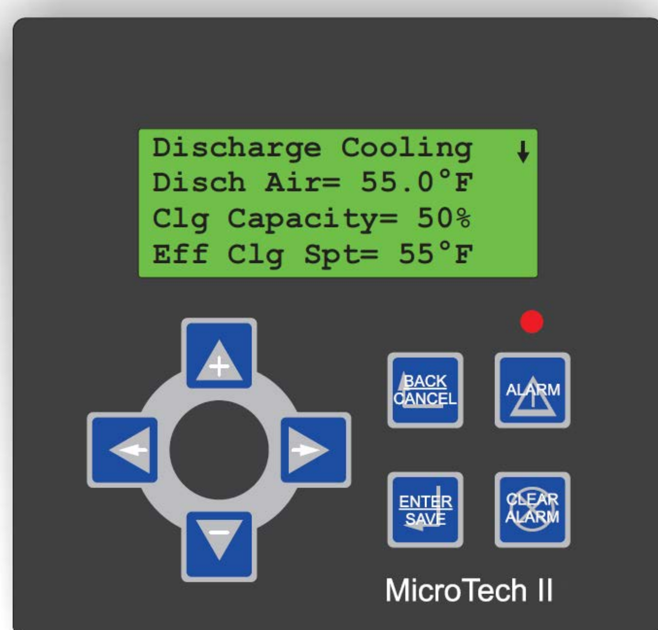
Installation and Maintenance	IM 696-3
	Group: **Applied Systems**
	Part Number: **IM 696**
	Date: **December 2004**

MicroTech® II
Applied Rooftop Unit Controller

- **Used with Daikin models: RPS, RFS, RCS, RDT, RPR, RFR, RPE, RDE, RCE, RDS, RAR & RAH**



© 2004 Daikin Applied

Contents

Daikin and MicroTech II are registered trademarks of Daikin Applied . Microsoft is a registered trademark of Microsoft Corporation.
Windows is a trademark of Microsoft Corporation.
Copyright © 2004 Daikin Applied . All rights reserved throughout the world.

Introduction

This manual contains information regarding the MicroTech II® control system used in the Daikin® RoofPak® applied rooftop product line. It describes the MicroTech II components, input/output configurations, field wiring options and requirements, and service procedures.

For a description of operation and information on using the keypad to view data and set control parameters, refer to the appropriate program-specific operation manual, see Table 1. For installation and commissioning instructions and general information on a particular rooftop unit model, refer to its model-specific installation manual, refer to Table 2.

Table 1: Program-specific unit operation literature

	Operation manual bulletin number
Discharge Air Control (VAV or CAV)	OM-137-2
Space Comfort Control (CAV-zone temperature control)	OM-138-2

Table 2: Model-specific rooftop unit installation literature

	Installation and maintenance data bulletin number
RPS/RDT/RFS/RCS 015-135C	IM 738-1
RPE/RDE/RCE (evaporative condensing units)	IM 791-1
RDS and RAH	IM 487-4

This equipment generates, uses, and can radiate radio frequency energy. If not installed and used in accordance with this instruction manual, it can interfere with 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 users will be required to correct the interference at their own expense.
Daikin Applied disclaims any liability resulting from any interference or for the correction thereof.

Electric shock hazard. Can cause personal injury or equipment damage.
This equipment must be properly grounded. Connections and service to the MicroTech II control panel must be performed only by personnel knowledgeable in the operation of the equipment being controlled.

Excessive moisture in the control panel can cause hazardous working conditions and improper equipment operation.
Protect the electrical components in the main control panel from precipitation.

Extreme temperature can damage system components.
This MicroTech II controller is designed to operate in ambient temperatures from –40°F to 158°F. It can be stored in ambient temperatures from –65°F to 176°F. The controller is designed to operate in a 10% to 90% RH (noncondensing) and be stored in a 5% to 95% RH (noncondensing) environment.

Static sensitive components. A static discharge while handling electronic circuit boards can damage components.
Discharge any static electrical charge by touching the bare metal inside the main control panel before performing any service work. Never unplug any cables, circuit board terminal blocks, relay modules, or power plugs while power is applied to the panel.

To prevent possible unit damage, before removing power to the controller, pump down compressor.

General Description

The MicroTech II Applied Rooftop Unit Controller is a microprocessor-based controller designed to provide sophisticated control of Daikin RoofPak® applied rooftop units. In addition to providing normal temperature, static pressure, and ventilation control, the controller can provide alarm monitoring and alarm-specific component shutdown if critical system conditions occur.

The operator can access temperatures, pressures, operating states, alarm messages, control parameters, and schedules with an 8-key keypad and a 4-line by 20-character display. The controller includes password protection against unauthorized or accidental control parameter changes.

This MicroTech II controller is capable of complete, stand-alone rooftop unit control, or it can be incorporated into a building-wide network using an optional plug-in communication module. Available communication modules include BACnet®/IP, BACnet MS/TP, LONMARK® Space Comfort Controller (SCC) and LONMARK Discharge Air Controller (DAC).

Component Data

The main components of the MicroTech II control system include the main control board (MCB), one or two optional auxiliary cooling control boards (CCB1, CCB2, or GCB1), an optional auxiliary electric heating control board (EHB1), an optional auxiliary energy recovery wheel control board (ERB1), and a keypad/display. These control components are located in the main control panel as shown in Figure 1 (smaller units), Figure 2 (larger units), and Figure 3. These components are interconnected by shielded multiconductor communication cables, or in the case of the keypad/display by a six conductor cable with an RJ-11 style modular connector. Transformers T2, T3 and T9 supply power to the system. The following pages contain descriptions of these components and their input and output devices.

Figure 1: Main control panel, RPS/RFS/RPR/RFR 15 to 40C and RDS/RAR 800 to 802C

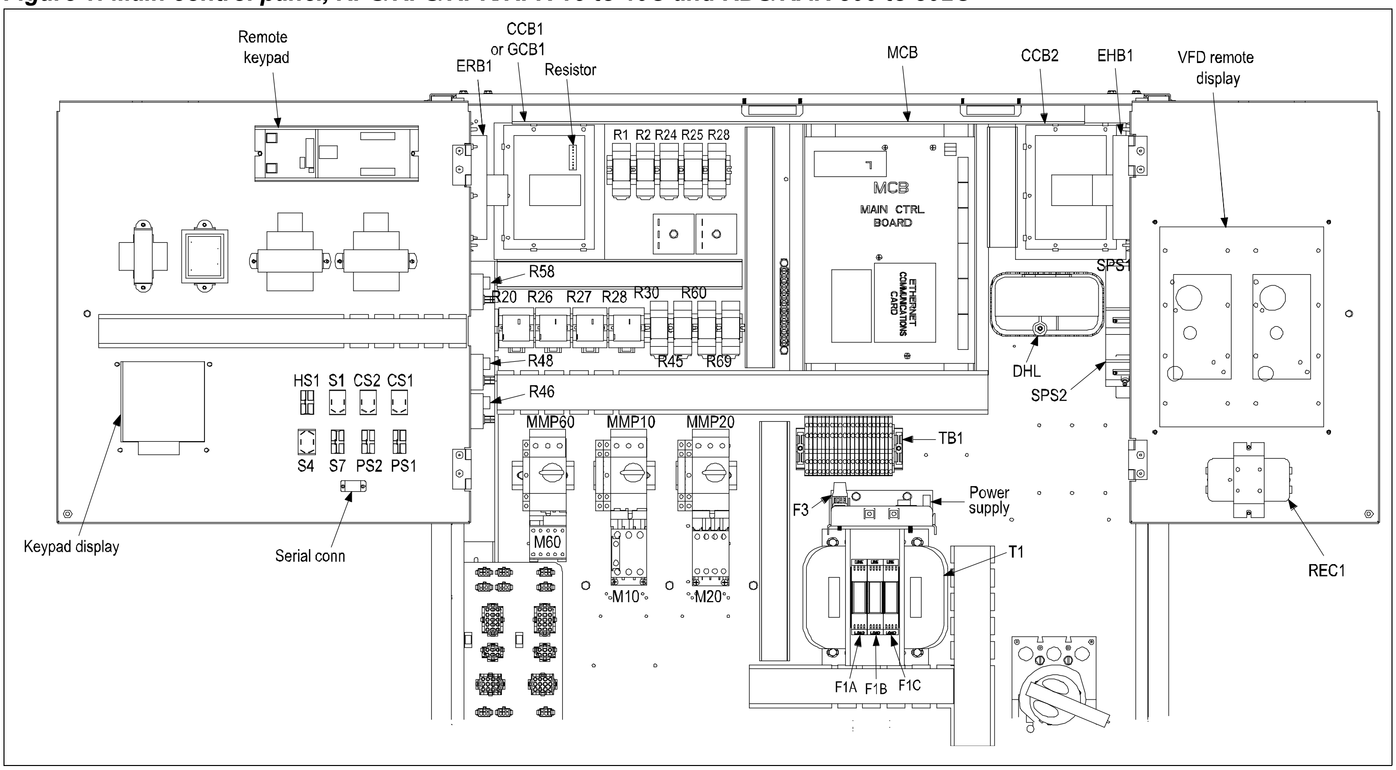


Figure 2: Main control panel, RPS/RFS/RPR/RDT 45 to 75C and RAH/RAR 47C

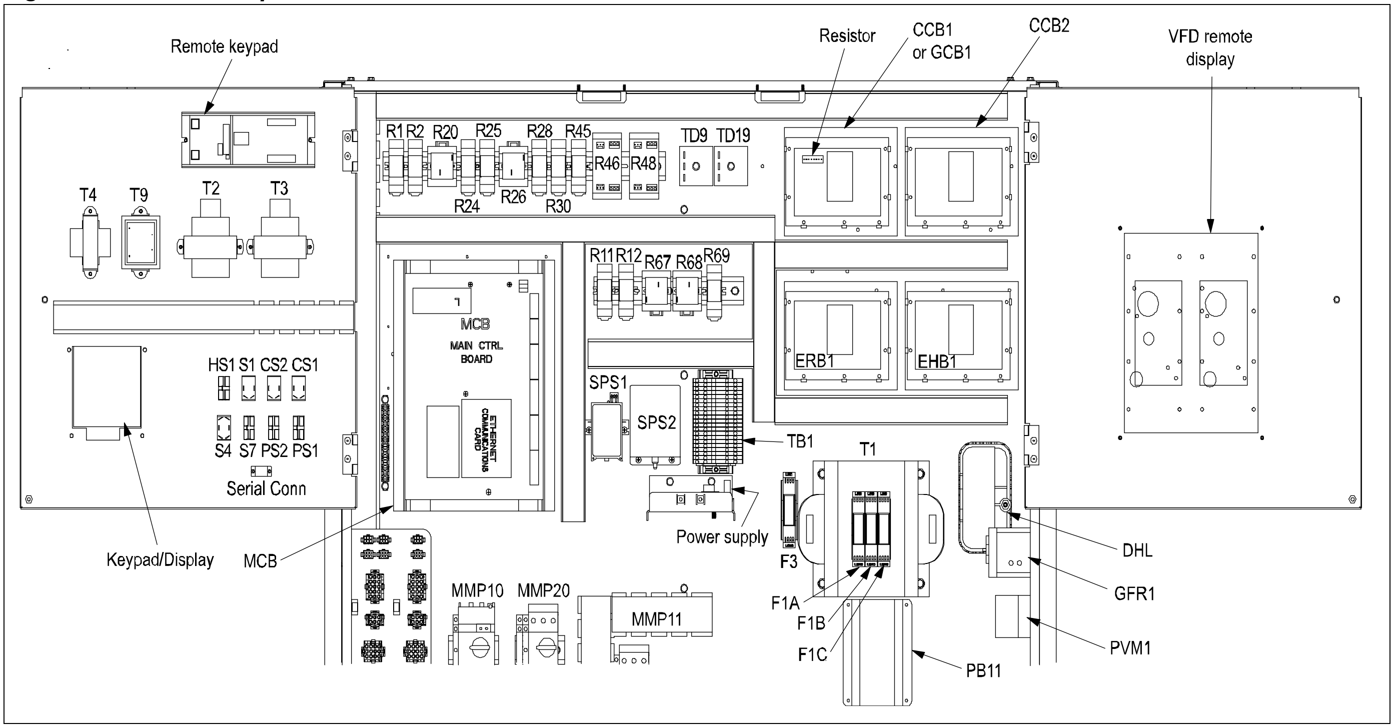
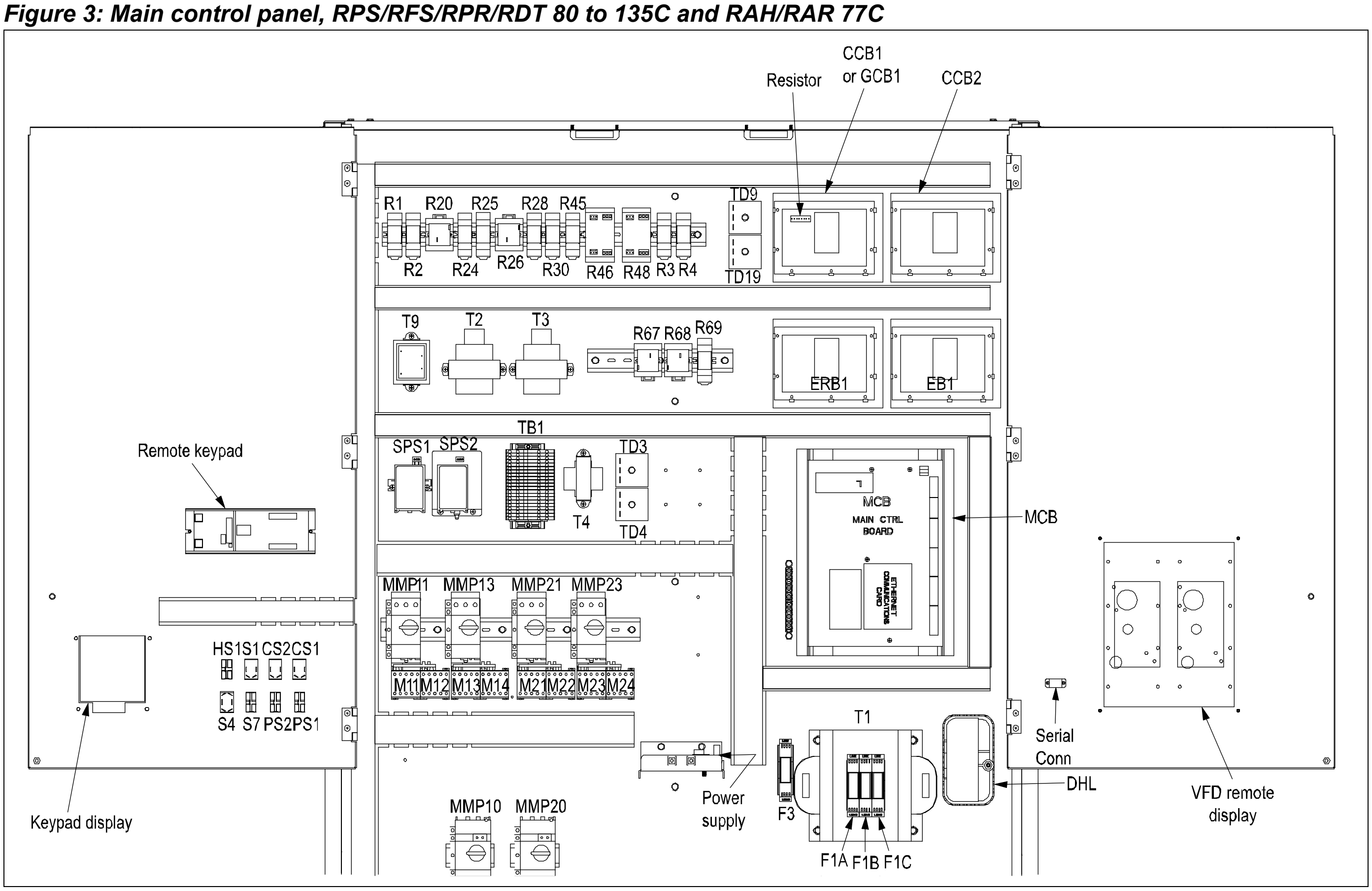


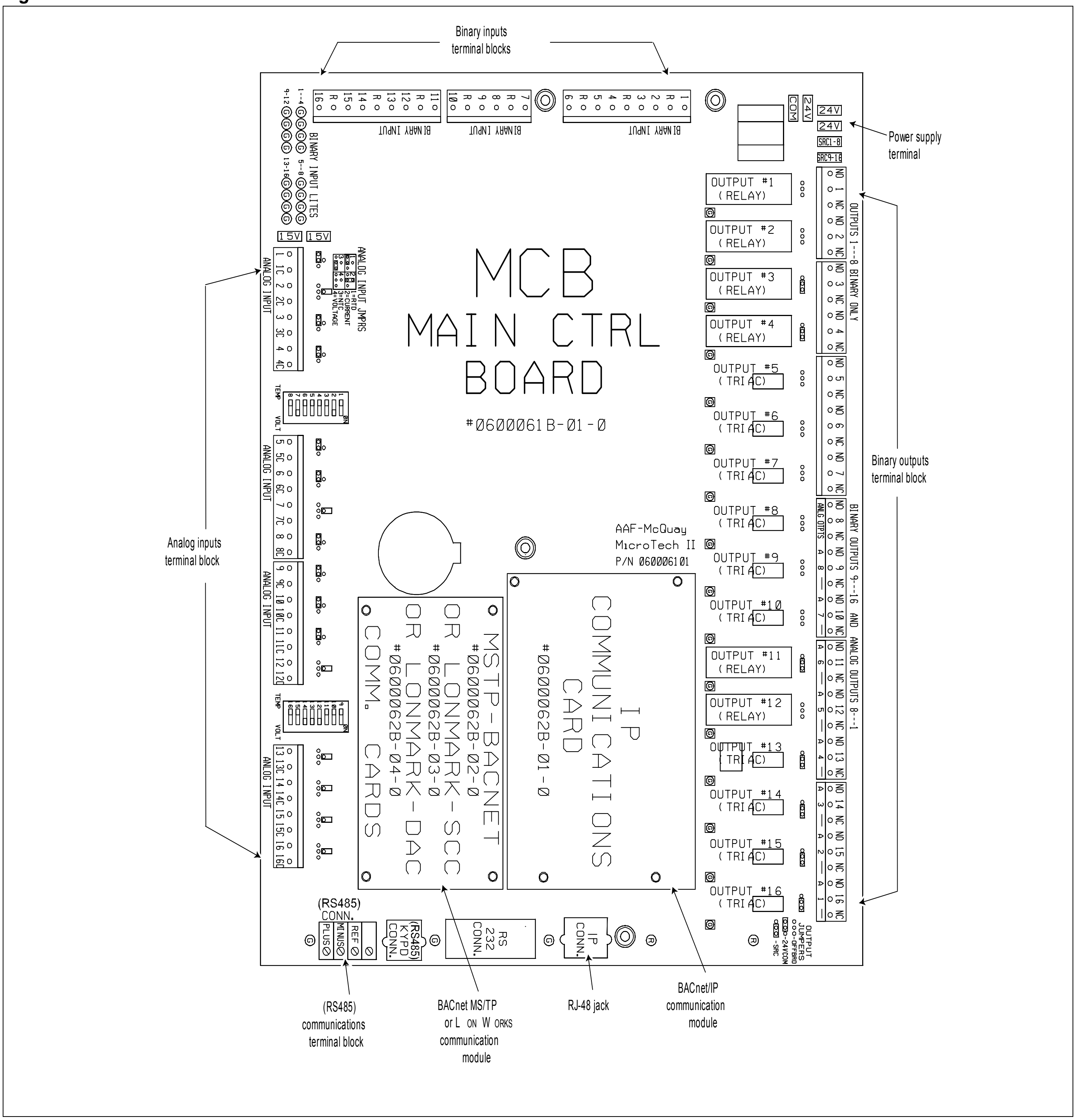
Figure 3: Main control panel, RPS/RFS/RPR/RDT 80 to 135C and RAH/RAR 77C



Main Control Board (MCB)

Figure 4 shows the main control board (MCB). It contains a microprocessor that is programmed with the main application code to control the unit. The MCB receives up to 16 analog and 16 binary inputs directly and up to 6 analog and 12 binary inputs from each optional auxiliary control board (CCB1, CCB2, GCB1, EHB1, and ERB1). Auxiliary control boards communicate this data with the MCB via an RS-485 communication bus interface. The MCB controls its own 16 binary outputs and up to 9 binary outputs on each auxiliary board based on the inputs.

Figure 4: Main control board



Analog Inputs Terminal Blocks

The MCB receives up to 16 analog input signals on four terminal blocks located on the left side of the board. From top to bottom, analog inputs AI1 through AI4 are terminated on the first terminal block, AI5 through AI8 on the second, AI9 through AI12 on the third, and AI13 through AI16 on the fourth. Each analog input has two terminals. The terminals for AI1 are 1 and 1C, the terminals for AI2 are 2 and 2C, and so forth. Refer to “Analog Inputs-Main Control Board (MCB)” on page 21 for details regarding analog inputs.

Binary Inputs Terminal Blocks

The MCB receives up to 16 binary input signals on three terminal blocks located on the top of the board. From right to left, binary inputs BI1 through BI6 are terminated on the first terminal block, BI7 through BI10 on the second and BI11 through BI16 on the third. Refer to “Binary Inputs—Main Control Board (MCB)” on page 23 for details regarding binary inputs.

Binary Outputs Terminal Blocks

The MCB controls up to 16 binary outputs when controlling the unit. The binary outputs either energize on-board electromechanical relays (BO1 through BO4, BO11 and BO12) or triacs (BO5 through BO10 and BO13 through BO16).

The unit control devices are wired to these relays or triacs through six output terminal blocks on the right side of the MCB. From top to bottom binary outputs BO1 and BO2 are terminated on the first terminal block, BO3 and BO4 on the second, BO5 through BO7 on the third, BO8 through BO10 on the fourth, BO11 through BO13 on the fifth, and BO14 through BO16 on the sixth.

Each binary output has three terminals. The terminals for BO1 are NO, 1, and NC, the terminals for BO2 are NO, 2, and NC, and so forth. Each binary output lights an LED when the output is active. Refer to “Binary Outputs—Main Control Board (MCB)” on page 24 for details regarding binary outputs.

RS-485 Communications Terminal Block

The MCB exchanges information with up to four optional auxiliary control boards via the RS-485 communication bus terminal block in the lower left corner of the MCB. This terminal block has four terminals, three of which are labeled REF, Minus, and Plus. These terminals connect the auxiliary boards to the RS-485 communication bus to interface them with the MCB.

