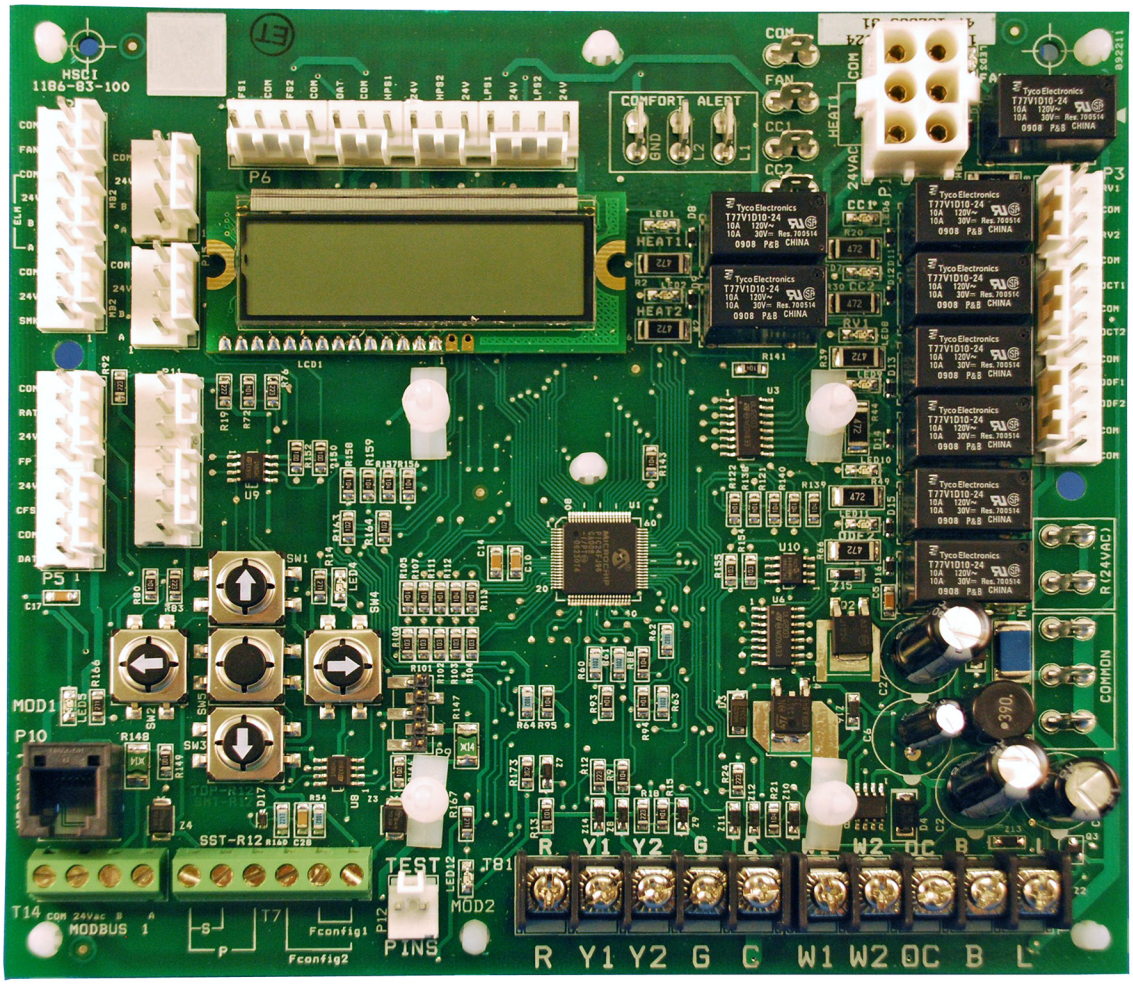
Operation Manual

OM 1077-2

Group: **Applied Air Systems**
Part Number: **OM 1077**
Date: **May 2020**

Maverick® I Package Air Conditioner DDC Rooftop Unit Controller

Heating & Cooling, Gas/Electric and Electric/Electric
Models MPS 003B – 025B
3 to 25 Tons [10.6 to 87.9 kW]
R-410A Refrigerant



General

Read this manual and any instructions packaged with separate equipment prior to installation. Give this manual to the owner and explain its provisions. The owner should retain this manual for future reference.

Unit	Manual
Rooftop unit control configuration	OM 1077
BACnet Communication Module	IM 1000
LonWorks Communication Module	IM 999
Field Installed Accessories	IM 921
Maverick I, 3 to 5 ton Installation and Maintenance	IM 970
Maverick I, 6 to 12 ton Installation and Maintenance	IM 971
Maverick I, 15 to 25 ton Installation and Maintenance	IM 972

Hazardous Information Messages

⚠ DANGER

These instructions are intended as an aid to qualified service personnel for proper installation, adjustment, and operation of this unit. Read these instructions thoroughly before attempting installation, adjustment, or operation. Failure to follow these instructions can result in improper installation, adjustment, service or maintenance, possibly resulting in fire, electrical shock, property damage, personal injury, or death.

⚠ DANGER

Before beginning any modification, be sure main disconnect switch is in the “off” position. Failure to do so can cause electrical shock resulting in property damage, personal injury or death. Tag disconnect with a suitable warning label.

⚠ CAUTION

Static sensitive components. Discharge any static electrical charge by touching the bare metal inside the control panel before performing any service work. Never unplug cables, circuit board terminal blocks, or power plugs while power is applied to the panel.

⚠ NOTICE

This equipment generates, uses, and can radiate radio frequency energy and; if not installed and used in accordance with this instruction manual, may cause interference to radio communications. It has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at their own expense.

⚠ WARNING

Warning indicates potentially hazardous situations for PVC (Polyvinyl Chloride) and CPVC (Clorinated Polyvinyl Chloride) piping in chilled water systems. In the event the pipe is exposed to POE (Polyolester) oil used in the refrigerant system, the pipe can be chemically damaged and pipe failure can occur.

The Maverick I 3 to 25 ton Package has a Rooftop Unit Controller factory mounted and wired in their respective control panel. The DDC Controller is a solid-state microprocessor-based control board that provides flexible control and extensive diagnostics for all unit functions. The DDC Controller through proportional/integral control algorithms perform specific unit functions that govern unit operation in response to; zone conditions, system temperatures, ambient conditions and electrical inputs. The DDC Controller features an LCD display and a five-button keypad for local configuration and direct diagnosis of the system.

The Maverick I 3 to 25 ton Package Air Conditioner with integral Rooftop Unit Controller (DDC Controller) is specifically designed to be applied in three distinct applications:

Third party Building Management System

In an application where a third party building management is in use or will be incorporated the Maverick I is communication compatible with the system that supports the BACnet Application Specific Controller device profile, LonMark Space Comfort Controller functional profile. This is accomplished with a field installed BACnet or LonMark communication module. The BAS system provides the schedule functions for the DDC controller.

BACnet® Communication Module

The BACnet Communication Module allows communication between the DDC Controller and the BACnet network. The communication module translates input and output variables between the DDC Controller protocol and the BACnet protocol.

The BACnet Communication Module is compatible with MSTP EIA-485 daisy chain networks communicating at 38.4 bps. It is compatible with twisted pair, shielded cables.

See IM 1000 for full documentation

LonMark® Communication Module

Communication module translates input and output variables between the DDC Controller protocol and the LonTalk protocol. The LonTalk Communication Module has been developed to communicate with building automation systems that support the LonMark Space Comfort Controller (SCC).

The LonMark Communication Module utilizes an FTT-10A free topology transceiver communicating at 78.8 kbps. It is compatible with Echelon qualified twisted pair cable, Belden 8471 or NEMA Level 4 cables. The Module can communicate up to 1640 ft. with no repeater. The LonWorks limit of 64 nodes per segment applies to this device.

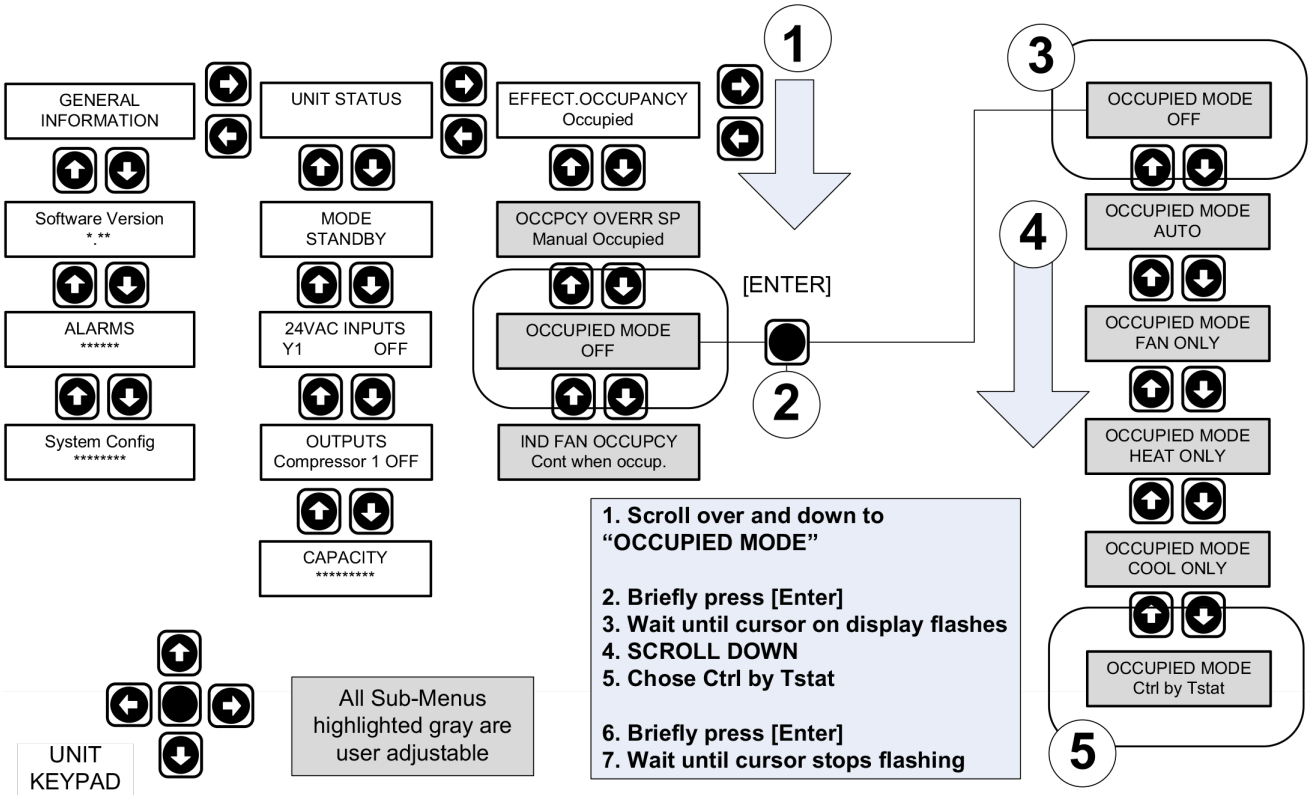
See IM 999 for full documentation

Quick Start

Units with Thermostat Control

- Connect Room Thermostat (and Time Clock if used) to DDC Controller rooftop unit controller circuit board. Follow Unit Installation Instructions obeying all safety guidelines. Replace any low voltage shields removed during the installation of the thermostat wires
- Connect line voltage power wires to the appropriate main power terminal block or disconnect. Connect gas lines for heater section (if applicable)
- Apply power to rooftop unit
- Using keypad and Display on DDC Controller circuit board, take unit from “OFF” mode to “Control By Thermostat” by following numbered instructions (Figure 1)
- Check for any alarms on DDC Controller display. If any alarms are present, find the source and clear the alarm condition
- Scroll through the DDC Controller display using the keypad and set to Runtest mode. Choose either Heating or Cooling runtest. Enter the password to start Runtest, (5555) refer to Initial Test Sequence, for more information
- Record temperatures and refrigerant pressures (if applicable) during the runtest. Check for any alarms on the DDC Controller display. If any alarms are present, find the source and clear the alarm conditions

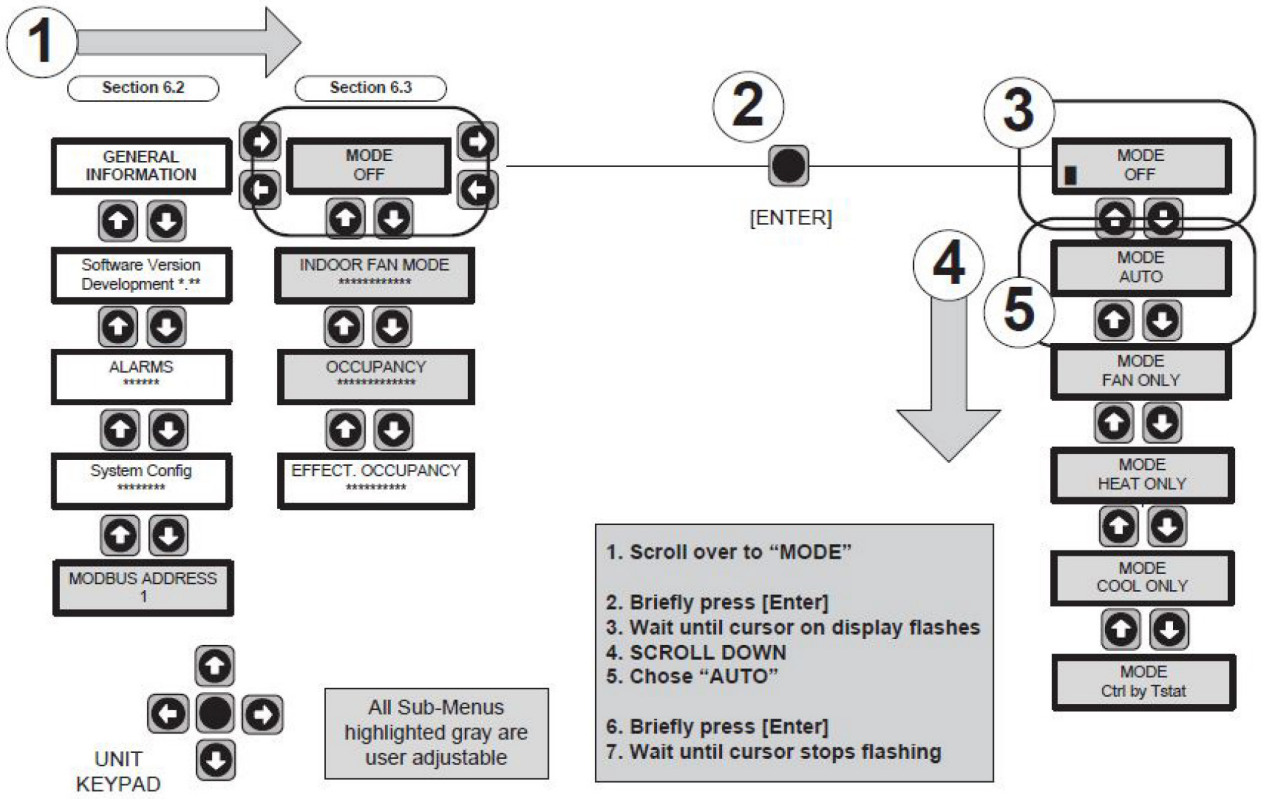
Figure 1: Units with Thermostat Control – Occupied Mode Off



Units with BACnet Communications Card Accessory (RXRX-AY01)

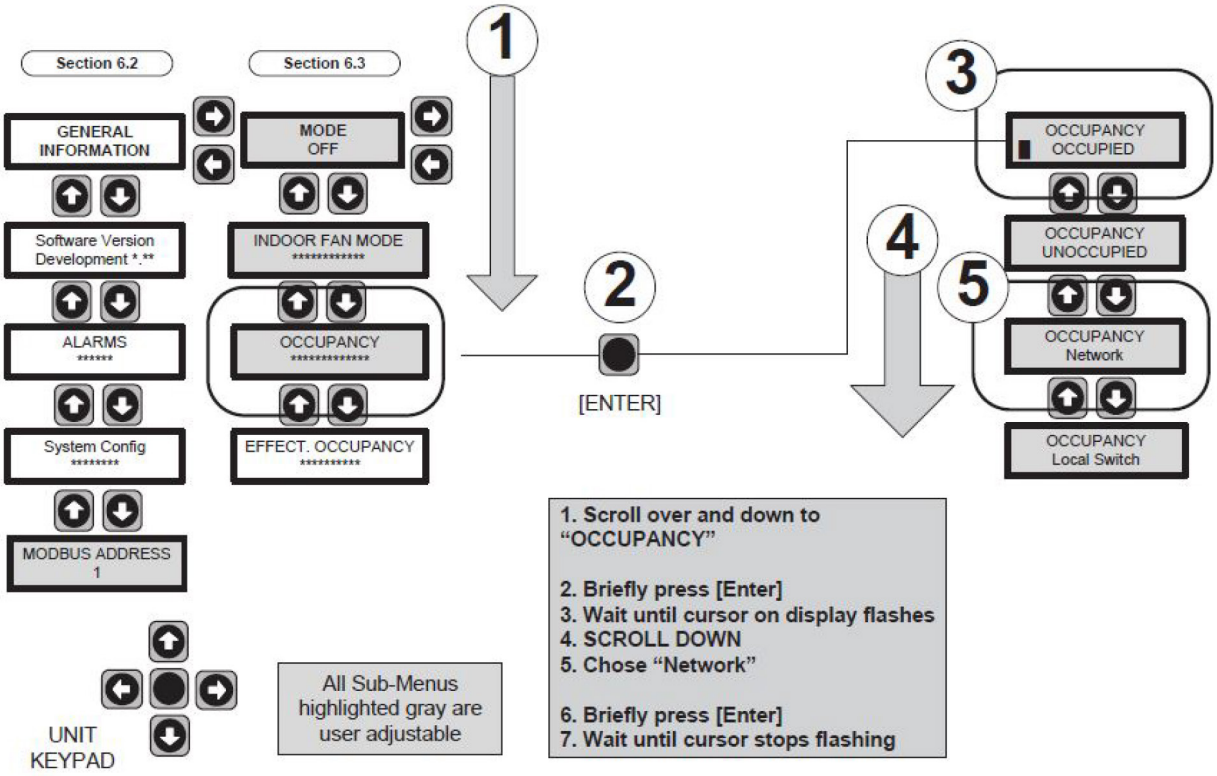
- Connect Zone sensor to the RTU-C circuit board. Follow unit instructions obeying all safety guidelines
- Connect BACnet Communications card Accessory to the RTU-C rooftop unit controller circuit board
- Connect the RS-485 network cable to the BACnet communications card. Follow installation instructions for unit obeying all safety guidelines. Replace any low voltage shields which were removed during the installation of the sensor wires and communication cable
- Connect line voltage power wires to the appropriate main power terminal block or disconnect. Connect gas lines for heater sections (if applicable)
- Apply power to rooftop unit. Check for any alarms on the RTU-C display, find source and clear alarms
- Using keypad and display on RTU-C circuit board, take unit from “OFF” mode to Auto by following numbered directions (Figure 2)
- Refer to “MODE Screen” section in this manual for more detail

Figure 2: Units with BACnet Communications Card – Mode Off



- Using the keypad and display on RTU-C circuit board, take the unit from “Manual Occupied” mode to “Network” by following numbered directions below. THIS STEP MUST BE COMPLETED or the unit will not communicate and receive commands from the network
- Check for any alarms on RTU-C display. If alarms are present, identify the source and clear the alarm
- Scroll through the RTU-C display using the keypad and set to Runtest mode. Choose either Heating or Cooling Runtest. Enter password to start Runtest. For more information refer to “initial test sequence” section in the manual
- Record temperatures and refrigeration pressures (if applicable) during the run test
- Using a laptop computer connected to RJ-11 jack on RXRX-AY01 (BACnet communications card) Set device ID on communications card

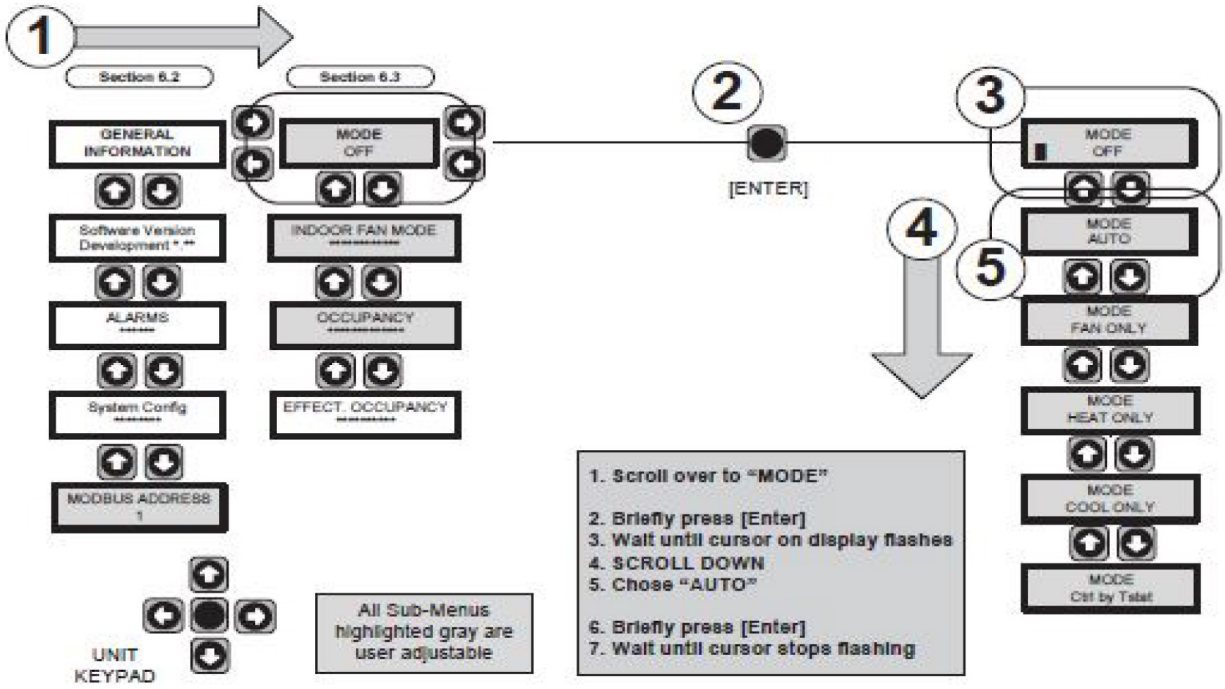
Figure 3: Units with BACnet Communications Card – Occupied



Units with LonWorks Communications Card Accessory (RXRX-AY02)

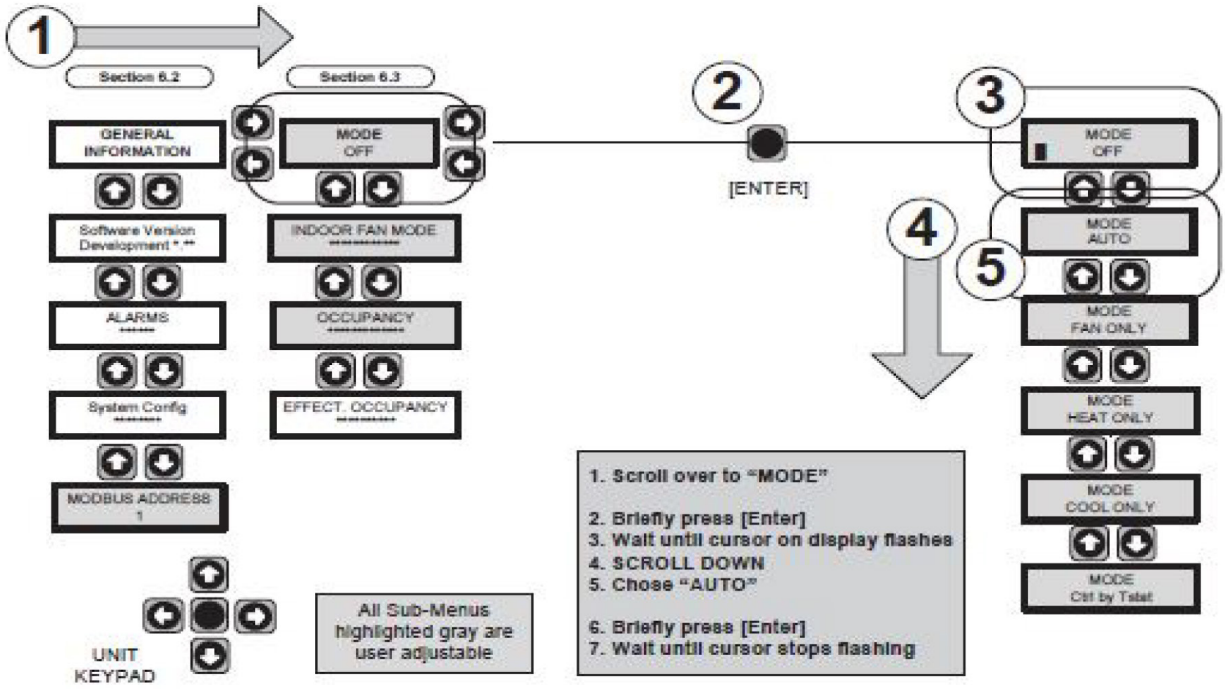
- Connect Zone sensor to the RTU-C circuit board. follow Unit installation instructions obeying all safety guidelines
- Connect LonWorks communication Card Accessory to the RTU-C rooftop unit controller circuit board
- Connect RS-485 (2 wire) network cable to LonWorks communication card. Follow installation instructions for unit obeying all safety guidelines. Replace any low voltage shields removed during the installation of the sensor wires and communication cable
- Connect line voltage power wires to the appropriate main power terminal block or disconnect. Connect gas lines for heater section (if applicable)
- Apply power to rooftop unit. Check for any alarms on the RTU-C display, locate the source and clear alarms
- Using keypad and display on RTU-C circuit board, take unit from “OFF” mode to “AUTO” by following numbered directions below. Refer to “Mode screen” for more information and details.

