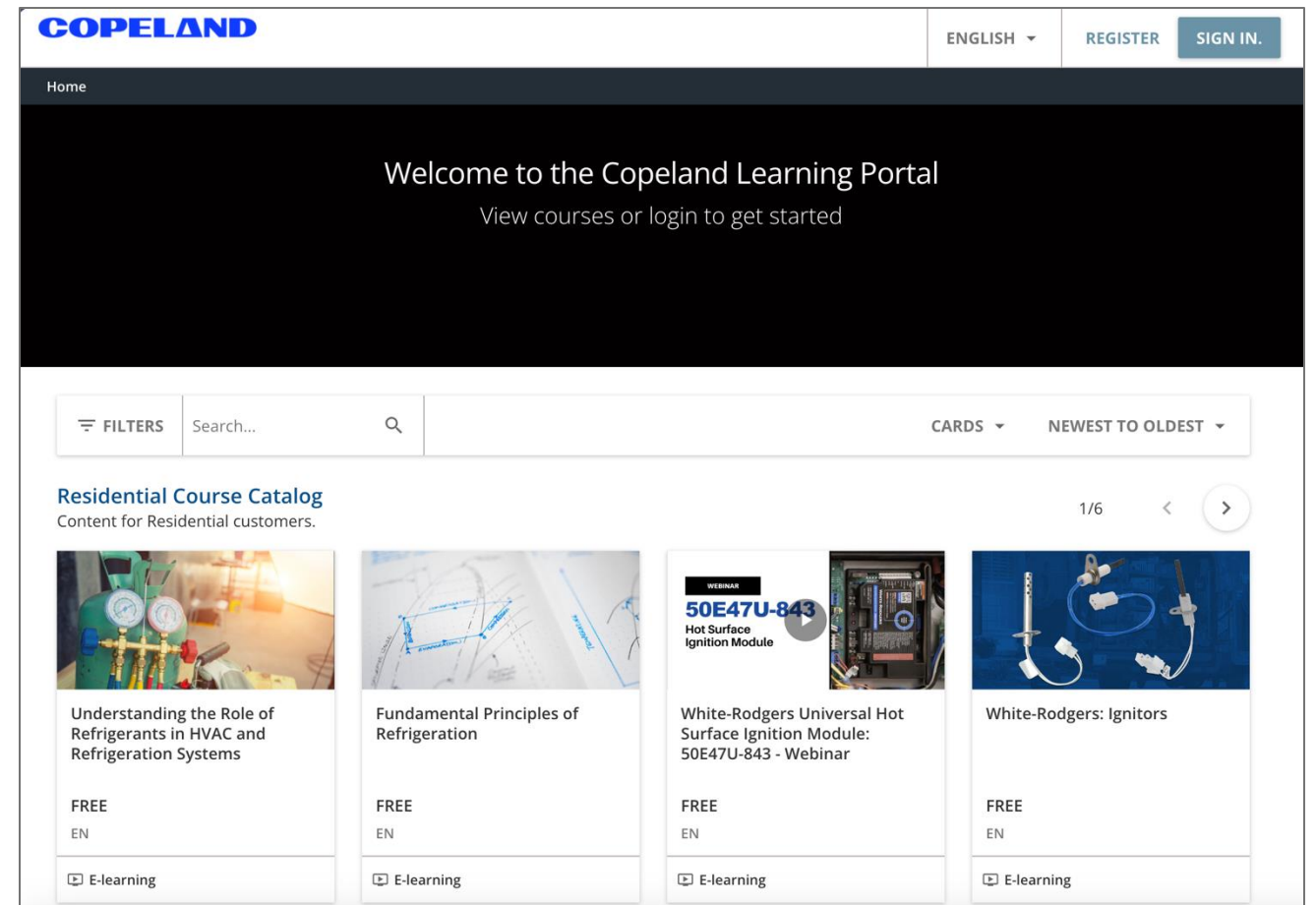
Key Takeaways

A proper understanding of the sequence of operation is a valuable tool in the technician's troubleshooting kit.

Having a wiring diagram of the IFC and the furnace helps the technician trace wiring and find faults.

Most IFC boards display fault codes which assist the technician in troubleshooting.

For additional information, consult the manual included with the replacement universal controller or visit White Rodgers Education Central
<https://education.copeland.com/learn>.



The screenshot displays the Copeland Learning Portal website. At the top, the Copeland logo is on the left, and navigation links for "ENGLISH", "REGISTER", and "SIGN IN." are on the right. Below the header, a dark banner reads "Welcome to the Copeland Learning Portal" with a sub-link "View courses or login to get started". A navigation bar includes a "FILTERS" button, a search bar, and sorting options for "CARDS" and "NEWEST TO OLDEST". The main content area is titled "Residential Course Catalog" and "Content for Residential customers." It features a carousel of four course cards. The first card is "Understanding the Role of Refrigerants in HVAC and Refrigeration Systems" (FREE EN, E-learning). The second is "Fundamental Principles of Refrigeration" (FREE EN, E-learning). The third is a webinar titled "White-Rodgers Universal Hot Surface Ignition Module: 50E47U-843 - Webinar" (FREE EN, E-learning). The fourth is "White-Rodgers: Ignitors" (FREE EN, E-learning). Each card includes a representative image and a play button icon.

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Thank you.