If unit is equipped with and evaporative condenser and a VFD controlling the first condenser fan on each circuit (condenser fan #11 and #21), this VFD is also controlled via this RS-485 communication bus terminal block.

Power Supply Terminals

Transform T2 supplies 24 VAC power to the MCB on the 24V and COM terminals located at the upper right corner of the MCB.

Some of the binary outputs on the MCB drive 24 VAC pilot relays in the unit control circuit. 24 VAC to power these pilot relays is provide from transformer T3, through the SRC 1–8 and SRC 9–16 terminals located at the upper right corner of the MCB, and through the particular binary output contacts. Place the output jumper associated with these outputs in the SRC position. For detailed information regarding binary output jumpers, refer to “Binary Outputs—Main Control Board (MCB)” on page 24.

Keypad/LCD Display Connection

The keypad is connected to the main control board via a six-conductor cable connected to a modular jack located at the bottom of the MCB. This connects the keypad to the RS-485 communication bus interface with the MCB.

Communication Modules

In systems that require networking, one of the following communications modules can be installed.

BACnet/IP Communication Module

A BACnet/IP Communication Module can be plugged into the MCB as shown in Figure 4 on page 4.

The BACnet/IP Communication Module is designed to be an add-on module to the MCB for networking to Building Automation and Control Network (BACnet) systems. It is a plug-in module that can be attached to the MCB via a 36-pin header, and includes four locking stand-offs to securely attach it to the board. The MicroTech II Applied Rooftop Unit Controller meets the requirements of ANSI/AHRAE 135-2001 standard for BACnet/IP per Annex J of the standard with a conformance level of 3.

For a detailed description and troubleshooting information regarding this communications module, refer to installation and maintenance bulletin *IM 703, MicroTech II Applied Rooftop Unit Controller and Self-Contained Unit Controller BACnet Communication Module—BACnet / IP*. For details regarding BACnet protocol data, refer to engineering data document, *ED 15060, MicroTech II Applied Rooftop Unit Controller Protocol Information*.

A unit equipped with the optional BACnet/IP Communication Module is connected to an BACnet network through an eight-position RJ-48 style modular jack located on the bottom edge of the MCB. This connection is shown schematically in Figure 5 on page 7.

BACnet MS/TP Communications Module

A BACnet MS/TP Communication Module can be plugged into the MCB as shown in Figure 4 on page 4.

The BACnet MS/TP Communication Module is designed to be an add-on module to the MCB for networking to Building Automation and Control Network (BACnet) systems. It is a plug-in module that can be attached to the MCB via a 12-pin header, and includes four locking stand-offs to securely attach it to the board. It allows the MCB to interoperate with systems that use the BACnet Master Slave/Token Passing (MS/TP) protocol with a conformance level of 3. The MicroTech II Applied Rooftop Unit Controller meets the requirements of ANSI/AHSRAE 135-2001 standard for BACnet systems.

For a detailed description and troubleshooting information regarding this communications module, refer to installation and maintenance bulletin *IM 704, MicroTech II Applied Rooftop Unit Controller and Self-Contained Unit Controller BACnet Communication Module—BACnet / MS/TP*. For details regarding BACnet protocol data, refer to engineering data document, *ED 15060, MicroTech II Applied Rooftop Unit Controller Protocol Information*.

A unit equipped with the optional BACnet MS/TP Communication Module is connected to a BACnet network through terminals 128 (+) and 129 (-) on terminal block TB2 in the main control panel. These terminals are factory wired to the BACnet MS/TP module when the module is factory installed. When the module is field installed, the add on communication module kit includes a wiring harness to be installed between terminals 128 and 129 and the BACnet MS/TP module. This connection is shown schematically in Figure 5 on page 7.

LONWORKS® Communication Modules

A LONWORKS Communication Module can be plugged into the MCB as shown in Figure 4 on page 4. This module provides LONWORKS network communication capability to the MCB. It is a plug-in module that can be attached to the MCB via a 12-pin header, and includes 4 locking stand-offs to securely attach it to the board.

For a detailed description and troubleshooting information regarding this communications module, refer to installation and maintenance bulletin *IM 702, MicroTech II Applied Rooftop Controller and Self-Contained Unit Controller LONWORKS Communication Modules*. For details regarding LONMARK® protocol data for these modules, refer to engineering data document, *ED 15060, MicroTech II Applied Rooftop Unit Controller Protocol Information*.

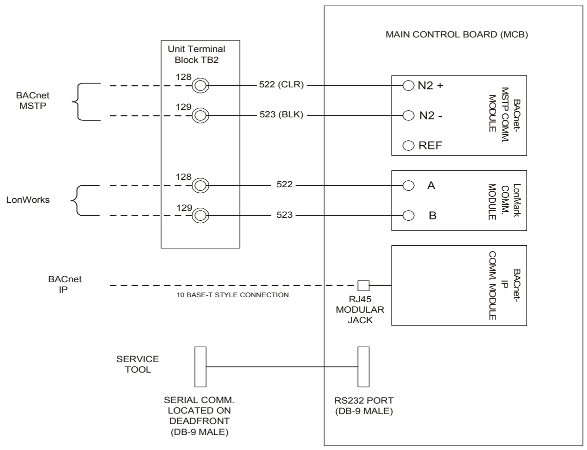
There are two versions of this module available. One is the LONMARK Space Comfort Controller (SCC) module and the other is the LONMARK Discharge Air Control (DAC) module.

Space Comfort Control (SCC) Module. The Space Comfort Controller (SCC) module supports the LonMark Space Comfort Controller (SCC) functional number 8500.

Discharge Air Control (DAC) Module. The Discharge Air Controller (DAC) Communication module supports the LONMARK Discharge Air Controller (DAC) functional number 8610.

A unit equipped with an optional LONWORKS Communication module can be connected to a LONWORKS network through terminals 128 (A), 129 (B) on terminal block TB2 in the main control panel. These terminals are factory wired to the module when the module is factory installed. When the module is field installed, the add-on communication module kit includes a wiring harness to be installed between terminals 128 and 129 and the module. This connection is shown schematically in Figure 5 on page 7.

Figure 5: MCB communication interface



RS-232 Connection Port

A PC loaded with MicroTech II Service Tool software can be connected directly or via a telephone modem to the RS-232 communications port located on the bottom edge of the MCB. This connection is shown schematically in Figure 5.

15 VDC Supply Connection

The two 15V terminals located above the analog input terminals blocks provide 15 VDC power. This power supply is not used in the rooftop controller application. This power supply is limited to 30 mA.

This is an unregulated power supply and should not be used to feed three-wire potentiometer inputs.

Main Control Board LEDs

There are a number of LEDs in various locations on the MCB. These LEDs consist of three groupings. There are 16 Binary Input (BI) LEDs located in the upper left corner of the MCB. These LEDs are lit when the corresponding Binary Input is turned ON. For information regarding the functions of the Binary Inputs refer to “Binary Inputs—Main Control Board (MCB)” on page 23. There are 16 Binary Output (BO) LEDs, one located next to each Binary Output on the right side of the MCB. These LEDs are lit when the corresponding Binary Output is turned ON. For information regarding the functions of the Binary Outputs refer to “Binary Outputs—Main Control Board (MCB)” on page 24. There are four miscellaneous LEDs located along the bottom of the MCB. These LEDs provide error code information and indication of activity on the various communication channels. Table 3 lists these LEDs with their functions.

Table 3: Main control board miscellaneous LEDs

<table>
<tr><th colspan="2"></th><th>Location on MCB</th><th>LED color</th></tr>
<tr><td colspan="2">RS-485 bus activity indication (LED is ON when activity present on the bus)</td><td>Left of RS-485 port connector</td><td>Green</td></tr>
<tr><td colspan="2">RS-232 port activity indication (LED is ON when activity present at the port)</td><td>Left of RS-232 port connector</td><td>Green</td></tr>
<tr><td colspan="2">BACnet/IP port activity Indication (LED is ON when activity present at the port)</td><td>Left of BACnet/IP port connector</td><td>Green</td></tr>
<tr><td colspan="2">MCB error indication*</td><td rowspan="3">Right of BACnet/IP port connector</td><td rowspan="3">Red</td></tr>
<tr><td>Off</td><td>Blinking</td></tr>
<tr><td>Normal</td><td>Battery low or defective</td></tr>
</table>

*Refer to “Troubleshooting Main Control Board (MCB)” on page 58.

Auxiliary Control Boards (CCB1, CCB2, EHB1, and ERB1)

There are up to four optional auxiliary control boards. These are the cooling control boards (CCB1 and CCB2 or GCB1), the electric heat control board (EHB1) and the energy recovery wheel control board (ERB1). Although the input and output functions on the four boards are defined differently in software, the boards are physically identical.

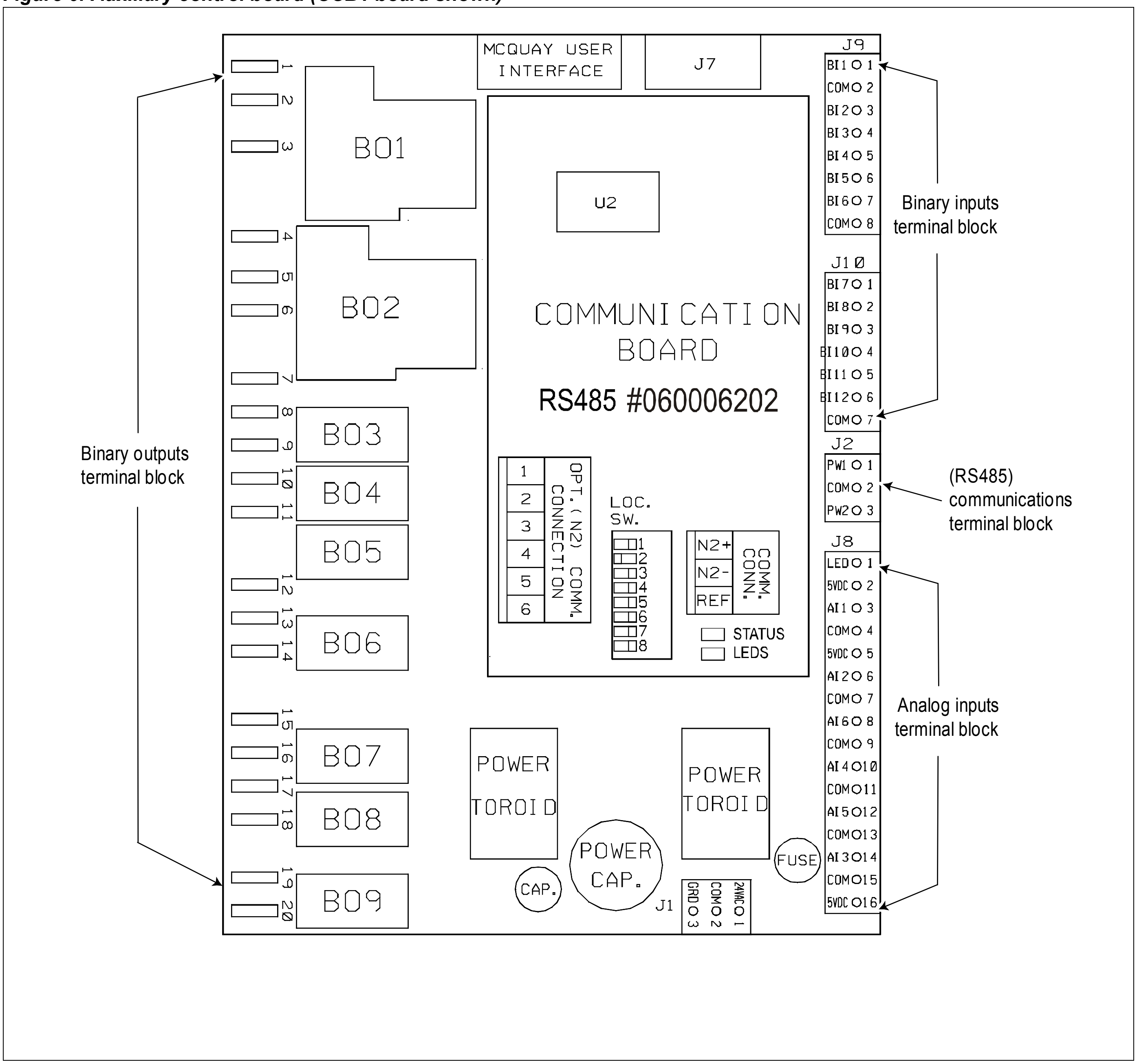
The CCB1 and CCB2 are used whenever a unit is equipped with a factory DX condensing unit (models RPS, RFS/RCS, RDT, RPR, RPE, RDE, RCE, and RFR). The GCB1 board, loaded with special generic cooling staging software, can also be used to control a field supplied condensing unit interfaced with an air handling unit (RDS or RAH) equipped with a DX cooling coil. The CCB1 and CCB2 or GCB1 are not used on units equipped with chilled water or no cooling.

The EHB1 is used whenever a unit is equipped with more than one stage of electric heat. It is not used on units with single stage or modulating heat.

The ERB1 is used whenever a unit is equipped with an optional energy recovery wheel system.

A typical auxiliary control board is shown in Figure 6. This board receives up to 6 analog and 12 binary inputs and exchanges information with the MCB via an RS-485 communication bus.

Figure 6: Auxiliary control board (CCB1 board shown)



Analog Inputs Terminal Block (J8)

The auxiliary control board receives up to six analog input signals via the AI (J8) terminal block on the right side of the board.

Note – These analog inputs are only used on the ERB1 application. Refer to "Analog Inputs—Auxiliary Control Boards (CCB1, CCB2, GCB1, EHB1 & ERB1)" on page 23 for details regarding analog inputs.

Binary Inputs Terminal Blocks (J9 and J10)

The auxiliary control board receives up to 12 binary input signals via the BI (J9 and J10) terminal blocks on the right side of the board. BI1 through BI6 are located on terminal block J9 and BI7 through BI12 are located on terminal block J10. Refer to "Binary Inputs—Auxiliary Control Boards (CCB1, CCB2, GCB1, EHB1 & ERB1)" on page 23 for details regarding binary inputs.

Binary Outputs Terminal Blocks

The auxiliary control board includes nine binary output relays (BO1 through BO9) that are energized based on commands received from the MCB. These relays provide the appropriate switching actions for the control devices that are wired to them through the BO terminals on the left side of the board. Refer to "Binary Outputs—Auxiliary Control Boards (CCB1, CCB2, GCB1, EHB1 & ERB1)" on page 26 for details regarding binary outputs.

RS-485 Communications Module

Each auxiliary control board is equipped with a plug-in RS-485 Communication module. This module includes a three-position terminal block with terminals labeled N2+, N2- and REF. These terminals are wired to the +, - and REF terminals on the RS-485 communication terminal block on the MCB. The auxiliary control board exchanges information with the MCB via this interface.

Each auxiliary board RS-485 Communication module includes an 8-position dip switch assembly (SW1) for addressing the board. Refer to Figure 6 on page 8. The CCB1 must always be set to address 2, the CCB2 to address 3, the GCB1 to address 5, the EHB1 to address 4 and the ERB1 to address 6. This is done by setting the switches on each of the auxiliary control boards as indicated in Table 4. If the switches are not set as indicated, the MCB will not communicate correctly with the board and it will not function properly.

Table 4: Auxiliary control board address switches

	Dip switch #							
	1	2	3	4	5	6	7	8
CCB1 (2)	Up	Down	Up	Up	Up	Up	Up	Up
CCB2 (3)	Down	Down	Up	Up	Up	Up	Up	Up
EHB1 (4)	Up	Up	Down	Up	Up	Up	Up	Up
GCB1 (5)	Down	Up	Down	Up	Up	Up	Up	Up
ERB1 (6)	Up	Down	Down	Up	Up	Up	Up	Up

Power Supply Terminals (J1)

Either transformer T9 (CCB1 and CCB2) or T3 (GCB1, EHB1, and ERB1) supplies 24 VAC power to terminal block J1, terminals 1 (24VAC) and 2 (COM) on the auxiliary control board.

J7 Terminal Block

The J7 terminal block located at the top of the auxiliary control board is not used in this product application.

J2 Terminal Block

The J2 terminal block located between the J10 and J8 terminal block on the right side of the auxiliary control board is not used in this product application.

Main Control Board (MCB) Output Relays and Triacs

Binary outputs BO1 through BO4, BO11, and BO12 control pilot duty Form C electromechanical relays mounted on the MCB. The output terminals of these relays are connected to a set of binary output terminal blocks located right side of the MCB. These relays are designed for Class 2 operation and to switch loads with either of the following characteristics:

- 5VDC @ 10 mA minimum, 1 A maximum
- 30 VAC @ 2 A nominal, 10 A inrush

Binary outputs BO5 through BO10 and BO13 through BO16 control triacs mounted on the MCB. The output terminals of these triacs are connected to a binary output terminal block located on the right side of MCB. These triacs are designed to switch loads with either of the following characteristics:

- 20 mA minimum, 24 VAC @ 1 A maximum (with a total load current from all triacs not to exceed 2.8 A, TBV).

Auxiliary Control Boards (CCB1, CCB2, GCB1, EHB1, and ERB1) Output Relays

Binary outputs BO1 and BO2 control high power Form A electromechanical relays mounted on the auxiliary control board. The output terminals of these relays are connected to the binary output terminals located on the left side of the auxiliary control board. These relays are designed to switch loads with either of the following characteristics:

- 1 hp 120 VAC
- 25 A resistive @ 120 VAC

Note – For this product application, place both jumpers on the boards just below the upper right corner of the RS-485 Communication Card on the right most pins. If these are not positioned correctly, the devices controlled by binary outputs BO1 and BO2 will not function properly.

Binary outputs BO3 through BO5 and BO7 through BO9 control low power Form A electromechanical relays mounted on the auxiliary control board. The output terminals of these relays are connected to the binary output terminals located on the left side of the auxiliary control board. These relays are designed to switch loads with either of the following characteristics:

- 1/10 hp 120 VAC
- 5 A resistive @ 120 VAC

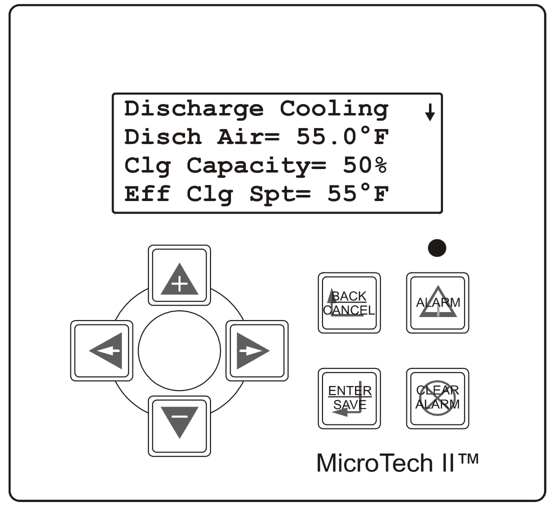
Binary output BO6 controls one low power Form C electromechanical relay mounted on the auxiliary control board. The output terminals of this relay are connected to the binary output terminals located on the left side of the auxiliary control board. This relay is designed to switch loads with either of the following characteristics:

- 1/10 hp 120 VAC
- 5 A resistive @ 120 VAC

Keypad/Display

The keypad/display, shown in Figure 7 on page 10, has eight keys and a 4-line by 20-character LCD display. The keypad/ display is the operator interface to the MCB. All operating conditions, system alarms, control parameters, and schedules can be monitored from the keypad/display. If the correct password is entered, adjustable parameters or schedules can be modified. For information on using the, keypad/display refer to the “Getting Started” section of the applicable operation manual (Refer to Table 1 on page 1).

Figure 7. Keypad/display



Remote Keypad Display Option

A unit may be equipped with a remote keypad/display option. When this is the case, either the local unit keypad/display or the remote keypad/display is active. When the selector switch on the remote keypad/display control board in the unit is switched to the “local” setting, the local keypad/display is active and the remote keypad/display is disabled (the “local” LED on the board is ON and the “remote” LED on the board is OFF). When the selector switch is switched to the “remote” setting, the remote keypad/display is active and the local keypad/display is disabled (the “local” LED on the board is OFF and the “remote” LED on the board is ON).

Note – When the selector switch position is changed, the selected keypad/display goes through the “normal” power up sequence before becoming active. Generally this takes about 60 seconds.

The operation of the remote keypad is identical to that of the local keypad/display as described in the appropriate operation manual for the unit. Refer to Table 1 on page 1.

Unit can be started from a remote location. Severe personal injury or death can occur.
When the remote keypad is enabled, the unit can be started from a remote location. Before servicing unit, make sure the keypad/display selector switch is in the “local” position (“local” LED on the remote keypad/display control board is ON and the “remote” LED is OFF) or that remote keypad is physically disconnected. If the local unit keypad/display is blank, assume that the remote keypad display is enabled.

Temperature Sensors

The MicroTech II controller uses passive positive temperature coefficient (PTC) sensors. These sensors vary their input resistance to the MCB as the temperature changes. Resistance versus temperature information is included in “Troubleshooting Temperature Sensors” on page 63.

Pressure Transducers

The MicroTech II controller uses 0 to 5" w.c., 1 to 6 VDC static pressure transducers for measuring duct static pressure. If building static pressure control is provided, a –0.25" w.c. to 0.25" w.c., 1 to 5 VDC static pressure transducer is used. Voltage-to-pressure conversion data is included in “Troubleshooting Pressure Transducers” on page 65.

Humidity Sensors

The MicroTech II controller uses 0–100% RH, 0–5 VDC humidity sensors. Refer to “Humidity Sensors” on page 18 for details regarding these sensors.

Actuators

The MicroTech II controller uses floating-point (tri-state) control actuators for valve and damper modulation.

Spring-return actuators are used for the cooling and heating valves and mixing dampers (outside air and return air). All cooling and heating valves are normally open and the mixing dampers are normally closed to the outside air. On units equipped with face and bypass (F&BP) dampers, a spring-return, two-position end-of-cycle (EOC) valve is used to prevent overheating or overcooling when the dampers are in the full bypass position. All EOC valves are normally open.

The controller senses position feedback in the form of 0–5 VDC signals through 0–500 ohms potentiometers on the heating and cooling valve and mixing damper actuators. The MCB uses these feedback signals to display cooling or heating capacity, mixing damper position and discharge and return fan capacity.

Note – Face and bypass damper actuators are not equipped with feedback to the controller. When a unit is equipped with chilled water cooling with face and bypass or hot water or steam heating with face and bypass, the cooling or heating capacity is calculated by the MCB based on drive open versus drive close time of the actuator.

Variable Frequency Drives (VFDs)

When controlling discharge, return, or exhaust fan variable frequency drives, the MicroTech II controller uses floating-point (tri-state) output signals to modulate the drive speed.