Figure 4: Units with LonWorks Communications Card – Mode Off



- Using the keypad and display on RTU-C circuit board, take the unit from “Manual Occupied” mode to “Network” by following numbered directions below. THIS STEP MUST BE COMPLETED or the unit will not communicate and receive commands from the network
- Check for any alarms on RTU-C display. If any alarms are present, find the source and clear the alarms
- Scroll through the RTU display using the keypad and set to RunTest Mode. Choose either heating or cooling runtest. Enter password to start runtest (5555) for more information refer to initial test sequence
- Record temperatures and refrigerant pressures (if applicable) during the run test
- While monitoring communications network, press ID pin on communications card to send device ID on the communication card to the network

Figure 5: Units with LonWorks Communications Card – Mode Auto



Programmable 24 Volt Thermostat

The Maverick with integral DDC Controller is compatible with programmable 24 volt thermostats. The programmable thermostat can supply the time schedule functions when the DDC controller is not connected to a BAS system. Connections are made via conventional thermostat connection screw terminals on terminal T81. Extensive unit status and diagnostics are displayed on the LCD screen.

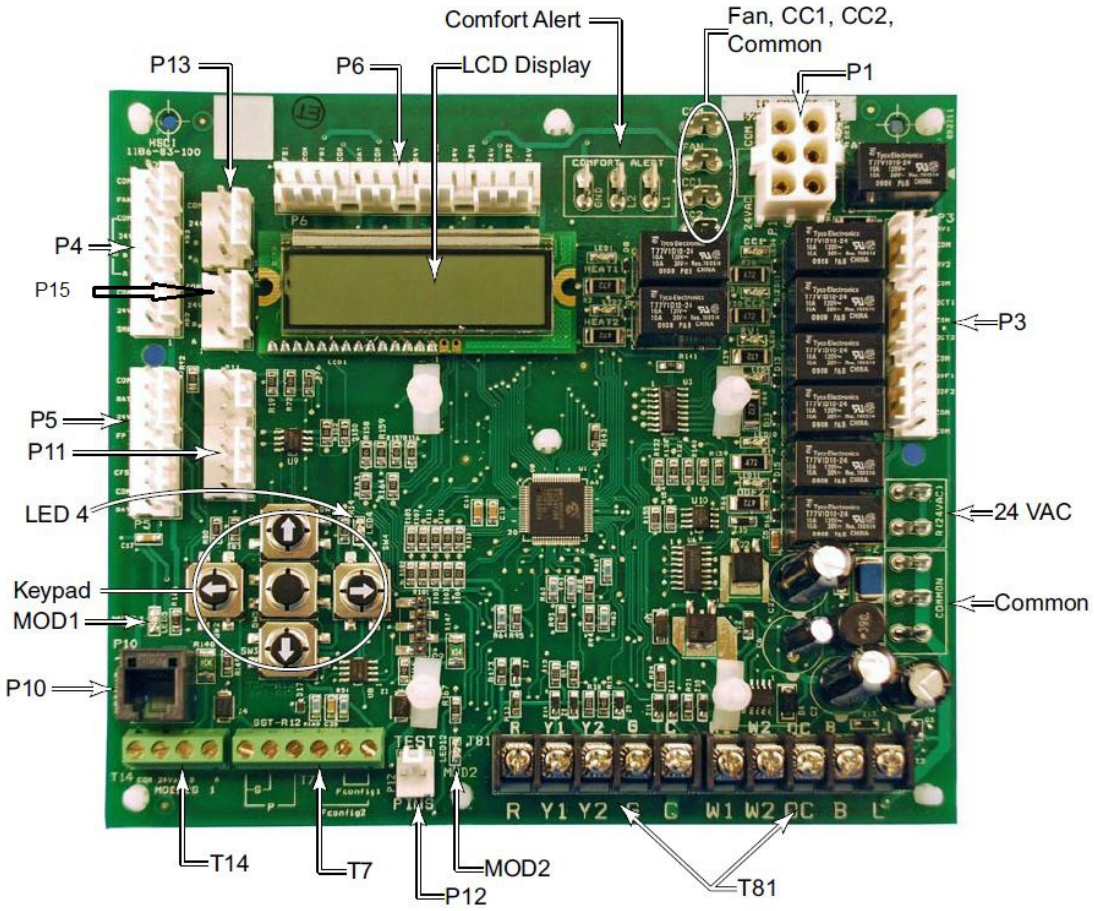
Zone sensor with time clock

The Maverick I with integral DDC Controller is compatible with a zone sensor and mechanical or solid state time clock.

The DDC Controller in each Maverick I, 3 to 25 ton, package air conditioner has many design features that optimize operation, installation and service. Each unit with the DDC Controller has the following features:

- **Blower ON/OFF Delay.** Adjustable time delay between blower ON and mode
- **Built-in Control Parameter Defaults.** No programming required.
- **Compressor Time-OFF Delay.** Adjustable time delay between compressor shutoff and start up
- **Dirty Filter Switch Input.** The DDC Controller will signal an increase in static pressure across the air filter, indicating a dirty filter condition.
- **On Board User Interface Display/Keypad.** Displays control parameters, diagnostic codes, and sensor readings. The keypad allows scrolling through display menu and field configurable changes to be made.
- **Economizer Control.** The economizer is controlled by the Economizer Logic Module (ELM) that comes with the economizer. The DDC Controller communicates with the ELM for control, set point, and diagnostics. The DDC Controller has several choices for controlling the economizer. See Economizer Menu Screen. The ELM monitors the mixed air temperature, return air enthalpy (optional), minimum position set point (local or remote), power exhaust set point, CO_2 set point, CO_2, and outdoor enthalpy sensor, if selected, to control dampers to an accuracy of ±5% of stroke. The actuator is spring returned to the closed position any time that power is lost to the unit. It is capable of delivering up to 44 inch pounds of torque and is powered by 24VAC.
- **Unit Diagnostics.** The DDC Controller monitors all sensors and functions related to unit operation to provide critical information and maintain diagnostic code information even if a power failure occurs.
- **Exhaust Fan Control Modes.** Exhaust fans are controlled by fresh air damper position. Set point is adjustable through the unit display and keypad.
- **Field Changeable Control Parameters.** Over 50 different control parameters allow customization of the unit operation by changing delays, cooling stages, dead bands, and set points.
- **Minimum Compressor Run Time.** Ensures proper oil return to the compressor.
- **Comfort Alert.** The DDC Controller has two inputs to monitor optional Copeland Comfort Alerts. The inputs can provide the following information: Locked rotor, Open Circuits, Missing Phase, Reverse Phase, and Welded Contactor.
- **Smoke Alarm Mode.** The input will shutdown the unit and requires a manual reset. The sensor is used to detect smoke due to fire in the air conditioning or ventilation ducts.
- **Lead Lag Compressor Operation.** On units with two compressors, first stage (lead) compressor operation is based on compressor accumulated run time. After 100 hours of operation, the second stage compressor automatically becomes the lead compressor.
- **Staging.** Depending on the unit controls up to 2 stages of cooling, 2 stages of gas heat, 2 stages of heat pump, and 2 stages of electric heat.
- **Active Protection.** Provides active unit protection when any of the following occurs three times within a thermostat cycle: low pressure trip, high pressure trip, gas heat limit trip
- **Thermostat Bounce Delay.** Protects compressor from short cycling when mechanical thermostat is used
- **Warm-up Mode Delay.** The warm-up delay is adjustable 1 to 60 minutes. Warm up is a timer that when the system goes from unoccupied to occupied will only allow the indoor blower to run for the time selected. After this time if either heating or cooling will operate as required. The economizer is triggered by a fan call and will open for minimum position

Figure 6: Controller Component Locations



Item	Description
P1	Electric heat connector
Fan	Indoor blower motor connector
CC1	Compressor 1 connector
CC2	Compressor 2 connector
P3	Reversing valve 1, Reversing valve 2, Outdoor Coil temperature sensor 1, Outdoor Coil temperature sensor 2, Outdoor Fan 1, and Outdoor Fan 2 connector
P4	Motorized Fresh Air Damper, Economizer Logic Module (ELM), and Smoke Detector connector
P5	Return air temperature sensor, Fan proving switch, Clogged filter switch, and Discharge air temperature sensor connector
P6	Freeze sensor 1, Freeze sensor 2, Outside air temperature sensor, High pressure switch 1, High pressure switch 2, Low pressure switch 1, and Low pressure switch 2 connector
P10	RJ11 connector for factory run test
P11	Configurable pins used to set unit type
P12	Test Pins to force defrost for heat pump models
P13	Connector to Integrated Furnace Control (IFC) – provides power and communication between DDC Controller and IFC
P15	Connector to eSYNC control board, provides power and communication (Modbus) between RTU-C and IFC
T7	Field Installed Space Temperature Sensor with Set Point and Override, Field configurable 1, and Field configurable 2 terminal block
T14	Not supported
T81	Thermostat screw terminals Common terminals Terminals used for 24 volt common connections & power supply
24 Volt terminals	Terminals used for 24 volt hot connections & power supply
Comfort Alert	Terminals used to connect a Comfort Alert module
LED4	LED4 is blinking when the control has an ALARM present, solid when power is applied.
MOD1 LED	MOD1 LED blinks when the control is communicating on the internal network between the IFC and/or economizer
MOD2 LED	MOD2 LED blinks when the control is communicating between the DDC Controller and field installed communication card

Control Inputs

Table 1: Control Inputs

Item	Description	Type	Option
1	ST - Space temperature	Thermistor 10k Ω	Field Installed (optional)
2	RAT - Return Air Temperature	Thermistor 10k Ω	Factory Installed
3	SAT - Supply Air Temperature	Thermistor 10k Ω	Factory Installed
4	OAT - Outside Air Temperature	Thermistor 10k Ω	Factory Installed
5	FS1 - Freeze Stat	Thermistor 10k Ω	Factory Installed
6	FS2 - Freeze Stat	Thermistor 10k Ω	Factory Installed
7	Field Configurable input #1	Thermistor 10k Ω	Field Installed (optional)
8	Field Configurable input #2	Analog input	Field Installed (optional)
9	SPA - Set point Adjustment	Resistance input	Field Installed (optional)
OCT1	Outdoor Coil Temperature1	Thermistor 10K	Factory Installed
OCT2	Outdoor Coil Temperature2	Thermistor 10K	Factory Installed
10a	G - Thermostat fan input	24VAC	Field Installed (optional)
11†	Y1 - Thermostat 1st stage compressor	24VAC	Field Installed (optional)
12	Y2 - Thermostat 2nd stage compressor	24VAC	Field Installed (optional)
13	W1 - Thermostat heating demand	24VAC	Field Installed (optional)
14	W2 - Thermostat heating demand	24VAC	Field Installed (optional)
B	Thermostat reversing valve	24VAC	Field Installed (optional)
15	HP1 - High Pressure Switch 1	24VAC	Factory Installed
16	LP1 - Low Pressure Switch 1	24VAC	Factory Installed
17†	HP2 - High Pressure Switch 2	24VAC	Factory Installed
18	LP2 - Low Pressure Switch 2	24VAC	Factory Installed
19	Smoke Detector	24VAC	Factory or Field Installed
20	FP - Fan proving	24VAC	Factory Installed
21	CFS - Clogged Filter Switch	24VAC	Factory Installed
22	Occupied input	24VAC	Field Installed (optional)
23	L1 - Comfort Alert 1 Pulsed	24VDC	Factory or Field Installed (optional)
24	L2 - Comfort Alert 2 Pulsed	24VDC	Factory or Field Installed (optional)
	Test Pin	Pull-up resistor	Factory or field installed
25	Configuration pins	Polarized Plug P11	Factory Installed

a. Heat Pump Only
†

Control Input Descriptions

(1) ST - Space temperature. The space temperature sensor is used to measure the building zone temperature. Sensors should be located on an interior building wall.

(2) RAT - Return Air Temperature. The DDC Controller has a return air temperature input. This input is used to monitor system functionality and to provide diagnostics on how the system is operating. This sensor input can be used in place of the space temperature input. It also acts as a backup in case of a space temperature sensor failure.

(3) SAT - Supply Air Temperature. The DDC Controller has a supply air temperature input. This input is used to monitor system functionality and to provide diagnostics on how the system is operating.

(4) OAT - Outside Air Temperature. The outdoor air temperature sensor is factory installed in the unit to monitor the outside temperature. This temperature is used to control low ambient cooling lockout, high ambient heating lockout, demand defrost control calculations, and for eSYNC™ control functions.

(5) FS1 - Freeze Stat. When the thermistor reads a temperature below 37°F continuously for 15 minutes, the control will shutdown compressor #1 and continue to run the indoor blower. The system will return to normal operation when the thermistor reads a temperature above 42°F for 15 minutes.

(6) FS2 - Freeze Stat. When the thermistor reads a temperature below 37°F continuously for 15 minutes, the control will shutdown compressor #2 and continue to run the indoor blower. The system will return to normal operation when the thermistor reads a temperature above 42°F for 15 minutes.

(7) Field Configurable input #1. Used for custom installation of a 10K ohm temperature sensor (e.g. discharge air temperature sensor installed in supply duct).

(8) Field Configurable input #2. Used for custom installation of an analog input (e.g. 0-10VDC input from outdoor airflow monitoring station).

(9) SPA - Set point Adjustment. If the set point adjustment is enabled, then the control will consider the hard wired potentiometer input to determine occupied set points only. If the remote set point adjustment is enabled but the input reads an invalid number, the control will default back to the occupied set point selection.

OCT1 - Outdoor Coil Temperature 1. This is a thermistor input that is used to determine if a heat pump needs to initiate or terminate defrost. For non-heat pump models with the eSYNC™ control, this input is repurposed to measure the liquid line temperature for determination of refrigerant superheat. Models with dehumidification monitoring the liquid line temperature with this input.

OCT2 - Outdoor Coil Temperature 2. This is a thermistor input that is used to determine if a heat pump needs to initiate or terminate defrost.

(10) G - Thermostat fan input. This is a 24 volt input that is used to control the indoor fan when the DDC Controller is used in conjunction with a thermostat.

(11) Y1 - Thermostat 1st stage compressor. This is a 24 volt input that is used to control the first stage of mechanical cooling when the DDC Controller is used in conjunction with a thermostat.

(12) Y2 - Thermostat 2nd stage compressor. This is a 24 volt input that is used to control the second stage of mechanical cooling when the DDC Controller is used in conjunction with a thermostat.

(13) W1 - Thermostat heating demand. This is a 24 volt input that is used to control the first stage of heating (electric heat or gas heat) when the DDC Controller is used in conjunction with a thermostat.

(14) W2 - Thermostat heating demand. This is a 24 volt input that is used to control the second stage of heating (electric heat or gas heat) when the DDC Controller is used in conjunction with a thermostat.

B - Thermostat reversing valve. This is a 24 volt input that is used to request a change in the reversing valve position for heat pump mode when the RTU-C is used in conjunction with a thermostat. The reversing valve is energized in the heating mode.

(15 &17) HP1, HP2 - High Pressure Switch 1 & 2. When the HPC is opened, the compressor for that circuit is turned OFF. The compressor will not be allowed to restart for a minimum of 3 minutes. If three consecutive open conditions occur during an active call for operation, the compressor will be locked out, a diagnostic will appear on the LCD display and communicated to the network if applicable. Cycling the call for operation will restart the compressor. On dual compressor units only the affected compressor circuit is locked out.

(16 & 18) LP1, LP2 - Low Pressure Switch 1 & 2. When the LPC is opened, the compressor for that circuit is turned OFF. The compressor will not be allowed to restart for a minimum of 3 minutes. The low pressure switch is ignored during defrost and for the first 90 seconds of compressor run time. If three consecutive open conditions occur during an active call for operation, the compressor will be locked out, a diagnostic will appear on the LCD display and communicated to the Network if applicable. Cycling the call for operation will restart the compressor. On dual compressor units only the affected compressor circuit is locked out.

(19) Smoke Detector. The sensor is only applicable on units equipped with a smoke detector. The input will shutdown the unit and requires a manual reset. The sensor is used to detect smoke due to fire in the air condition or ventilation ducts.

(20) FP - Fan proving. The unit mounted fan proving switch monitors the pressure differential across the unit blower to detect when the indoor fan is blowing air. A diagnostic signal is sent to the LCD display if the pressure differential indicates that the indoor blower is not operating. The control will also monitor the system and if the blower is running and is not required a fault will be sent to the DDC Controller.

(21) CFS - Clogged Filter Switch. The unit mounted clogged filter switch monitors the pressure differential across the return air filters. It is mounted in the filter section and is connected to the DDC Controller. A diagnostic signal is sent to the LCD display if the pressure differential across the filters is at least 0.5" w.c. The contacts will automatically open when the pressure differential across the filters decreases to approximately 0.4" w.c., the clogged filter output is operating, and the clogged filter switch has been closed for at least 2 minutes. The system will continue to operate regardless of the status of the filter switch.

(22) Occupied input (OC). This is a 24 volt input that is used to control the occupancy (occupied or unoccupied mode) when the DDC Controller is used in conjunction with a zone sensor and solid state time clock.

(23 & 24) L1, L2 - Comfort Alert. The DDC Controller has two inputs to monitor up to two compressor circuits using optional Copeland Comfort Alerts. The inputs can provide the following information: Locked rotor, Open Circuits, Missing Phase, Reverse Phase, and Welded Contactor. NOTE: The Comfort Alert sends the Open Circuit Alarm (code 5) only after the fault has been sensed for a minimum of 4 hours.

Test pins. Shorting this input is used to force a defrost cycle for heat pump units during factory test mode.

(25) Configuration pins (P11). The DDC Controller features a 7 pin header (P11) on board for the connection of a configuration key. This 7-position connector allows the controller to determine the unit application mode without a menu entry. Table 2 describes the connections necessary for each one of the possible options. The configuration connector provides a quick and safe way of replacing boards while keeping the proper configuration of the unit.

Table 2: Configuration Connector Parameters

#	P11 - Unit Configuration	1	2	3	4
0	Cooling Only / Default				
1	Single Stage Cooling with 2 Stages EH	X	X		
2	Single Stage HP / Cooling with 2 Stages EH	X		X	
3	Single Stage G/E (Cool) with 1 Stage GH	X			X
4	2 Stages G/E (Cool) with 2 Stages GH		X	X	
5	Single Stage G/E (Cool) with 2 Stages GH		X		X
6	2 Stages Cool with 2 Stages EH			X	X
7	2 Stages HP / Cool with 2 Stages EH	X	X	X	
8	Single Stage Dual Fuel	X	X		X
9	2 Stages Dual Fuel	X		X	X
10	Single Stage HP, 2 Stages Cool with 2 Stages EH		X	X	X
	Selection is made through the display	X	X	X	X

Control Outputs

Table 3: Control Outputs

Item	Description	Type	Option
1	CC1 - Compressor output 1	24VAC	1.5A @ 24VAC, pilot duty
2	CC2 - Compressor output 2	24VAC	1.5A @ 24VAC, pilot duty
3	W1 - Heat output	24VAC	1.5A @ 24VAC, pilot duty
4	W2 - Heat Output	24VAC	1.5A @ 24VAC, pilot duty
5	G - Fan Output	24VAC	1.5A @ 24VAC, pilot duty
RV1	Reversing Valve	24VAC	1.5A @ 24VAC, pilot duty
RV2	Reversing Valve	24VAC	1.5A @ 24VAC, pilot duty
ODF1	Outdoor Fan 1	24VAC	1.5A @ 24VAC, pilot duty
ODF2	Outdoor Fan 2	24VAC	1.5A @ 24VAC, pilot duty
6	L - thermostat signal	24VAC	25mA loading

Table 4: Thermostat Options

Device	Part Number	Description
Stand alone 24V thermostat / touch screen	113129801	Up to 2-heat / 2-cool
Stand alone 24V thermostat	113129901	Up to 2-heat / 2-cool

Table 5: Zone Sensor Module Wire Guide

Device	Part Number	Wire Gauge	Conductors	Type	Listings
Wall mounted sensor with tenant override	113117701	18	3	Solid	18 AWG 3/C CL2P Thermostat
Wall mounted sensor with space point adjustment	113117701	18	3	Solid	18 AWG 3/C CL2P Thermostat

Control Output Descriptions

(1) CC1 - Compressor output 1. The DDC Controller can control the compressor contactors. The DDC Controller can monitor the system and respond to system faults and comfort alert inputs to shut down the compressors in the event of a failure.

(2) CC2 - Compressor output 2. The DDC Controller can control the compressor contactors. The DDC Controller can monitor the system and respond to system faults and comfort alert inputs to shut down the compressors in the event of a failure.

(3) W1 - Heat output. The DDC Controller has two outputs to control resistance electric heat.

(4) W2 - Heat Output. The DDC Controller has two outputs to control resistance electric heat.

(5) G - Fan Output. Energizes the indoor fan relay unless a properly functioning IFC control is connected.

RV1 - Reversing Valve. This output is used to energize reversing valve 1 in heating on heat pump models only. For non-heat pump models with humidity control this output is repurposed to switch the refrigerant liquid line solenoid valve. For non-heat pump models with the eSYNC™ control board, this output is repurposed to power an emergency water shut-off valve relay.

RV2 - Reversing Valve. This output is used to energize reversing valve 2 in heating on heat pump models only. For non-heat pump models with humidity control this output is repurposed to switch the refrigerant reheat solenoid valve.

ODF1 - Outdoor Fan 1. This output is used to de-energize outdoor fan 1 on heat pump models only. For non-heat pump models with humidity control this output is repurposed to allow Outdoor Fan Motor Speed Control (OFMC) while humidity control is active.

ODF2 - Outdoor Fan 2. This output is used to de-energize outdoor fan 2 on heat pump models only. For non-heat pump models with humidity control this output is repurposed to switch the refrigerant discharge line solenoid valve.

(6) L - Thermostat signal. The “L” terminal will output a flash code to an indoor 24 V thermostat equipped with an “L” terminal.

⚠ DANGER

Before beginning any modification, be sure main disconnect switch is in the "OFF" position. Disconnect all electric power, including remote disconnect before servicing. Failure to do so can cause electrical shock resulting in property damage, personal injury or death. Follow proper lockout/tag out procedures to ensure the power cannot be inadvertently energized.

⚠ IMPORTANT

The DDC Controller is shipped with the control disabled so units do not accidentally energize during installation. The commissioning of the rooftop unit therefore requires the configuration of the Occupied Mode menu prior to initial startup. See Effective Occupancy on page 27.

The unit DDC Controller must have a thermostat or zone sensor input in order to operate the unit. If the zone sensor is not present, or has failed, the unit will use the return air temperature sensor to maintain the occupied set point. The flexibility of the unit mode capabilities depends upon the type of zone sensor or thermostat selected to interface with the DDC controller.

The descriptions of the following basic Input Devices used within the DDC controller network are to acquaint the operator with their function as they interface with the various modules. Refer to the unit's electrical schematic for the specific module connection.

The following controls are available from the factory for field installation.

Controls using 24 VAC

Before installing any connecting wiring, refer to the unit installation manual for AC conductor sizing guidelines "Field Wire Size For 24 Volt Thermostat Circuits", for the electrical access locations provided on the unit, and;

- Use copper conductors unless otherwise specified.
- Ensure that the AC control wiring between the controls and the unit's termination point does not exceed three (3) ohms per conductor for the length of the run.

NOTE: Note: Resistance in excess of 3 ohms per conductor may cause component failure due to insufficient AC voltage supply.

- Be sure to check all loads and conductors for grounds, shorts, and mis-wirings.
- Do not run the AC low voltage wiring in the same conduit with the high voltage power wiring.
- Some thermostat wire insulation has a voltage rating less than the line voltage. Route Thermostat Wire behind low voltage shield during unit installation per Figure 7. This is necessary to meet National Electrical Code (NEC) and UL 1995 requirements for separation of high and low voltage circuits.