Speed feedback is supplied to the controller via a 0–10 VDC signal from the VFD. The MCB uses these feedback signals to display discharge and return fan capacity.

Field Wiring

Below are descriptions of the various options and features that may require field wiring to the MicroTech II controller. Refer to the job plans and specifications and the as-built wiring schematics. For a typical set of wiring schematics, refer to "Typical Wiring Diagrams" on page 34.

For more information on the electrical installation, refer to "Field Control Wiring" in the "Electrical Installation" section of the applicable unit installation manual (see Table 2 on page 1).

Field Output Signals

The following output signals may be available for field connections to a suitable device:

- Remote Alarm Output (MCB-BO4)
- Fan Operation Output (MCB-BO3)
- VAV Box Output (MCB-BO12)
- Generic condensing unit staged cooling outputs (GCB1–BO1 through GCB1–BO9)

The Remote Alarm Output and Fan Operation Output are available on all units. The VAV Box Output is available only on VAV units. The optional staged cooling outputs are available only on RDS and RAH units interfaced to a field-supplied condensing unit.

Remote Alarm Output

The Remote Alarm Output (MCB-B04) supplies 24 VAC to terminal 115 on the field terminal block (TB2) when the output is on. To use this signal, wire the coil of a field supplied and installed 24 VAC pilot relay across terminals 115 and 117 on TB2. When this output is on, 24 VAC is supplied from the T3 control transformer through output relay MCB-B04 to energize the field relay. Refer to the as-built wiring diagrams.

> The total VA of all field-mounted relays cannot exceed 15 VA, and they must have a 24 VAC Class 2 coil. Other power can cause unit malfunction.

The action of this output depends on the setup of each of the possible alarms. The output is on continuously (field relay energized) when there are no active alarms within the unit controller. Each alarm is then configured to cause the output to turn off, blink on and off rapidly, blink on and off slowly, or remain on (no alarm indication). For details regarding how to use the keypad to configure these alarms, refer to the "Alarm Monitoring" section of the applicable operation manual (see Table 1 on page 1).

Fan Operation Output

The Fan Operation Output (MCB-B03) supplies 24 VAC to terminal 116 on the field terminal block (TB2) when the output is on. To use this signal, the coil of a field supplied and installed 24 VAC pilot relay must be wired across terminals 116 and 117 on TB2. When the output is energized, 24 VAC is supplied from the T3 control transformer through output relay MCB-B03 to energize the field relay. Refer to the as-built wiring diagrams.

> The total VA of all field-mounted relays cannot exceed 15 VA, and they must have a 24 VAC Class 2 coil. Other power can cause unit malfunction.

The Fan Operation Output (MCB-BO3) can be used to control field equipment that depends on fan operation (field installed isolation dampers, VAV boxes, etc.) This output is turned on at the beginning of the Startup operating state and remains on during fan operation. The fans remain off during the Startup operating state allowing time for equipment such as isolation dampers to open prior to the starting of the fan. The duration of the Startup operating state is adjustable by setting the *Start Init=* parameter in the Timer Settings menu on the keypad. When the unit is shut off this output remains on for 30 seconds after the airflow switch stops sensing airflow. This output is on whenever the airflow switch senses airflow.

Note – If the *DF CapCtrl=* parameter in the Unit Configuration menu of the keypad is set to "Position," the output turns off three minutes after the unit shuts off and remains off until the unit is restarted. For more details regarding the sequence of this output, refer to the applicable operation manual (see Table 1 on page 1).

VAV Box Output

The VAV Box Output (MCB-B012) supplies 24 VAC to terminal 118 on the field terminal block (TB2) when the output is on. To use this signal, the coil of a field supplied and installed 24 VAC pilot relay must be wired across terminals 118 and 117 (units with inlet guide vanes) or 119 and 117 (units with VFDs) on TB2. When the output is energized, 24 VAC is supplied from the T3 control transformer through output relay MCB-B012 to energize the field relay. Refer to the as-built wiring diagrams or to "Auxiliary VFD control" on page 48.

> The total VA of all field-mounted relays cannot exceed 15 VA, and they must have a 24 VAC Class 2 coil. Other power can cause unit malfunction.

The VAV Box Output (MCB-BO12) is designed to coordinate unit operation with VAV box control. Field use of this output is optional; however, it is highly recommended, especially for VAV systems that have heating capability (unit or duct mounted).

The following are application guidelines for four basic heating configurations. For all of these configurations, the VAV Box Output (MCB-BO12) is off for an adjustable time period after unit start-up (default is 3 minutes). During this period (the Recirc operating state), heating and cooling is disabled, and the outside air damper is held closed. The fans circulate building air and equalize space, duct, and unit temperatures.

Cooling Only Units

For cooling only VAV systems, the VAV Box Output can override zone thermostat control and drive the VAV boxes fully open to facilitate air circulation during the Recirc operating state. During this time, the VAV Box Output is in the OFF (or heat) position (field-installed pilot relay de-energized).

VAV units have a "post heat" control feature that forces the discharge air volume to a minimum before turning on the VAV Box Output when the Recirc operating state is complete. Post heat operation prevents excessive duct static pressure that could otherwise occur when the zone thermostats regain VAV box control.[1]

When the unit is not in the Startup or Recirc operating state and "post heat" is not active, the VAV Box Output is in the ON (or cool) position (field relay energized) so that the zone thermostats control the VAV boxes.

The field-supplied fan operation and VAV box relay contacts can be wired in series so that the boxes open when the unit is not operational.

Cooling Only Units with Field Supplied Heat

For VAV systems with cooling only rooftop units and duct mounted reheat coils, the VAV Box Output can override zone thermostat control and drive the VAV boxes fully open when heating is required. If necessary, the MicroTech II controller energizes the fans for night setback and morning warm-up heating operation. When this occurs, the unit enters and remains in the UnocFanO or MWU operating state until heat is no longer required. The temperature control sequences are the same as those for units with factory-supplied heating equipment. While the unit is in these states, the VAV Box Output is in the OFF (or heat) position (field-supplied pilot relay de-energized).

VAV units have a "post heat" control feature that forces the discharge air volume to a minimum before closing the VAV box output when the heating period is complete. "Post heat" operation prevents excessive duct static pressure that could otherwise occur when the zone thermostats regain VAV box control.[1]

When the unit is not in the Startup, Recirc, or any heating operating state and "post heat" is not active, the VAV Box Output is in the ON (or cool) position (field-supplied pilot relay energized) so that the zone thermostats control the boxes.

The field supplied fan operation and VAV box relay contacts can be wired in series so that the boxes open when the unit is not operational.

Units with One-Stage Heat

The VAV Box Output should be used to override zone thermostat control and drive the VAV boxes fully open when heating is required. While the unit is in Startup, Recirc, or any heating operating state (UnocHtg, MWU, or Heating), the VAV Box Output is in the OFF (or heat) position (field-installed pilot relay de-energized).

VAV units have a "post heat" control feature that forces the discharge air volume to a minimum before closing the VAV Box Output when the unit leaves the Recirc or any other heating operating state. "Post heat" operation prevents excessive duct static pressure conditions that could otherwise occur when the zone thermostats regain VAV box control.[1]

When the unit is not in Startup, Recirc, or any other heating state and post heat operation is not active, the VAV Box Output is in the ON (or cool) position (field-supplied pilot relay energized) so that the zone thermostats control the boxes.

The field-supplied fan operation and VAV box relay contacts can be wired in series so that the boxes open when the unit is not operational.

---

1. The setting of a "post heat" timer determines the duration of post heat operation. This timer is set to zero at the factory and must be set to a non-zero value to enable the "post heat" function. For more information on post heat operation, refer to "Post Heat Operation" in the "Discharge Fan Airflow Control" section of the applicable VAV operation manual (see Table 1 on page 1).

Units with Modulating Heat

The VAV Box Output should be used to switch the VAV boxes between heating and cooling control. While the unit is in Startup, Recirc, or any heating operating state (UnocHtg, MWU, or Heating), the VAV Box Output is in the OFF (or heat) position (field-installed pilot relay de-energized) switching the VAV boxes into heating operation.

VAV units have a “post heat” control feature that forces the discharge air volume to a minimum before closing the VAV Box Output when the unit leaves Recirc or any other heating operating state. “Post heat” operation prevents excessive duct static pressure that could otherwise occur when the zone thermostats regain VAV box control.[1]

When the unit is not in Startup, Recirc, or any other heating operating state, the VAV Box Output is in the ON (or cool) position (field-supplied pilot relay energized) switching the boxes to cooling control.

Staged Cooling Outputs

Model RDS and RAH rooftop air handlers can be ordered with factory-installed evaporator coils and the capability to control up to eight stages of field-supplied cooling equipment. The MicroTech II outputs designated for these applications are GCB1-BO1 through GCB1-BO8. These outputs are wired to terminal block TB4 in the main control panel for connection to the field supplied condensing unit. Refer to the as-built wiring schematics for the unit or to Figure 25 on page 56.

As the controller increases cooling capacity, it sequentially energizes the relays in ascending order. As the controller decreases cooling capacity, it sequentially de-energizes the relays in descending order. Refer also to Table 19 on page 31.

Field Analog Input Signals

Zone Temperature Sensor Packages

Table 5 lists the two zone (space) temperature sensor packages that are available for use with applied rooftop units equipped with a MicroTech II controller. A zone temperature sensor (ZNT1) is optional for all rooftop units except for the 100% outdoor air CAV-ZTC (SCC) unit in which case one is required. In all unit configurations, however, a zone temperature sensor is required to take advantage of any of the following standard controller features:

- Unoccupied heating or cooling
- Pre-occupancy purge
- Discharge air reset based on space temperature (DAC units only)
- Timed tenant override
- Remote set point adjustment (CAV-ZTC units only)

Table 5: MicroTech II zone temperature sensors

	Tenant override switch	Remote set point adjustment	For use with	
			DAC	CAV-ZTC (SCC)
111048101	Yes	No	X	X
111048102	Yes	Yes		X

Zone Sensor without Remote Set Point Adjustment

The standard MicroTech II room temperature sensor package that does not include set point adjustment can be used with any applied rooftop MicroTech II control configuration. It includes a tenant override button.

This zone sensor must be field installed and field-wired to the unit using twisted pair, shielded cable (Belden 8761 or equivalent). Figure 8 shows the required wiring termination points.

Zone Sensor with Remote Set Point Adjustment

The standard MicroTech II room temperature sensor package equipped with a set point adjustment potentiometer is available to use with CAV-ZTC (SCC) units. This sensor package also includes a tenant override button. The set point adjustment potentiometer is wired across analog input MCB-AI2. The set point varies from 52°F to 83.2°F as the resistance changes from 0–1660 ohms.

This zone sensor package must be field installed and field wired to the unit using twisted, shielded cable. Four conductors with a shield wire are required. Cable with 22 AWG conductors (Belden 8761 or equivalent) is sufficient. Figure 9 shows the required wiring termination points.

Do not install this cable in the same conduit as power wiring. Such installation can cause unit malfunction.

Figure 8. Zone sensor with tenant override

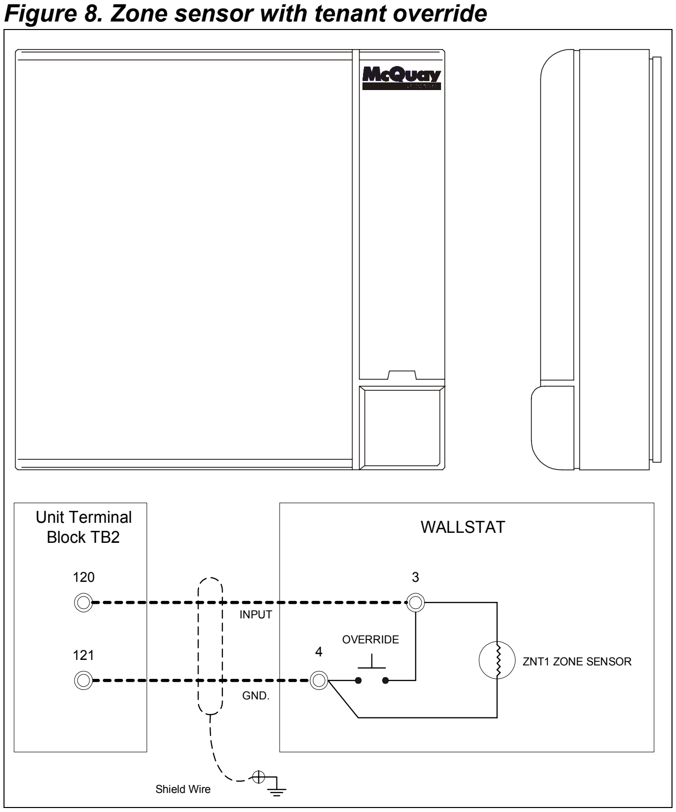
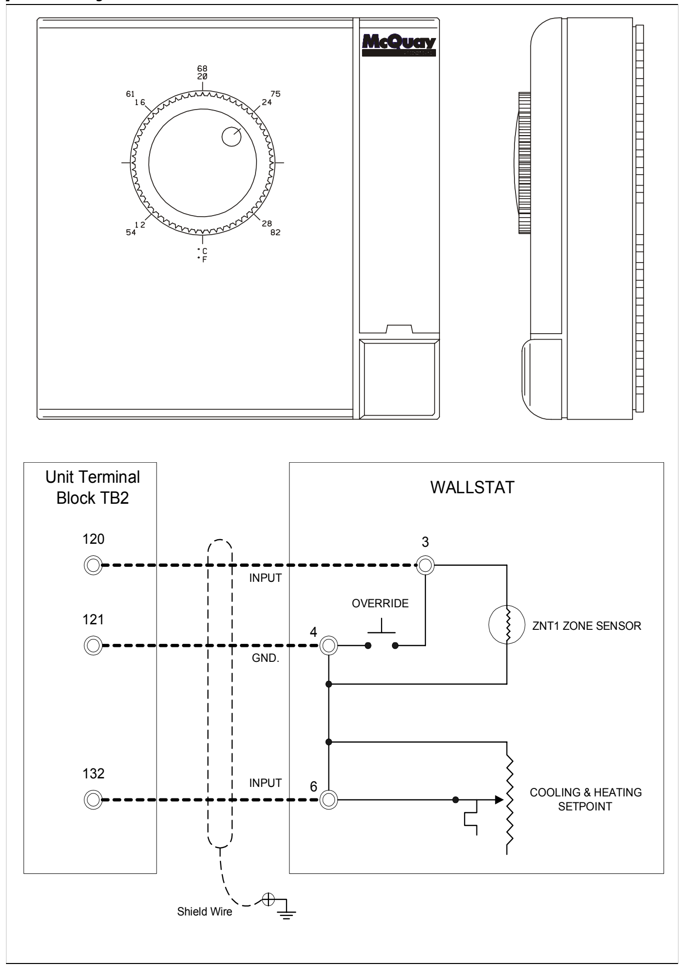


Figure 9. Zone sensor with tenant override and remote set point adjustment



Tenant Override (Timed)

The tenant override button provided with the two optional zone temperature sensor packages can be used to override unoccupied operation for a programmed time period. This time period is adjustable between 0 and 5 hours using the *TntOvrd=* parameter in the Timer Settings menu of the keypad/display (default is 2 hours). Except for the fact that it is temporary, tenant override operation is identical to occupied operation.

Pressing and releasing the push button switch on the sensor momentarily shorts zone temperature sensor ZNT1, resetting and starting the override timer. The unit then starts up and runs until the override timer times out.

Note – Hold the button in for at least 1 second but not more than 30 seconds.

For detailed information on setting the override timer, refer to the "Auto/Manual Operation" section of the applicable operation manual (see Table 1 on page 1).

Note – If this tenant override feature is used on a VAV unit, it may be necessary to signal the VAV boxes that the unit is operating. Use the VAV Box Output for this purpose.

External Discharge Air Reset Signal

The discharge air temperature set point on DAC units can be reset by an external voltage or current signal applied to analog input MCB-AI2. The external reset method can be selected at the controller keypad. External reset requires a field supplied reset signal in the range of 0–10 VDC or 0–20 mA wired to terminals 132 and 133 on the field terminal block (TB2). Refer to the unit wiring diagrams or Figure 16 on page 38 for wiring termination details.

Ground loop current hazard. Can cause equipment damage.
Isolate the external reset signal from any ground other than MicroTech II controller chassis ground. If not isolated, ground loop currents can occur, causing damage or erratic unit operation. The device or system providing external reset signal must be connected to the MicroTech II controller chassis, or it must be providing an isolated output. If not, condition the signal with a signal isolator.

If the external reset option is selected, the controller linearly resets the cooling and heating discharge air temperature set points between user-programmed minimum and maximum values as the field supplied reset signal varies from a minimum to maximum (or maximum to minimum) value.

Field wire the external reset signal to the unit using a twisted pair, shielded cable (Belden 8761 or equivalent). Cable with 22 AWG conductors is sufficient.

Do not install this cable in the same conduit as power wiring. Such installation can cause unit malfunction.

Note – If the field signal is in the 0–10 VDC range, configure the analog input jumper associated with analog input MCB-AI2 in the no-jumper (NJ-VDC) position. The analog input DIP switch for this input then must be in the ON (V) position. If the field signal is in the 0–20 mA range, configure the jumper in the current (2-MA) position. The analog input DIP switch for this input then must be in the OFF (T) position.

Detailed information regarding discharge air temperature reset is located in the “Discharge Set Point Reset” section of the applicable operation manual (see Table 1 on page 1).

External Outdoor Air Damper Reset Signal

Ground loop current hazard. Can cause equipment damage.
Isolate the external reset signal from any ground other than MicroTech II controller chassis ground. If not isolated, ground loop currents can occur, causing damage or erratic unit operation. The device or system providing external reset signal must be connected to the MicroTech II controller chassis, or it must be providing an isolated output. If not, condition the signal with a signal isolator.

On units equipped with a 0–100% modulating economizer but not equipped with the optional Design Flow outdoor air measuring option, the minimum outside air damper position set point can be reset by an external voltage or current signal applied to analog input MCB-AI7. The external reset method can be selected at the controller keypad. External reset requires a field supplied reset signal in the range of 0–10 VDC or 0–20 mA wired to terminals 124 and 125 on the field terminal block (TB2). Refer to the unit wiring diagrams or Figure 18 on page 42 (SCC units) for wiring termination details.

If the external reset option is selected, the controller linearly resets the outside air damper position set point between user-programmed minimum and maximum values as the field supplied reset signal varies between a minimum and maximum (or maximum to minimum) value.

The external reset signal must be field-wired to the unit using a twisted pair, shielded cable (Belden 8761 or equivalent). Cable with 22 AWG conductors is sufficient.

Do not install this cable in the same conduit as power wiring. Such installation can cause unit malfunction.

Note – If the field signal is in the 0–10 VDC range, configure the analog input jumper associated with analog input MCB-AI7 in the no-jumper (NJ-VDC) position. The analog input dip-switch for this input then must be in the ON (V) position. If the field signal is in the 0–20 mA range, configure the jumper in the current (2-MA) position. The analog input dip-switch for this input then must be in the OFF (T) position.

Detailed information regarding outside air damper position reset can be found in the “Economizer” section of the applicable operation manual (see Table 1 on page 1).

Field Valve Actuator Feedback

When the MicroTech II controller is interfaced with a field supplied hot water, steam, or chilled water valve actuator, a position feedback signal can be field-wired from the actuator and input to the MCB. This signal is not required for control purposes but is required for 0–100% capacity indication on the keypad or via a network interface. If the signal is not supplied, the valve is controlled properly, but associated capacity parameter will always indicate 0%.

Field wire the external feedback signal to the unit using a twisted pair, shielded cable (Belden 8761 or equivalent). Cable with 22 AWG conductors is sufficient.

> Do not install this cable in the same conduit as power wiring. Such installation can cause unit malfunction.

Field Hot Water or Steam Valve Actuator. When interfaced with a field-supplied hot water or steam valve actuator, a valve feedback signal in the form of a resistance that varies from 0 to 500 ohms or 0–5 VDC as the actuator strokes from 0 to 100% open can be wired to terminals 91 and 92 on the field terminal block (TB2). These terminals are factory-wired to analog input MCB-AI10. Refer to the unit wiring diagrams or Figure 16 on page 38 (DAC units) or Figure 18 on page 42 (SCC units) for wiring termination details.

If the field-supplied feedback signal is 0–500 ohms, the following procedures are required:

1. Set the analog input jumper associated with MCB-AI10 to the resistance (1-RTD) position.
2. Set the analog input DIP switch associated with MCB-AI10 to the OFF (or T) position.
3. Set the *Feedback*= parameter in the Heating Setup menu on the unit keypad/display to “2 Wire.”
4. After the three items above are set, run the unit through the Calibrate Mode.

If the field supplied feedback signal is 0–5 VDC, the following procedures are required:

1. Set the analog input jumper associated with MCB-AI10 to the no jumper (NJ-VDC) position.
2. Set the analog input DIP switch associated with MCB-AI10 to the ON (or V) position.
3. Set the *Feedback*= parameter in the Heating Setup menu on the unit keypad/display to “3 Wire.”
4. After the three items above are set, run the unit through the Calibrate Mode.

Field Chilled Water Valve Actuator. When interfaced with a field-supplied chilled water valve actuator, a valve feedback signal in the form of a resistance that varies from 0 to 500 ohms or 0–5 VDC as the actuator strokes from 0 to 100% open can be wired to terminals 8 and 9 on the terminal block (TB5). These terminals are factory-wired to analog input MCB-AI11. Refer to the unit wiring diagrams for wiring termination details.

If the field-supplied feedback signal is 0–500 ohms, the following procedures are required:

1. Set the analog input jumper associated with MCB-AI1 to the resistance (1-RTD) position.
2. Set the analog input dip-switch associated with MCB-AI11 to the OFF (or T) position.
3. Set the *Feedback*= parameter in the Chilled Water Setup menu on the unit keypad/display to “2 Wire.”
4. After the three items above are set, run the unit through the Calibrate Mode.

If the field supplied feedback signal is 0–5 VDC, the following procedures are required:

1. Set the analog input jumper associated with MCB-AI11 to the no jumper (NJ-VDC) position.
2. Set the analog input dip-switch associated with MCB-AI11 to the ON (or V) position.
3. Set the *Feedback*= parameter in the Chilled Water Setup menu on the unit keypad/display to “3 Wire.”
4. After the three items above are set, run the unit through the Calibrate Mode.

Humidity Sensors

When the MicroTech II controller is configured for constant volume zone temperature control (SCC), a dehumidification sequence is available and can be activated through the keypad. In order to use this function, an optional factory-supplied, field-mounted humidity sensor is required.

Either a wall mount or duct mount sensor is available. The sensor must be wired to terminals 126, 127 and 131 on the unit field terminal block (TB2). Terminal 126 is wired to OUT (0–5 VDC), terminal 127 to GND and terminal 131 to PWR on the humidity sensor. These terminals are factory wired to the MCB analog input MCB-AI12. The input must be 0–5 VDC as the relative humidity varies from 0–100%. Refer to the unit wiring diagrams or Figure 18 on page 42 for wiring termination details.

Note – The output select jumper (J1) on the sensor must be in the 0–5 VDC position. The TEMP terminals on the sensor are not used (see Figure 10 or Figure 11 on page 18).

Field wire the humidity sensor wiring to terminals 126 and 127 to the unit using a twisted pair, shielded cable (Belden 8761 or equivalent). Cable with 22 AWG conductors is sufficient.

Do not install this cable in the same conduit as power wiring. Such installation can cause unit malfunction.

Note – Set the analog input jumper associated with MCB-AI12 to the no jumper (NJ-VDC) position. Set the analog input dip switch associated with this input to the ON (V) position.

Figure 10: Humidity sensors (wall mount)

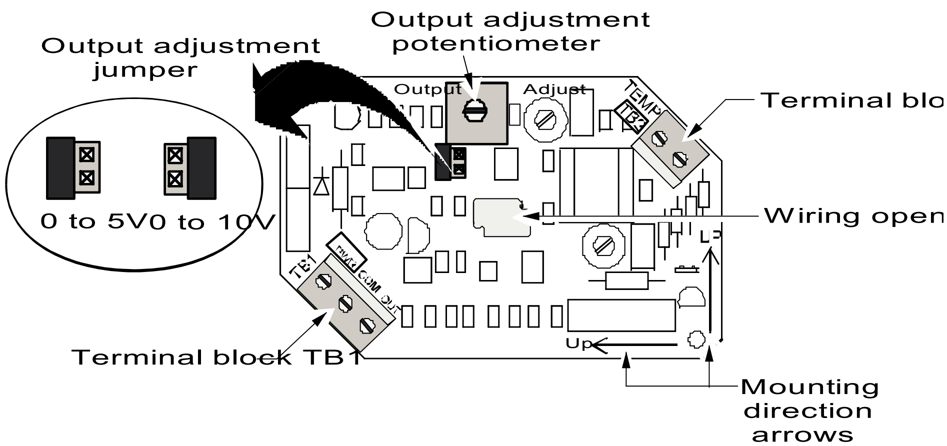
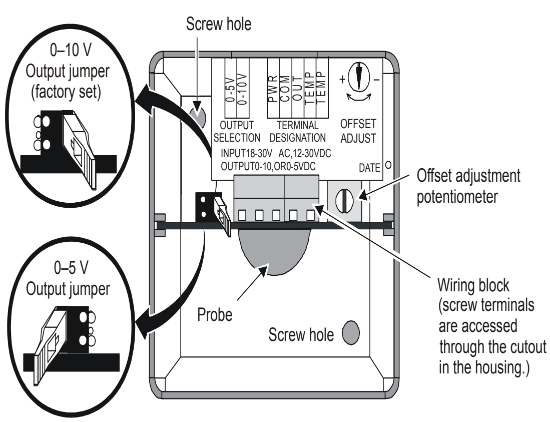


Figure 11: Humidity sensor (duct mounted)



Humidity Sensor—Discharge Air Control (DAC) Unit

A humidity sensor can be wired to terminals 126, 127 and 131 on TB2 on a discharge air control (DAC) unit as shown on the unit wiring diagram or Figure 16 on page 39. However, this input is not used for control purposes and the current relative humidity value from the sensor cannot be read via the keypad/ display. The current value from the sensor can be read via a network interface only.

Field Binary Input Signals

The following sections describe options that, if used, require field wiring to binary input terminals. Twisted pair, shielded cable is not required for binary input wiring.

Manual Cooling and Heating Enable

Cooling Enable

24 VAC must be applied to binary input MCB-BI3 to enable cooling operation. If not, the unit *Clg Status*= parameter in the System menu of the keypad/display indicates “Off Sw” and cooling operation is unavailable. 24 VAC is applied to MCB-BI3 when terminals 101 and 105 on the unit field terminal block (TB2) are made; either with a factory installed jumper wire or a field supplied switch. Refer to the unit wiring diagrams or Figure 16 on page 39 (DAC units) or Figure 17 on page 40 (SCC units) for wiring termination details.

Heating Enable

24 VAC must be applied to binary input MCB-BI4 to enable heating operation. If not, the *Htg Status*= parameter in the System menu of the keypad/display indicates “Off Sw” and heating operation is unavailable. 24 VAC is applied to MCB-BI4 when terminals 101 and 106 on the field terminal block (TB2) are made; either with a factory installed jumper wire or field supplied switch. Refer to the unit wiring diagrams or Figure 16 on page 38 (DAC units) or Figure 17 on page 41 (SCC units) for wiring termination details.

Manual Unit Enable

Unit operation is manually disabled when 24 VAC is applied to binary input MCB-BI2. The *UnitStatus*= parameter in the System menu of the keypad/display indicates “Off Sw” and the unit will not operate. This occurs when a field supplied and installed switch across terminals 101 and 104 on the field terminal block (TB2) is in the on or closed position. Refer to the unit wiring diagrams or Figure 16 on page 39 (DAC units) or Figure 17 on page 40 (SCC units) for wiring termination details.

If not disabled by this method, the unit is enabled to run when placed in the occupied mode. For details regarding occupied/ unoccupied operation refer to the “Auto/Manual Operation” section of the appropriate program-specific operation manual (refer to Table 1 on page 1).

External Time Clock or Tenant Override

There are several methods of switching the rooftop unit between occupied and unoccupied operation. It can be done by the controller internal schedule, a network schedule, an external time clock, or a tenant override switch.

If the internal schedule or a network schedule is used, field wiring is not required.

An external time clock or a tenant override switch can be used by installing a set of dry contacts across terminals 101 and 102 on the field terminal block (TB2). When these contacts close, 24 VAC is applied to binary input MCB-BI1, overriding any internal or network schedule and placing the unit into occupied operation (provided the unit is not manually disabled). When the contacts open (24 VAC is removed from MCB-BI1) the unit acts according to the controller internal time schedule or a network schedule. Refer to the unit wiring diagrams or Figure 16 on page 39 (DAC units) or Figure 17 on page 40 (SCC units) for wiring termination details.

For information on setting internal and network controller schedules, refer to the “Scheduling” section in the applicable operation manual (refer to Table 1 on page 1).

Miscellaneous Output Signals

The five optional output signals listed below can be provided by installing field supplied 24 VAC relays wired between terminal 107 on the field terminal block (TB2) and the terminals listed in Table 6. Refer to the unit wiring diagrams or Figure 16 on page 39 (DAC units) or Figure 17 on page 40 (SCC units) for wiring termination details.

> The total VA of all field-mounted relays cannot exceed 15 VA and they must have a 24 VAC Class 2 coil. Other power can cause unit malfunction.

- Airflow status
- Dirty filter (including optional final filter)
- Gas furnace fail alarm (Heat Fail)
- Freeze alarm (steam or water coils, optional)
- Smoke alarm (optional

Table 6: Miscellaneous field signal termination points

	Description	Energized field relay indication
107	Ground	NA
108	Fan operation (airflow indication)	Airflow present
109	Dirty filter indication	Filters dirty
111	Heat alarm detected (gas heat flame failure)	Alarm
112	Freezestat (freeze condition detected)	Normal
113	Smoke (smoke detected)	Normal

External Exhaust Fan Status

When a large exhaust fan or group of exhaust fans is started or stopped during normal rooftop unit operation, the building static pressure may become too positive or negative. If a field binary input signal is delivered to the unit when an external exhaust fan is started, a VAV unit controller that uses “fan tracking” control can modify its return fan control algorithm to compensate for the change in exhaust fan airflow. The fan tracking control feature can reduce or eliminate objectionable building pressure fluctuations that might otherwise occur.

To take advantage of this exhaust fan airflow compensation feature, field wire a set of dry contacts across terminals 101 and 103 on the field terminal block (TB2). When these contacts close, 24 VAC is applied to binary input MCB-BI13, indicating that the external exhaust fan is on. When the contacts open, 24 VAC is removed from MCB-BI13, indicating that the exhaust fan is off. Refer to the unit wiring diagrams or Figure 16 on page 39 for wiring termination details.

For detailed information on the fan tracking feature, refer to the “Return Fan Capacity Control” section of the DAC operation manual (refer to Table 1 on page 1).

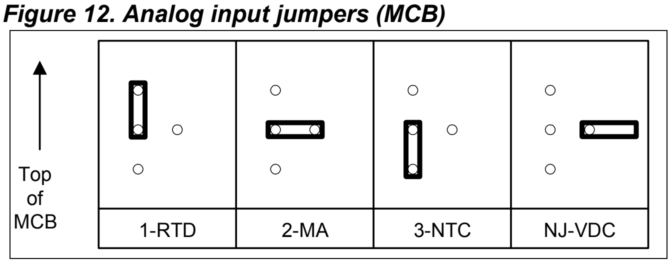
Service Information

Controller Inputs

Analog Inputs-Main Control Board (MCB)

The 16 analog inputs to the MCB are configurable for four different input types by positioning a jumper associated with each input position (refer to Figure 12). The four jumper positions are 1-RTD (temperature sensor or potentiometer), 2-MA (current), 3-NTC (10K ohms thermistor) or no jumper NJ-VDC (voltage).

Figure 12. Analog input jumpers (MCB)



The 1-RTD jumper position is used for all the temperature sensor inputs and 0-500 ohm actuator potentiometer position feedback inputs. The NJ-VDC (no jumper) position is used for 0–5 VDC actuator position feedback inputs and the remainder of the standard input devices which are configured for either 0–5 VDC or 0–10 VDC. The 2-MA and the 3-NTC (10K ohm thermistor) jumper positions are not used in this product application for any of the standard input devices. Refer to Table 7 on page 22 (DAC units) and Table 8 on page 22 (SCC units) for a description of all the analog inputs including the correct jumper positions.

In addition to the analog input jumpers, there are two sets of dip switches (SW1 and SW4) associated with the MCB analog inputs. Each set contains eight switches numbered 1 through 8. Refer to Figure 13. The switches on SW1 correspond to inputs MCB-AI1 through MCB-AI8 and the switches on SW4 correspond to inputs MCB-AI9 through MCB-AI16. One switch corresponds to each analog input. If the input is a temperature sensor or potentiometer input (input jumper in the 1-RTD position) then the corresponding switch must be in the T (OFF) position. If the input is a voltage input (no input jumper NJ-VDC position) then the corresponding switch must be in the V (ON) position. Table 7 on page 22 (DAC units) and Table 8 on page 22 (SCC units) include the correct switch settings for all the analog inputs.

Note – If a special application requires a current input with the input jumper set to the 2-MA position, then the corresponding input switch must be set to the T (OFF) position.

Figure 13. Analog input switches (MCB)

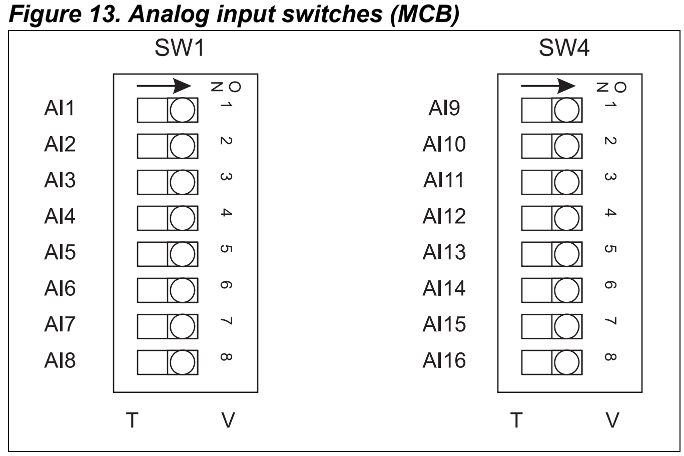


Table 7: Analog inputs for main control board (MCB)—discharge air controller (DAC)

	Input description	Input jumper	Input switch
MCB-AI1	Zone (space) air temperature (optional)	1-RTD	T (OFF)
MCB-AI2	External discharge air temperature reset	NJ-VDC (no jumper)	V (ON)
MCB-AI3	Discharge air temperature	1-RTD	T (OFF)
MCB-AI4	Return air temperature	1-RTD	T (OFF)
MCB-AI5	Outdoor air temperature	1-RTD	T (OFF)
MCB-AI6	Entering fan air temperature[a]	1-RTD	T (OFF)
MCB-AI7	External OA damper reset	NJ-VDC (no jumper)	V (ON)
	DesignFlow OA airflow #1 (right-hand station)[b]	NJ-VDC (no jumper)	V (ON)
MCB-AI8	DesignFlow OA airflow #2 (left-hand station)[c]	NJ-VDC (no jumper)	V (ON)
MCB-AI9	Outdoor air damper position[h]	NJ-VDC (no jumper)	V (ON)
MCB-AI10	Heating valve position[h]	NJ-VDC (no jumper)	V (ON)
MCB-AI11	Cooling valve position[h]	NJ-VDC (no jumper)	V (ON)
	Evaporative Condenser Sump Temperature	1-RTD	T (OFF)
MCB-AI12	Relative humidity[d]	NJ-VDC (no jumper)	V (ON)
MCB-AI13	Duct static pressure #1[e]	NJ-VDC (no jumper)	V (ON)
MCB-AI14	Duct static pressure #2/building static pressure (optional)[f]	NJ-VDC (no jumper)	V (ON)
MCB-AI15[e]	Discharge fan VFD speed /inlet vane position	NJ-VDC (no jumper)	V (ON)
MCB-AI16[g]	Return fan VFD speed	NJ-VDC (No Jumper)	V (ON)

a. EFT sensor supplied only on units equipped with gas or electric heat.
b. If unit equipped with DesignFlow OA airflow measuring stations, input is an airflow signal from the right-hand DesignFlow station. Otherwise, is an optional external OA damper position reset signal supplied by field.
c. If unit equipped with DesignFlow OA airflow measuring stations, input is an airflow signal from the left-hand DesignFlow station. Otherwise it is a spare input.
d. A humidity sensor can be wired to this input to provide a space humidity reading via a BACnet network interface to the unit.
e. This input applicable to VAV units only (discharge fan VFD or inlet vanes).
f. This input defined as a second duct static pressure input on VAV units if the unit is configured for “fan tracking” return fan control. It is defined as a building static pressure input if unit is configured for “direct building pressure” return fan control.
g. This input applicable on units equipped with a return VFD or inlet vanes.
h. Some older units are equipped with a 0–500Ω (2-wire) resistance feedback signal. In this case, the analog input jumper must be in the 1-RTD position, the corresponding input switch must be in the T (OFF) position and the *Feedback*= parameter in the Economizer Setup, Heating Setup or Chilled Water Setup menu (as applicable) must be set to “2 Wire.”

Table 8: Analog inputs for main control board (MCB)—CAV-ZTC (SCC)

	Input Description	AI jumper	AI switch
MCB-AI1	Zone (space) air temperature[a]	1-RTD	T (OFF)
MCB-AI2	Remote space temperature set point (optional)	1-RTD	T (OFF)
MCB-AI3	Discharge air temperature	1-RTD	T (OFF)
MCB-AI4	Return air temperature	1-RTD	T (OFF)
MCB-AI5	Outdoor air temperature	1-RTD	T (OFF)
MCB-AI6	Entering fan air temperature[b]	1-RTD	T (OFF)
MCB-AI7	External OA damper reset	NJ-VDC (no jumper)	V (ON)
	Designflow OA airflow #1 (right-hand station)[c]	NJ-VDC (no jumper)	V (ON)
MCB-AI8	designflow OA airflow #2 (left-hand station)[d]	NJ-VDC (no jumper)	V (ON)
MCB-AI9	Outdoor air damper position[f]	NJ-VDC (no jumper)	V (ON)
MCB-AI10	Heating valve position[f]	NJ-VDC (no jumper)	V (ON)
MCB-AI11	Cooling valve position[f]	NJ-VDC (no jumper)	V (ON)
	Evaporative condenser sump temperature	1-RTD	T (OFF)
MCB-AI12	Relative humidity	NJ-VDC (no jumper)	V (ON)
MCB-AI13	Not used	NA	NA
MCB-AI14	Building static pressure (optional)	NJ-VDC (no jumper)	V (ON)
MCB-AI15	Not used	NA	NA
MCB-AI16[e]	Return fan VFD speed	NJ-VDC (no jumper)	V (ON)

a. Sensor required if unit is 100% OA. Otherwise, it is optional.
b. Sensor supplied only on units equipped with gas or electric heat.
c. If unit equipped with DesignFlow OA airflow measuring stations, this input is an airflow signal from the right-hand DesignFlow station. Otherwise, it is an external OA damper position reset signal supplied by the field.
d. If unit equipped with DesignFlow OA airflow measuring stations, this input is an airflow signal from the left-hand DesignFlow station. Otherwise, it is a spare input.
e. This input applicable on units equipped with a return VFD or inlet vanes.
f. Some older units are equipped with a 0-500W (2-wire) resistance feedback signal. In this case the analog input jumper must be in the 1-RTD position, the corresponding input switch must be in the T (OFF) position and the *Feedback*= parameter in the Economizer Setup, Heating Setup or Chilled Water Setup menu (as applicable) must be set to “2 Wire.”

Analog Inputs—Auxiliary Control Boards (CCB1, CCB2, GCB1, EHB1 & ERB1)

The optional auxiliary control boards (CCB1, CCB2, GCB1, EHB1 and ERB1) have up to six analog inputs available. However, in this product application, these are used only on the ERB1. Analog inputs ERB1-A1 and ERB1-A2 are configured for temperature sensor inputs. The remainder are spare inputs.

Refer to Table 9 for a description of each analog input on the ERB1 board.

Table 9: Analog inputs for energy recovery wheel control board (ERB1)

	Input description
ERB1-AI1	Leaving energy recovery wheel temperature (exhaust), optional
ERB1-AI2	Leaving energy recovery wheel temperature (discharge)
ERB1-AI3	Not used
ERB1-AI4	Not used
ERB1-AI5	Not used
ERB1-AI6	Not used

Binary Inputs—Main Control Board (MCB)

The 16 binary inputs to the MCB are in the form of 0 VAC (off) or 24 VAC (on) applied to the binary input terminals. Transformer T2 is the source of this the 24 VAC for these inputs.

Each binary input has an LED associated with it that lights when 24 VAC is present at the corresponding input terminal. These binary input LEDs are grouped together and are located in the upper left had corner of the board. Table 10 summarizes the binary input functions and LED indications for the binary inputs to the MCB.

Table 10: Binary inputs for main control board (MCB)

Binary input	Input description	Lit LED indication
MCB-BI1	External Time clock or tenant override	Occupied
MCB-BI2	Manual system disable	Disabled
MCB-BI3	Remote cool enable	Enabled
MCB-BI4	Remote heat enable	Enabled
MCB-BI5	Gas furnace flame failure alarm	Alarm
MCB-BI6	Airflow status	Airflow detected
MCB-BI7	Freeze alarm for steam or hot water coils	Normal
MCB-BI8	Smoke alarm: supply air, return air or both	Normal
MCB-BI9	First filter switch	Normal
MCB-BI10	Final filter switch (optional)	Normal
MCB-BI11	Outdoor enthalpy status[a]	Low OA enthalpy
MCB-BI12	Not used	—
MCB-BI13	External exhaust fan status (optional)[b]	On
MCB-BI14	Duct hi limit[c]	Normal
MCB-BI15	Not used	—
MCB-BI16	Not used	—

a. Not used on 100% outdoor air units.
b. Applicable only on VAV units configured for "fan tracking" return fan control.
c. Applicable on VAV units only.

Binary Inputs—Auxiliary Control Boards (CCB1, CCB2, GCB1, EHB1 & ERB1)

The optional auxiliary control boards include 12 binary inputs. Inputs BI1 through BI6 are designed for a set of dry contacts between the COM terminal and the individual binary input terminals on J9. BI7 through BI12 are designed for 24 VAC inputs (input is ON when 24 VAC is present at the corresponding input terminal on J10 and OFF when 0 VAC is not present). The following sections described how these inputs are defined for each of the auxiliary control boards.

Note – The set of two jumpers in the upper right corner of the board (below the RS-485 Communications module) must both be placed on the right most pins. Placing the jumper on the left most pins interlocks binary inputs BO1 with BI1 and BO2 with BI2 respectively. This interlock is not used on this product application

CCB1 & CCB2 (7RPS, RFS/RCS, RDT, RPR & RFR)

When a unit is equipped with a factory condensing unit, each of the two cooling circuits is controlled with an auxiliary control board. Circuit #1 is controlled by the CCB1 and circuit #2 is controlled by the CCB2. Table 10 and Table 11 on page 24 summarize the binary inputs for the CCB1 and CCB2 respectively.

GCB1 (RDS & RAH)

When a rooftop air handling unit is interfaced with a field supplied condensing unit, the cooling stages in the condensing unit are controlled by a generic condenser auxiliary control board. This board is designated GCB1. In this case only GCB1-BI12 is defined in the GCB1 control software. It is a "cool enable" input. Cooling is enabled when 24 VAC is present and disabled when 24 VAC is not present at this input. This input is supplied to the GCB1 through a "cooling enable" output from the MCB.

EHB1

When a unit is equipped with multistage electric heat, the heating stages are controlled by an electric heat auxiliary control board. This board is designated EHB1. In this case only EHB1-BI12 is defined for the EHB1. It is a "heat enable" input. Heating is enabled when 24 VAC is present and disabled when 24 VAC is not present at this input. This input is supplied to the EHB1 through a "heating enable" output from the MCB.

ERB1

When a unit is equipped with an optional energy recovery wheel system, the system is controlled by an energy recovery auxiliary control board. This board is designated ERB1. None of the binary inputs are used on the ERB1.