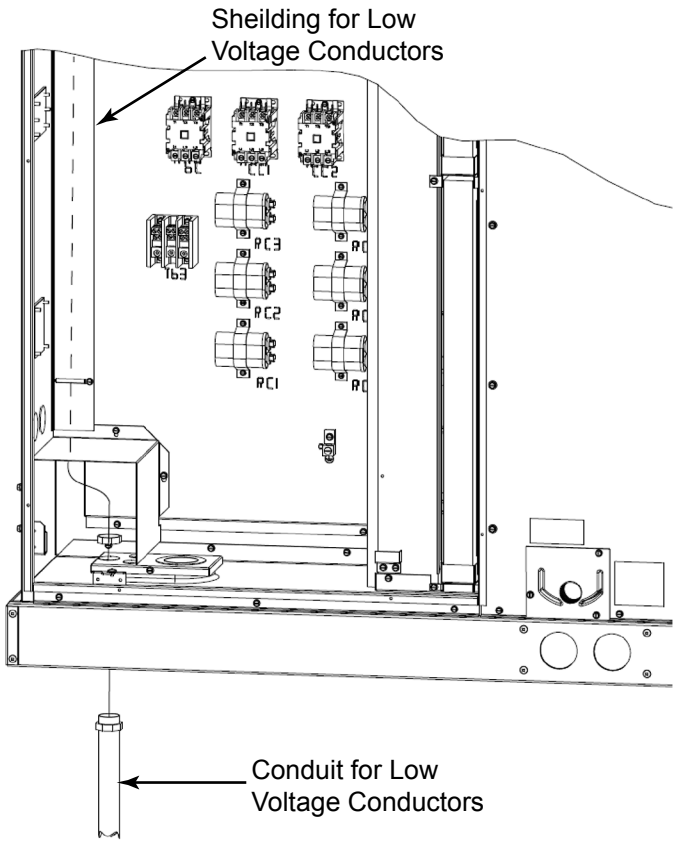
Controls using DC Analog Input/Outputs

(Standard Low Voltage Multi-conductor Wire)

Before installing any connecting wiring between the unit and components utilizing a DC analog input/output signal, refer to the unit installation manual for the electrical access locations provided on the unit.

- Use shielded cable for high EMI environments.
- Note: Resistance in excess of 2.5 ohms per conductor can cause deviations in the accuracy of the controls.
- Ensure that the wiring between controls and the unit's termination point does not exceed two and a half (2.5) ohms per conductor for the length of the run.
- Do not run the electrical wires transporting DC signals in or around conduit housing high voltage wires.
- Most sensor wire insulation has a voltage rating less than the line voltage. Route Zone Sensor and Network Cable behind low voltage shield during unit installation per Figure 7. This is necessary to meet NEC and UL 1995 requirements for separation of high and low voltage circuits.

Figure 7: Low Voltage Shielding

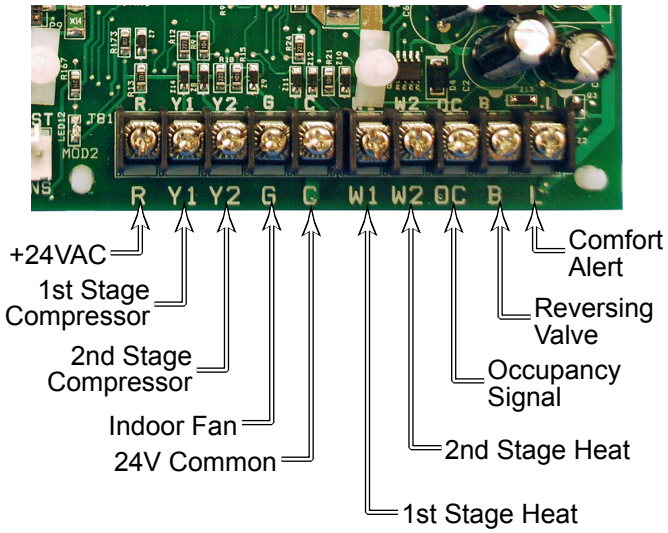


Stand Alone with Thermostat

Once Occupied Mode is set to “Control by Thermostat” the DDC Controller will follow the commands from a regular 24VAC thermostat, according to the following convention:

- •G - Indoor fan
- •Y1 - First stage of compressor
- Y2 - Second Stage of compressor
- B - Not Used
- W1 - First Stage Auxiliary heat (electric or gas)
- W2 - Second Stage Auxiliary heat (electric or gas)
- L - Comfort Alert signal (output)
- R & C - 24VAC

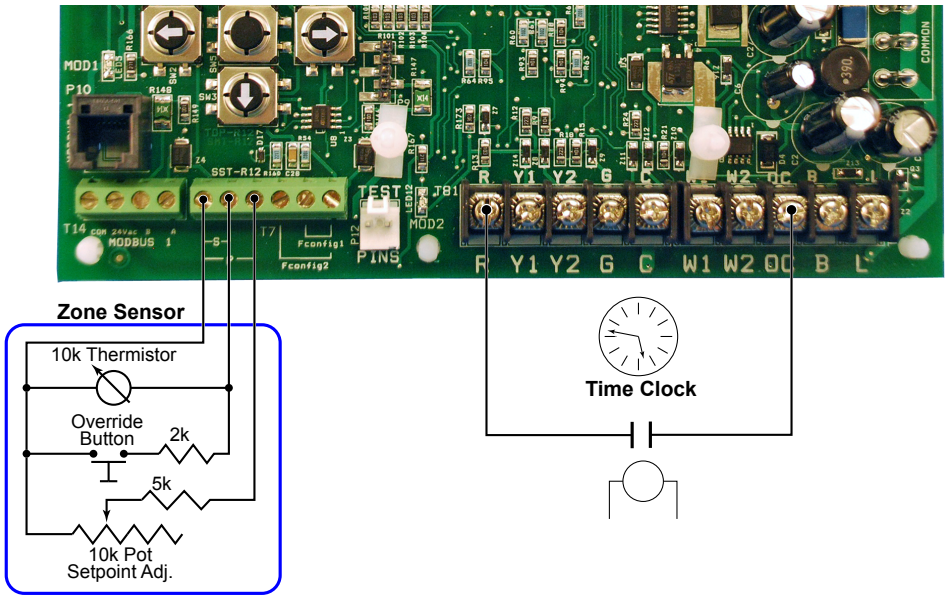
Figure 8: Thermostat Inputs and Outputs



Standalone with Zone Sensor and Time Clock

If Occupied Mode is set to any of the options other than “Off” and “Control By Thermostat”, the control will operate in Stand Alone mode or network using its local temperature sensors to determine demand. The system can be set up with a zone sensor to determine heat or cool demand and a solid state time clock to determine occupancy. (See Occupancy Mode on page 27)

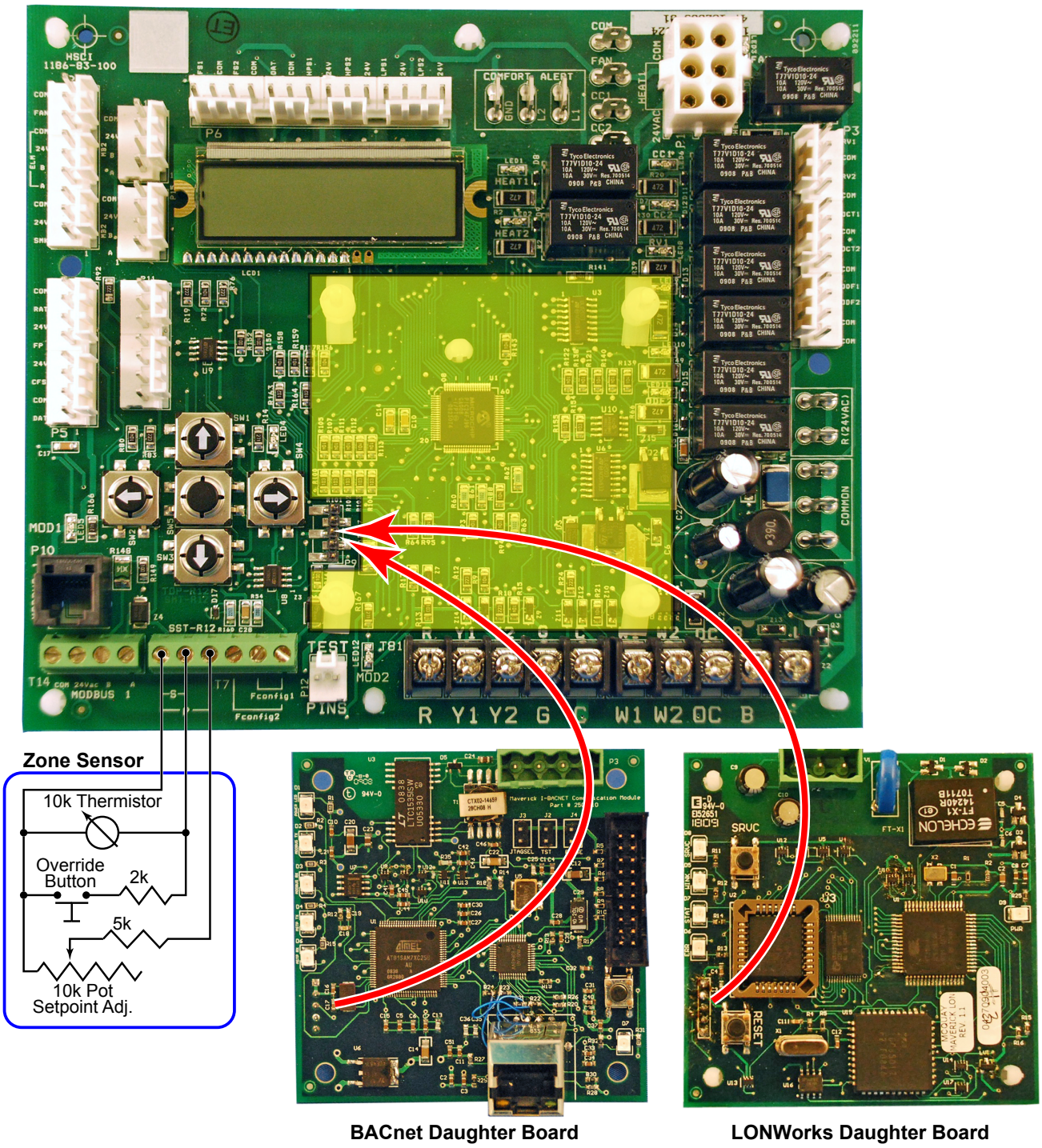
Figure 9: Standalone with Zone Sensor and Time Clock



Standalone with Building Automation System

If Occupied Mode is set to any of the options other than “OFF” and “Control By Thermostat”, the control will operate in Stand Alone mode or network using its local temperature sensors to determine demand. The system can be set up with a zone sensor, 910108514 or 910108214 communication card, and 2nd-party building automation system that will be controlled from a central location.

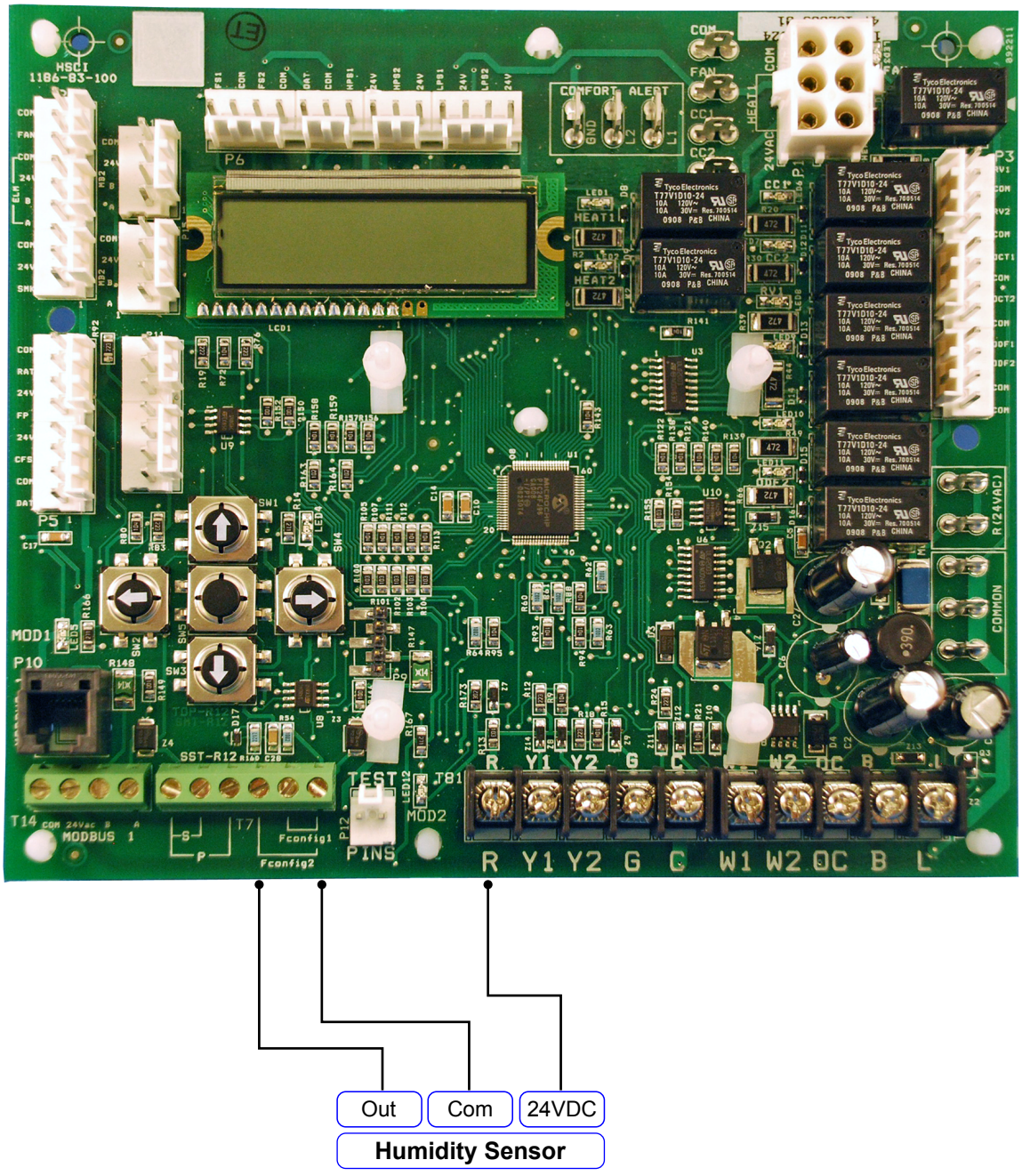
Figure 10: Zone Sensor with Building Automation System



Indoor Relative Humidity Sensor

Field-configurable Input #2 can be used to connect an indoor relative humidity sensor that has a 0–10Vdc output for a 0–100% indoor relative humidity input. Units with the optional dehumidification control require this indoor relative humidity sensor to operate the optional hot gas reheat coil. Because this is a “powered” sensor, an additional wire to the 24Vac power supply from the unit is required. The “R” thermostat input can be used for this purpose. The indoor relative humidity sensor can be used along with thermostat control, a zone sensor with a time clock, or the BAS communication card and a third-party BAS that will be controlled from a central location.

Figure 11: Indoor Relative Humidity Connection



IMPORTANT

The DDC Controller is shipped with the control disabled so units do not accidentally energize during installation. The commissioning of the rooftop unit therefore requires the configuration of the Occupied Mode menu prior to initial startup. See Occupancy Mode on page 27.

Cooling

When the DDC Controller receives a call for cooling via thermostat or zone sensor compressor 1 energizes. After the indoor fan on delay (1-180 sec / default 10 sec) the indoor fan energizes. The indoor fan on delay starts when the call for cooling is initiated.

When used in local zone sensor mode of operation, the DDC Controller satisfies the set point using all or a partial number of stages available. When cooling demand exists, the DDC Controller will stage up in the following order: Economizer, First Stage Cooling, and Second Stage Cooling based on demand.

When used in local thermostat mode of operation, the DDC Controller allows the thermostat to control the demand for cooling. When cooling demand exists, the DDC Controller will stage up in the following order: Economizer, First Stage Cooling. Only two stages will be allowed to energize, so if the economizer is active then the first stage mechanical cooling will become second stage and second stage mechanical cooling will not be used.

Heat

When in heating mode of operation, the DDC Controller satisfies the set point using all or a partial number of stages available. When heating demand exists, the DDC Controller will utilize heat sources in the following order of priority as available: Gas Heat and Electric.

When the heat demand requires multiple heating outputs at the same time, a minimum staging delay of 5 seconds between energizing and de-energizing heating outputs is necessary to prevent the inrush current startup of multiple loads. The inter stage is adjustable between 5 and 50 seconds.

The source of demand, like the other modes of operation, is a result of one of either thermostat or remote sensors.

Heat Pump

When the RTU-C control receives a call for heat pump via thermostat or zone sensor compressor 1 and reversing valve 1 energizes. After the indoor fan on delay (1-180 sec / default 10 sec) the indoor fan energizes. The indoor fan on delay starts when the call for heating is initiated.

During heat pump mode the control energizes the reversing valve along with the correspondent stages of compressor. Once the reversing valve is energized, it will remain energized until the unit exits the heat pump mode, thus avoiding the frequent noise associated with the equalization of the refrigerant pressure.

Whenever the system is equipped with reversing valves, the mechanical heating (heat pump) is considered the primary source of heat. Certain circumstances may prevent the heat pump from operating, such as outdoor air temperature being below its set point, discharge air temperature below its set point, or alarms related to the compressor operation. The heat pump operation is never available when the outdoor air temperature is below the low balance set point. Once the heat pump has been prevented from operating in such circumstances, it will only be available again if the outdoor air temperature exceeds the high balance set point.

The control allows the user to adjust low and high balance set points through the display, as long as the selection provides a minimum difference of 5°F between the two. If for example the low balance set point was set at 35°F, the minimum high balance set point would be 40°F. If the heating set point is not satisfied within the demand delay, additional stages of mechanical heating are engaged in operation. When those stages are complete, electric heat may work in conjunction with the compressors. However, if the secondary heat source is fossil fuel, the heat pump and gas furnace are exclusive and cannot work in conjunction with each other.

As long as the outdoor air temperature is above the balance point, the heat pump will continue to operate without the furnace, even if the set point is not satisfied. If the outdoor temperature crosses the low balance set point, then the heat pump will cease operation and the furnace will be the only source of heat available to satisfy the effective ambient set point.

Integrated Furnace Control

The Integrated Furnace Control (IFC) is external to the DDC Controller, and on units so equipped, controls the furnace and gas valve operation based on ModBus communication interface from the DDC controller. The IFC also provides furnace troubleshooting information via LED flashing fault codes. When a fault condition exists, the LED (see Figure 12) flashes the number of times indicated by the code number, pauses, and repeats.

Figure 12: Integrated Furnace Control Status LED

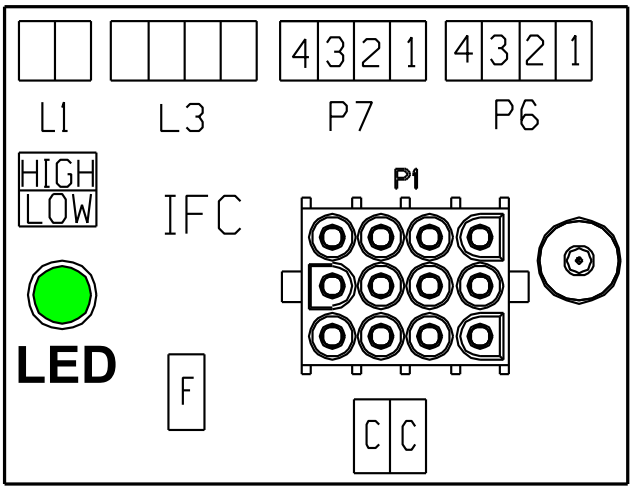


Table 6: Integrated Furnace Control Fault Codes

Code	Meaning
1	Failure To Detect Or Sustain Flame
2	Pressure Switch Or Inducer Problem Detected
3	High Limit Protection Deice Open
4	Gas Valve Not Energized Or No “W” Signal
5	Flame Toll Out Switch Open

Call for Heat

After a call for heat the IFC checks to ensure the high temperature limit and rollout switches are closed. If either is open, the IFC responds with a fault code. If high limit and rollout switches are closed, the IFC checks that both pressure switches are open. If either pressure switch is closed, the IFC will respond with a fault code and it will flash code “2” on the LED, waiting indefinitely for both pressure switches to open. If both pressure switches are open, the IFC proceeds to prepurge.

Pre-Purge

The IFC energizes the low inducer motor, flashes code “2” on LED, and waits for the low pressure switch to close. If the low pressure switch does not close within 3 minutes, the control will energize the high inducer and wait for both pressure switches to close. The IFC will light on high fire and remain on high fire for the remainder of the heat cycle.

When the low pressure switch has closed, the IFC stops flashing the LED and begins timing the 30 second pre-purge period. If flame is sensed as present during pre-purge, the IFC restarts the pre-purge time to require a full pre-purge after flame is removed. When pre-purge time has expired, the IFC begins the ignition trial.

Ignition Trial

The IFC energizes the gas valve and spark. The IFC ignores flame sense for the first 2 seconds of the ignition trial. If flame is not established within 7 seconds, the gas valve and spark is de-energized and the IFC goes to an inter-purge. If flame is established, the spark is de-energized, the IFC energizes the high inducer (low inducer remains energized) and begins heat blower on delay.

Heat Blower On-Delay

The control waits for 45 second heat fan on delay and then energizes the indoor blower heat speed. If the blower is already energized by a call for cooling or continuous fan, or in a blower off delay period, the on delay is skipped and the blower remains energized. After the blower on delay time is complete, the control goes to high fire warm-up mode.

The high pressure switch is ignored during the heat blower on delay to give time for the high pressure switch to close if lighting on low fire.

High-fire Warm-up

The IFC remains on high fire for 120 seconds after flame is established. If the DDC Controller is calling for 2nd stage heat, the IFC remains in high heat. If the IFC lit on high fire because the low pressure switch did not close within 3 minutes, then the IFC remains on high fire for the entire call for heat regardless of 2nd stage thermostat call. If there is no DDC Controller demand for 2nd stage heat when the 120 second time has expired, the IFC transitions from high heat to low heat.

Low Heat

IFC inputs are continuously monitored to ensure limit, rollout, and pressure switches are closed, flame is established, and the thermostat call for heat remains. Low gas, low inducer, and blower remain energized. If the DDC Controller calls for 2nd stage heat (Hi Heat), the IFC transitions to high heat.

High Heat

IFC inputs are continuously monitored to ensure limit, rollout, and pressure switches are closed, flame is established, and the DDC Controller calls for heat remain. Low gas, high gas, low inducer, high inducer, and blower remain energized. If the DDC Controller terminates the call for 2nd stage heat and the first stage call remains, the IFC transitions to low heat.

Low Heat to High Heat Transition

When the DDC Controller calls for 2nd stage heat after low heat is established, the IFC checks the high pressure switch. If the high pressure switch is closed, the IFC flashes “2” on the LED and waits indefinitely for the high pressure switch to open. When the high pressure switch is proven open, the IFC energizes the high inducer motor and waits for the pressure switch to close. If the high pressure switch does not close within 60 seconds, the control flashes “2” on the LED and deenergizes the high inducer motor for 5 minutes. The high inducer is re-energized after the 5 minute period for 60 seconds and the cycle repeats indefinitely until the high pressure switch closes. When the high pressure switch closes, the IFC energizes the high gas output and proceeds to high heat.

High Heat to Low Heat Transition

When the DDC Controller ends the call for 2nd stage heat and the first stage call remains, the IFC de-energizes the high gas output. The high inducer remains energized for 60 seconds after the high gas de-energizes. The IFC proceeds to low heat.

Post Purge

When the DDC Controller demand for heat is satisfied, the IFC immediately de-energizes the gas valve(s). The Inducer output(s) remains on for a 5 second post-purge period. The IFC continues the heat blower off delay.

Heat Blower OFF Delay

The IFC de-energizes the Indoor blower motor 90 seconds after the call for heat terminated

Interrupted Call For Heat

If the DDC Controller demand for heat is removed before the ignition period, the IFC will immediately de-energize the inducer.

If the DDC Controller demand for heat is removed after ignition has begun, the induced draft motor will run through a post purge and the indoor blower motor will run on heat speed for the delay OFF time.

Ignition Retry

If flame is not established on the first trial for ignition period, the induced draft motor remains energized and the IFC deenergizes the low gas valve. The IFC waits for a 60 second inter-purge period then attempts an ignition re-try. If the second ignition trial is unsuccessful, the IFC energizes the high inducer and waits indefinitely for the high pressure switch to close. When the high pressure switch closes, the IFC energizes the high gas output, interpurges 60 seconds and tries the 3rd and 4th ignition attempts on high fire.

If flame is not established on the fourth trial for ignition, the IFC de-energizes the high and low gas outputs and goes into lockout. The IFC indicates a fault by flashing the status LED 1 time to indicate lockout is due to failed ignition.

Ignition Recycle

If flame is established and maintained during the trial for ignition period and then flame is lost, the gas valve is deenergized, the induced draft motor continues to run, and the control begins timing the pre-purge delay. The indoor blower motor will be energized and/or remain energized on heat speed for the delay OFF time.