Table 11: Binary inputs for circuit #1 auxiliary cooling control board (CCB1)

	Input Description	24 VAC Present Indication
CCB1-BI1	Compressor #5 Contactor Auxiliary Switch Status	M5 Contactor Energized
CCB1BI2	Not Used	-
CCB1-BI3	Not Used	-
CCB1-BI4	Not Used	-
CCB1-BI5	Not Used	-
CCB1-BI6	Circuit #1 Low Pressure Switch Status (LP1)	Switch Closed
CCB1-BI7	Circuit #1 High Pressure Switch Status (HP1 or HP3)	Normal
CCB1-BI8	Circuit #1 Frost Protection Switch Status (FP1)	Normal
CCB1-BI9	Compressor #1 Contactor Auxiliary Switch Status	M1 Contactor Energized
CCB1-BI10	Compressor #3 Contactor Auxiliary Switch Status	M3 Contactor Energized
CCB1-BI11	Circuit #1 Pumpdown Switch Status	Switch Closed
CCB1-BI12	Circuit #1 Cool Enable Input	Enabled

Table 12: Binary inputs for circuit #2 auxiliary cooling control board (CCB2)

	Input Description	24 VAC Present Indication
CCB2-BI1	Compressor #6 Contactor Auxiliary Switch Status	M6 Contactor Energized
CCB2-BI2	Not Used	-
CCB2-BI3	Not Used	-
CCB2-BI4	Not Used	-
CCB2-BI5	Not Used	-
CCB2-BI6	Circuit #2 Low Pressure Switch Status (LP2)	Switch Closed
CCB2-BI7	Circuit #2 High Pressure Switch Status (HP2 or HP4)	Normal
CCB2-BI8	Circuit #2 Frost Protection Switch Status (FP2)	Normal
CCB2-BI9	Compressor #2 Contactor Auxiliary Switch Status	M2 Contactor Energized
CCB2-BI10	Compressor #4 Contactor Auxiliary Switch Status	M4 Contactor Energized
CCB2-BI11	Circuit #2 Pumpdown Switch Status	Switch Closed
CCB2-BI12	Circuit #2 Cool Enable Input	Enabled

Controller Outputs

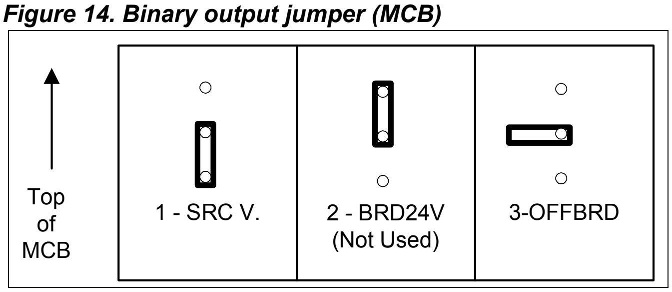
Binary Outputs—Main Control Board (MCB)

The main control board has 16 binary outputs that provide unit control in response to input conditions. Binary outputs energize on-board electromechanical relays (BO1 through BO4, BO11 and BO12) or triacs (BO5 through BO10 and BO13 through BO16). Unit control devices are wired to the relays and triacs through six output terminal blocks located on the right side of the MCB.

There are three terminals associated with each binary output. The terminals associated with BO1 are labeled NO, 1, and NC, the terminals associated with BO2 are labeled NO, 2, and NC, and so forth. Each binary output has an LED associated with it that lights when the corresponding output relay or the triac is turned on.

Each binary output has an output jumper associated with it. The three jumper positions are: 1-SRC V (jumper on the bottom two pins), 2-BRD24V (jumper on the top two pins) and 3-OFFBRD (no jumper). Refer to Figure 14.

Figure 14. Binary output jumper (MCB)



When the jumper is in position 1-SRC V, 24 VAC from the SRC 1-8 terminal (BO1 through BO8) or the SRC 9-16 terminal (BO9 through BO16) is applied to the numbered terminal of the associated outputs. In the case of BO1 through BO4, BO11 and BO12, this signal is then delivered to either the NC terminal when the corresponding output is off (output relay de-energized) or the NO terminal when the corresponding output is on (output relay energized). In the case of BO5 through BO10 and BO13 through BO16, this signal is then delivered to the NO terminal when the corresponding output is on (triac energized). Transformer T3 furnishes 24 VAC to the SRC 1-8 terminal and the SRC 9-16 terminal. This jumper configuration is used when a specific binary output is used to energize a 24 VAC pilot relay in the unit. Refer to Table 13 on page 25 for the correct jumper position for all the standard binary outputs.

When the jumper is in position 3-OFFBRD (no jumper installed) there is no on-board voltage applied to the numbered terminal of the corresponding binary output. In the case of BO1 through BO4, BO11 and BO12, the numbered terminal is simply “made” to the NO terminal when the corresponding output is on (output relay energized) or to the NC terminal when the corresponding output is off (output relay de-energized). In the case of BO5 through BO10 and BO13 through BO16, the numbered terminal is simply “made” to the NO terminal when the corresponding triac output is on. This jumper configuration is used most often in this product application. Refer to Table 13 on page 25 for the correct jumper position for all the standard binary outputs.

The 2-BRD24V jumper configuration is not used in this product application.

Table 13: Binary outputs for main control board (MCB)

	Output description	Lit LED indication	Jumper position
BO1	Discharge air fan, On/Off	Fan ON	3-OFFBRD (no jumper)
BO2	Return air fan, ON/OFF	Fan ON	3-OFFBRD (no jumper)
BO3	Fan Operation Output Signal	Fans ON	1-SRC V
BO4	Alarm Output Signal	Normal	1-SRC V
BO5	Close outdoor air dampers	Closing	3-OFFBRD (no jumper)
BO6	Open outdoor air dampers	Opening	3-OFFBRD (no jumper)
BO7[a]	Close chilled water valve	Closing	3-OFFBRD (no jumper)
	Close chilled water F&BP dampers	Closing	3-OFFBRD (no jumper)
	Cool enable	Enabled	3-OFFBRD (no jumper)
	Evaporative condenser sump pump, ON/OFF	Pump ON	3-OFFBRD (no jumper)
BO8[b]	Open chilled water valve	Opening	3-OFFBRD (no jumper)
	Open chilled water F&BP dampers	Opening	3-OFFBRD (no jumper)
BO9[c]	Close heating valve	Closing	3-OFFBRD (no jumper)
	Close heating F&BP dampers	Opening	3-OFFBRD (no jumper)
BO10[d]	Open heating valve	Opening	3-OFFBRD (no jumper)
	Open heating F&BP dampers	Opening	3-OFFBRD (no jumper)
BO11[e]	Gas furnace enable/disable	Enabled	1-SRC V
	Single stage heat ON/OFF	Heat On	1-SRC V
	F&BP damper/valve changeover	Dampers open / valve modulating	1-SRC V
	Heat enable	Enabled	1-SRC V
BO12	VAV box output signal	Cooling mode	3-OFFBRD (no jumper)
BO13	Decrease discharge fan VFD speed	Decreasing	1-SRC V
	Dehumidification reheat circuit # 2	Reheat ON	3-OFFBRD (no jumper)
BO14	Increase discharge fan VFD speed	Increasing	1-SRC
	Dehumidification reheat circuit # 1	Reheat ON	3-OFFBRD (no jumper)
BO15	Decrease return fan VFD speed	Decreasing	1-SRC V
BO16	Increase return fan VFD speed	Increasing	1-SRC V

a. If the unit is equipped with chilled water cooling, output BO7 closes the chilled water valve. If the unit is equipped with chilled water cooling with face and bypass dampers, output BO7 closes the face dampers. If the unit is equipped with DX cooling, BO7 provides a signal to the auxiliary cooling control boards (CCB1 and CCB2) to enable cooling operation. If unit is equipped with an evaporative condenser, BO7 turns the sump pump on.

b. If the unit is equipped with chilled water cooling, output BO8 opens the chilled water valve. If the unit is equipped with chilled water cooling with face and bypass dampers, output BO8 opens the face dampers.

c. If the unit is equipped with modulating heat, output BO9 closes the heating valve. If the unit is equipped with modulating heat with face and bypass dampers, output BO9 closes the face dampers.

d. If the unit is equipped with modulating heat, output BO10 opens the heating valve. If the unit is equipped with modulating heat with face and bypass dampers, output BO10 opens the face dampers.

e. If the unit is equipped with modulating gas heat, output BO11 enables the gas furnace. If the unit is equipped with single stage heat for morning warm up purposes, BO11 turns on the single stage of heat. If the unit is equipped with modulating heat with face and bypass dampers, BO11 changes the heat control such that BO9 and BO10 either modulate the heating value or the face and bypass dampers. If the unit is equipped with multiple stage electric heat, output BO11 provides a signal to the auxiliary electric heat control board (EHB1) to enable heating operation.

Binary Outputs—Auxiliary Control Boards (CCB1, CCB2, GCB1, EHB1 & ERB1)

The optional auxiliary control boards include nine binary outputs that control nine on-board electromechanical relays. Unit control devices are wired to these outputs through output terminals on the left side of the board. The functions of these outputs vary for the different auxiliary board applications. The following sections describe the output functions for the auxiliary control board applications.

CCB1 and CCB2 (RPS, RFS/RCS, RDT, RPE, RDE, RCE, RPR, and RFR)

When a unit is equipped with a factory condensing unit, each of the two cooling circuits is controlled with an auxiliary control board. Circuit #1 is controlled by the CCB1 and Circuit #2 is controlled by the CCB2. There are nine binary output relays on each cooling control board. These relays are energized based on commands received from the MCB to provide the appropriate switching actions in the DX cooling control circuits.

The output relays on the CCB1 and CCB2 board control compressor contactors, compressor unloaders, circuit liquid line solenoid valves, or condenser fan outputs. Tables 14 through 21 list the CCB1 and CCB2 output functions for the available unit compressor staging configurations.

The liquid line solenoid valve on each circuit opens (BO4 turned on) before the first compressor in the circuit is turned on. Normally the compressor outputs in the circuit begin turning on according to the controller staging logic as soon as the circuit low pressure switch closes. The exception to this rule is when a unit is equipped and configured for low ambient operation. In this case the first stage compressor in a circuit is turned on at the same time the liquid line solenoid valve is opened.

The condenser fan outputs are turned on and off based on ambient temperature set points adjustable through the unit keypad.

The compressor staging sequences for the available compressor staging configurations are described in the following sections.

2-Compressors/3-Stage. In this configuration there are two unequally sized scroll compressors and two cooling circuits. All cooling outputs are always controlled in the same way. There is no compressor or circuit lead/lag operation with this configuration.

The normal staging sequence is as follows:

When a capacity increase is required and the cooling capacity is 0%, the small compressor in Circuit #1 is turned on. When a further capacity increase is required, the large compressor in Circuit #2 is turned on while the small compressor in Circuit #1 is turned off. When a further capacity increase is required, the small compressor in Circuit #1 is turned on while the large compressor in Circuit #2 remains on. When capacity decrease is required, the compressors stage off in the reverse order.

If the small compressor (Circuit #1) is disabled, the large compressor (Circuit #2) operates when cooling is required and the cooling capacity is set to 66%. If the large compressor is disabled, the small compressor operates when cooling is required and the cooling capacity is set to 33%.

Table 14 summarizes the normal binary output functions and staging sequencing for the CCB1 and CCB2 for the 2-Compressor/3-Stage cooling configuration. The “X” characters in Table 14 indicate that the output is energized for a particular cooling capacity.

Table 14: Binary outputs for cooling control boards (CCB1 and CCB2): 2-compressors/3-stage

	Output number	Description	Action with output on	Cooling capacity (%)			
				0	33	66	100
1 (CCB1)	BO1	Compressor #1 (small compressor) ON/OFf	ON		X		X
	BO2	Not used	-				
	BO3	Not used	-				
	BO4	Circuit # 1 liquid line solenoid valve open/close[a]	Open		X		X
	BO5	Condenser fan #11 ON/OFF	ON		b		b
	BO6	Condenser fan #12 ON/OFF	ON		b		b
	BO7	Not used	-				
	BO8[d]	Not used	-				
	BO9	Not used	-				
2 (CCB2)	BO1	Compressor #2 ON/OFF (large compressor)	ON			X	X
	BO2	Not used	-				
	BO3	Not used	-				
	BO4	Circuit #2 liquid line solenoid valve open/close[a]	Open			X	X
	BO5	Condenser fan # 11 ON/OFF[c]	ON			b	b
	BO6	Condenser fan # 12 ON/OFF	ON			b	b
	BO7	Not used	-				
	BO8[d]	Not used	-				
	BO9	Not used	-				

a. Circuit Lead/Lag and Cross Circuit Loading versus Lead Circuit loading do not apply to this staging configuration.

b. Condenser fan outputs turn on and off based on ambient or evaporative condensing sump temperature set points adjustable through the unit keypad.

c. This output is not used on unit equipped with an evaporative condenser and a VFD controlling the first condenser fan on each circuit (Condenser Fan # 11 and # 21). The VFD controlling these fans is started and stopped and modulated via RS-485 communications with the main control board.

d. This output is used to open a sump dump valve on units equipped with an evaporative condenser. Output is energized to open valve.

4-Compressors/4-Stage or 6-Compressor/6-Stage. In this configuration there are four compressors and two cooling circuits. The unit cooling capacity is increased and decreased by turning on and off compressors. One of the circuits is designate the “Lead” and the other the “Lag” circuit. For detailed information regarding circuit lead/lag operation, refer to the “Compressor Staging” section of the applicable operation manual (refer to Table 1 on page 1). Disabled compressors are not turned on.

There are two methods for controlling the two circuits when both are enabled. These are referred to as Cross Circuit Loading and Lead Circuit Loading and are described in the following sections. For detailed information regarding selecting Cross Circuit Loading versus Lead Circuit Loading, refer to the “Compressor Staging” section of the applicable operation manual (refer to Table 1 on page 1).

Cross Circuit Loading. With this method, the two circuits are alternately loaded and unloaded as evenly as possible.

The normal staging sequence is as follows:

When a capacity increase is required and the number of operating compressors in both circuits is the same, the compressor in the “Lead” circuit with the fewest run hours that is not operating is turned on. When a capacity increase is required and the number of compressors in the two circuits is not the same, the compressor in the “Lag” circuit with the fewest run hours that is not operating is turned on.

When a capacity decrease is required and the number of operating compressors in both circuits is the same, the operating compressor in the “Lag” circuit with the most run hours is turned off. When a capacity decrease is required and the number of operating compressors in the two circuits is not the same, the operating compressor in the “Lead” circuit with the most run hours is turned off.

Lead Circuit Loading. With this method, one circuit is loaded completely before the first compressor in the second circuit is turned on, and one circuit is unloaded completely before the other circuit begins to be unloaded.

The normal staging sequence is as follows:

When a capacity increase is required and the number of operating compressors is 0, the compressor in the “Lead” circuit with the fewest run hours is turned on. When a further capacity increase is required, the second compressor in the “Lead” circuit is turned on, fully loading that circuit. When a further capacity increase is required, the compressor in the “Lag” circuit with the fewest run hours is turned on. When a further capacity increase is required, the remaining compressor on the “Lag” circuit is turned on, fully loading that circuit.

When a capacity decrease is required, the compressor in the “Lag” circuit with the most run hours is turned off. When a further capacity decrease is required, the remaining compressor in the “Lag” circuit is turned off. When a further capacity decrease is required, the compressor in the “Lead” circuit with the most run hours is turned off. When a further capacity decrease is required, the remaining compressor in the “Lead” circuit is turned off.

Table 15 on page 28 summarizes the normal binary output functions and staging sequencing for the CCB1 and CCB2 for the 4-compressor/4-stage cooling configuration. Table on page 28 summarizes the normal binary output functions and staging sequences for the CCB1 and CCB2 for the 6-compressor/ 6-stage cooling configuration. The Xs in the table indicate that the output is energized for a particular cooling capacity.

With either the Cross Circuit Loading or Lead Circuit Loading methods, a disabled circuit remains at zero capacity. If the other circuit is enabled, it acts as the “Lead” and the circuit capacity is controlled using the Lead Circuit Loading.

Table 15: Binary outputs for cooling control boards (CCB1 and CCB2): 4-compressors/4-stage (circuit #1 lead)[a]

	Output number	Description	Action with output on	Cooling capacity (%)									
				Cross circuit loading					Lead circuit loading				
				0	25	50	75	100	0	25	50	75	100
1 (CCB1)	BO1	Compressor #1 ON/OFF	ON		X	X	X	X		X	X	X	X
	BO2	Compressor #3 ON/OFF	ON		b	b	X	X		b	X	X	X
	BO3	Not used	—										
	BO4	Circuit #1 liquid line solenoid valve open/close	Open		X	X	X	X		X	X	X	X
	BO5	Condenser fan #11 ON/OFF[f]	ON		d	d	d	d		d	d	d	d
	BO6	Condenser fan #12 ON/OFF	ON		d	d	d	d		d	d	d	d
	BO7	Condenser fan #13 ON/OFF[e]	ON		d	d	d	d		d	d	d	d
	BO8[g]	Not used[g]	—										
	BO9	Not used	—										
2 (CCB2)	BO1	Compressor #2 ON/OFF	ON			X	X	X				X	X
	BO2	Compressor #4 ON/OFF	ON			c	c	X				c	X
	BO3	Not used	—										
	BO4	Circuit #1 liquid line solenoid valve open/close	Open			X	X	X				X	X
	BO5	Condenser fan #21 ON/OFF[f]	ON			d	d	d				d	d
	BO6	Condenser fan #22 ON/OFF	ON			d	d	d				d	d
	BO7	Condenser fan #23 ON/OFF[e]	ON			d	d	d				d	d
	BO8[g]	Not used	—										
	BO9	Not used	—										

a. If Circuit #2 is the "lead" circuit, interchange the data in the table between CCB1 and CCB2 for the correct output staging data.
b. If Compressor #3 has fewer run hours it operates instead of Compressor #1 at this cooling capacity.
c. If Compressor #4 has fewer run hours it operates instead of Compressor #2 at this cooling capacity.
d. Condenser fan outputs turn on and off based on ambient or evaporative condenser sump temperature set points adjustable through the unit keypad.
e. This output is applicable on 060C size units only.
f. This output is not used on unit equipped with an evaporative condenser and a VFD controlling the first condenser fan on each circuit (Condenser Fan # 11 and # 21). The VFD controlling these fans is started and stopped and modulated via RS-485 communications with the main control board.
g. This output is used to open a sump dump valve on units equipped with an evaporative condenser. Output is energized to open valve.

Table 16: Binary outputs for cooling control boards (CCB1 and CCB2): 6-compressors/6-stage (circuit #1 lead)[a]

Cooling circuit #	Output #	Description	Action with output ON	Cooling capacity (%)													
				Cross circuit loading							Lead circuit loading						
				0	16	33	50	66	83	100	0	16	33	50	66	83	100
1 (CCB1)	BO1	Compressor #1 ON/OFF	ON		X	X	X	X	X	X		X	X	X	X	X	X
	BO2	Compressor #3 ON/OFF	ON		b	b	X	X	X	X		b	X	X	X	X	X
	BO3	Not used	—														
	BO4	Circuit #1 liquid line solenoid valve open/close	Open		X	X	X	X	X	X		X	X	X	X	X	X
	BO5	Condenser fan #11 ON/OFF[f]	ON		d	d	d	d	d	d		d	d	d	d	d	d
	BO6	Condenser fan #12 ON/OFF	ON		d	d	d	d	d	d		d	d	d	d	d	d
	BO7	Condenser fan #13 ON/OFF	ON		d	d	d	d	d	d		d	d	d	d	d	d
	BO8	Condenser fan # 14 ON/OFF[e]	ON		d	d	d	d	d	d		d	d	d	d	d	d
	BO9	Compressor #5 ON/OFF	ON		b	b	b	b	X	X		b	b	X	X	X	X
2 (CCB2)	BO1	Compressor #2 ON/OFF	ON			X	X	X	X	X					X	X	X
	BO2	Compressor #4 ON/OFF	ON			c	c	X	X	X					c	X	X
	BO3	Not used	—														
	BO4	Circuit #2 liquid line solenoid valve open/close	Open			X	X	X	X	X					X	X	X
	BO5	Condenser fan #21 ON/OFF[f]	ON			d	d	d	d	d					d	d	d
	BO6	Condenser fan #22 ON/OFFf	ON			d	d	d	d	d					d	d	d
	BO7	Condenser fan #23 ON/OFF	ON			d	d	d	d	d					d	d	d
	BO8	Condenser fan #24 ON/OFF[e]	ON			d	d	d	d	d					d	d	d
	BO9	Compressor #6 ON/OFF	ON			c	c	c	c	X					c	c	X

a. If Circuit #2 is the "lead" circuit, interchange the data in the table between CCB1 and CCB2 for the correct output staging data.
b. If Compressor #5 has fewer run hours it operates instead of Compressor #1 or Compressor # 3 at this cooling capacity.
c. If Compressor #6 has fewer run hours it operates instead of Compressor #2 or Compressor #4 at this cooling capacity.
d. Condenser fan outputs turn on and off based on ambient or evaporative condenser sump temperature set points adjustable through the unit keypad.
e. This output is applicable on 075C size units only, or on units equipped with an evaporative condenser in which case the output is used to open a sump dump valve when energized.
f. This output is not used on unit equipped with an evaporative condenser and a VFD controlling the first condenser fan on each circuit (Condenser Fan # 11 and # 21). The VFD controlling these fans is started and stopped and modulated via RS-485 communications with the main control board.

4-Compressors/8-Stage. In this configuration there are four equally sized compressors and two cooling circuits. Compressor #1 and Compressor #3 are in Cooling Circuit #1 and Compressor #2 and Compressor #4 are in Cooling Circuit #2. Compressor #1 and Compressor #2 each have one unloader. Compressor #3 and Compressor #4 have no unloading. Each cooling circuit is controlled in the same way. One circuit is designated the "Lead" and the other the "Lag" circuit. For detailed information regarding circuit lead/lag operation, refer to the applicable operation manual (refer to Table 1 on page 1).

There are two methods for controlling the two circuits when both are enabled: Cross Circuit Loading and Lead Circuit Loading. For details regarding selecting Cross Circuit Loading versus Lead Circuit Loading, refer to the "Compressor Staging" section of the applicable operation manual (refer to Table 1 on page 1).

Cross Circuit Loading. With this method, the two circuits are alternately loaded and unloaded as evenly as possible.

The normal staging sequence is as follows:

When a capacity increase is required and both circuits are operating at the same capacity, the "Lead" circuit is staged up if not already at its maximum. When a capacity increase is required and both circuits are not operating at the same capacity, the "Lag" circuit is staged up if not already at its maximum capacity. When a capacity decrease is required and both circuits are operating at the same capacity, the "Lag" circuit is staged down. When a capacity decrease is required and both circuits are not operating at the same capacity, the "Lead" circuit is staged down.

Lead Circuit Loading. With this method, one circuit is loaded completely before the first compressor in the other circuit is turned on, and one circuit is unloaded completely before the other circuit is unloaded.

The normal staging sequence is as follows:

When a capacity increase is required and the "Lead" circuit is not at maximum, the "Lead" circuit is staged up. When a capacity increase is required and the "Lead" circuit is already at its maximum stage, the "Lag" circuit is staged up. When a capacity decrease is required and the "Lag" circuit is not at zero capacity, the "Lag" circuit is staged down. When a capacity decrease is required and the "Lag" circuit is at zero capacity, the "Lead" circuit is staged down.

Table 17 on page 29 summarizes the normal binary output functions and staging sequencing for CCB1 and CCB2 for the 4 Compressors/8 Stage Lead Circuit Loading cooling configuration. The Xs in the table indicate that the output is energized for a particular circuit cooling capacity.

With either the Cross Circuit Loading or Lead Circuit Loading methods, a disabled circuit remains at zero capacity. If the other circuit is enabled, it acts as the "Lead" and the circuit capacity is controlled using the Lead Circuit Loading method as shown in Table 17.

Table 17: Binary outputs for cooling control boards (CCB1 and CCB2): 4-compressors/8-stage

	Output #	Description	Action with output ON	Cooling capacity (%)																	
				Cross circuit loading									Lead circuit loading								
				0	12	25	37	50	62	75	87	100	0	12	25	37	50	62	75	87	100
1 (CCB1)	BO1	Compressor #1 ON/OFF	ON		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X
	BO2	Compressor # 3 ON/OFF	ON						X	X	X	X				X	X	X	X	X	X
	BO3	Unloader #1, Compressor #1	Unloaded		X	X			X	X		X		X		X					
	BO4	Circuit # 1 liquid line solenoid valve open/close	Open		X	X	X	X	X	X	X	X		X	X	X	X	X	X	X	X
	BO5	Condenser fan #11 ON/OFF[c]	ON		b	b	b	b	b	b	b	b		b	b	b	b	b	b	b	b
	BO6	Condenser fan #12 ON/OFF	ON		b	b	b	b	b	b	b	b		b	b	b	b	b	b	b	b
	BO7	Condenser fan #13 ON/OFF	ON		b	b	b	b	b	b	b	b		b	b	b	b	b	b	b	b
	BO8	Condenser fan #14 ON/OFF	ON		b	b	b	b	b	b	b	b		b	b	b	b	b	b	b	b
	BO9	Not used	—																		
2 (CCB2)	BO1	Compressor #2 ON/OFF	ON			X	X	X	X	X	X	X						X	X	X	X
	BO2	Compressor #4ON/OFF	ON							X	X	X								X	X
	BO3	Unloader #1, compressor #2	Unloaded			X	X			X	X							X		X	
	BO4	Circuit # 1 liquid line solenoid valve open/close	Open			X	X	X	X	X	X	X						X	X	X	X
	BO5	Condenser fan #21 ON/OFF[c]	ON			b	b	b	b	b	b	b						b	b	b	b
	BO6	Condenser fan #22 ON/OFF	ON			b	b	b	b	b	b	b						b	b	b	b
	BO7	Condenser fan #23 ON/OFF	ON			b	b	b	b	b	b	b						b	b	b	b
	BO8	Condenser fan #24 ON/OFF	ON			b	b	b	b	b	b	b						b	b	b	b
	BO9	Not used	—																		

a. If Circuit #2 is the "lead" circuit, interchange the data in the table between CCB1 and CCB2 for the correct output staging data.
b. Condenser fan outputs turn on and off based on ambient or evaporative condenser sump temperature set points adjustable through the unit keypad.
c. This output is not used on unit equipped with an evaporative condenser and a VFD controlling the first condenser fan on each circuit (Condenser Fan # 11 and # 21).
The VFD controlling these fans is started and stopped and modulated via RS-485 communications with the main control board.

3-Compressors/4-Stage. In this configuration there are two equally sized small compressors in Cooling Circuit #1 and one large compressor in Cooling Circuit #2. The cooling outputs are always controlled in the same way. There is no circuit lead/lag operation with this configuration.

Starting with 0% cooling capacity, when a capacity increase is required, the small compressor on circuit #1 with the fewest run hours is turned on (25%). When a further capacity increase is required, the remaining compressor on circuit #1 is turned on (50%). When a further capacity increase is required, the large compressor on circuit #2 is turned on and the small compressor on circuit #1 with the most run hours is turned off (75%). When a further capacity increase is required, the small compressor on circuit #1 that is not operating is turned on (100%).

Starting with 100% capacity, when a capacity decrease is required, the small compressor on circuit #1 with the most run hours is turned off (75%). When a further capacity decrease is required, the large compressor on circuit #2 is turned off and the small compressor on circuit #1 that is not operating is turned on (50%). When a further capacity decrease is required, the small compressor on circuit #1 with the most run hours is turned off (25%). When a further capacity decrease is required, the operating small compressor on circuit #1 is turned off (0%)

Note – If one of the small compressors on circuit #1 is disabled, the unit stages between 25% (using the enabled small compressor on circuit #1) and 75% (small compressor on circuit #1 and large compressor on circuit #2) skipping the 50% capacity step. If both of the small compressors on circuit #1 are disabled, the large compressor on circuit #2 (50% capacity) cycles on and off to maintain the load. If the large compressor on circuit #2 is disabled, the two small compressors on circuit #1 cycles on and off (based on run hours) to maintain the load.

Table 20 on page 31 summarizes the normal binary output functions and staging sequencing for CCB1 and CCB2 for the 3 Compressors/4 Stage cooling configuration. The Xs in the table indicate that the output is energized for a particular cooling capacity.

Table 18: Binary outputs for cooling control boards (CCB1 & CCB2): 3-compressors/4-stage (circuit #1 lead)[a]

		Description	Action with output ON	Cooling capacity (%)				
				0	25	50	75	100
1 (CCB1)	BO1	Compressor # 1 ON/OFF (small compressor)	On		X	X	X	X
	BO2	Compressor # 3 ON/OFF (small compressor)	On		b	X	b	X
	BO3	Not used	—					
	BO4	Circuit # 1 liquid line solenoid valve open/close	Open		X	X	X	X
	BO5	Condenser fan # 11 ON/OFF[d]	On		c	c	c	c
	BO6	Condenser fan # 12 ON/OFF	On		c	c	c	c
	BO7	Condenser fan # 13 ON/OFF	On		c	c	c	c
	BO8	Not used[e]	—					
	BO9	Not used	—					
2 (CCB2)	BO1	Compressor # 2 ON/OFF	On				X	X
	BO2	Not used	On					
	BO3	Not used	—					
	BO4	Circuit # 2 liquid line solenoid valve open/close	Open				X	X
	BO5	Condenser fan # 21 ON/OFF[d]	On				c	c
	BO6	Condenser fan # 22 ON/OFF	On				c	c
	BO7	Condenser fan # 23 ON/OFF	On				c	c
	BO8	Not used[e]	—					
	BO9	Not used	—					

a. Circuit Lead/Lag does not apply to this staging configuration.
b. If Compressor #3 has fewer run hours it operates instead of Compressor #1 at this cooling capacity.
c. Condenser fan outputs turn on and off based on ambient or evaporative condenser sump temperature set points adjustable through the unit keypad.
d. This output is not used on unit equipped with an evaporative condenser and a VFD controlling the first condenser fan on each circuit (Condenser Fan # 11 and # 21).
The VFD controlling these fans is started and stopped and modulated via RS-485 communications with the main control board.
e. This output is used to open a sump dump valve on units equipped with an evaporative condenser. Output is energized to open valve.

GCB1 (RDS & RAH)

For RDS and RAH model air handling units interfaced with generic condensing units, the cooling stages are controlled by an auxiliary control board loaded with special generic condensing unit control software. This board is designated GCB1. There are nine binary output relays on the GCB1. These relays are energized based on commands received from the MCB to provide the appropriate switching action in the condensing unit control circuitry. The condensing unit control circuit terminals are wired to these output relays through the binary output terminals on the left side of the board.

These cooling outputs are energized and de-energized sequentially to maintain the cooling load. The outputs are sequentially turned on whenever the cooling capacity is increased. The outputs are sequentially turned off whenever the cooling capacity is decreased.

This sequence of one output per stage is shown in Table 19 on page 31. With this arrangement, protection of the compressors and control of condenser fans are not provided by the MicroTech II controller but rather by the condensing unit control system.

EHB1

When a unit is equipped with a multiple stage electric heater the heat is controlled by an auxiliary electric heat control board. The board is designated EHB1. There are nine binary output relays on the EHB1 board. These relays are energized based on commands from the MCB to provide the appropriate switching action in the electric heat control circuitry. The electric heat control terminals are wired to these output relays through the binary output terminals on the left side of the board.

These heating outputs are energized and de-energized sequentially to maintain the heating load. These outputs are sequentially turned on whenever the heating capacity is increased. These outputs are sequentially turned off whenever the heating capacity is decreased. The sequence of one output per stage is shown in Table 20.

Table 19: Binary outputs for cooling control board (CCB21): RDS or RAH with up to 8 DX cooling stages

	Output description	Action with output ON	Cooling stage								
			0	1	2	3	4	5	6	7	8
GCB1-BO1	Cooling stage #1 ON/OFF	On		X	X	X	X	X	X	X	X
GCB1-BO2	Cooling stage #2 ON/OFF	On			X	X	X	X	X	X	X
GCB1-BO3	Cooling stage #3 ON/OFF	On				X	X	X	X	X	X
GCB1-BO4	Cooling stage #4 ON/OFF	On					X	X	X	X	X
GCB1-BO5	Cooling stage #5 ON/OFF	On						X	X	X	X
GCB1-BO6	Cooling stage #6 ON/OFF	On							X	X	X
GCB1-BO7	Cooling stage #7 ON/OFF	On								X	X
GCB1-BO8	Cooling stage #8 ON/OFF	On									X
GCB1-BO9	Not used	—									

Table 20: Binary outputs for electric heat control board (EHB1): up to 8 heat stages

	Output description	Action with output on	Heating stage								
			0	1	2	3	4	5	6	7	8
EHB1-BO1	Heating stage #1 ON/OFF	ON		X	X	X	X	X	X	X	X
EHB1-BO2	Heating stage #2 ON/OFF	ON			X	X	X	X	X	X	X
EHB1-BO3	Heating stage #3 ON/OFF	ON				X	X	X	X	X	X
EHB1-BO4	Heating stage #4 ON/OFF	ON					X	X	X	X	X
EHB1-BO5	Heating stage #5 ON/OFF	ON						X	X	X	X
EHB1-BO6	Heating stage #6 ON/OFF	ON							X	X	X
EHB1-BO7	Heating stage #7 ON/OFF	ON								X	X
EHB1-BO8	Heating stage #8 ON/OFF	ON									X
EHB1-BO9	Not used	—									

EERB1

When a unit is equipped with an optional energy recovery wheel, the system is controlled by an auxiliary energy recovery control board. The board is designated ERB1. There are nine binary output relays on the ERB1. These relays are energized based on commands from the MCB to provide the appropriate switching action in the energy recovery wheel control circuitry. The energy recovery wheel control terminals are wired to these output relays through the binary output terminals on the left side of the board. Table 21 summarizes the binary output connections for the ERB1 board.

Table 21: Binary outputs for energy recovery wheel control board (ERB1)

	Output description	Action with output ON
ERB1-BO1	Enthalpy wheel ON/OFF	On
ERB1-BO2	Not used	—
ERB1-BO3	Not used	—
ERB1-BO4	Close enthalpy wheel bypass dampers	Closing
ERB1-BO5	Open enthalpy wheel bypass dampers	Opening
ERB1-BO6	Not used	—
ERB1-BO7	Decrease enthalpy wheel speed	Decreasing
ERB1-BO8	Increase enthalpy wheel speed	Increasing
ERB1-BO9	Not used	—

Software Identification and Configuration

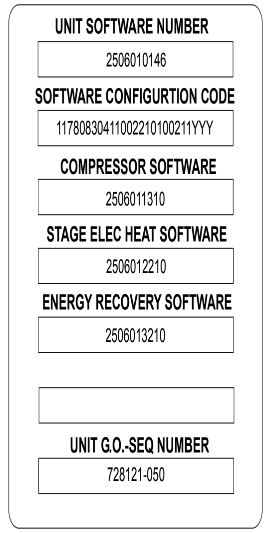
The MicroTech II control system code is made up of up to four different software components. All unit applications include a main control board application code component that resides in the main control board (MCB). Then, depending on the unit configuration, there may be one or two cooling auxiliary control boards, an electric heat auxiliary control board, or an energy recovery auxiliary control board each loaded with an application code component.

The application code in the main control board and any auxiliary control boards are each assigned a ten-digit software identification number. This includes a seven-digit base number followed by a three-digit version number.

The software identification numbers the unit was loaded with at the factory appears on the software identification label located near the keypad/display. Figure 16 shows a typical label. The box labeled "UNIT SOFTWARE NUMBER" contains the software identification number for the code in the main controller (MCB). The box labeled "COMPRESSOR SOFTWARE" contains the software identification number for the code in the auxiliary cooling control board(s) (CCB1, CCB2 and GCB1) when applicable. The box labeled "STAGE ELEC HEAT SOFTWARE" contains the software identification number for the code in the auxiliary electric heat control board (EHB1), when applicable. The box labeled "ENERGY RECOVERY SOFTWARE" contains the software identification number for the code in the auxiliary energy recovery control board (ERB1), when applicable.

Note – The "UNIT SOFTWARE NUMBER" loaded into the main controller (MCB) also appears in the *AHUID*= parameter in the Unit Configuration menu on the unit keypad/display.

Figure 15. Software identification label



Main Control Board (MCB) Configuration

After the main control board software component is loaded into the MCB, it must be "configured" for the specific control application. This consists of setting the value of 20 configuration variables within the MCB. These variables define things such as the type of cooling, number of compressors and cooling stages and the type of heat. If all of these items are not set appropriately for the specific unit, the unit will not function properly. The correct settings for these parameters are defined for a given unit by the unit Software Configuration Code. The Software Configuration Code consists of a 26-character string of numbers and letters. The code id located on the unit Software Identification Label on the back of the door where the unit keypad is mounted. See also Figure 22 on page 33.

Only the first 22 characters of this code are used for software configuration purposes. The first 22 characters of the Software Configuration Code currently loaded into a unit controller can be determined via the unit keypad/display by viewing the six menu items under the Configuration Code menu. The six menu items are *Pos #1–4=, Pos #5–8=, Pos #9–12=, Pos #13–16=, Pos #17–20=* and *Pos #21–22=.* The Software Configuration Code in the unit is determined by combining the values of these six parameters.

For example, if the six parameters read as *Pos #1–4=1.178, Pos #5–8=0.830, Pos #9 12=4.104, Pos #13–16=0.221, Pos #17–20=0.100* and *Pos #21–22=2.0,* then the Software Configuration Code in the unit is 1178083041040221010020. Note that the decimal points in the values are ignored when constructing the code. Table 22 on page 33 lists the configuration code variables including the position within the code, a description of the parameter, the variable object and attribute name and the applicable settings for each. The factory default values are shown in bold font.

Table 22: Software configuration string

	Description	Values (default in bold)
1	Unit Type	0 **RA zone control** 1 RA DAT control 2 100 OA zone control 3 100 OA DAT control
2	Cooling Type	0 None 1 Compressorized clg 2 Chilled water (2-wire FB) A Chilled water (3-wire FB)
3	Compressorized cooling configuration	0 2 comp/2 stage 1 2 comp/3 stage 2 2 comp/4 stage 3 2 comp/6 stage 4 3 comp/4 stage 5 4 comp/4 stage 6 6 comp/6 stage 7 4 comp/8 stage 8 Generic condenser
4	Generic condenser stages	1 – 8 Stages **(Default = 8)**
5	Low ambient	0 No 1 Yes
6*	Condenser fan type	0 No evap cond control 1 2 cond fans/cir– ABB VFD 2 2 cond fans/cir– Graham VFD 3 2 cond fans/cir– Reliance VFD 4 2 cond fans/cir– no VFD 5 3 cond fans/cir– ABB VFD 6 3 cond fans/cir– Graham VFD 7 3 cond fans/cir– Reliance VFD 8 3 cond fans/cir– no VFD
7	Damper type	0 None 1 Single position 30% (2-wire FB) 2 Single position 100% (2-wire FB) 3 Economizer (2-wire FB) A Single position 30% (3-wire FB) B Single position 100% (3-wire FB) **C Economizer (3-wire FB)**
8	DesignFlo	0 No DesignFlo 1 018–030 (800) (non-precision PS) 2 036–040 (802) (non-precision PS) 3 045–075 (047) (non-precision PS) 4 080–135 (077) (non-precision PS) A 018–030 (800) (precision PS) B 036–040 (802) (precision PS) C 045–075 (047) (precision PS) D 080–135 (077) (precision PS)
9	Heating type	0None 1F BP ctrl 2Multi staged 3Modulated gas, 3–1 (2-wire FB) 4Modulated gas, 20–1 (2-wire FB) 5Steam or hot water (2-wire FB) 6Single stage gas 7Single stage electric AModulated gas, 3–1 (3-wire FB) BModulated gas, 20–1 (3-wire FB) CSteam or hot water (3-wire FB)
10	Max heating stages	1 – 8 stages **(default = 1)**
11,12, and 13	Max heat rise	Three digits **(default = 100)**
14	Discharge fan type	0 Constant volume 1 Variable inlet vanes 2 Variable freq drive
15	Return fan type	0 Constant volume 1 Variable inlet vanes 2 Variable freq drive 3 No Return fan 4 Propeller exhaust

Table 22: Software configuration string (continued)

Configuration string position	Description	Values (default in bold)
16	Return/ exhaust fan capacity control method	0 None 1 Tracking 2 Bldg press 3 Position
17	Second pressure sensor type	0 None 1 Duct 2 Bldg
18	Entering fan temp sensor	0 No 1 Yes
19	Energy recovery	0 None 1 Constant speed wheel 2 Variable speed wheel
20	Final filter	0 No 1 Yes
21	Heating configuration	**0 Draw through preheat** 1 Draw through reheat 2 Blow through
22	Cooling configuration	0 Draw through 1 Blow through

Main Control Board (MCB) Data Archiving

All MCB control parameters and the real time clock settings are backed up by the MCB battery when power is removed from the MCB. In the event of a battery failure, the MCB includes a data archiving function. Once a day, just after midnight, all the MCB control parameter settings are archived to a file stored in the MCB FLASH memory. If the MCB is powered up with a low or defective battery (or with the battery removed), the most recently archived data is restored to the controller.

Note – When this archived data restoration process occurs, it increases the controller start up and initialization time period by approximately 75 seconds.

Typical Wiring Diagrams

The applied rooftop unit wiring diagrams on the following pages are typical. They are included to show common factory and field wiring schemes. For exact wiring information pertaining to a particular unit, refer to the wiring diagrams supplied with the unit.

Note – Some of the component designations depend on unit sizes. The following legend applies to Figure 16 through Figure 25. For complete, exact component designations and locations, refer to the legend supplied with the unit.

Legend

ID	Description	Standard location
ACT3, 4	Actuator motor, economizer	Economizer section
ACT5	Actuator motor, discharge isolation damper	Discharge section
ACT6	Actuator motor, return air isolation damper	Return section
ACT7	Actuator motor, heat face/ bypass	Coil section, heat
ACT8	Actuator motor, cool face/ Bypass	Coil section, cool
ACT10, 11	Actuator motor, exhaust dampers	Return section
ACT12	Actuator motor, enthalpy wheel bypass damper	Energy recovery section
AFD10	Adjustable frequency drive, supply fan	AFD/supply fan section
AFD11	Adjustable frequency drive, evap cond. fans	Main/RCE control box
AFD20	Adjustable frequency drive, return/exhaust fan	AFD/ret. ex. fan section
AFD60	Adjust. freq. drive, energy recovery wheel(s)	Energy recovery section
AS	Airflow switch, burner blower	Gas heat box
BM	Burner blower motor	Heat section, gas
C1–8	Power factor capacitors, compressors	Condenser section
C10	Power factor capacitors, supply fan	Supply Fan section
C11	Capacitors, Speedtrol, circuit #1	Condenser bulkhead
C20	Power factor capacitors, return fan	Return section
C21	Capacitors, Speedtrol, circuit #2	Condenser bulkhead
CB10	Circuit breaker, supply fan	Main control box
CB11	Circuit breaker, evaporative condenser fan(s)	Main/cond. control box
CB20	Circuit breaker, return/ exhaust fan	Main control box
CB60	Circuit breaker, energy recovery wheel	Main control box
CCB1, 2	Compressor control boards, refrig. circuits	Main control box

ID	Description	Standard location
CPC	Circuit board, main, micro controller	Main control box
CPR	Circuit board, expansion, micro controller	Main control box
CS1, 2	Control switches, refrig. circuits	Main/cond. control box
DAT	Discharge air temperature sensor	Discharge section
DFLH	Design flow lefthand sensor	Return section
DFRH	Design flow righthand sensor	Return section
DHL	Duct hi-limit	Main control box
DS1	Disconnect, total unit or cond/ heat	Main control box
DS2	Disconnect, SAF/RAF/controls	Main control box
DS3	Disconnect, electric heat	Electric heat box
DS4	Disconnect, condenser (RCS Only)	RCS control box
EAT	Exhaust air temperature sensor	Energy recovery section
EFT	Entering fan air temperature sensor	Supply fan section
EHB1	Staged electric heat board	Main control box
ERB1	Energy recovery board	Main control box
ERM1	Energy recovery wheel motor #1	Energy recovery section
ERM2	Energy recovery wheel motor #2	Energy recovery section
F1A, B	Fuse, control circuit transformer (T1), primary	Main control box
F1C	Fuse, control circuit transformer (T1), secondary	Main control box
F2	Fuse, control circuit transformer (T2), primary	Main control box
F3	Fuse, burner blower motor	Main control box
F4	Fuse, ctrl. circuit transformer (T4), primary	Main control box
FB11, 12	Fuseblock, Speedtrol	Main/cond. control box
FB31–40	Fuseblock, electric heat (top bank)	Electric heat box
FB41–50	Fuseblock, electric heat (bot. bank)	Electric heat box
FB65	Fuseblock, evap. cond. sump heater	Main/cond. control box
FD	Flame detector	Heat section, gas
FLC	Fan limit control	Heat section, gas
FP1, 2	Frost protection, refrig. circuits	Coil section, cool
FS1, 2	Freezestat control	Coil section, heat/cool
FSG	Flame safeguard	Gas heat box
GCB1	Generic condenser board, refrig. circ.	Main control box
GFR1, 2	Ground fault relay	Main control box
GFS1, 2	Ground fault sensor	Main control box
GFR4	Ground fault relay, condenser	Condenser control box
GFS4	Ground fault sensor, condenser	Condenser control box