When the pre-purge delay is over, the control energizes the spark and gas valve for an ignition attempt. If ignition is unsuccessful, the IFC will attempt up to 3 more retries as described above. The IFC will recycle up to 17 flame losses (16 recycles) within a single call for heat before going to lockout. The IFC status LED will flash 1 time if lockout is due to too many flame loses. (This is same flash code as failed ignition.).

Open Limit switch

The limit switch is ignored unless a call for heat is present. If the limit switch opens while a call for heat is present, the indoor fan is energized on heat speed and both inducers are energized. The gas valve is de-energized if it was energized. The status LED will flash 3 times indicating the Limit switch is open. The blower and inducers will remain energized as long as the limit is open and there is a call for heat.

If the call for heat goes away while the limit switch is open, the induced draft motor will run through post purge and the indoor blower will run through the heat fan off delay. The status LED will return to steady on.

If the limit switch re-closes and the call for heat remains, the status LED will return to steady on and the IFC will begin a pre-purge time with high gas output energized to begin a re-ignition attempt. The indoor blower remains on (for the delay OFF time) through the re-ignition attempt.

Open Rollout switch

The rollout switch is ignored unless a call for heat is present and the limit switch is closed. If the rollout switch opens for more than 1 second, the indoor fan is energized on heat speed for a heat blower OFF delay period and the inducer motor is energized for a post-purge time period. The gas valve is de-energized if it was energized. The status LED will flash 5 times indicating the rollout switch is open and the IFC is in lockout.

If the rollout switch re-closes before the call for heat goes away, the IFC will remain in lockout with the LED flashes 5 times.

NOTE: Rollout switch open for less than 1 second will cause interrupted heat cycle from open PS, however it will not lock out.

Pressure switch

The pressure switches are ignored unless a call for heat is present and the limit and rollout switches are closed. When a call for heat occurs and either pressure switch is closed before the inducer is energized, the inducer will remain OFF and the LED will flash 2 times until both pressure switches open.

If either pressure switch opens before the ignition period, both induced draft motor will remain ON, the high gas output will be de-energized, and the LED will flash 2 times. When both pressure switches are closed, the LED flash code is cleared, the high gas output is energized, and the control re-starts the prepurge period.

If the low pressure switch opens after the gas valve has been energized, the control will de-energize both gas outputs and run the indoor blower on heat speed through the fan OFF delay. The low inducer remains energized and the high inducer energizes if it was not already energized. When both pressure switches re-close, the control begins the pre-purge period and re-ignites. If the call for heat goes away before the pressure switches close, both inducer motors are de-energized and the control goes to standby.

If the high pressure switch opens while in high heat and the low pressure switch remains closed, the control de-energizes the high gas output and attempts to reestablish high heat.

Call for Fan

When the DDC Controller calls for continuous fan (Cont Fan) without a call for heat, the indoor fan is immediately energized. The fan remains energized as long as the call for fan remains without a call for heat.

The continuous fan operation continues to function while the control is in heat mode lockout.

Undesired Flame

If flame is sensed longer than 2 seconds while the gas valve is de-energized, the IFC will energize both induced draft motors and indoor blower motor. When flame is no longer sensed, the induced draft motors and indoor blower motor will deenergize. The IFC will do a soft lockout, but will still respond to open limit and flame. The status LED will flash 4 times when lockout is due to undesired flame. If there is no call for heat, or the call for heat is removed, lockout will reset.

Gas Valve relay fault

If the IFC senses the gas valve is energized for more than 1 second when the control is not attempting to energize the gas valve, or if the gas valve is sensed as not energized when it is supposed to be energized, then the IFC will lockout with the LED OFF. The IFC assumes either the contacts of the relay driving the gas valve have welded shut, or the sensing circuit has failed. The inducer is forced OFF to open the pressure switch to stop gas flow unless flame is present.

If the gas valve was sensed as closed when it should be open, and has not de-energized after the inducer was shut off for 15 seconds, then both inducers are re-energized to vent the unburned gas.

Soft Lockout

The IFC shall not initiate a call for heat while in lockout. A call for continuous fan operates as normal. The IFC will still respond to an open limit and undesired flame.

Lockout shall automatically reset after 1 hour. Lockout may be manually reset by removing the thermostat call for heat for more than 3 seconds or removing power from the control for more than 5 seconds.

Hard lockout

If the IFC detects a fault, the status LED will be de energized and the IFC will lockout as long as the fault remains. Hard lockout may be reset by removing power to the control for more than 5 seconds. Faults detected within the microcontroller continually re-test to see if they are hard failures. Failures detected within the flame sensor or gas valve drive circuits re-test every 1 hour.

Electric Heat

The DDC Controller will always consider two available stages of electric heat, although installation may have only one.

The electric heat is energized whenever the demand for heat is not satisfied. The heat source it will be staged on based on demand.

During electric heat operation the control does not delay energizing the indoor fan.

Keypad

The keypad consists of Up, Down, Left, Right arrow keys, and an Enter key. The Right and Left keys allow the user to select among the different groups of menus. The Up and Down keys allow the user to scroll vertically through sub-menus within the menu group. Up and Down keys also allow the input of certain parameters, such as set points and time delays. Before changing any parameter please see the appropriate sections and have a full understanding of what you are changing. Adjustment are possible only when a blinking cursor is over or next to the parameter to be adjusted. The blinking cursor is available for adjustable parameters after the user presses the Enter key (center key) while the value in question is shown on the display. Once the adjustment is made, the user must press the Enter key again for the change to take effect. During the adjustment, either left or right keys work as “escape” so the parameter reverts back to its original value and the cursor is no longer visible.

Figure 13: Keypad and Display

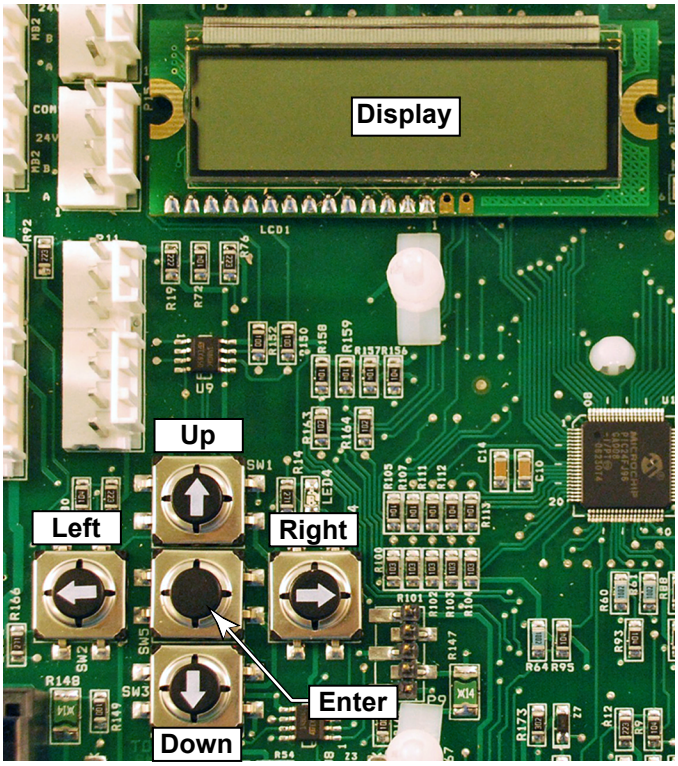
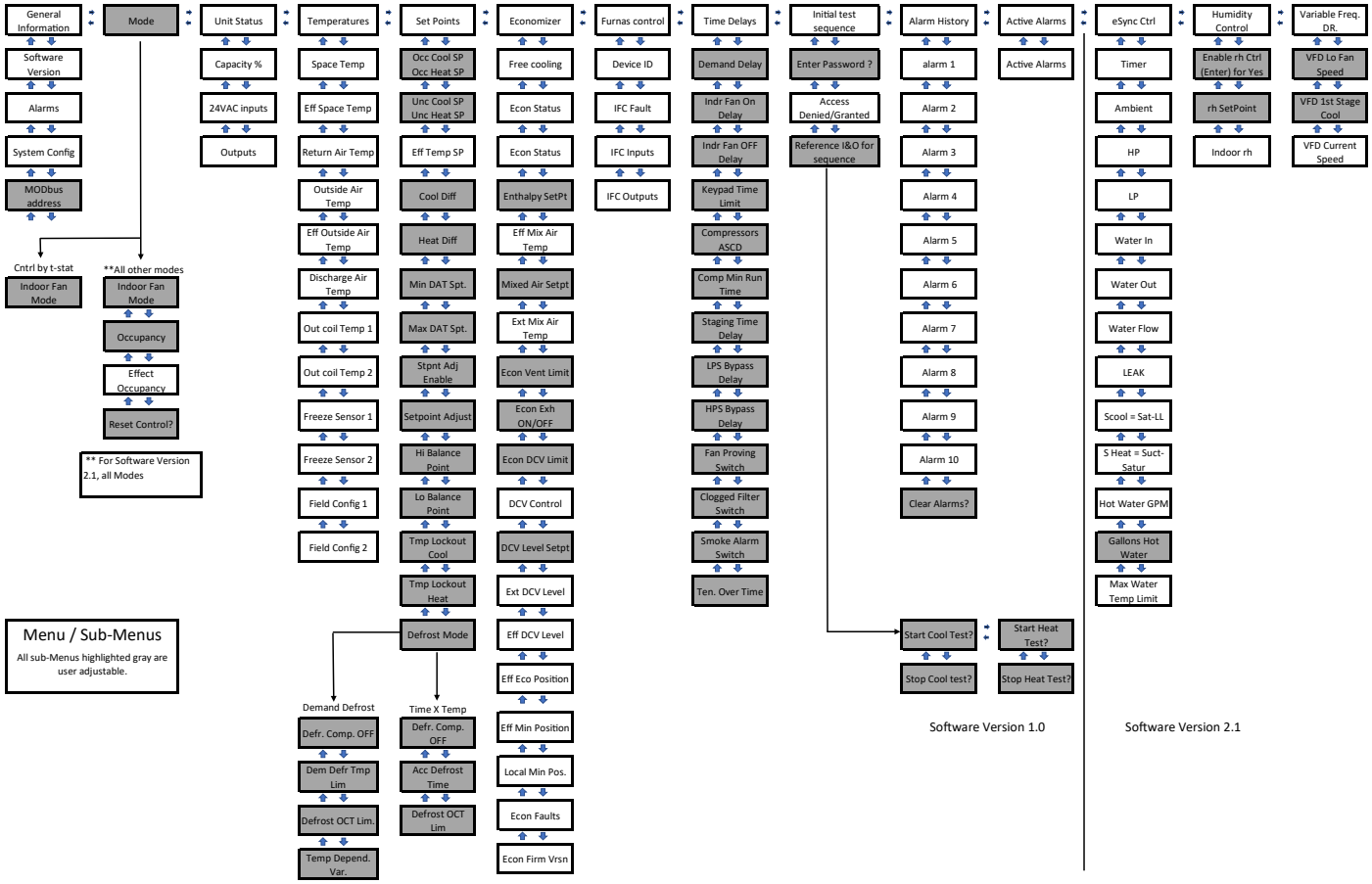


Figure 14: Menu Structure



General Information Screen

This is the homepage of the system. The software version is programmed in the factory and cannot be changed. The item “Alarms” is dependent upon the existence of an alarm and it may display either “No Active Alarm” or “CHECK ALARMS!” Another screen outside this group shows the details of existing alarms. The option for system configuration is set with a configuration key from the factory. The MODBUS Address has a default value of “1” and should not be changed unless the RTU-C is directly connected to a Building Automation System (BAS) that uses MODBUS as the communication protocol.

Figure 15: General Information Home Page

General Information
Software version X.X
Alarms No Active Alarms / Check Alarms
System config 2 stg Cool Only 1s Cool 2s Elec 1s HP/Cool 2s EL 1s G/E 1s G/H 2s G/E 2s GH 1s G/E 2s GH 2s Cool 2s Elec 2s HP/C 2s Elec 1stg Dual Fuel 2stg Dual Fuel 1sHP 2sCool 2sEH
MODBUS ADDRESS 1

At power up or after a period of time of 5 minutes (display delay) without the selection of any buttons the system returns to a modified version of this screen, and resumes scrolling through the items of this group.

The modified general information screen automatically scrolls through the different menu items described in the following table, at 2-second intervals. When the user presses any button, the changing of screens stops until the display delay expires.

Figure 16: General Information Page Modified

Software version X.X
Alarms No Active Alarms / Check Alarms
System Config xxxxxx MODE OFF AUTO FAN ONLY HEAT ONLY COOL ONLY Ctrl by Tstat
UNIT STATUS STANDBY Fan Only COOL STG1 ECON COOL STG2 CC/ECO COOL STG1 COMP COOL STG2 COMP HEAT STG1 COMP HEAT STG2 COMP HEAT STG1 ELEC HEAT STG2 ELEC HEAT STG1 GAS HEAT STG2 GAS HEAT STG2 CC/ELE HEAT STG3 CC/ELE HEAT STG4 CC/ELE Defrost 1 Defrost 2

MODE Screen

The MODE screen determines whether the unit is connected to a network, a regular thermostat, or if it is just using its local sensors for controlling the temperatures . It also determines the indoor fan operation, whether it is operating in occupied mode, unoccupied mode, or tenant override and displays the effective occupancy.

Figure 17: Mode Screen

Mode:
Off
Auto
Fan only
Heat only
Cool only
Ctrl by t-stat
Indoor fan mode
Continuous
Auto
Cont. when Occ.
Occupancy
Occupied / Unoccupied / network / Local Switch
Effect Occupancy
Occupied / unoccupied / Tenant override XXX min
Re-set control?
(Enter) for Yes

Mode

The Mode is available through network and user interface. The possible selections are:

- OFF
- Auto
- Cooling only
- Heating only
- Fan Only
- Control by thermostat: not available through network. This is exclusive to the human interface.

OFF mode is the default factory selection, so units do not accidentally energize during installation. The commissioning of the rooftop unit therefore requires the configuration of the Occupied Mode register prior to initial startup.

Auto mode is used with a zone sensor and solid state time clock.

Indoor Fan Mode

The INDOOR FAN MODE is the option that decides the Indoor fan function. It includes the following options.

- Continuous
- Auto
- Cont. when occup.

Continuous is used if it is desired that the fan runs all the time regardless of Effect Occupancy. The Auto option allows the fan to cycle with the heat or cool call regardless of Effect Occupancy. The Cont. when occup. option lets the indoor fan run continuous when Effect Occupancy is occupied.

Occupancy

The Occupancy is only available through human interface and includes the following options:

- Manual Occupied
- Manual Unoccupied
- Network
- Local Switch

Manual Occupied and Manual Unoccupied have priority over other selections of occupancy. Those selections are not limited in time and the BAS system does not have the ability to change them. If the end user desires to relinquish the occupancy control to the Building Automation System, they must set the Occupancy to “Network.”

The Local Switch option allows the determination of occupied mode through a hardwired 24Vac signal, identified as “OC” in connector T8. If that input is connected to “R” (24Vac), the unit is operating in occupied mode; otherwise it operates in unoccupied mode.

Effective Occupancy

Tenant Override, Occupied, or Unoccupied will be displayed depending on the actual mode. The RTU-C control allows separate adjustment of temperature set points and fan operation according to the building occupancy. This feature is only available when a thermostat is not controlling the ambient. For the following sections, Occupied Mode implies that the calculation for demand utilizes occupied set points, which are used to satisfy the comfort in the ambient. Unoccupied mode utilizes unoccupied set points and is normally set to save energy during periods in which buildings are closed and unoccupied.

Tenant Override Mode is a state in which the control utilizes occupied set points for a limited amount of time, after which it returns to unoccupied mode. To start the Tenant override, the user would press a button on the space sensor for more than 2 seconds. The Tenant override period is adjustable between 2 and 6 hours and has priority over any other settings.

Reset Control by pressing enter when in reset control the controller will reset all adjustable menu items back to the factory default values.

Unit Status Screen

The unit status screen shows basic information about the operation of the unit, such as actual mode of operation, capacity of cooling or heating, inputs, and outputs.

Table 7: Unit Status Screen

Mode	STANDBY
	Fan Only
	COOL STG1 ECON
	COOL STG2 CC/ECO
	COOL STG1 COMP
	COOL STG2 COMP
	HEAT STG1 COMP
	HEAT STG2 COMP
	HEAT STG1 ELEC
	HEAT STG2 ELEC
	HEAT STG1 GAS
	HEAT STG2 GAS
	HEAT STG2 CC/ELE
	HEAT STG3 CC/ELE
	HEAT STG4 CC/ELE
	Defrost 1
	Defrost 2
CAPACITY Heating: / Cooling:	0 – 100%
24Vac Inputs	Y1 – ON/OFF
	Y2 – ON/OFF
	W1 – ON/OFF
	W2 – ON/OFF
	B – ON/OFF
	G – ON/OFF
	OCC – ON/OFF
	LPS1 – ON/OFF
	LPS2 – ON/OFF
	HPS1 – ON/OFF
	HPS2 – ON/OFF
	CFS – ON/OFF
	SMKS – ON/OFF
	FPS – ON/OFF
Outputs	Compressor 1 – ON/OFF
	Compressor 2 – ON/OFF
	Rev Vlv 1 – ON/OFF
	Rev Vlv 2 – ON/OFF
	Heat 1 – ON/OFF
	Heat 2 – ON/OFF
	Outdr Fan 1 – ON/OFF
	Outdr Fan 2 – ON/OFF
	Indoor Fan – ON/OFF

Effective Occupancy Screen

The Occupancy screen determines whether the unit is operating in occupied mode, unoccupied mode, or tenant override. It also displays whether the control is connected to a network, regular thermostat, or if it is just using its local sensors for controlling the temperatures.

Table 8: Effective Occupancy Screen

Item	Range
Effective Occupancy	Occupied / Unoccupied / TntOverr XXX min
Occupied Mode	OFF
	AUTO
	FAN ONLY
	HEAT ONLY
	COOL ONLY
	Ctrl by Tstat
Ind Fan Occupcy	Continuous
	Auto
	Cont when occup

Effective Occupancy

Tenant Override, Occupied, or Unoccupied will be displayed depending on the mode. The DDC Controller allows separate adjustment of temperature set points and fan operation according to the building occupancy. This feature is only available when a thermostat is not controlling the ambient. For the following sections, Occupied Mode implies that the calculation for demand utilizes occupied set points, which are used to satisfy the comfort in the ambient. Unoccupied mode utilizes unoccupied set points and is normally set to save energy during periods in which buildings are closed and unoccupied. Tenant Override Mode is a state in which the control utilizes occupied set points for a limited amount of time, after which it returns to unoccupied mode. To start Tenant Override, the user presses a button on the space sensor for more than 2 seconds. The Tenant Override period is adjustable between 2 and 6 hours and it has priority over any other settings.

All set points are available via network and local human interface.

Occupancy Mode

The Occupancy Mode is available through network and user interface. The possible selections are:

- OFF
- Auto
- Cooling only
- Heating only
- Fan Only
- Control by thermostat: not available through network. This is exclusive to the human interface.

OFF mode is the default factory selection, so units do not accidentally energize during installation. The commissioning of the rooftop unit therefore requires the configuration of the Occupied Mode register prior to initial startup.

Auto mode is used with a zone sensor and solid state time clock.

Set Points Screen

These screens allow the input of desired cooling, heating, and defrost set points.

Table 9: Set Points Screen

Item	Range	
Occ Cool Spt XXX °F Occ Heat Spt XXX °F	Cooling: 40 to 100°F, default 76°F Heating: 36 to 96°F, default 68°F	
Cooling: 40 to 100°F, default 76°F Heating: 36 to 96°F, default 68°F	Cooling: 40 to 100°F, default 86°F Heating: 36 to 96°F, default 56°F	
Cool. Diff. X.X °F	0.5 to 9.9°F, default 1.0°F	
Heat Diff. X.X °F	0.5 to 9.9°F, default 1.0°F	
Min DAT Spt XXX °F	10 to 90°F, default 55°F	
Max DAT Spt XXX °F	50 to 120°F, default 55°F	
Stpnt Adj Enable	Enable / Disable	
Setpoint Adjust. XXX °F	36 to 100°F, default 76°F	
Hi Balance Point XXX °F	0 to 120°F, default 40°F	
Lo Balance Point XXX °F	0 to 120°F, default 5°F	
Tmp Lockout Cool XXX °F	0 to 50°F, default 35°F	
Tmp Lockout Heat XXX °F	70 to 145°F, default 90°F	
Defrost Mode	No Defrost Demand Defrost Time × Temperature Defrost	Default - Demand Defrost (heat pump models)
Time × Temp Defrost (conditional to previous selection)	Defr. Comp. OFF: 90sec to 1sec, default 3sec Acc defrost time: 90min to min 1min, default 60min Defrost OCT lim: 80°F to 50°F, default 70°F	
Demand Defrost (conditional to previous selection)	Defr. Comp. OFF: 90sec to 1sec, default 3sec Dem Defr Tmp Lim: 25°F to 45°F, default 35°F Defrost OCT lim: 80°F to 50°F, default 70°F Temp.Depend.Var: 15°F to 5°F, default 10°F	

Set Points

Set point is the desired temperature of comfort. The user has two ways to adjust the set point: (a) using the User interface, or (b) sending a command through the network. The set point selection will only be valid when the board is not connected to a thermostat.

The user can select occupied and unoccupied set points for both heating and cooling through either the display or the network. The selection through display does not allow the user to choose set points closer than the value of the dead band plus differential, so the control automatically changes the value of the set point not being adjusted. As an example, if the differential plus dead band equals to three degrees and the user is adjusting cooling set point at 72°F, the control will lower the heating set point to 69°F if the difference between the two is less than three.

If the remote set point adjustment is enabled, then the control will consider the hardwired potentiometer input to determine occupied set points only. If the remote set point adjustment is enabled but the input reads an invalid number, the control will default back to the occupied set point selection.

Network data takes precedence over local selections. In other words the control will follow a valid remote set point adjustment from the network, even if the remote set point adjustment is enabled and the hardwired input reading is valid.

The DDC Controller will consider the hardwired potentiometer reading or the network remote set point adjustment as the cooling set point. It calculates the heating set point by subtracting dead band (2.0°F) and differential from the cooling set point.

Cooling Differential, Heating Differential, and DeadBand

Differential is the maximum difference allowed between the temperature reading and set point before the control considers a valid demand for cooling or heating. The differential is also valid for determining that the unit has satisfied demand. Depending of the mode of operation, the differential will either be added or subtracted from the set point to determine those points.

Dead band is the difference between cooling set point minus cooling differential and heating set point plus heating differential.

Min DAT Spt

The Minimum DAT set point is used to create warnings in the system.

Max DAT Spt

The Maximum DAT set point is used to create warnings in the system.

Stpnt Adj Enable

If the set point adjustment is enabled, then the control will consider the hardwired potentiometer input to determine occupied set points only. If the remote set point adjustment is enabled but the input reads an invalid number, the control will default back to the occupied set point selection.

Set Point Adjust

This is the actual reading of the potentiometer set point “Stpnt Adj Enable”.

Hi Balance Point/Lo Balance Point

The heat pump operation is never available when the outdoor air temperature is below the low balance set point. Once the heat pump has been prevented from operating in such circumstances, it will only be available again if the outdoor air temperature exceeds the high balance set point. The control allows the user to adjust low and high balance set points through the display, as long as the selection provides a minimum difference of 5°F between the two. If for example the low balance set point was set at 35°F, the minimum high balance set point would be 40°F.

Cooling Lockout Temperature

If the outdoor air temperature is below the cooling lockout temperature the control will prevent the operation of mechanical cooling. The default cooling lockout temperature is 35°F with a range of adjustment from 0°F to 50°F and the cooling lockout resets at 5°F above the set point. As an example, if the setting is 40°F and the compressors are not operating due to low outdoor air temperature, then the DDC Controller will only allow the operation of mechanical cooling again once the OAT reading exceeds 45°F.

Heating Lockout Temperature

If the outdoor air temperature is above the heating lockout temperature the control will prevent the operation of heating. The default heating lockout temperature is 90°F with a range of adjustment from 70°F to 145°F and the heating lockout resets at 5°F below the set point.

Defrost Operation

The control allows the selections of time versus temperature defrost control, demand-defrost control, or no defrost cycle. The user can opt for the default, which is demand defrost control, or change it to time versus temperature via Human System Interface (HSI) or network. The same applies for the no defrost operation.

During the defrost operation the low pressure switch is ignored.

Time × Temperature

The control accumulates compressor run time, based upon the compressor contactor output being energized. When the accumulated time reaches the selected defrost interval time (from 30 to 90 minutes), the control enters the defrost mode.

While in defrost, the control de-energizes the outdoor fan. The compressor de-energizes for the initial 3 seconds, which are configurable between 1 and 90 seconds. The control de-energizes the reversing valve and auxiliary heat outputs. It accumulates compressor run time while in the defrost mode. If the indoor thermostat is satisfied while the control is in the defrost mode (call for compressor de-energizes), the compressor is de-energized and the reversing valve is energized, and the control stops the defrost timer. When the compressor contactor output is energized once again, the defrost cycle and timer will resume at the point where the demand was satisfied.

Time × Temp Defrost Termination

The control terminates the defrost mode when the coil temperature reaches the limit of 50, 60, 70, or 80°F degrees (default 70°F), or 15 minutes of compressor run time has elapsed with the control in the defrost mode. The control immediately energizes the reversing valve and energizes the outdoor fan and the compressor de-energizes for 3 seconds (configurable between 1 and 90 seconds). The control resets the defrost interval timer and begins accumulating compressor run time for the next defrost cycle, based upon the compressor contactor output being energized with the defrost switch closed.

Demand Defrost

If the coil temperature is above the Defrost Temperature Limit, all defrost functions are disabled. The default value for the Defrost Temperature Limit is 35°F and the user can adjust it from 25°F to 45°F via Human System Interface (HSI) or network.

Defrost Calibration Mode

The control is considered un-calibrated when power is applied to the control, after cool mode operation and following a 14-minute time termination of a defrost cycle. Calibration of the controller occurs after a defrost cycle to ensure that there is no ice on the coil. During calibration, the temperature of both the coil and ambient sensors are measured to establish a Dry Coil Delta T.

When the controller is in an un-calibrated state, the controller should initiate a sacrificial defrost after 34 minutes of accumulated compressor runtime with coil temperature below Defrost Temperature Limit. The defrost cycle will terminate if the coil sensor reaches the selected termination temperature or after a 14 minute defrost. Once the sacrificial defrost has terminated, a clear coil (non-iced condition) is established by averaging coil temperature readings once a minute (for four minutes) starting on the fourth minute (stabilized coil condition, allowing system pressures and temperatures to stabilize) following termination of the last defrost.

At that point a Dry Coil Delta T at the particular outdoor ambient temperature can be determined.

After initial calibration has been completed, the controller prevents a defrost occurrence for 34 minutes of accumulated runtime in order to avoid unnecessary defrost operation due to system transient conditions.

Demand Defrost Operation

The need for a defrost cycle while in Demand Defrost operation is determined by one of two factors: Time or Frost Detection.

Should six hours of compressor run time elapse without a defrost cycle and the coil temperature is below the frost accumulation temperature, a defrost cycle will be initiated. The controller shall establish a new Dry Coil Delta T following termination of this defrost cycle. The compressor run time will be reset when the defrost cycle is complete.

The Frost Detection functionality of the control can be influenced by the Coil Temperature Dependent Variable, an adjustable value between 5 and 15°F. The Coil Temperature Dependent Variable is set at 10ºF by default. This has proven satisfactory for most applications. However, if the unit is not defrosting often enough the setting can be adjusted to a lower number to allow the unit to enter defrost a little quicker. If the unit is defrosting too often, the value can be adjusted to a larger number to allow the unit to enter defrost a little later. Before making any adjustments to the setting it is STRONGLY recommended that proper airflow and refrigerant charge be confirmed.

Small, incremental, adjustments are recommended over larger ones.

Defrost Mode Activation

To activate a defrost sequence, the unit must be in the heating mode (for thermostat control the “B” thermostat input must be active), and the coil temperature must be below 35 conditions are met, the defrost enable timer tracks the compressor output, and accumulates compressor run time in the heating mode. If the unit is not in the heating mode (for thermostat control the “B” thermostat input is inactive), the defrost enable timer is cleared. If the coil temperature is above 35°F. If the coil temperature is above the selected defrost termination temperature, the defrost enable timer will be cleared.

When the defrost enable timer reaches 34 minutes, the defrost mode is enabled. If the control is in the time/ temperature defrost operation mode, defrost operation will be initiated immediately.

Defrost Mode Operation

When operating in the defrost mode, the control will temporarily deactivate the compressor contactor for an adjustable time of 1 - 90 seconds with a default value of 3 seconds. The control will activate the auxiliary heat outputs. The reversing valve shall de-energize. The condenser fan relay contacts will be closed, de-energizing the fan motor. The accumulated defrost time is monitored while in the defrost mode and compressor is energized.

When a defrost cycle has been initiated, if the call for heating is removed (for thermostat control units the Y thermostat input is removed), the current defrost cycle will be suspended, but the accumulated defrost time is frozen, and the control will resume defrost operation at the start of the next heating cycle (for thermostat control units, Y active, B active and coil temperature is below 35°F) without delay. The accumulated defrost time resumes when the compressor output is re- energized.

Defrost Mode Termination

Once a defrost mode has been initiated and the outdoor coil temperature exceeds the selected termination temperature, the control will immediately terminate the defrost cycle and reset the internal timing.

Once a defrost mode has been initiated, an internal timer shall count the time that the defrost mode is engaged, and compressor is energized. After 14 minutes of operation in the defrost mode, the defrost sequence shall terminate immediately and reset internal timing regardless of the state of the coil sensor temperature.

If a defrost cycle had been terminated on time (rather than temperature), the next defrost cycle will be a sacrificial defrost (34-minutes after termination of the previous defrost).

Temperature Screen

The temperature screen shows all available temperature readings in the system. If any sensors are not available, the control will either show “Sensor shorted” or “Sensor open” messages.

Table 10: Temperature Screen

Item	Range
Space Temp	XXX °F
Eff Space Temp	XXX °F
Return Air Temp	XXX °F
Outside Air Temp	XXX °F
Eff Out Air Temp	XXX °F
Disch. Air temp	XXX °F
Outdoor Coil temp 1	XXX °F
Outdoor Coil temp 2	XXX °F
Freeze Sensor 1	XXX °F
Freeze Sensor 2	XXX °F
Field Config 1	XXX °F
Field Config 2	XXX V

Economizer

This screen shows the information available from the Economizer. When this device is not connected, the control will show the word “Unavailable” on the second line of the display.

The Economizer uses controllable dampers to increase the amount of outside-air intake into the building whenever enabled and whenever outside air enthalpy is favorable for conditioning the ambient.

The DDC Controller board communicates to the Economizer Logic Module (ELM) via RS485. Once the ELM receives communication from the main control indicating a cooling demand, the ELM will calculate the outdoor air enthalpy and determine if the economizer operation is favorable for conditioning the ambient. The main control will read the status of the economizer and determine whether it is a valid stage for cooling or not.

If mechanical cooling is active and the enthalpy is favorable for ELM operation, the DDC Controller will override the Economizer opening the damper 100%. ELM will regain control of the damper whenever mechanical cooling is no longer necessary.

If operating from a thermostat, the Economizer is the first stage of cooling. If the unit has two compressors available, the second stage will never be active as long as free cooling is available.

When the DDC Controller is operating from its local temperature sensors, the Economizer is also a first stage of cooling, if free cooling is available. First and second stages of mechanical cooling may be necessary for satisfying the demand in case the temperature trend towards the set point is not large enough. Whenever mechanical cooling is active, DDC Controller overrides the Economizer, opening the damper 100%.

Table 11: Demand Control Ventilation

Economizer	Adjustable Range	Default Setting
Econ. Status	Economizer OK / Economizer Not OK	
Econ. Status	Diff Enthalpy / Single Enthalpy	
Econ. Status	Exh. Fan is ON/OFF	
* Enthalpy Setpt.	A/B/C/D/E	A
Eff.Mix.Air Temp	XXX.X °F	
* Mixed Air Setpt.	0 – 99	45
Ext.Mix.Air Temp		
* Econ. Vent. Limit	0 – 100	0
* Econ.Exh. ON/OFF	0 – 100	50
* Econ. DCV Limit	0 – 100	0
DCV Control	Enabled / Disabled	Disabled
* DCV Level Setpt.	500 – 2000 ppm	700
Ext. DCV Level		
Eff. DCV Level		
Eff.Eco.Position		
Eff.Min.Position		
Local. Min. Pos.		
Econ. Faults	DCV Sensor Fault	
	OAE Sensor Fault	
	RAE Sensor Fault	
	MAT Sensor Fault	
Econ Firm Vrsn		0103

* Menus that are user adjustable

Economizer Status

This screen confirms if the enthalpy is acceptable for economization.

Enthalpy Status

This screen indicates if the system is using single or differential enthalpy.

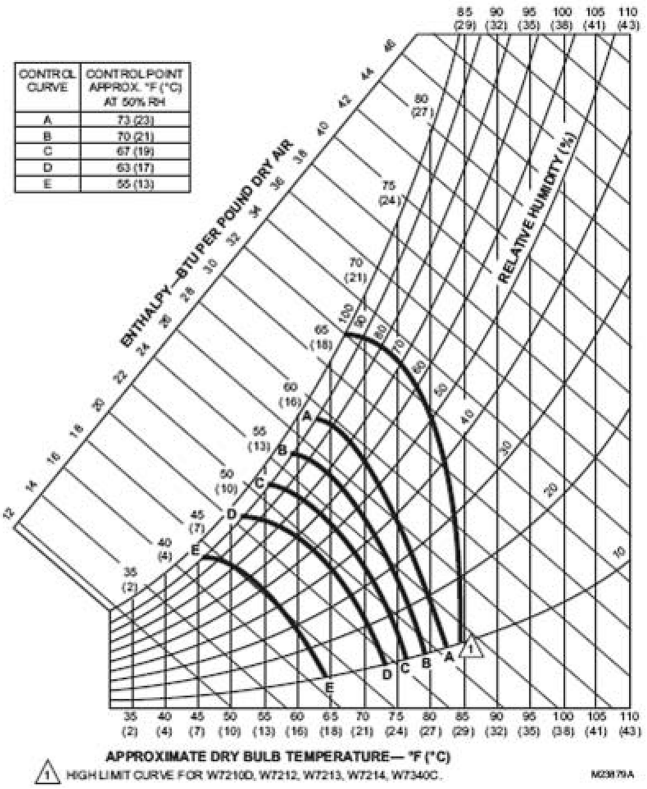
Exhaust Status

This screen gives the status of the exhaust fan.

Enthalpy Set Point

The user has five levels to choose for the enthalpy set point. Figure 18 indicates what each of those levels represents in the psychometric chart. This setting determines the level at which economization is allowed. This setting is only adjustable on the economizer ELM module.

Figure 18: Demand Control Ventilation



Effective Mixed Air Temperature

This is the current value of mixed air temperature.

Mixed Air Set Point

When the mixed air temperature falls below this set point, the freeze protection control will disable the mixed air control and close the outdoor damper to the effective minimum position.

External Mixed Air Temperature

This screen corresponds to the discharge air temperature reading from the DDC Controller.

Economizer Ventilation Limit

The ventilation limit corresponds to a minimum position of the Economizer that complies with the minimum acceptable outside-air ventilation rate. The volumetric flow-rate of outside air required to provide healthful, comfortable conditions for occupants can be determined from building codes, ASHRAE standards, or standard practice. It is usually expressed in terms of volumetric flow-rate (cfm) per occupant or per unit floor area. The use of a CO_2 sensor can lower the ventilation limit by verifying that the indoor air quality is suitable for human occupancy, as described in the next section for Demand Control Ventilation (DCV).

The system allows the adjustment of the ventilation limit through four different methods, listed below in order of priority:

1. Network interface (BACnet, BAS, or LonWorks)
2. Human Systems Interface (HSI)
3. Remote potentiometer
4. Direct adjustment through a potentiometer on ELM control.

Economizer Exhaust ON/OFF

This screen allows the user to change the set point of what percentage the exhaust fan is energized.

Economizer DCV Limit

The economizer will allow the dampers to close more than the minimum position if the indoor air quality is not contaminated. The Econ. DCV Limit can be set from 0 to 100% but must be lower than the minimum position.

Economizer DCV Control

If connected to a CO_2 sensor, the ELM measures and regulates the amount of outdoor air supplied to the space in order to maintain the levels of carbon dioxide below the recommended 700ppm above the outdoor levels. In this case, CO_2 levels serve as a proxy for building occupancy and the rate of human-generated indoor pollutants.

Once the DCV is operating, the minimum damper position can then be lowered to the DCV ventilation limit. By default, this value is 50% of the ventilation limit, but the user has the option to adjust it through network or human system interface. The user also has the option to disable DCV altogether.

DCV Level Set Point

The DCV level setpt is a selectable level of carbon dioxide that the system does not allow to be exceeded. The set point is communicated to the economizer and the minimum ventilation position is changed in order to prevent the increase of CO_2.

External DCV Level

This is the value DDC Controller sends to the Economizer.

Effective DCV Level

This is the actual DCV Level in ppm.

Effective Economizer Position

This is the actual position of the economizer.

Effective Minimum Position Demand Delay

This displays current value of the effective minimum damper position.

Local Minimum Position

This displays the local minimum position that is set at the ELM.

Economizer Faults

This screen displays any ELM sensor or actuator faults. Check for proper installation of the sensor or actuator, or replace the sensor or actuator so the alarm is cleared. Note: The actuator fault must be present for at least 2 minutes with the unit powered, the indoor fan running, and the outside damper commanded to open more than 0% before the alarm is set.

Integrated Furnace Control Screen

This screen shows the information available from the IFC board. When this device is not connected the control will show the word “Unavailable” on the second line of the display.

Device ID

This screen displays the IFC software version.

IFC Fault

This screen displays any IFC faults. The faults will also be displayed on the main DDC Controller fault screen.

IFC Inputs

Status of IFC Inputs

IFC Outputs

Status of IFC outputs

Time Delays Screen

This screen allows the input of time constants of the system.

Table 12: Time Delays Screen

Time Settings	Adjustable Range	Default
Demand Delay	30 – 1800 sec	300 sec
Indoor Fan ON Delay	1 sec – 180 sec	10 sec
Indoor Fan OFF Delay	1 sec – 180 sec	45 sec
Keypad Auto Scroll Timeout	30 sec – 10 min	5 min
Compressors ASCD (Anti Short Cycle Delay)	10 sec – 30 min	3 min
CMRT (Compressor Minimum Run Time)	1 – 20 min	2 min
Stage Delay	5 – 300 sec	5 sec
LPS (Low Pressure Switch) Bypass Timer	10 – 90 sec	30 sec
HPS (High Pressure Switch) Bypass Timer	1 – 5 sec	2 sec
Fan Proving Switch	1 sec – 180 sec	20 sec
Clogged Filter Switch	1 sec – 180 sec	20 sec
Smoke Alarm Switch	1 sec – 180 sec	20 sec
Tenant Override	2h – 6h	2h

Demand Delay

The demand delay is the time period in which the control compares set point to zone temperature readings and determines whether the current stage of either cooling or heating is sufficient to satisfy the set point. The demand delay is set by default at 5 minutes, and it can be configured between 30 seconds and 30 minutes.

Indoor Fan ON Delay

The indoor fan on delay is the time delay before the fan is allowed to energize after a call for cool, heat, or fan only. This delay is ignored if the indoor fan is in continuous mode. In the heating mode, for electric heat models, there is not a delay; for gas heat models the delay is handled by the integrated furnace control (IFC).

Indoor Fan OFF Delay

The indoor fan off delay is the time delay after a call for cool or heat is terminated. This delay is ignored for gas heat units or if the indoor fan is in continuous mode. For gas heat units, the indoor fan OFF delay is handled by the integrated furnace control (IFC).

Keypad Auto Scroll Timeout

The keypad auto scroll timeout will keep the User Interface from returning to the general information screen for the selected time.

ASCD (Anti Short Cycle Delay)

The anti short cycle delay is an adjustable delay used to keep the compressor from re-energizing too quickly after a cycle. The delay time starts after the compressor de-energizes.

CMRT (Compressor Minimum Run Time)

The compressor minimum run time is an adjustable time used to ensure proper compressor oil return.

Stage Delay

The stage delay is an adjustable time that keeps the next stage of cooling or heat pump from energizing.

LPS (Low Pressure Switch) Bypass Timer

The low pressure switch bypass timer is an adjustable time that the DDC Controller ignores the refrigerant low pressure switch after a call for cooling or heat pump.

HPS (High Pressure Switch) Bypass Timer

The high pressure switch bypass timer is an adjustable time that the DDC Controller ignores the refrigerant high pressure switch after a call for cooling or heat pump.

Fan Proving Switch

The fan proving switch bypass timer is an adjustable time that starts after the indoor fan is energized. The purpose of the timer is to give the indoor fan time to come up to speed.

Clogged Filter Switch

The clogged filter switch bypass timer is an adjustable time that can only be activated if the indoor fan is energized. If the clogged filter switch input is continuously closed until the time expires, the clogged filter alarm is tripped. The purpose of the delay is to prevent nuisance trips when the indoor fan is started or other pulsations in the airflow.

Smoke Alarm Switch

The smoke alarm switch is an input that will lock out the system when an open switch is detected for 2 seconds between terminals (P4) 24V & SMK. If an economizer in installed find the “red wire” linking terminals 11 & 2 on PL7 located in the economizer section. One can interrupt the circuit (red wire) with the smoke detector contacts.

To reset the system power must be cycled to the unit or an “all clear” signal must be communicated through the network.

Tenant Override

The DDC Controller allows separate adjustment of temperature set points and fan operation according to the building occupancy. This feature is only available when a thermostat is not controlling the space temperature. For the following sections, Occupied Mode implies that the calculation for demand utilizes occupied set points, which are used to satisfy the comfort in the space. Unoccupied mode utilizes unoccupied set points and is normally set to save energy during periods in which buildings are closed and unoccupied. Tenant Override Mode is a state in which the control utilizes occupied set points for a limited amount of time, after which it returns to unoccupied mode. To start Tenant Override, the user presses a button on the space sensor for more than 2 seconds.

Initial Test Sequence

The DDC Control allows a technician to Field Commission a new or existing installation of a package unit with the DDC control. By entering a password (5555), the technician can select a cooling test or a heating test. If a cooling test was selected, the first stage of cooling is now energized for 5 minutes to check for alarms. At the end of the test, the temperature sensor readings are displayed. If the technician connected refrigerant gauges to the unit, the technician can record their gauge readings along with the sensor temperature readings for future reference or to calculate refrigerant superheat. If the unit has two stages of cooling, the next stage of cooling is now energized for 5 minutes to check for alarms.

At the end of the test, the temperature sensor readings are displayed. If the technician connected refrigerant gauges to the unit, the technician can record their gauge readings along with the sensor temperature readings for future reference or to calculate refrigerant superheat for the second stage of cooling. Using the reading from the outdoor air temperature sensor and the refrigerant pressure and temperature readings, the technician can verify unit operation obeys the refrigerant charge chart. The DDC then de-energizes the second stage compressor, the first stage compressor, and finally the indoor fan. The test is then terminated. Temporarily shorting across the “TEST PINS” (P12) on the DDC board during the heating test will cause the gas valves to energize and de-energize instead of the compressors. No temperature display is provided at the end of the gas heat test.

History of Alarms

This screen shows the last 10 alarm occurrences of the system. A new alarm enters in position 1, shifting the other occurrences one position down.

The last position of the screen allows the user to clear the entire alarm history, by pressing the enter key.

Current Alarms

This screen shows the current alarms of the system. A maximum of ten alarms can be displayed.

Humidity Control

This screen allows a indoor relative humidity sensor connected to the “field-configurable input #2” on the DDC control to monitor and control the indoor relative humidity on units with optional dehumidification control and equipped with a factory-installed refrigerant hot gas reheat system. This feature is not available on heat pump models.

Table 13: Humidity Control

	Adjustable Range	Default
*Enable rh Control [Enter] for Yes	Enable/Disable	Disable
*rh Set Point Indoor rh	35% – 100%	60%

* Menus that are user adjustable

Enable Dehumidification Control

If an indoor relative humidity sensor (0–10 Vdc output) is connected to the “field-configurable input #2” on the DDC control, the sensor can be enabled by this menu item. If an indoor relative humidity sensor is not connected, and humidity control is enabled, an alarm will be activated, but the normal air conditioning function of the unit will not be affected.

If an indoor relative humidity sensor is connected to the “field-configurable input #2” on units not equipped with humidity control and humidity control is enabled, the unit operation is not affected, but unused output relays B1-Reversing Valve, B2-Reversing Valve, ODF1-Outdoor Fan 1, ODF-Outdoor Fan 2 on the DDC control will be energized, or de-energized as if humidity control were present. Heat pump models configure the DDC controller so that the humidity control cannot be activated.

NOTE: Humidity Control is active only if the unit is in the “Occupied” mode.

For models with factory-installed refrigerant hot gas reheat system for humidity control, if Humidity Control is not enabled, higher than normal refrigerant subcooling may be observed during unit operation.

For models with a factory-installed refrigerant hot gas reheat system for humidity control, lead-lag operation is disabled during reheat mode.

Relative Humidity Set Point

The indoor relative humidity set point can be adjusted from 35% to 100% with a default of 60%. If the indoor relative humidity exceeds the set point, the operation of the unit changes to dehumidification control mode, which will also activate the indoor fan, if it is not already running. Table 14 and Table 15 explain the various modes available.

Indoor Relative Humidity

If humidification control is enabled and an indoor relative humidity sensor is connected, this is the actual indoor relative humidity measured by the sensor. The actual voltage output from the indoor relative humidity sensor can be read on “field-configurable input #2”.

Table 14: Units with Single Stage Cooling

Mode	Compressor 1	Indoor Fan	Notes
Reheat	Reheat	High	Operates with (H1 only)
Cooling	Cool	High	Operates with (Y1) or (Y1 and H1)
Economizer1	OFF	High	Operates with (Y1) only, ignores (H1)
Economizer2	ON	High	Operates with (Y2) only, ignores (H1)

Definitions: H1 - Indoor relative humidity is 2% or more above humidity set point
Y1 - First stage cooling call from thermostat or network
Y2 - Second stage cooling call from thermostat or network

Table 15: Units with Two Stage Cooling

Mode	Compressor1	Compressor2	Indoor Fan	Notes
Low Reheat	Reheat	OFF	*1st Stage Cool Speed	Operates with (H1 only) or (H2 only)
High Reheat	Reheat	Cool	High	Operates with (Y1 and H2)
Low Cool – Low Fan	Cool	OFF	*1st Stage Cool Speed	Operates with (Y1) or (Y1 and H1)
Low Cool – High Fan	Cool	OFF	High	[Future Enhancement] Operates with (Y1) or (Y1 and H1)
High Cool	Cool	Cool	High	Operates with (Y2) call – ignores (H1, H2)
Economizer1	OFF	OFF	Low	Operates with (Y1) only, ignores (H1, H2)
Economizer2	ON	OFF	High	Operates with (Y1 and Y2) only, ignores (h1, H2)

Definitions: H1 - Indoor relative humidity is 2% or more above humidity set point
H2 - Indoor relative humidity is more than 5% above humidity set point
Y1 - First stage cooling call from thermostat or network
Y2 - Second stage cooling call from thermostat or network
*1st stage cooling speed has a default value of 50% of high fan speed

Variable Frequency Drive

This screen shows the information available when a Variable Frequency Drive (VFD) is connected to the DDC rooftop unit controller for speed control of the indoor blower. When this device is not connected, the control will show the word “UNAVAILABLE” on the second line of the display. The VFD control is only available on units with a factory-installed variable frequency drive. To meet ASHRAE 90.1-2010, First Stage Cool and Fan Only speeds have a default setting of 50% airflow. Unit air balancing should be performed by adjusting the blower motor sheave at 100% airflow during W1, W2, or Y2 call.

Table 16: Variable Frequency Drive

Status	Adjustable Range	Default
UNAVAILABLE / AVAILABLE		
*VFD Low Fan Speed – XXX%	50% – 100%	50%
*VFD 1st Stage Cool – XXX%	50% – 100%	50%
VFD Current Speed – XXX%		

*Menus that are user adjustable

Status Line

The Status Line shows whether a VFD is available. If this device is not connected, the control will show the word “UNAVAILABLE”.

VFD Low Fan Speed

The Low Fan Speed, or “Continuous Fan Speed” is the percentage of the full speed that the indoor fan is commanded to run when a “Fan Only” call is given by the building manager network (if connected) or the room thermostat. The Low Fan Speed can be adjusted between 50% and 100% of the full fan speed and has a default of 50% (a 50% reduction in fan speed is equal to a 50% reduction in airflow).

NOTE: If the indoor fan is ramping up to speed from a dead stop, the Low Fan Speed will briefly ramp to 75% of the full speed in order to “set” the fan proving switch and confirm proof of indoor airflow.

VFD 1st Stage Cool

This value is the percent of full speed that the indoor fan is commanded to run an a 1st stage cool call. For two-stage models equipped with Humidity Control, this is the indoor fan speed used for a high indoor relative humidity call without an additional 1st stage cooling call. The 1st stage cooling speed can be adjusted between 50% and 100% of the full fan speed and has a default value of 50% (a 50% reduction in fan speed is equal to a 50% reduction in airflow).

NOTE: If the indoor fan is ramping up to speed from a dead stop, the Low Fan Speed will briefly ramp to 75% of the full speed in order to “set” the fan proving switch and confirm proof of indoor airflow.

VFD Current Speed

This displays the actual speed of the indoor fan speed as a percent of full speed.