ID	Description	Standard location
GRD	Ground	All control boxes
GV1	Gas valve, pilot	Heat section, gas
GV2	Gas valve, main/safety	Heat section, gas
GV3	Gas valve, redundant/safety	Heat section, gas
GV4–8	Gas valve, main, hi turn down	Heat section, gas
HL1–10	Hi-limits, pwr, elec heaters (top bank)	Heat section, electric
HL11–20	Hi-limits, pwr, elec heaters (bot. bank)	Heat section, electric
HL22	Hi-limits, gas heat (pre-filters)	Supply fan section
HL23	Hi-limits, gas heat (final filters)	Final filter section
HL31–40	Hi-limits, ctl. elec heaters (top bank)	Heat section, electric
HL41–50	Hi-limits, ctl. elec heaters (bot. bank)	Heat section, electric
HP1–4	Hi-pressure controls, refrig	On compressors
HP5	Hi-pressure controls, gas	Heat section, gas
HS1	Heat switch, electric heat shutdown	Main control box
HS3	Heat switch, electric heat deadfront interlock	Electric heat box
HTR1–6	Crankcase heaters	On compressors
HTR65	Heater, sump	Evap. condenser section
HTR66	Heater, vestibule	Evap. condenser vestibule
HUM1	Humidstat sensor	Energy recovery section
IT	Ignition transformer	Gas heat box
LAT	Leaving air temperature sensor	Energy recovery section
LP1, 2	Low-pressure controls, refrigeration	On compressors
LP5	Low-pressure control, gas	Heat section, gas
LR10	Line Reactor, supply fan	Inverter bypass box
LR20	Line reactor, return/exhaust fan	Inv. bypass/main cont. box
LS1, 2	Limit switch, low fire, high fire	Gas heat box
LT10–23	Light, cabinet sections	Supply fan section
M1–8	Contactor, compressor	Main/cond. control box
M10	Contactor, supply fan	Main control box
M11–18	Contactor, condenser fans, circuit #1	Main/cond. control box
M20	Contactor, return fan	Main control box
M21–28	Contactor, Condenser fans, circuit #2	Main/cond. control box
M29	Contactor, burner motor	Gas heat box
M30	Contactor, reversing, invertor bypass, supply fan	Inverter bypass box
M31–39	Contactor, electric heat (top bank)	Electric heat box
M40	Contactor, reversing, Invertor Bypass, Return Fan	Inverter bypass box
M41–50	Contactor, electric heat (bot. bank)	Electric heat box

ID	Description	Standard location
M60	Contactor, energy recovery wheel	Main control box
M64	Contactor, sump pump	Main/cond. control box
M65	Contactor, sump heater	Main/cond. control box
MCB	Microprocessor circuit board	Main control box
MJ	Mechanical Jumper	All control boxes
MMP1–8	Manual motor protector, compressors	Main/cond. control box
MMP10	Manual motor protector, supply fan	Main control box
MMP11–18	Manual motor protector, cond. fans, ckt#1	Main/cond. control box
MMP20	Manual motor protector, return fan	Main control box
MMP21–28	Manual motor protector, cond. fans, ckt#2	Main/cond. control box
MMP30	Manual motor protector, invrtr. bypass, sup. fan	Inverter bypass box
MMP40	Manual motor protector, invrtr. bypass, ret. fan	Inverter bypass box
MMP51, 52, 53	Manual motor protector, exhaust fan(s)	Prop exhaust box
MMP60	Manual motor protector, energy recovery wheel	Main control box
MMP64	Manual motor protector, sump pump	Main/RCE control box
MP1–6	Motor protector, compr.#1-6	On compressors
OAE	Outside air enthalpy sensor	Economizer section
OAT	Outside air temperature sensor	Economizer section
OP1–4	Oil pressure controls, compr.#1-4	Condenser section
PB1, 2	Power block, power distribution	Main control box
PB3	Power block, power distribution, electric heat	Electric heat box
PB4	Power block, power distribution, condenser	Condenser control box
PB9, 10	Power block, supply fan	Junction box, split unit
PB11, 12	Power block, power distribution	Main control box
PB19, 20	Power block, return/exhaust fan	Junction box, split unit
PC5	Pressure control, clogged filter	Pre filter section
PC6	Pressure control, clogged final filter	Final filter section
PC7	Pressure control, proof airflow	Supply fan section
PC8	Pressure control, minimum airflow	Coil section, cool
PC12, 22	Pressure control, Fantrol	Condenser section
PM1	Phone modem	Main control box
PS1, 2	Pumpdown switches, refrig circuits	Main/cond. control box
PS3	Pumpdown switch, RFS only	Main control box
PVM1, 2	Phase voltage monitor	Main control box

ID	Description	Standard location
PVM4	Phase voltage monitor, condenser	Condenser control box
R1, 2	Relay, hi pressure reset	Main/cond. control box
R3, 4	Relay, hi pressure delay	Main/cond. control box
R5–8	Relay, safety, cool fail	Main/cond. control box
R9, 10	Relay, compressor lockout	Main/cond. control box
R11, 12	Relay, Speedtrol fan cycling	Main/cond. control box
R20	Relay, Heat, gas/ steam/ hot water	Gas heat/main cont. box
R21, 22	Relay, heat, gas (hi-turn down)	Gas heat box
R23	Relay, heat, gas & electric	Gas/electric heat box
R24	Relay, heat alarm, gas	Main control box
R25	Relay, heat, gas, start supply fan inverter	Main control box
R26	Relay, isol/exh. dampers, open/close	Main control box
R28	Relay, isolation damper, safety	Main control box
R29	Relay, remote fire alarm	Main control box
R30	Relay, cool valve with face bypass	Main control box
R45	Relay, UV lights	Main control box
R46, 47	Relay, supply fan inverter, incr/ decr	Main control box
R48, 49	Relay, return fan inverter, incr/ decr	Main control box
R56	Relay, heater, water pipe	Main/RCE control box
R58,59	Relay, heat wheel inverter, incr/ decr	Main control box
R60	Relay, energy recovery wheel, enable	Main control box
R61	Relay, smoke detector, discharge air	Main control box
R62, 63, 65	Relay, use on specials	Main control box
R64	Relay, sump pump	Main/RCE control box
R66	Relay, smoke detector, return air	Main control box
R67	Relay, supply fan, enable	Main control box
R68	Relay, return fan, enable	Main control box
R69	Relay, Inv. bypass VAV box interlock	Main control box
R70–79	Relay, use on specials	Main control box
RAE	Return air enthalpy sensor	Return section
RAT	Return air temperature sensor	Return section
REC1	Receptacle, main box	Main control box
REC2	Receptacle, condenser box	Condenser control box
REC3	Receptacle, field power, 115V	Discharge bulkhead
REC10–23	Receptacle, cabinet sections	Cabinet sections

ID	Description	Standard location
S1	Switch, system on/off	Main control box
S2	Switch, system on/off, condenser unit	Condenser control box
S3	Switch, furnace on/off	Gas heat box
S4	Switch, inverter bypass, on/ off	Main control box
S7	Switch, local on/auto/off to controller	Main control box
S10–23	Switches, cabinet section lights	Cabinet sections
S40–45	Switches, door interlock, UV lights	Cabinet sections
SC11	Speed control, circuit #1	Condenser bulkhead
SC21	Speed control, circuit #2	Condenser bulkhead
SD1	Smoke detector, supply	Discharge section
SD2	Smoke detector, return	Return section
SPS1, 2	Static pressure sensors, duct/ building	Main control box
SR1-3	Sequencing relays, electric heat	Electric heat box
SV1, 2	Solenoid valves, liquid	Condenser section
SV5, 6	Solenoid valves, hot gas	Condenser section
SV61, 62	Solenoid valves, sump, fill	Main/RCE control box
SV63	Solenoid valves, sump, drain	Main/RCE control box
SWT	Sump water temperature sensor	Evap. condenser section
T1	Transformer, main control (line/ 115VAC)	Main control box
T2	Transformer, control input (115/ 24VAC)	Main control box
T3	Transformer, control output (115/24VAC)	Main control box
T4	Transformer, exh. damper actuator (115/12VDC)	Main control box
T5	Transformer, electric heat	Electric heat box
T6	Transformer, dew point controller (115/24VAC)	Main control box
T9	Transformer, refrig. circuit 24V	Main control box
T11	Transformer, speedtrol (line/ 240VAC)	Condenser section
TB1	Terminal block, internal	Main control box
TB2	Terminal block, field	Main control box
TB3	Terminal blocks, factory	Main control box
TB4	Terminal block, RFS, field	Main control box
TB5	Terminal block, RCS, field	Condenser control box
TB6	Terminal block, RCS, factory	Condenser control box
TB7	Terminal block, 115V convenience outlet, field	Main control box
TB8	Terminal block, 115V conv. outlet, RCS, field	Condenser control box
TB11	Terminal block, heat	Heat control box

ID	Description	Standard location
TB23	Terminal block, oil pressure box, RPE/RCE only	Evap. condenser vestibule
TB25, 26, 27, 28	Terminal block, split unit junction box	Junction box, split unit
TC12, 13, 14	Temperature controls, Fantrol	Condenser section
TC56	Temperature control, water pipe heater	Evap. condenser vestibule
TC66	Temperature control, vestibule exhaust fan	Evap. condenser vestibule
TD1, 2	Time delay, compressor lockout	Main/cond. control box
TD3, 4	Time delay, hi-pressure	Main/cond. control box
TD5–8	Time delay, part winding, compr #1 - 4	Main control box
TD10	Time delay, hi turn down burner	Gas heat box
TD11, 12	Time delay, low ambient	Main/cond. control box
TR1, 2	Transducer, pressure	Main control box
U1, 2	Unloaders, compressors	On compressors
UV	Ultra-violet light(s)	Coil/discharge section
VM1	Valve motor #1, heating	Gas heat box/ heat section
VM5	Valve motor #5, cooling	Coil section, cool
VV1	Vent valve, gas heat	Heat Section, Gas
WL63	Water level, sump, fill	Evap. condenser section
WL64	Water level, sump, low water	Evap. condenser section
ZNT1	Zone temp. sensor, setback	Field installed

General Notes

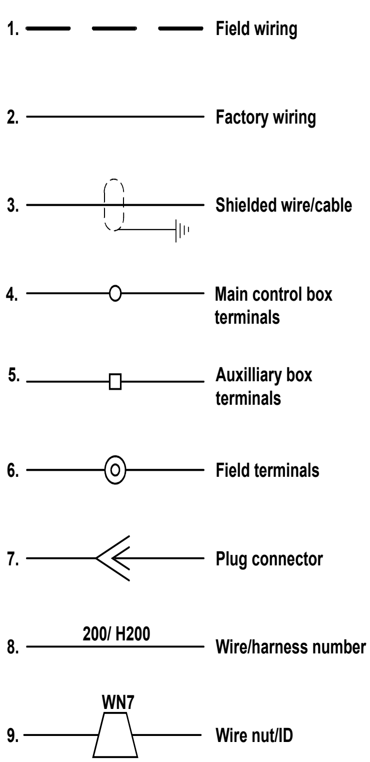
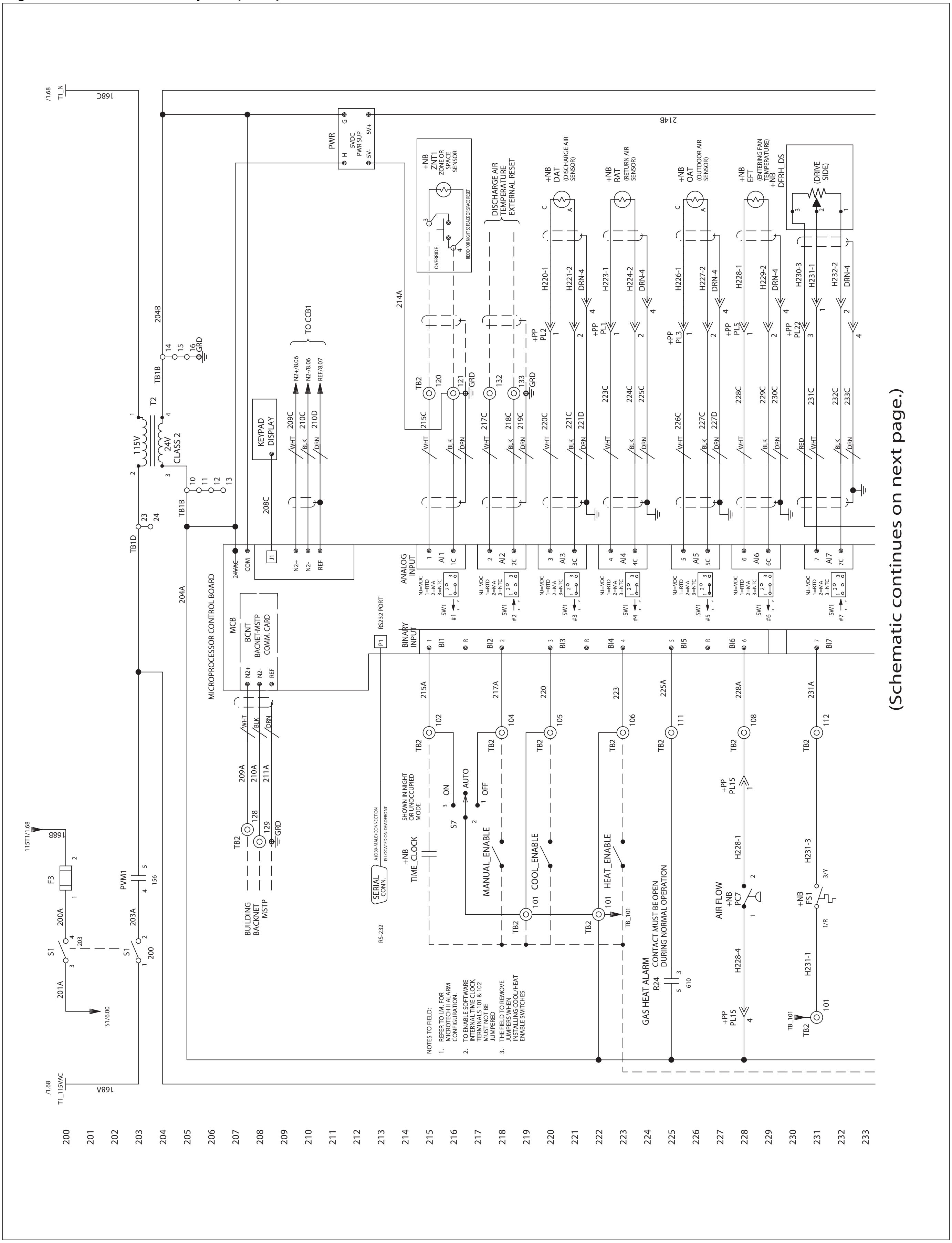


Figure 16: VAV control inputs (DAC)



(Schematic continues on next page.)

Figure 16: VAV control inputs (DAC), continued

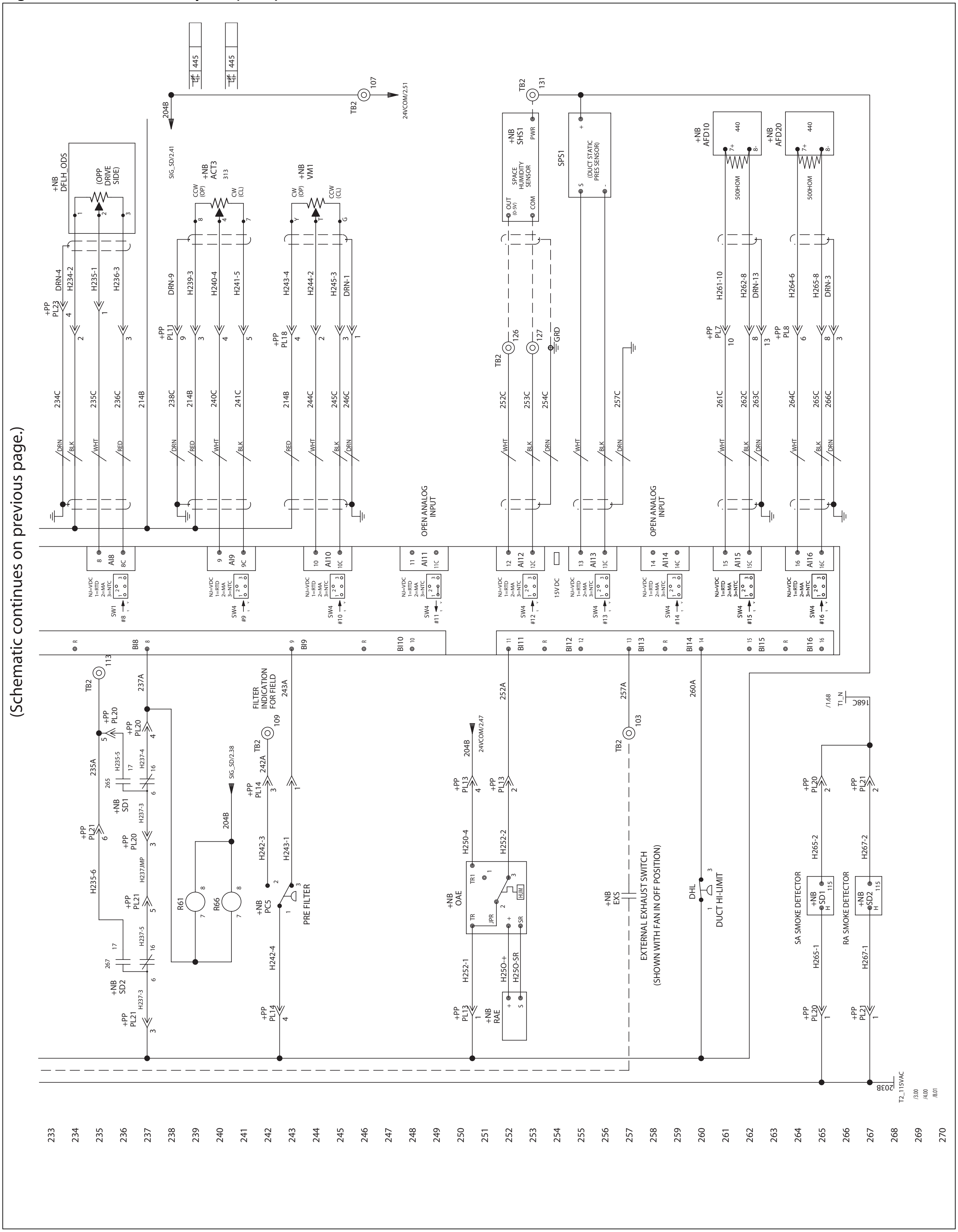
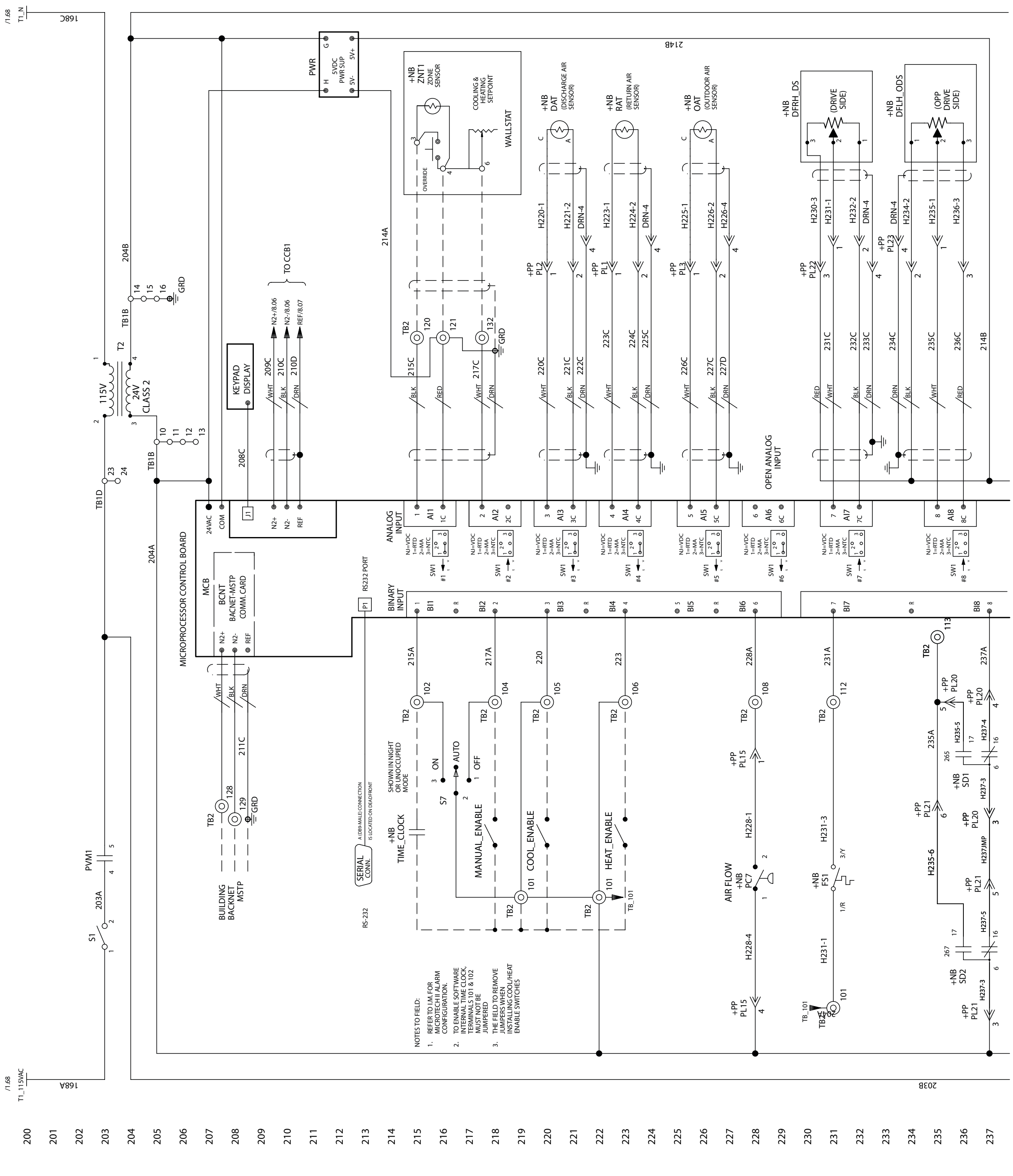


Figure 17: Constant volume control inputs (SCC)



(Schematic continues on next page.)