Table 17: Alarm and Diagnostic List

Alarm Designation	Origin	Description	Status/Troubleshooting Information
No Active Alarm			
Locked Rotor Circuit 1	CA1	**Comfort Alert Code 4.** Circuit 1 shutdown and retry after Anti-Short Cycle Delay (ASCD). Maximum is 3 attempts.	• Low line voltage • Excessive Refrigerant in compressor • Seized bearings in compressor
Open Circuit 1	CA1	**Comfort Alert Code 5.** Circuit 1 shutdown and retry after ASCD. Note: This alarm is sent by the Comfort Alert Module only after the fault has been sensed for a minimum of 4 hours.	• Condensing unit power disconnect is open • Compressor circuit breaker or fuses are open • Compressor contactor has failed open • High pressure switch is open and requires manual reset • Broken supply wires or connector is not making contact • Unusually long compressor protector reset time due to extreme ambient temperature • Compressor windings are damaged
Missing Phase Circuit 1	CA1	**Comfort Alert Code 6.** Circuit 1 shutdown.	• Compressor fuse is open on one phase • Broken wire or connector on one phase • Compressor motor winding is damaged • Utility supply has dropped one phase
Reverse Phase Circuit 1	CA1	**Comfort Alert Code 7.** Circuit 1 shutdown.	• Compressor running backward due to supply phase reversal
Welded Contactor Circuit 1	CA1	**Comfort Alert Code 8.** Run outdoor and indoor fans continuously for circuit 2 and change mode of operation to Unoccupied Auto. This procedure prevents the Space Temperature from reaching extreme values.	• Compressor contactor has failed closed • Thermostat demand signal not connected to module
Low Voltage Circuit 1	CA1	**Comfort Alert Code 9.** Shutdown and wait for voltage to return to operational levels.	• Control circuit transformer is overloaded • Low line voltage to compressor
Low Voltage	DDC Controller	De-energize all relay outputs.	
Failed Ignition	IFC	IFC locks out for 1 hour	• Gas Valve Not Turned On • Little or No Supply Gas • Incorrect Manifold Pressure • No Ignition Source, Direct Spark Ignition (DSI) • No 24 Volt Power to Gas Valve •Bad Gas Valve
Low Flame Sense	IFC	IFC flashes error code on LED, transmits the warning through the network, but otherwise operates normally	• Dirty Flame Sensor • Unit Not Properly Grounded • Incorrect Polarity • Flame Sensor Incorrectly Wired • Bad Flame Sensor
Flame Lost	IFC	If lost 17 times within single call for heat, locks out for 1 hour. Otherwise retry ignition.	
Unexpected Flame	IFC	IFC Energizes inducer and main blower. Locks out for 1 hour	
AC Low Pressure Switch 1 Trip-LP1	DDC Controller	If the low pressure switch trips 3 times within 120 minutes of operation during the same call for heating operation, the control will lock out compressor and outdoor fan operation. If the lock-out due to low pressure occurs at an outdoor ambient temperature below 5 °F, the control will automatically exit the lock-out mode when the outdoor ambient temperature rises above 5 °F. LPS is ignored during defrost.	• Unit has low refrigerant charge • Indoor coil frozen (cooling mode) • Dirty indoor coil or filter (cooling mode) • Outdoor coil is frozen (heating mode) • Expansion valve in not operating correctly
AC Low Pressure Switch 2 Trip-LP2	DDC Controller		

Alarm Designation	Origin	Description	Status/Troubleshooting Information
Main Limit Open	IFC	IFC Energizes inducer and main blower	• Burner Over Fired • Low Air Flow • Dirty Filter • Poor Duct Design • Blocked Duct, Supply and/or Return • Incorrect Blower Speed Selection
Clogged Filter Warning – CFS	DDC Controller	DDC Controller Displays warning.	• Dirty Filter
AC HI Pressure Switch 1 Trip-HP1	DDC Controller	The DDC Controller recognizes an open high pressure switch after two seconds from its occurrence. Since the high pressure switch is wired in series with the compressor relay, the compressor shuts down immediately until the pressure switch is closed again AND the anti-short cycle delay is expired. Three occurrences of a high pressure switch within the same call will lock the circuit out. The lockout is reset by removing the call.	• Outdoor coil is dirty (heating mode) • Outdoor fan is not running (cooling mode) • Dirty indoor coil or filter (heating mode) • Indoor blower is not running (heating mode) • Liquid line restriction • Excessive refrigerant charge
AC HI Pressure Switch 2 Trip-HP2	DDC Controller		
Manual Reset Limit Switch Open (Flame Rollout Switch)	IFC	IFC Runs blower for off delay, inducer for post-purge time and locks out for one hour	• Excessive Burner Pressure • Improper Venting • Incorrect Burner Orifices • Sooted Heat Exchanger • Bad Inducer Gasket • Bad Heat Exchanger
Locked Rotor Circuit 2	CA2	**Comfort Alert Code 4.** Circuit 2 shutdown.	• Low line voltage • Excessive Refrigerant in compressor • Seized bearings in compressor
Open Circuit 2	CA2	**Comfort Alert Code 5.** Circuit 2 shutdown and retry after Anti-Short Cycle Delay (ASCD). Note: This alarm is sent by the Comfort Alert Module only after the fault has been sensed for a minimum of 4 hours.	• Condensing unit power disconnect is open • Compressor circuit breaker or fuses are open • Compressor contactor has failed open • High pressure switch is open and requires manual reset • Broken supply wires or connector is not making contact • Unusually long compressor protector reset time due to extreme ambient temperature • Compressor windings are damaged
Missing Phase Circuit 2	CA2	**Comfort Alert Code 6.** Circuit 2 shutdown.	• Compressor fuse is open on one phase • Broken wire or connector on one phase • Compressor motor winding is damaged • Utility supply has dropped one phase
Reverse Phase Circuit 2	CA2	**Comfort Alert Code 7.** Circuit 2 shutdown.	• Compressor running backward due to supply phase reversal
Welded Contactor Circuit 2	CA2	**Comfort Alert Code 8.** Run outdoor and indoor fans continuously for circuit 2 and change mode of operation to Unoccupied Auto. This procedure prevents the Space Temperature from reaching extreme values.	• Compressor contactor has failed closed • Thermostat demand signal not connected to module
Low Voltage Circuit 2	CA2	**Comfort Alert Code 9.**	• Control circuit transformer is overloaded • Low line voltage to compressor
Duct High Limit Fault		Future implementation	
Invalid Thermostat selection		Indicates that a combination of thermostat inputs is invalid.	
Pressure Switch 1 Closed	IFC	Leave inducer de-energized until pressure switch open	• Bad Pressure Switch

Alarm Designation	Origin	Description	Status/Troubleshooting Information
Pressure Switch 1 Open	IFC	Energize inducer indefinitely until pressure switch closes or call for heat goes away.	• Blocked Vent • Undersized Vent • Water in Pressure Switch Tubing • Cracked Pressure Switch Tubing • Inducer Not Running or Not Running to Full Speed • Low Line Voltage to Inducer Motor • Bad Inducer Motor Capacitor • Bad Inducer Motor Bearings • Bad Pressure Switch • Blocked Heat Exchanger
Freeze Sensor 1 Out of Range -FS1	DDC Controller	When reading the temperature below 37°F compressor and runs indoor fan continuously. After 15 minutes of continuous reading above 42°F, the control recovers from the alarm and resumes operation.	• If temperature is not below 37°F • Replace the sensor • Check sensor is installed correctly on control
Freeze Sensor 2 Out of Range -FS2	DDC Controller	When reading the temperature below 37°F continuously for 15 minutes, the control shuts down compressor and runs indoor fan continuously. After 15 minutes of continuous reading above 42°F, the control recovers from the alarm and resumes operation.	• If temperature is not below 37°F • Replace the sensor • Check sensor is installed correctly on control
Freeze Sensor #1 Fail FS1	DDC Controller	Occurs when sensors are either open or shorted.	• Replace the sensor • Check sensor is installed correctly on control
Freeze Sensor #2 Fail FS2	DDC Controller		
Lockout Temperature – Cooling	DDC Controller	When the outdoor temperature drops below the cooling lockout temperature set point, the unit will prevent the compressor from operating in cool mode. Selectable range is between 30°F and 50°F, with a default of 35°F.	• Check to make sure the outdoor temperature is not below the set point • Replace the sensor
Lockout Temperature – Heating	DDC Controller	When the outdoor temperature exceeds the heating lockout temperature set point, the unit will prevent any source of heat from operating. Selectable range is between 70°F and 95°F, with a default of 90°F.	• Check to make sure the outdoor temperature is not above the set point • Replace the sensor
Pressure Switch 2 Closed	IFC	Leave inducer de-energized until pressure switch open	• Bad Pressure Switch
Pressure Switch 2 Open	IFC	Energize inducer indefinitely until pressure switch closes or call for heat goes away.	• Blocked Vent • Undersized Vent • Water in Pressure Switch Tubing • Cracked Pressure Switch Tubing • Inducer Not Running or Not Running to Full Speed • Low Line Voltage to Inducer Motor • Bad Inducer Motor Capacitor • Bad Inducer Motor Bearings • Bad Pressure Switch • Blocked Heat Exchanger
Running Blower Fault – Air Flow Switch Stuck	DDC Controller	Unit continues to operate	• Replace the pressure switch
Blower Fault – Blower Not Running – FP	DDC Controller	Complete unit shutdown.	• Indoor motor Not Running or Not Running to Full Speed • Low Line Voltage to Indoor motor • Bad Indoor motor Capacitor/winding • Bad Indoor motor Bearings • Bad Pressure Switch • Broken belt • Indoor motor running backwards (3 phase) • Open internal motor protector
ELM - OAE Sensor Fail	ELM	Sensor short, failure	• Replace the sensor • Check sensor is installed correctly on control

Alarm Designation	Origin	Description	Status/Troubleshooting Information
ELM - RAE Sensor Fail	ELM	Sensor short, failure	• Replace the sensor • Check sensor is installed correctly on control
ELM - MAT Sensor Fail	ELM	Sensor short, failure	• Extreme temperatures • Replace the sensor • Check sensor is installed correctly on control
ELM – CO_2 Sensor Fail	ELM	Sensor short, failure	• DCV is enabled with no sensor • Replace the sensor • Check sensor is installed correctly on control
ELM Actuator Fault	ELM		
Low Discharge Air Temp – DAT	DDC Controller	Threshold is 30°F.	• Check to make sure the Discharge Air temperature is below the set point • Replace the sensor • Low refrigerant
High Return Air Temp – RAT	DDC Controller	Threshold is 120°F.	• Check to make sure the Return Air temperature is not above the set point • Replace the sensor
Return Air Sensor Fail – RAT	DDC Controller	If the sensor has ever been installed to the unit, the alarm will be set if it becomes unavailable.	• Extreme temperatures • Replace the sensor • Check sensor is installed correctly on control
Discharge Air Sensor Fail – DAT	DDC Controller	If the sensor has never been installed to the unit, the alarm will be set if it becomes unavailable.	• Extreme temperatures • Replace the sensor • Check sensor is installed correctly on control
Outdoor Air Temperature Sensor Fail – OAT	DDC Controller	Control changes defrost to time x temperature mode. The heat source continues to be heat pump, independently of the outdoor air temperature. Additional heat sources are also available in case the demand is not satisfied.	• Extreme temperatures • Replace the sensor • Check sensor is installed correctly on control
Condenser Coil 2 Temperature Out of Range	DDC Controller	No defrost operation, but unit continues to operate in either heating or cooling.	• Extreme temperatures • Replace the sensor • Check sensor is installed correctly on control
Discharge Air Temperature Out of Range	DDC Controller	If the sensor has ever been installed to the unit, the alarm will be set if it becomes unavailable.	• Extreme temperatures • Replace the sensor • Check sensor is installed correctly on control
Emergency Stop Fault		Complete shutdown	
Comm Card Miscommunication	DDC Controller	Communication card failed to communicate with the DDC Controller	• Check wire connection at both controls • Bad Comm card and/or DDC Controller
DDC Controller Miscommunication with IFC	IFC	IFC failed to communicate with the DDC Controller	• Check wire connection at both controls • Bad IFC and/or DDC Controller
Internal Control Fault – DDC Controller	DDC Controller		
Internal Control Fault – IFC	IFC		
Space Sensor Alarm	DDC Controller	If the space sensor fails open or shorted, the space sensor alarm will be set, but the control will continue to operate using the return air sensor in place of the space sensor. If the control has never sensed a valid space sensor input, it will assume no space sensor is present to be used, and not set the space sensor alarm. If a valid space sensor input is ever detected, the control will set a non-volatile flag to indicate the control should have and use a space sensor. When the non-volatile flag is set, the control will detect space sensor alarm conditions.	• Replace the sensor • Check sensor is installed correctly on control
Space Sensor & Return Sensor Fail	DDC Controller	Indicate presence of the alarm and convert operation to thermostat mode.	• Replace the sensors • Check sensors are installed correctly on control

Alarm Designation	Origin	Description	Status/Troubleshooting Information
Smoke Detection (Selectable Fault Response)	DDC Controller	DDC Controller reads the smoke detection input as open – complete shutdown.	• If not due to a fire • Replace the sensor • Check sensor is installed correctly on control
Low Pressure – Circuit 1 Problem - Lockout	DDC Controller	If the low pressure switch trips 3 times within 120 minutes of operation during the same call for heating operation, the control will lock out compressor and outdoor fan operation. If the lock-out due to low pressure occurs at an outdoor ambient temperature below 5 °F, the control will automatically exit the lock-out mode when the outdoor ambient temperature rises above 5 °F. LPS is ignored during defrost.	• Unit has low refrigerant charge • Indoor coil frozen • Dirty indoor coil or filter • Expansion valve in not operating correctly
Low Pressure – Circuit 2 Problem - Lockout	DDC Controller		
High Pressure– Circuit 1 Problem - Lockout	DDC Controller	The DDC Controller recognizes an open high pressure switch after two seconds from its occurrence. Since the high pressure switch is wired in series with the compressor relay, the compressor shuts down immediately until the pressure switch is closed again AND the anti-short cycle delay is expired. Three occurrences of a high pressure switch within the same call will lock the circuit out. The lockout is reset by removing the call.	• Outdoor coil is dirty • Outdoor fan is not running • Dirty indoor coil or filter • Indoor blower is not running • Liquid line restriction • Excessive refrigerant charge
High Pressure – Circuit 2 Problem - Lockout	DDC Controller		

eSYNC™ Control Screen

This screen shows the information available from the eSYNC unit control board. When this device is not connected the control will show the word “UNAVAILABLE” on the second line of the display. The eSYNC control is only available on units that have the eSYNC (water heating) equipment factoryinstalled.

Figure 19: eSync Control Screen

eSync Control	
Unavailable	
Standby	
Return Oil	
Water Temp Check	
Water Sample Delay	
Water Heating	
Low Ambient Fault	
Test Override	
Lockout	
Ambient Sensor Fault	
Pump Purge	
Timer=	XXXX
Amb=	XXX
HP=	XXX
LP=	XXX
WTR IN=	XXX
WTR OUT=	XXX
WTR FLOW=	XXX
LEAK=	XXX
SCool = Sat – LL	XX°F=XXX°F – XXX°F
SHeat = Suct – Satur	XX°F=XXX°F – XXX°F
Hot Water gpm	XXX
Gallons Hot Wtr	XXXXXXXX
Max Wtr Temp Lim	XXX

Status Line

The status line shows whether the eSYNC unit is running in the conventional air conditioning mode or the eSYNC (water heating) mode. If this device is not connected the control will show the word “UNAVAILABLE”.

Standby is displayed when there is not a call for cooling.

Return Oil is displayed when the unit is in the air conditioning mode and a solenoid valve is energized to drain refrigerant from the inactive water-side heat exchanger for 120 seconds. If this is the first cooling call after the “STANDBY” mode, the system will switch directly to “Wtr Temp Check” mode without delay.

Wtr Temp Check is displayed when the eSYNC water circulation pump is running to check if water heating is required.

Wtr Sample Delay is displayed if the unit has sampled the inlet water temperature and water heating is not required, so an adjustable time delay starts.

Water Heating is displayed when the unit is in the eSYNC mode and is actively heating water.

Low Ambient Fault is displayed when the unit is in the air conditioning mode, but low outdoor air temperatures are causing the eSYNC control to cycle the outdoor fans on and off to maintain system pressure.

Test Override is displayed whenever the test pins on the eSYNC control are shorted. The control will then energize a solenoid valve to drain refrigerant from the inactive water-side heat exchanger and de-energize all other outputs. The control does not interpret any commands, inputs or outputs while the test pins are shorted.

Lockout is displayed the eSYNC control de-energizes all outputs. A LED on the eSYNC control emits a flash sequence to indicate which alarm was issued and transmitted to the RTU-C. Only by resetting the power supply to the unit, or by issuing a “Clear All Alarms” to the RTU-C through the network will allow the control to recover from this mode.

Ambient Sensor Fault is displayed under this menu whenever the outdoor ambient sensor on the RTU-C does not provide a valid temperature reading. During this fault condition, the eSYNC water pump will run continuously until the ambient sensor is restored continuously for 6 seconds, at which time the eSYNC control will first switch to “Return Oil” mode and then normal operation. If during this fault condition, the refrigerant low pressure drops below 165 psig, then the control will enter the “Lockout” mode.

Pump Purge is displayed if the eSYNC water pump has not received a call for operation for more than 24 hours and is now running for 6 minutes to clear out stagnant water in the system.

Timer

After the eSYNC unit has been running for two minutes in the air conditioning mode, the eSYNC water circulation pump starts if water pressure is acceptable. After running for 1 minute the inlet water temperature is sampled to see if it is below the “Max Wtr Temp Lim” (default 95°F) temperature setpoint. If it is below the “Max Wtr Temp Lim” setpoint, then the unit switches to eSYNC mode. If it is above the setpoint, the unit continues in air conditioning mode and the timer resets for a (default) delay of 10 minutes before starting the pump again. The timer shows the actual status of this countdown.

AMB

This is the same value as the RTU-C outdoor air temperature sensor. If the outdoor air temperature is below 40°F then the unit will not operate in eSYNC (water heating) mode. If the outdoor air temperature is below 35°F, then the eSYNC water circulation pump starts and remains on until the outdoor air temperature rises above 37°F.

HP

The eSYNC control has a refrigerant pressure transducer that measures the refrigerant liquid line pressure for circuit #1. When in eSYNC (water heating) mode, if the refrigerant pressure reaches 570 psig, eSYNC mode is terminated and the unit reverts back to air conditioning mode until the 10 minute (default) timer setting for the next cycle has expired. When water heating mode starts, if the refrigerant pressure rises above 530 psig in less than one minute, an alarm is sent to the RTU-C. After three of these alarms within the same cooling call, eSYNC mode is locked out until power is removed from the unit or the alarm is cleared through the “Clear All Alarms” network command.

LP

The eSYNC control has a refrigerant pressure transducer that measures the refrigerant suction line pressure for circuit #1.

WTR IN

The eSYNC control monitors the water inlet temperature to the eSYNC unit. Before the eSYNC (water heating) mode starts, the “Wtr Temp Check” mode samples the inlet water temperature. If the water temperature is above the “Max Wtr Temp Lim” (default 95°F) temperature setpoint, then water heating mode cannot start and the unit reverts back to air conditioning mode.

WTR OUT

The eSYNC control monitors the water outlet temperature of the eSYNC unit. If the water outlet temperature exceeds 137°F during the eSYNC (water heating) mode, then water heating mode is terminated and the unit reverts back to air conditioning mode.

WTR FLW

The eSYNC control monitors the water pressure prior to entering the eSYNC (water heating) mode. If the water pressure is less than 5 psig, then water heating mode cannot start and the unit remains in air conditioning mode as long as a call for cooling is present. This protects the eSYNC water pump from damage if water is not present.

SCool = Sat - LL

Using the liquid line refrigerant pressure reading from the eSYNC control and the liquid line temperature reading from the RTU-C control, circuit #1 refrigerant subcooling is calculated and displayed on the RTU-C. The eSYNC control monitors the subcooling. If the subcooling is less than 4°F after 4 minutes, 30 seconds into the eSYNC (water heating) mode, water heating mode is terminated and operation reverts back to air conditioning mode. An alarm is sent to the RTU-C. After three of these alarms within the same cooling call, eSYNC mode is locked out until power is removed from the unit.

SHeat = Suct - Satur

Using the suction line refrigerant pressure reading from the eSYNC control and the suction line temperature reading from the RTU-C control, circuit #1 refrigerant superheat is calculated and displayed on the RTU-C. The eSYNC control monitors the superheat. If the superheat is more than 25°F after 4 minutes, 30 seconds into the eSYNC (water heating) mode, water heating mode is terminated and operation reverts back to air conditioning mode. An alarm is sent to the RTU-C. After three of these alarms within the same cooling call, eSYNC mode is locked out until power is removed from the unit.

Hot Water gpm

A spare input in available on the eSYNC control board which allows the addition of a field installed pulse type water meter (1 pulse/gallon) to monitor instanteous water usage in gallons per minute (GPM). By connecting a building management system (BMS) to the RTU-C, remote monitoring of water flow rate for establishing peak water heating load is possible.

Gallons Hot Wtr

As above, a spare input in available on the eSYNC control board which allows the addition of a field installed pulse type water meter (1 pulse/gallon). This input allows monitoring of hot water usage for verification of energy savings. By connecting a building management system (BMS) to the RTU-C, remote monitoring of water usage is possible. The value can be reset to zero by pressing the [ENTER] key.

Max Wtr Temp Lim

The eSYNC control has a self-adjusting temperature value for determining whether water heating is required. After a call for cooling, during the “Wtr Temp Check” mode, the eSYNC control uses a 95°F default value and compares this to the inlet water temperature. If the inlet water temperature is below 95°F, then eSYNC (water heating) mode is allowed. After one minute of operation during the water heating mode, the outlet water temperature of the eSYNC unit is recorded if the liquid line refrigerant pressure (HP) reaches 550 psig. The “Max Wtr Temp Lim” is then reset according Table 18

Table 18: Maximum Water Temperature Limit

Water Outlet Temperature @ 550 PSIG					Max Wtr Temp Limit
—	<	Water Outlet	<	105°F	85°F
105°F	<	Water Outlet	<	110°F	90°F
110°F	<	Water Outlet	<	115°F	95°F
115°F	<	Water Outlet	<	120°F	97°F
120°F	<	Water Outlet	<	—	100°F

Humidity Control Screen

This screen allows an indoor relative humidity sensor connected to the “Field Configurable Input #2” on the RTU-C control to monitor and control the indoor relative humidity on KNL-G or LNL-G units equipped with a factory installed refrigerant gas reheat system. This feature is not available on heat pump models. Shaded cells indicate adjustable Menu items.

Table 19: Humidity Control Screen

Humidity Control	Adjustable Range	Default
Enable rh control (enter for Yes)	Enable / Disable	Disabled
Rh Set Point	35% – 100%	60%
Indoor rh		

Enable rh Control

If an indoor relative humidity sensor (0–10 Vdc output) is connected to “Field Configurable Input #2” on the RTU-C control (see wiring diagram), the sensor can be enabled by this menu item. If an indoor relative humidity sensor is not connected, and humidity control is enabled, an alarm will be activated, but the normal air conditioning function of the unit will not be affected.

NOTE: 1: Humidity Control is active only if the unit is in the “Occupied” mode.

2: For models with a factory installed refrigerant gas reheat system for humidity control, if humidity control is not enabled, higher than normal refrigerant subcooling may be observed during unit operation.

If an indoor relative humidity sensor is connected to “Field Configurable Input #2” on units not equipped with humidity control and humidity control is enabled, the unit operation is not affected, but unused output relays B1 -Reversing Valve, B2 - Reversing Valve, ODF1 - Outdoor Fan 1, ODF2 - Outdoor Fan 2 on the RTU-C control will be energized, or de-energized as if humidity control were present. Heat pump models configure the RTU-C control so that humidity control cannot be activated.

NOTE: 3: For models with a factory installed refrigerant gas reheat system for humidity control, lead-lag operation is disabled during reheat mode.

rh Setpoint

The indoor relative humidity setpoint can be adjusted from 35% to 100% with a default of 60% . If the indoor relative humidity exceeds the setpoint, the operation of the unit changes to humidity control mode, which will also activate the indoor fan, if it is not already running. Table 20 and Table 21 explain the various modes available:

Table 20: Units with Single Stage Cooling

Mode	Compressor 1	Indoor Fan	Notes
Reheat	Reheat	High	Operates with (H1 only)
Cooling	Cool	High	Operates with (Y1 or Y1 & H1)
Economizer 1	OFF	High	Operates with (Y1) only ignores (H1)
Economizer 2	ON	High	Operates with (Y2) only ignores (H1)

H1 = Indoor relative humidity is 2% or more above humidity set point.
Y1 = first stage cooling call from thermostat or network.

Table 21: Units with Two Stage Cooling:

Mode	Compressor 1	Compressor 2	Indoor fan	Notes
Low Reheat	Reheat	OFF	*1st Stage Cool speed	Operates with (H1 Only) or (H2 Only)
High Reheat	Reheat	Cool	High	Operates with (Y1 & H2)
Low Cool	Cool	OFF	*1st Stage Cool speed	Operates with (Y1) or (Y1 & H1)
Low Fan				
Low Cool	Cool	OFF	High	Future Enhancement – Operates with (Y1) or (Y1 & H1)
High Fan				
High Cool	Cool	Cool	High	Operates with (Y2) call- Ignores (H1 & H2)
Economizer 1	OFF	OFF	Low	Operates with (Y1) only ignores (H1 & H2)
Economizer 2	On	OFF	High	Operates with (Y1& Y2) only ignores (H1 & H2)

Figure 20: MPS003B-MPS005B, 208-230/460V, 3-Phase, Gas Heat

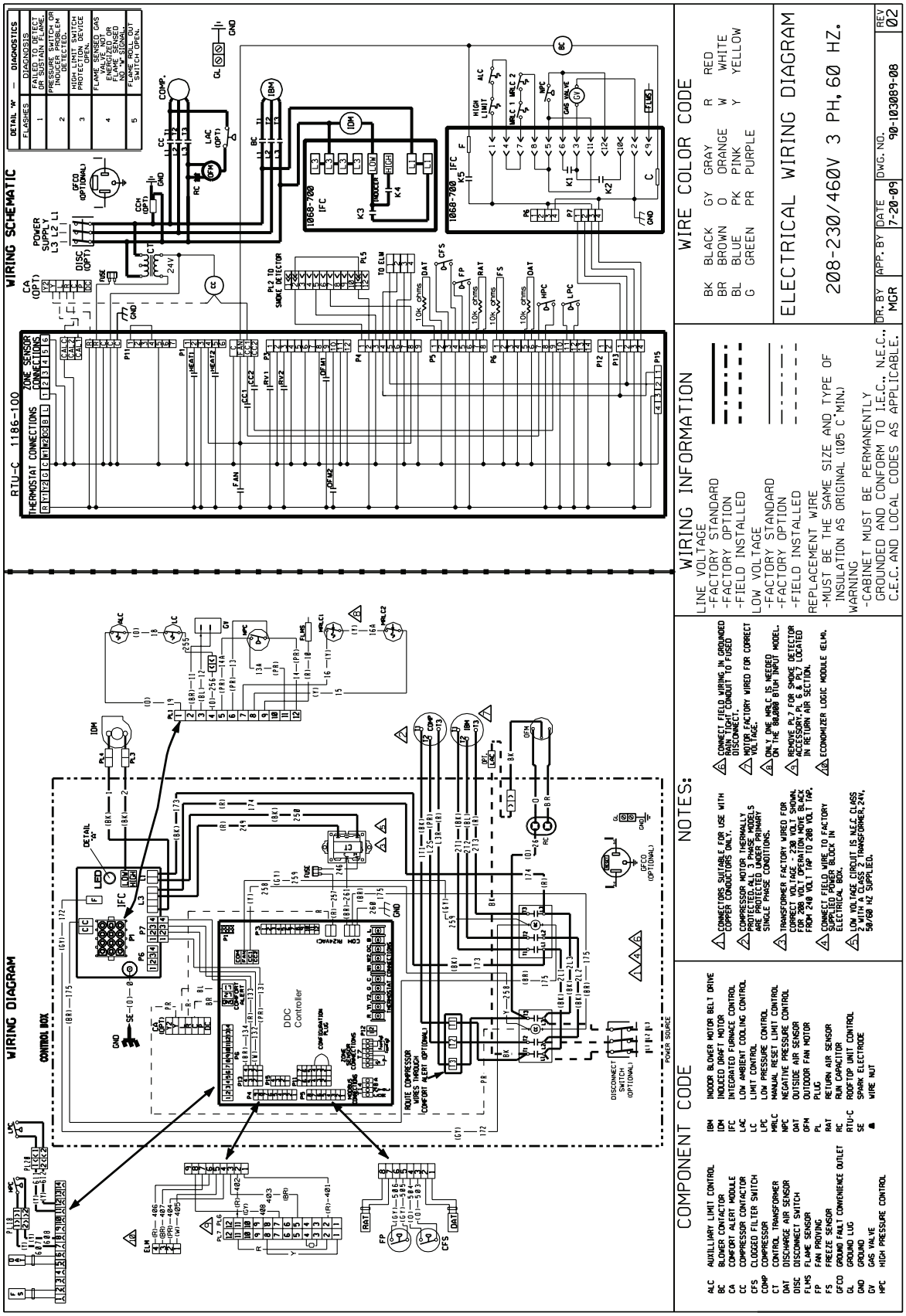


Figure 21: MPS003B-MPS005B, 575V, 3-Phase, Gas Heat

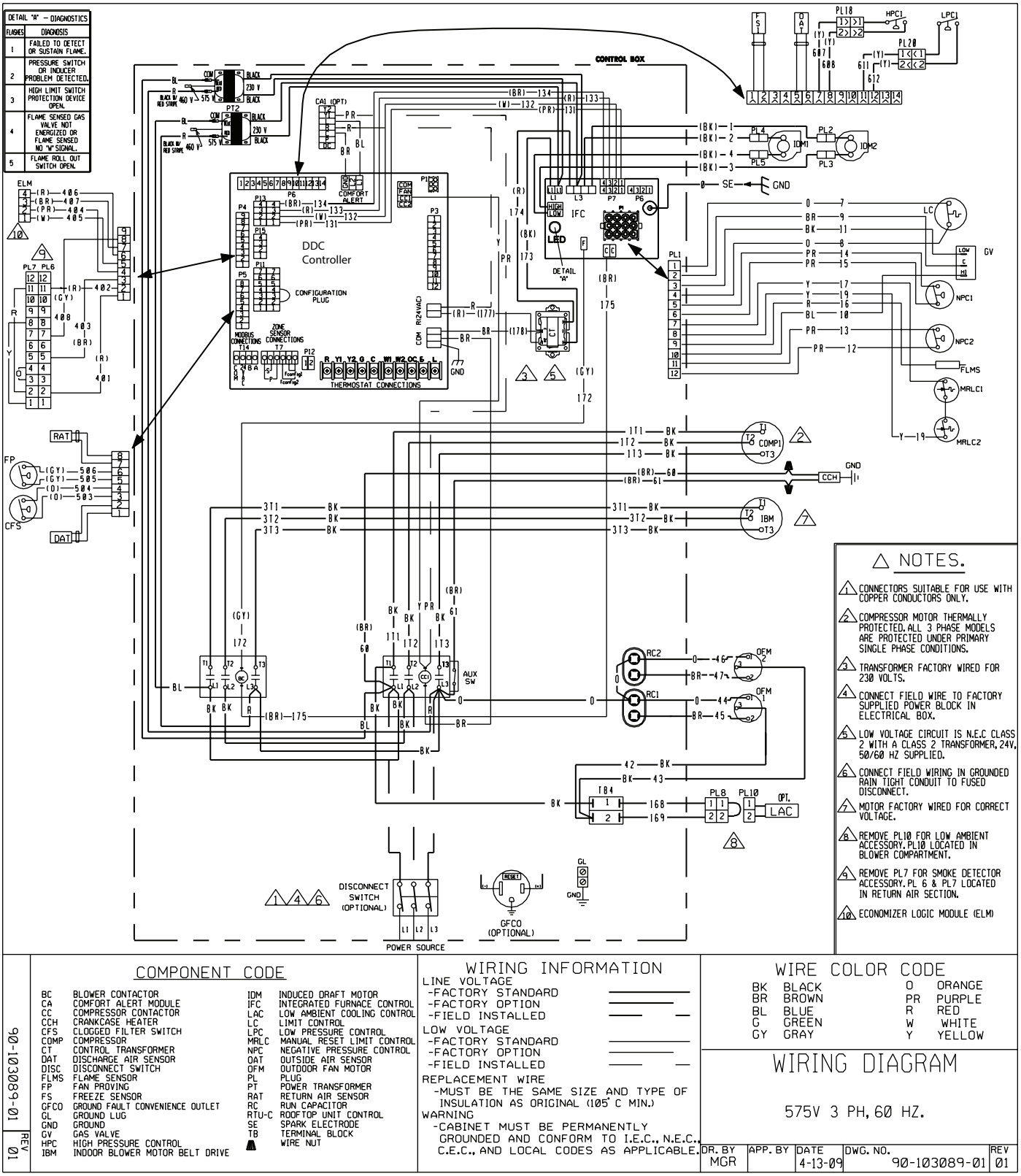


Figure 22: MPS006B-MPS007B, 208-230/460V, 3-Phase, Gas Heat

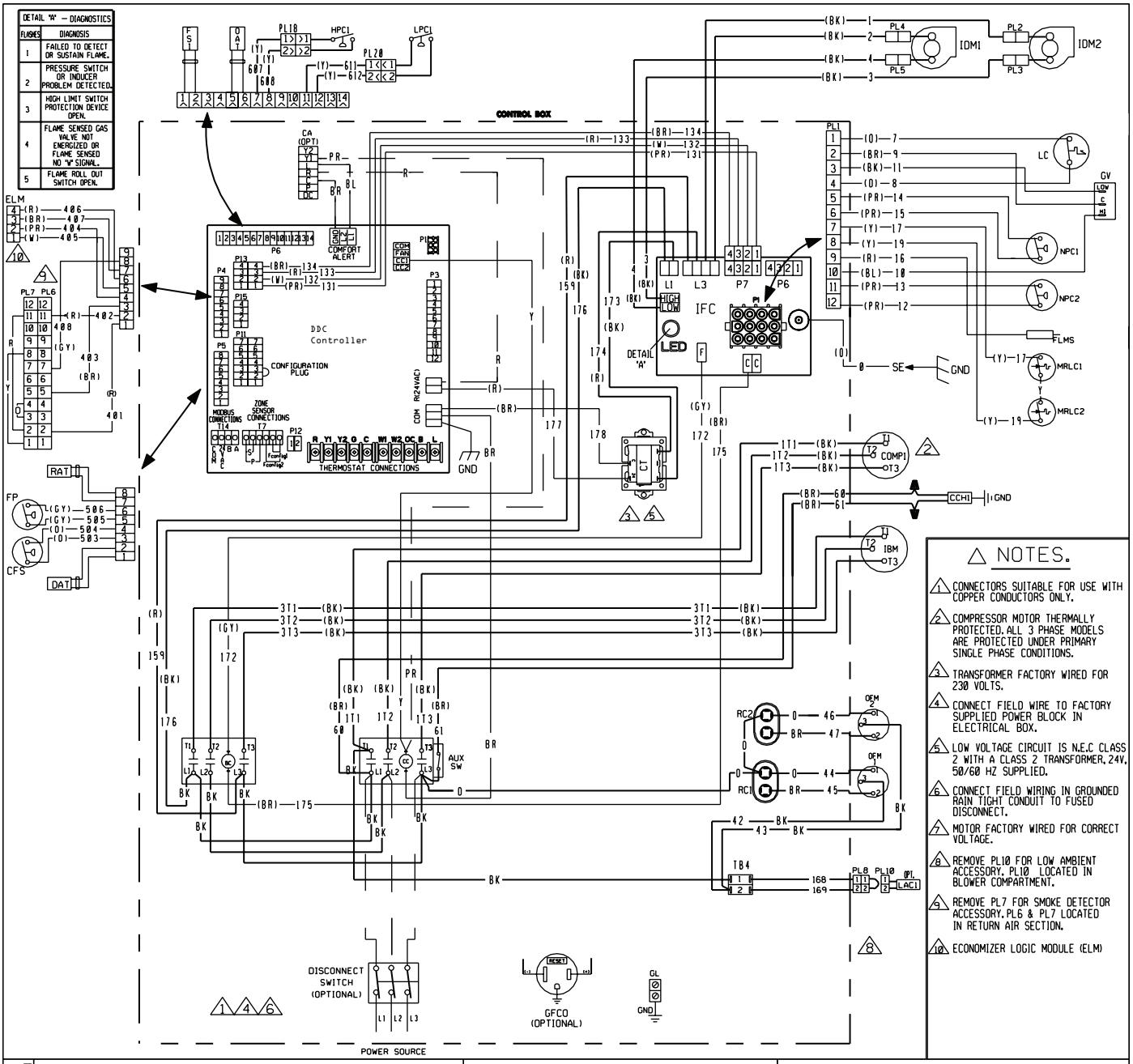


Figure 23: MPS006B-MPS007B, 575V, 3-Phase, Gas Heat

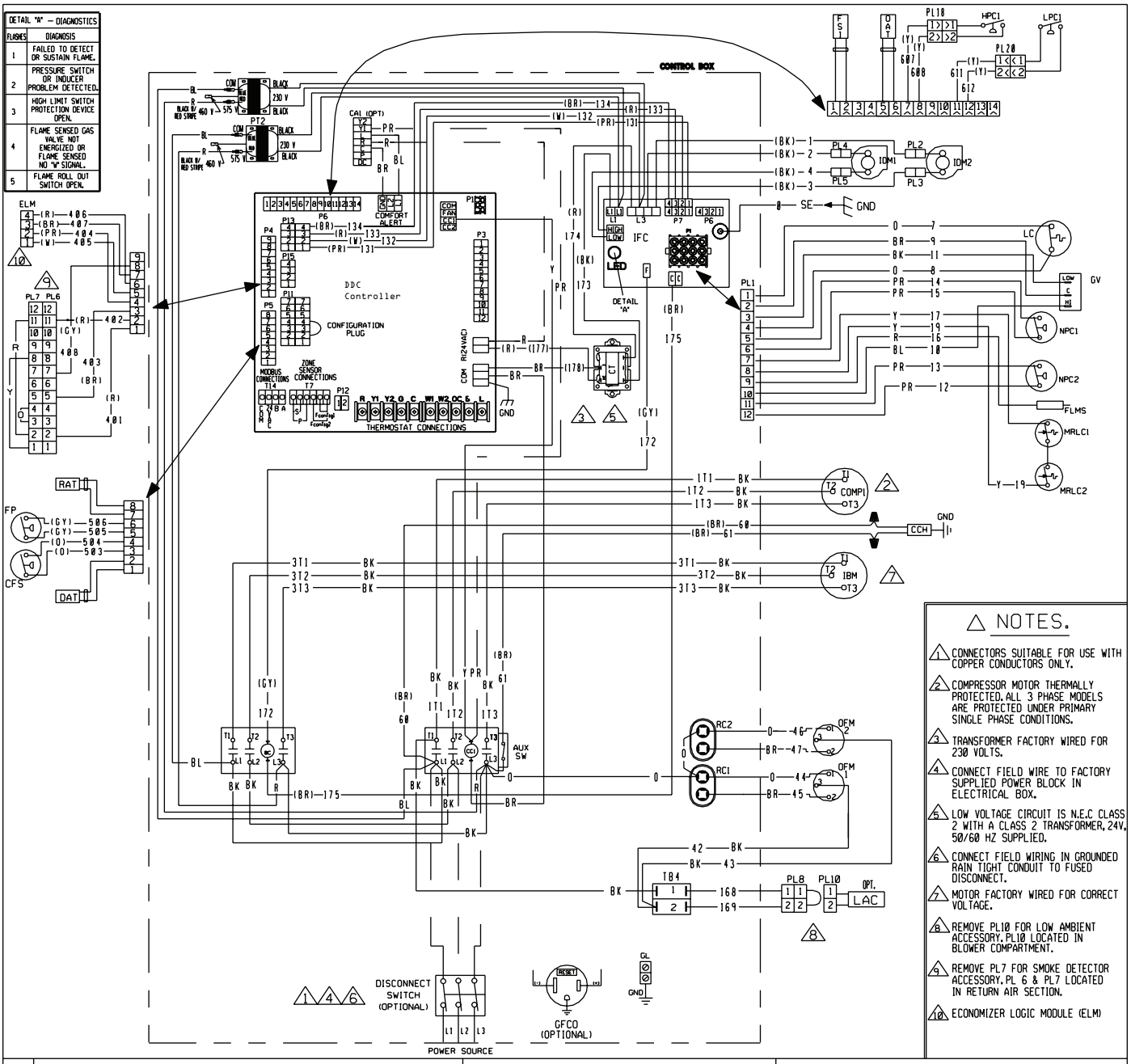


Figure 24: MPS008B-MPS012B, 208-230/460V, 3-Phase, Gas Heat

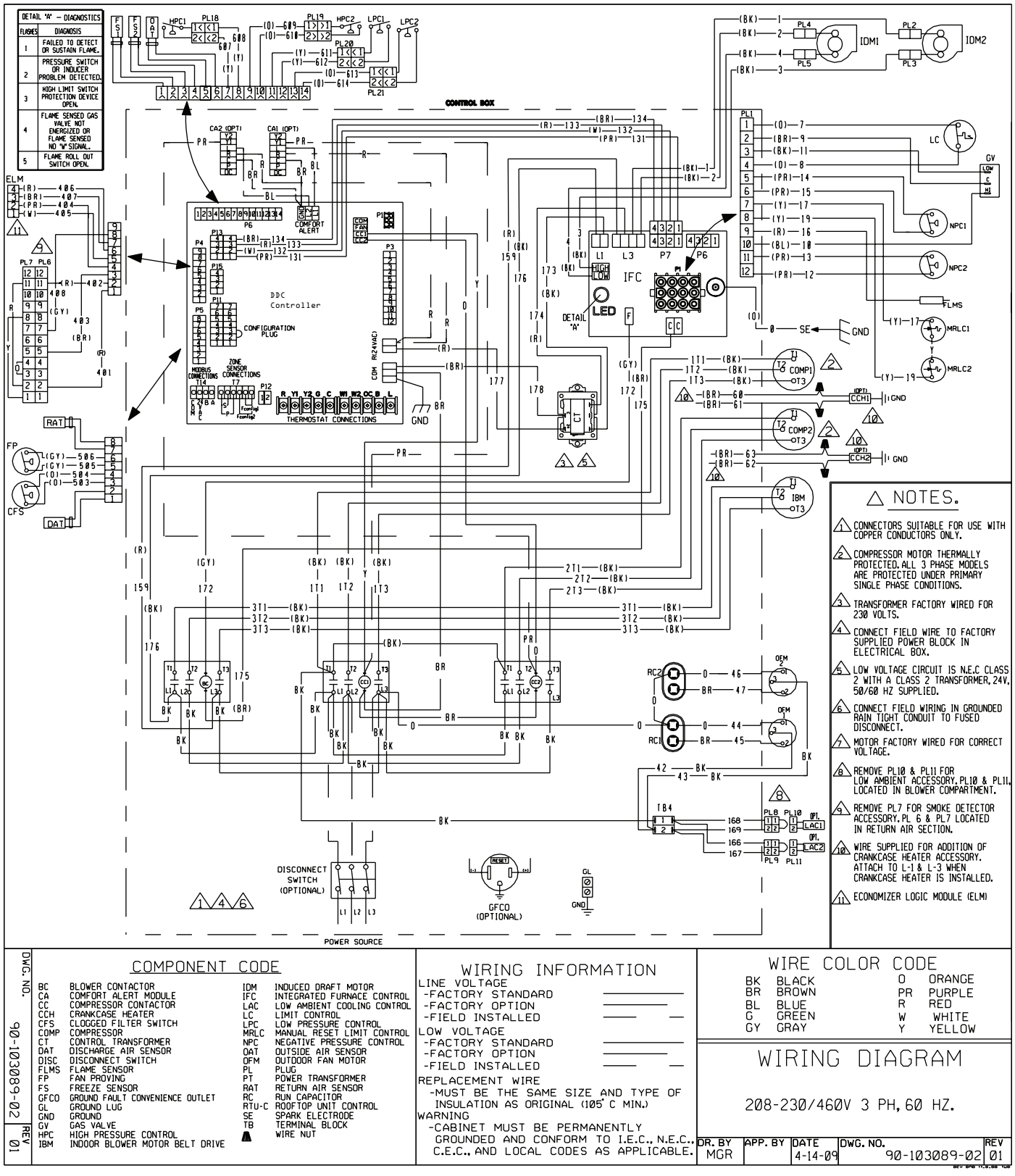


Figure 25: MPS008B-MPS012B, 575, 3-Phase, Gas Heat

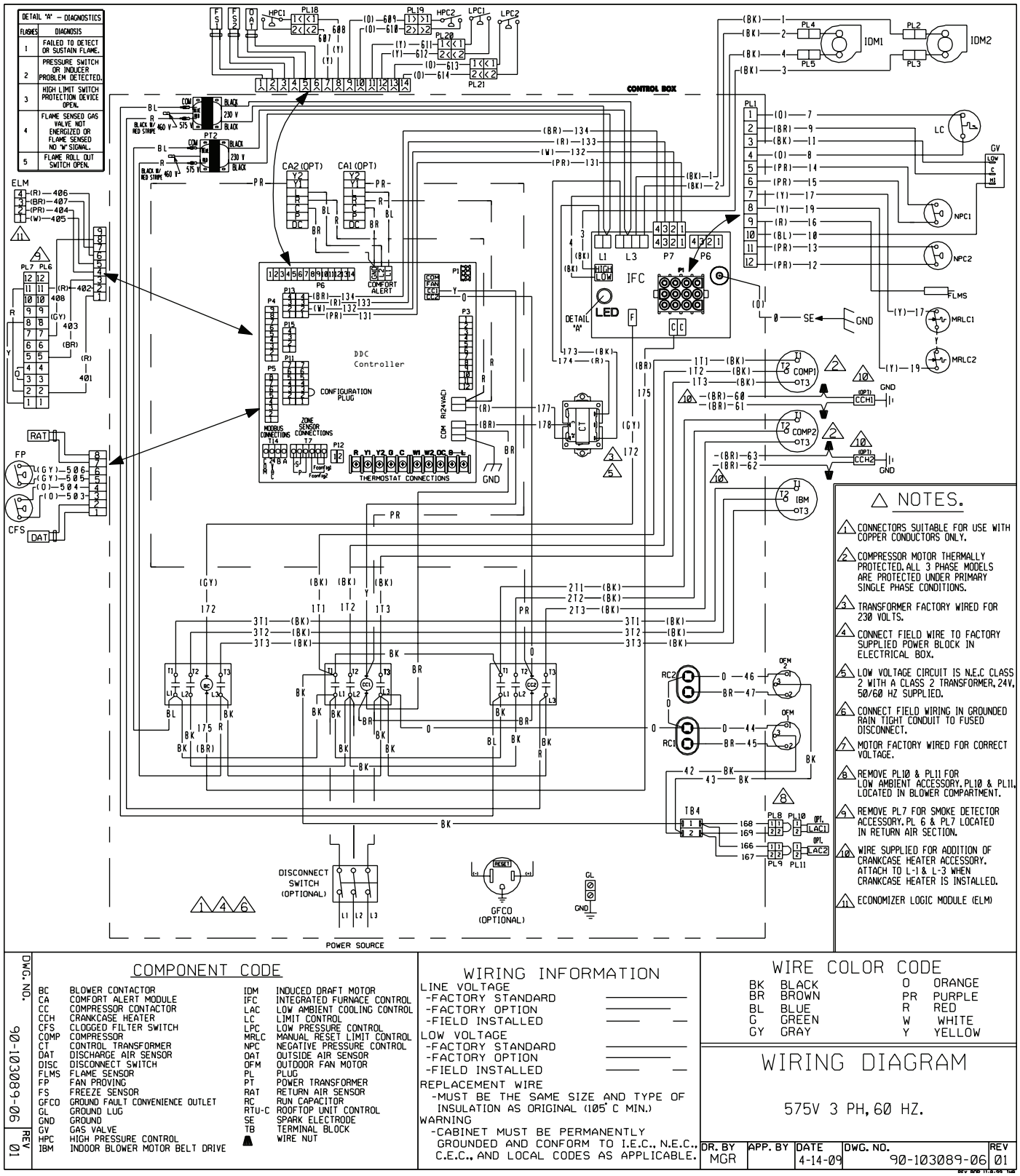


Figure 26: MPS015B-MPS025B, 208-230/460V, 3-Phase, Gas Heat

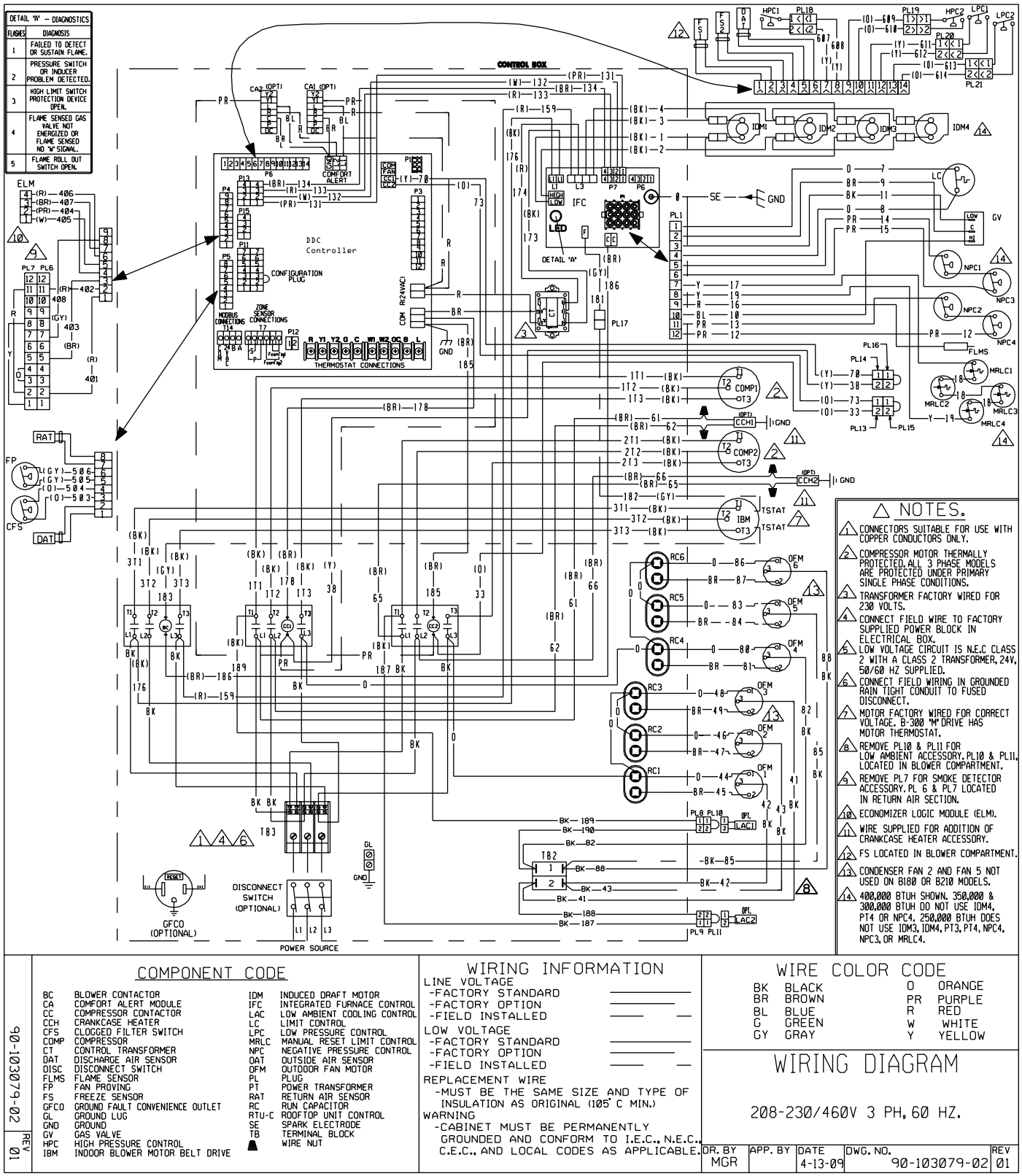


Figure 27: MPS015B-MPS025B, 575V, 3-Phase, Gas Heat

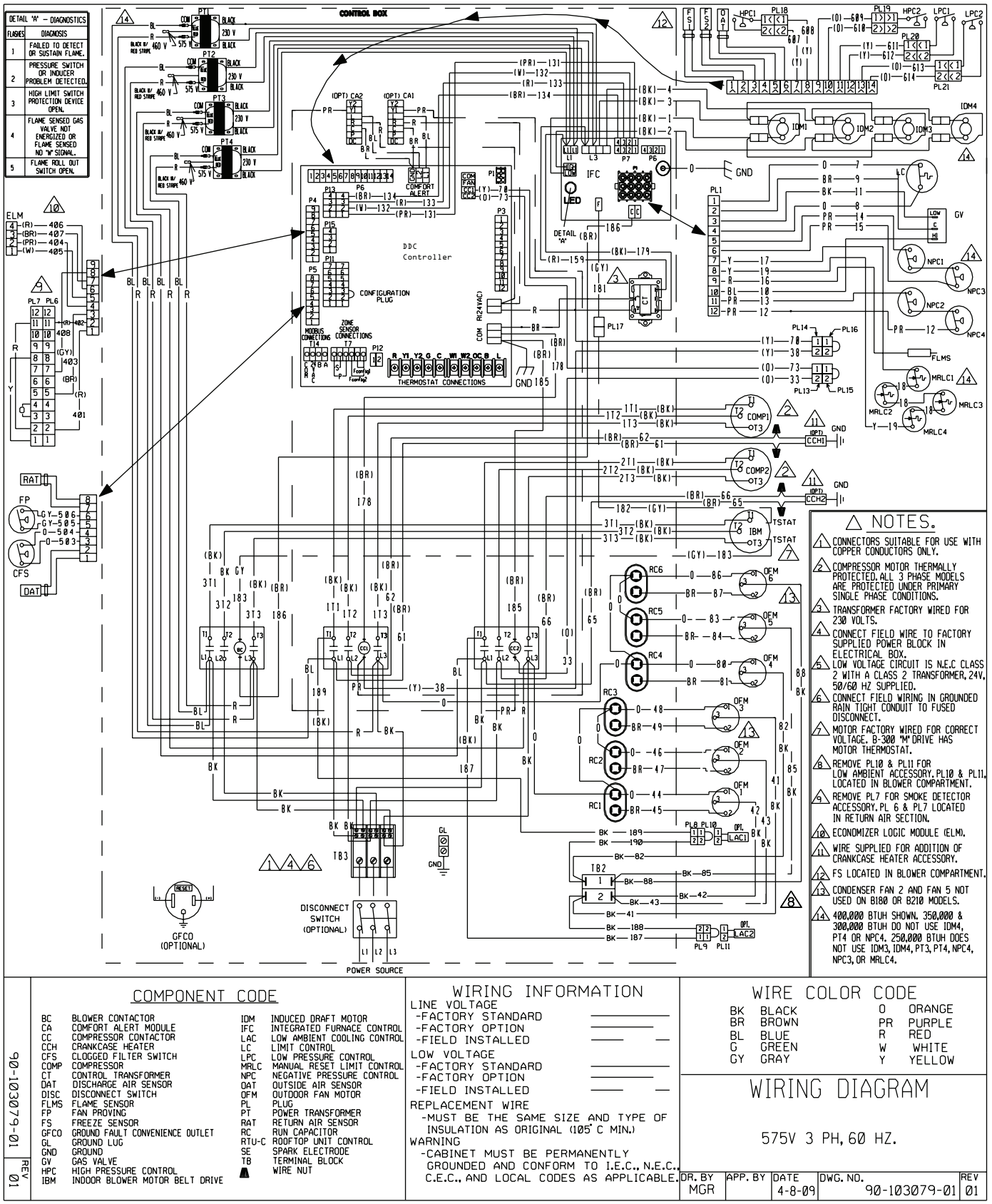


Figure 28: MPS003B-MPS005B, 208-230/460V, 3-Phase, Cooling Only

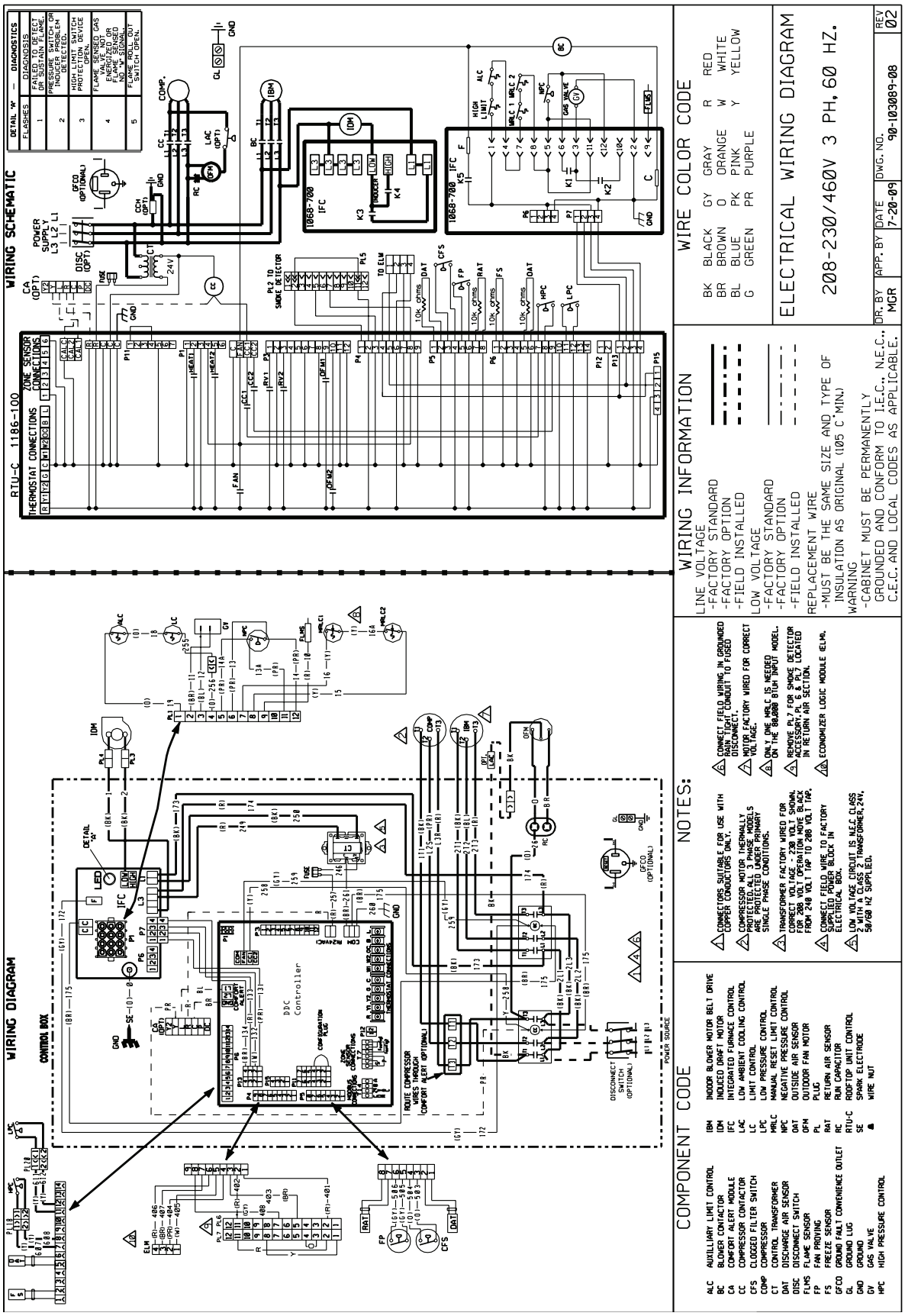


Figure 29: MPS006B-MPS007B, 208-230/460/575V, 3-Phase, Cooling Only

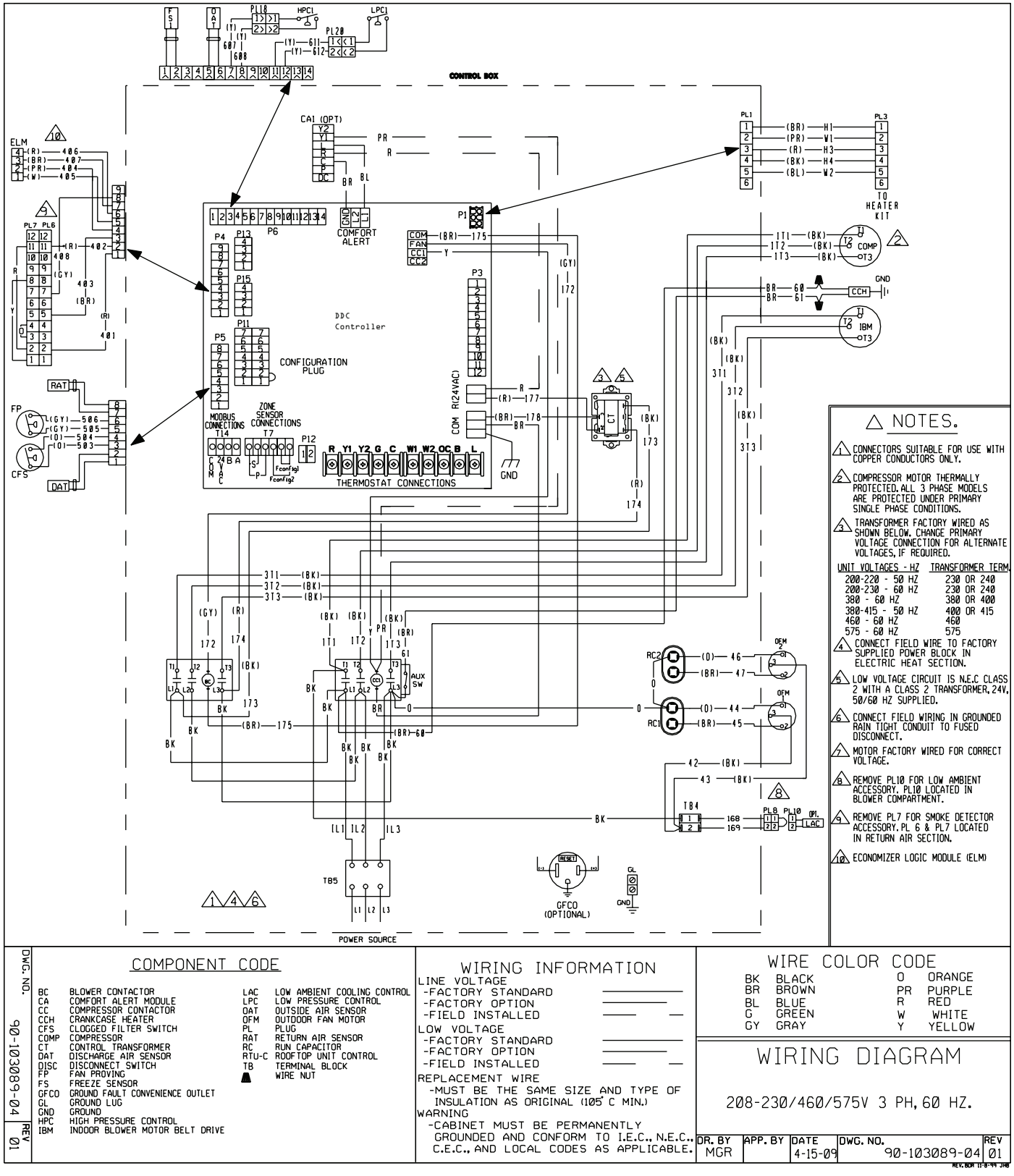


Figure 30: MPS008B-MPS012B, 208-230/460/575V, 3-Phase, Cooling Only

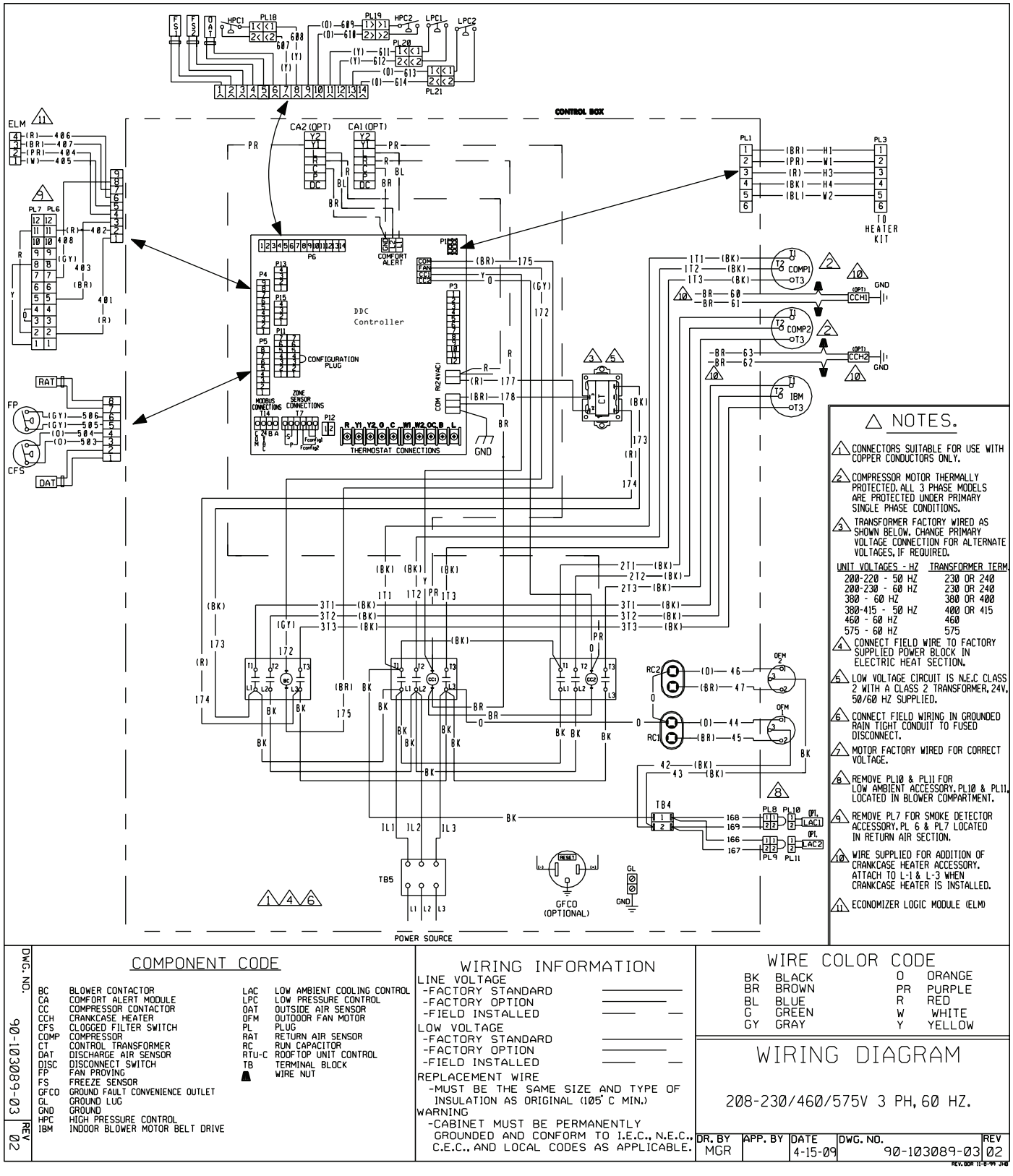


Figure 31: MPS015B-MPS025B, 208-230/460/575V, 3-Phase, Cooling Only

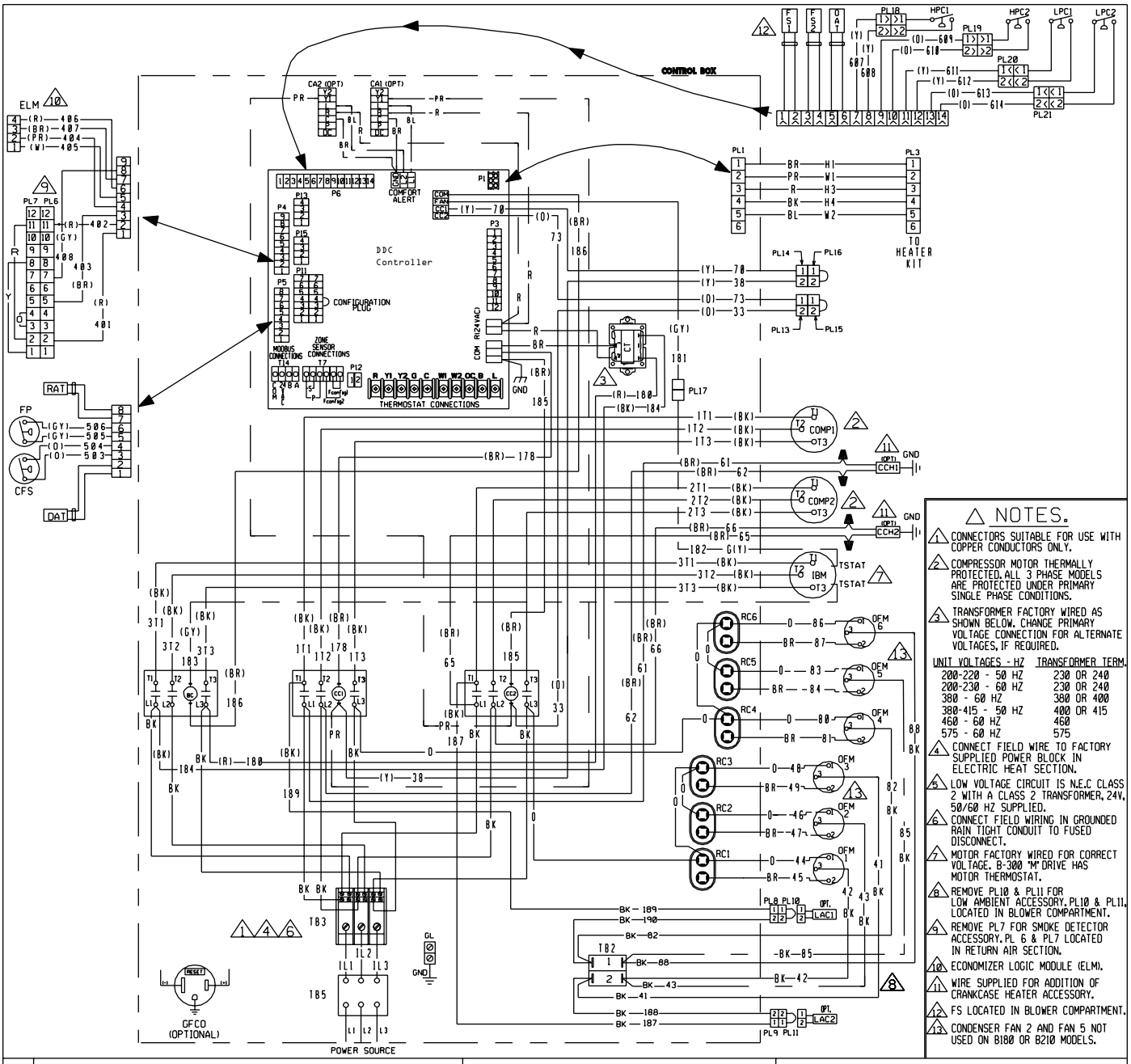


Table 22: Sensor Temperature vs. Resistance

TEMP °F	R (OHMS)	TEMP °F	R (OHMS)	TEMP °F	R (OHMS)	TEMP °F	R (OHMS)
1.4	81,662	77.0	10,000	150.8	2,011	224.6	561
3.2	77,162	78.8	9,571	152.6	1,943	226.4	546
5.0	72,940	80.6	9,164	154.4	1,876	228.2	531
6.8	68,957	82.4	8,776	156.2	1,813	230.0	517
8.6	65,219	84.2	8,407	158.0	1,752	231.8	503
10.4	61,711	86.0	8,056	159.8	1,693	233.6	489
12.2	58,415	87.8	7,720	161.6	1,637	235.4	476
14.0	55,319	89.6	7,401	163.4	1,582	237.2	463
15.8	52,392	91.4	7,096	165.2	1,530	239.0	450
17.6	49,640	93.2	6,806	167.0	1,480	240.8	437
19.4	47,052	95.0	6,530	168.8	1,431	242.6	425
21.2	44,617	96.8	6,266	170.6	1,385	244.4	413
23.0	42,324	98.6	6,014	172.4	1,340	246.2	401
24.8	40,153	100.0	5,803	174.2	1,297	248.0	390
26.6	38,109	100.4	5,774	176.0	1,255	249.8	379
28.4	36,182	102.2	5,546	177.8	1,215	251.6	369
30.2	34,367	104.0	5,327	179.6	1,177	253.4	359
32.0	32,654	105.8	5,117	181.4	1,140	255.2	349
33.8	31,030	107.6	4,918	183.2	1,104	257.0	340
35.6	29,498	109.4	4,727	185.0	1,070	258.8	332
37.4	28,052	111.2	4,544	186.8	1,037	260.6	323
39.2	26,686	113.0	4,370	188.6	1,005	262.4	315
41.0	25,396	114.8	4,203	190.4	974	264.2	305
42.8	24,171	116.6	4,042	192.2	944	266.0	300
44.6	23,013	118.4	3,889	194.0	915	267.8	293
46.4	21,918	120.2	3,743	195.8	889	269.6	285
48.2	20,883	122.0	3,603	197.6	861	271.4	278
50.0	19,903	123.8	3,469	199.4	836	273.2	272
51.8	18,972	125.6	3,340	201.2	811	275.0	265
53.6	18,090	127.4	3,217	203.0	787	276.8	259
55.4	17,255	129.2	3,099	204.8	764	278.6	253
57.2	16,464	131.0	2,986	206.6	742	280.4	247
59.0	15,714	132.8	2,878	208.4	721	282.2	241
60.8	15,000	134.6	2,774	210.2	700	284.0	235
62.6	14,323	136.4	2,675	212.0	680	285.8	230
64.4	13,681	138.2	2,579	213.8	661	287.6	224
66.2	13,071	140.0	2,488	215.6	643	289.4	219
68.0	12,493	141.8	2,400	217.4	626	291.2	214
69.8	11,942	143.6	2,315	219.2	609	293.0	209
71.6	11,418	145.4	2,235	219.9	595	294.8	204
73.4	10,921	147.2	2,157	221.0	592	296.6	199
75.2	10,449	149.0	2,083	222.8	576	298.4	194

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