Figure 17: Constant volume control inputs (SCC), continued

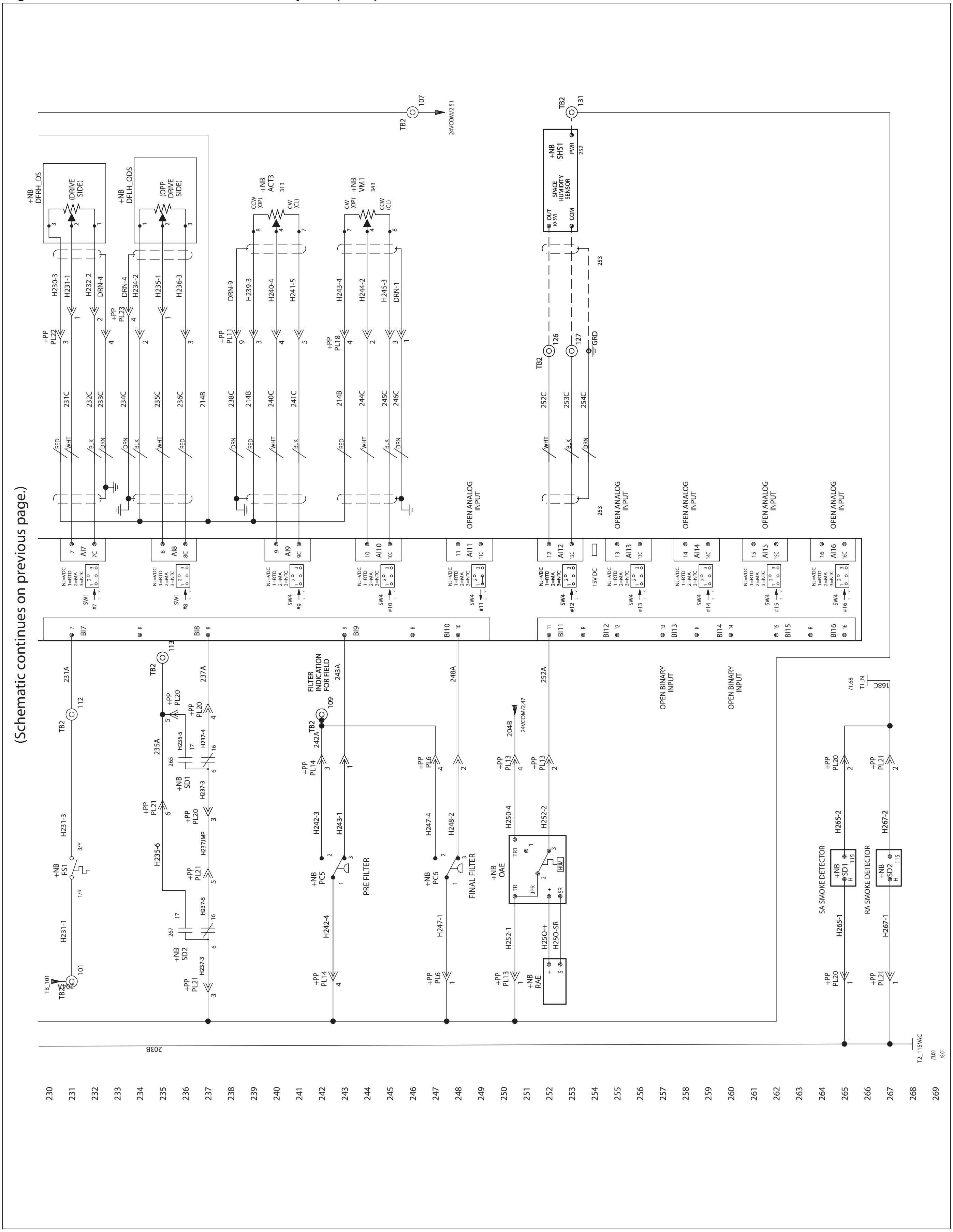
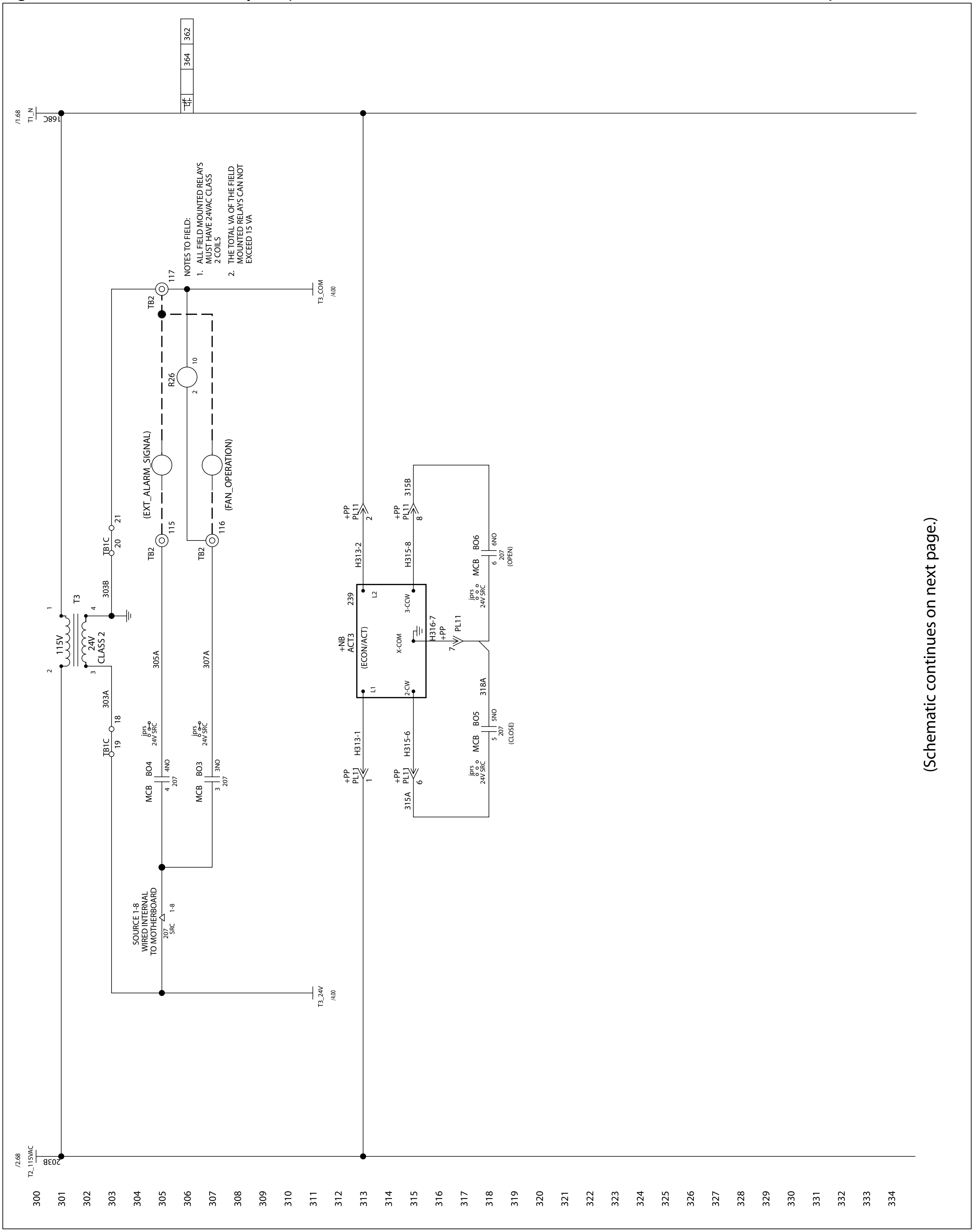


Figure 18: Control actuator outputs (constant volume RPS with hot water or steam heat with economizer)



(Schematic continues on next page.)

Figure 18: Control actuator outputs (constant volume RPS with hot water or steam heat with economizer), continued

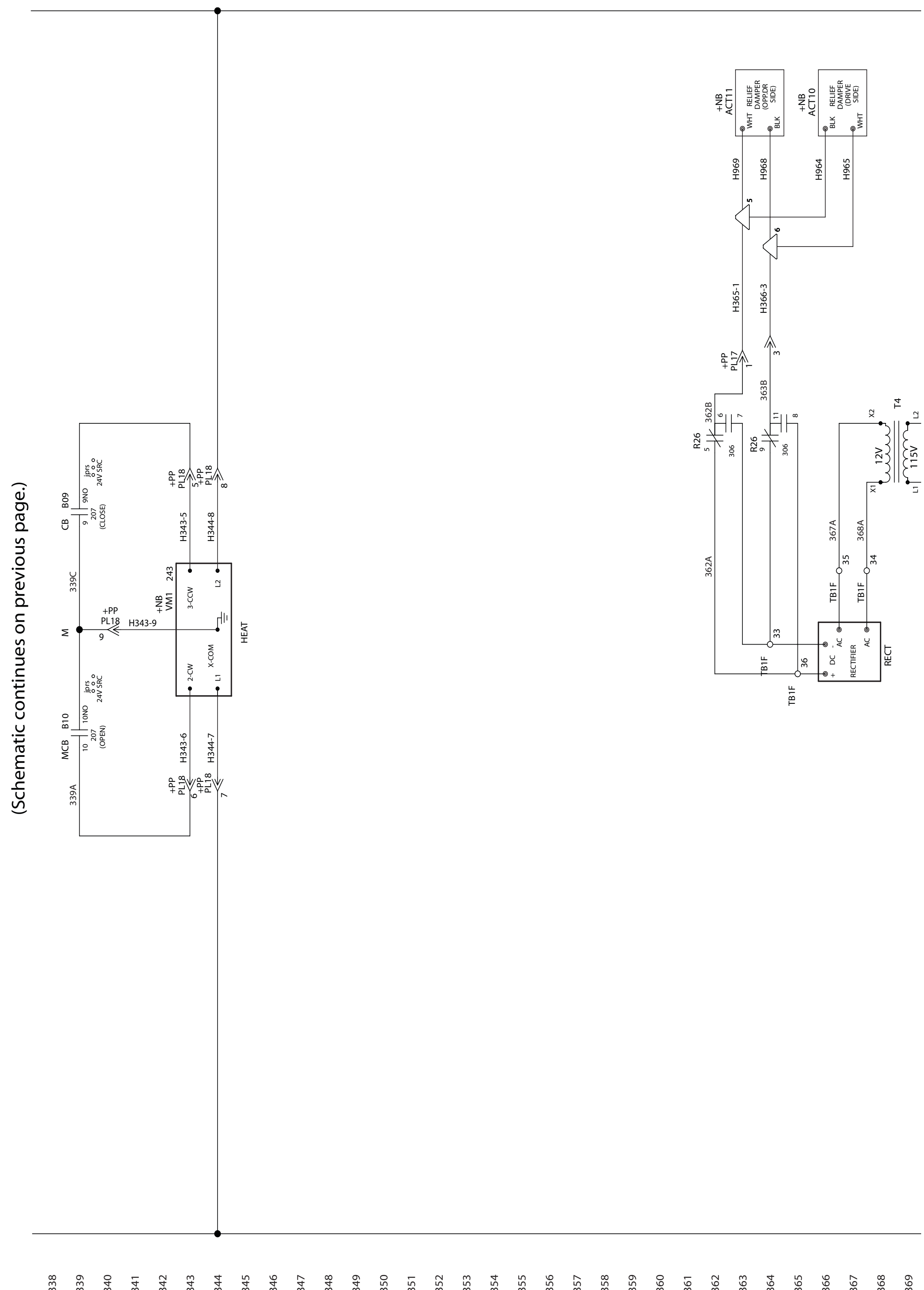
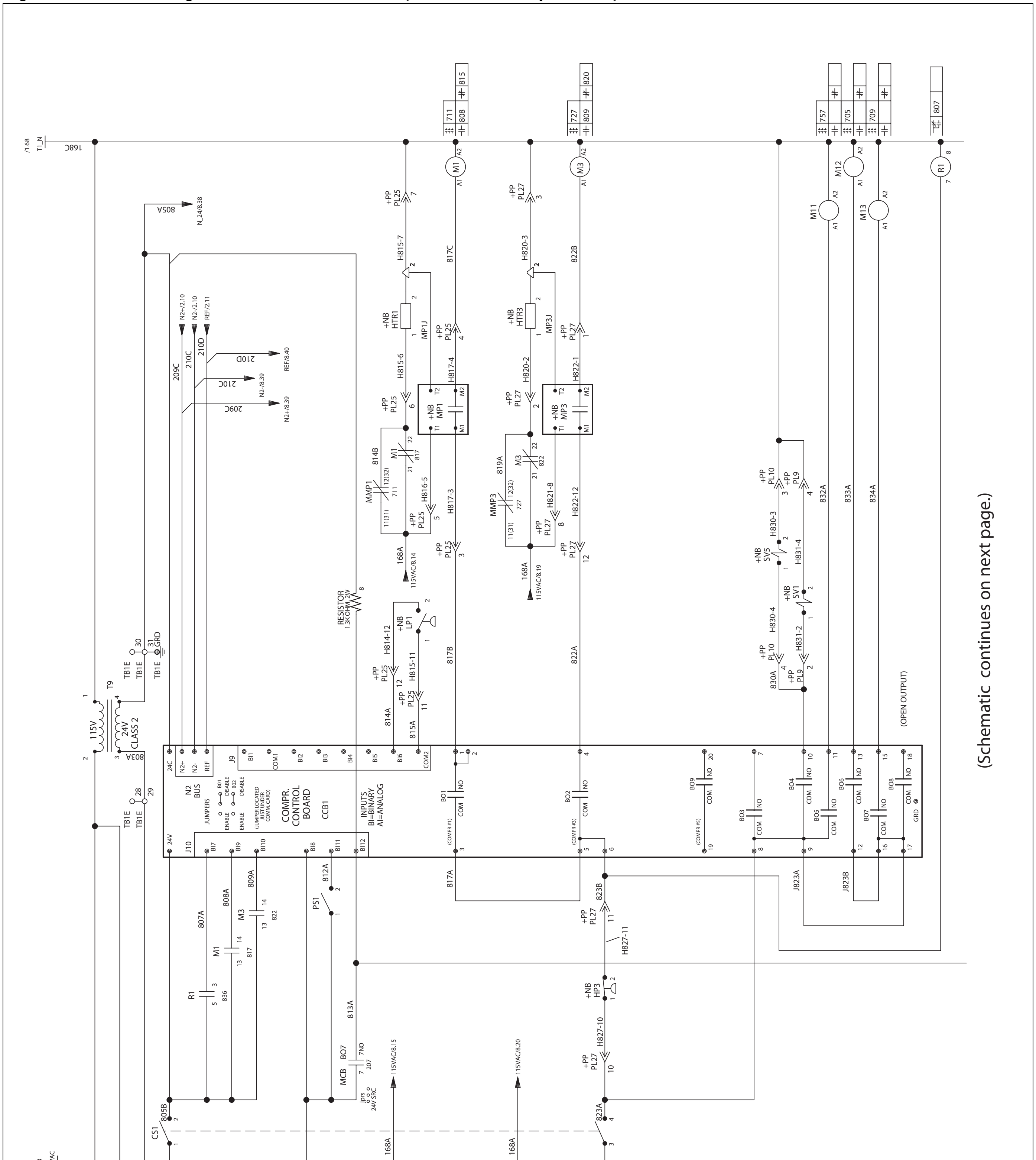


Figure 19: Condensing section control, RPS 60 (with scroll compressors)



(Schematic continues on next page.)

Figure 19: Condensing section control, RPS 60 (with scroll compressors), continued

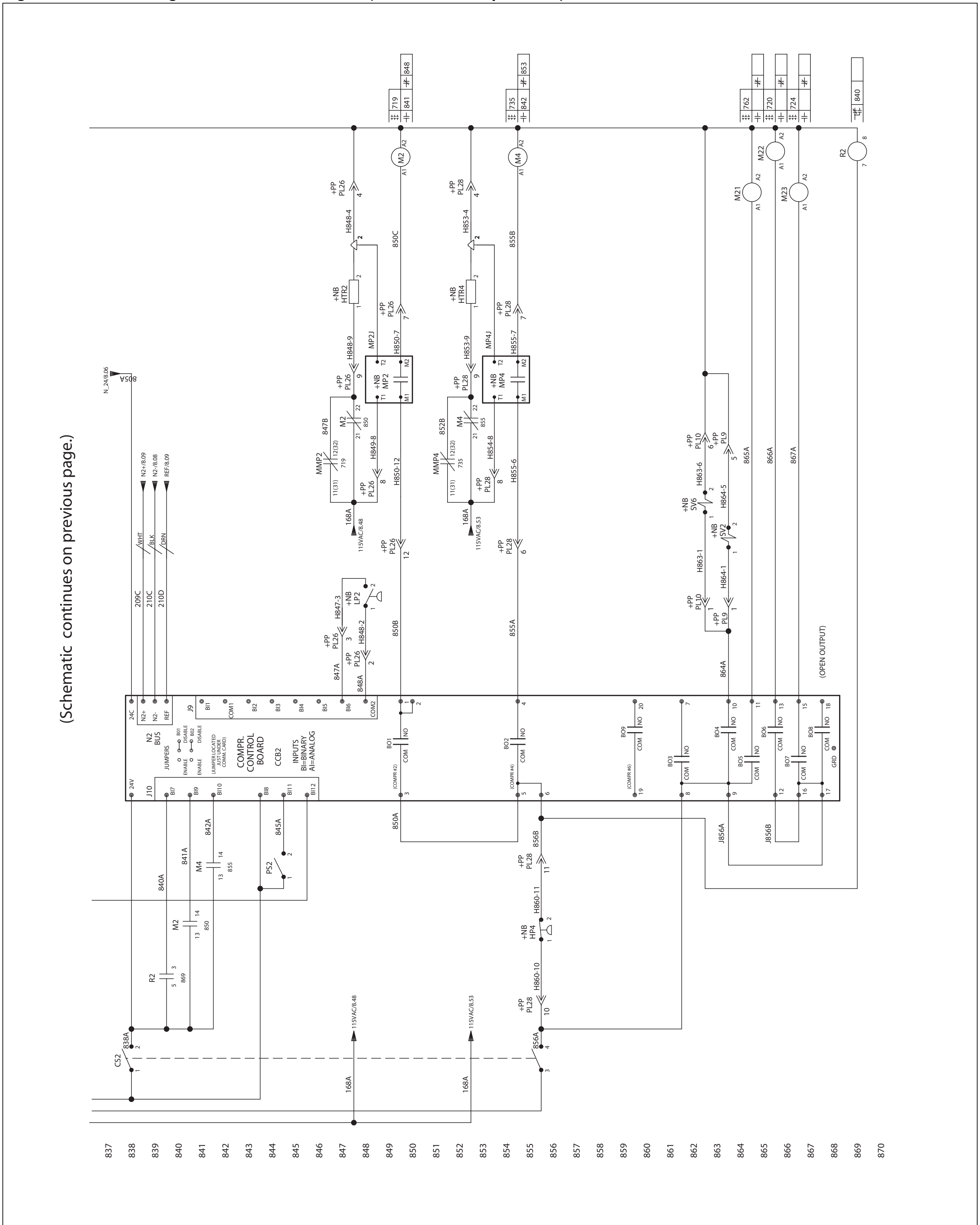


Figure 20: Condensing section control, RPS 135 (with reciprocating compressors)

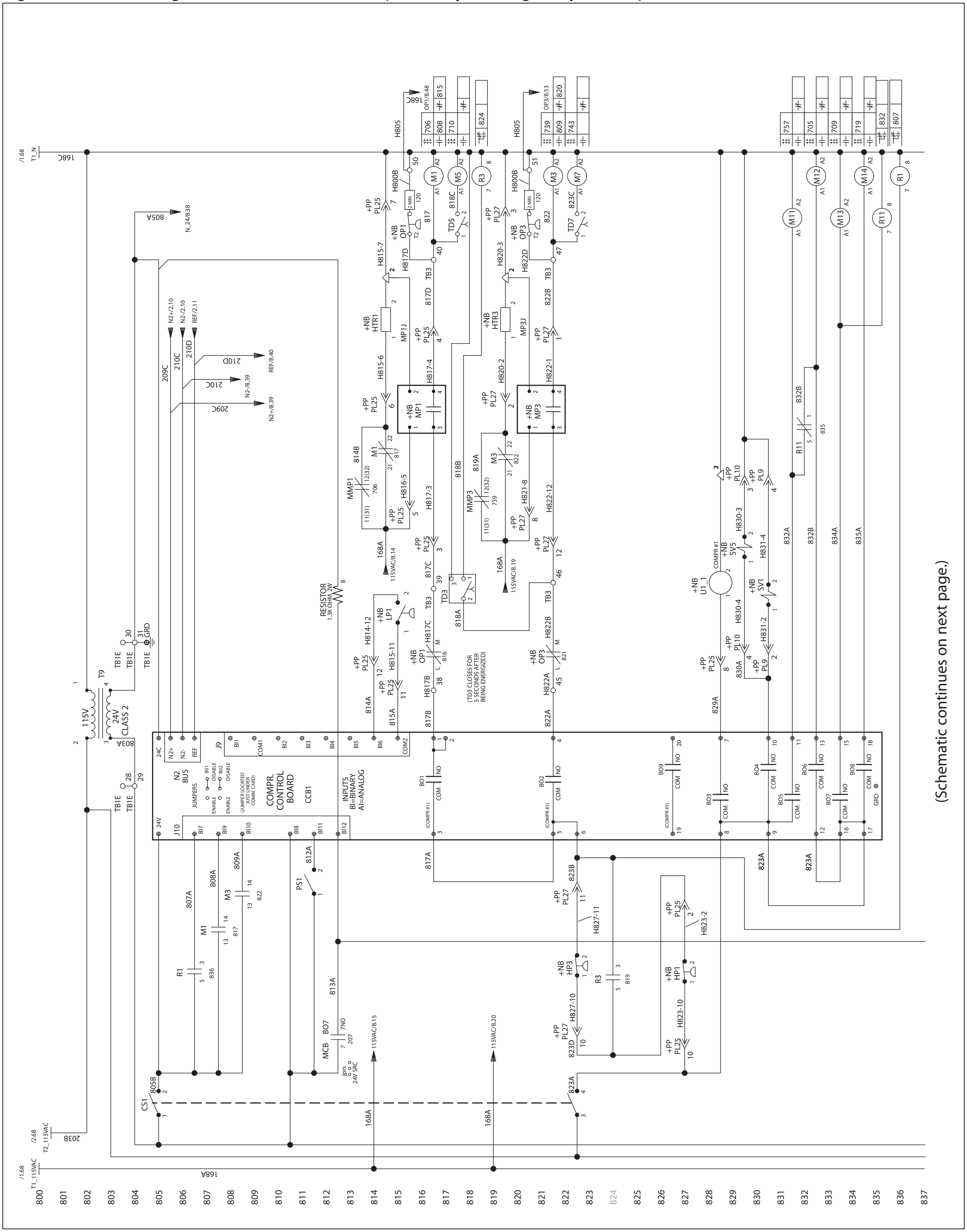


Figure 21: Condensing section control, RPS 135 (with reciprocating compressors), continued

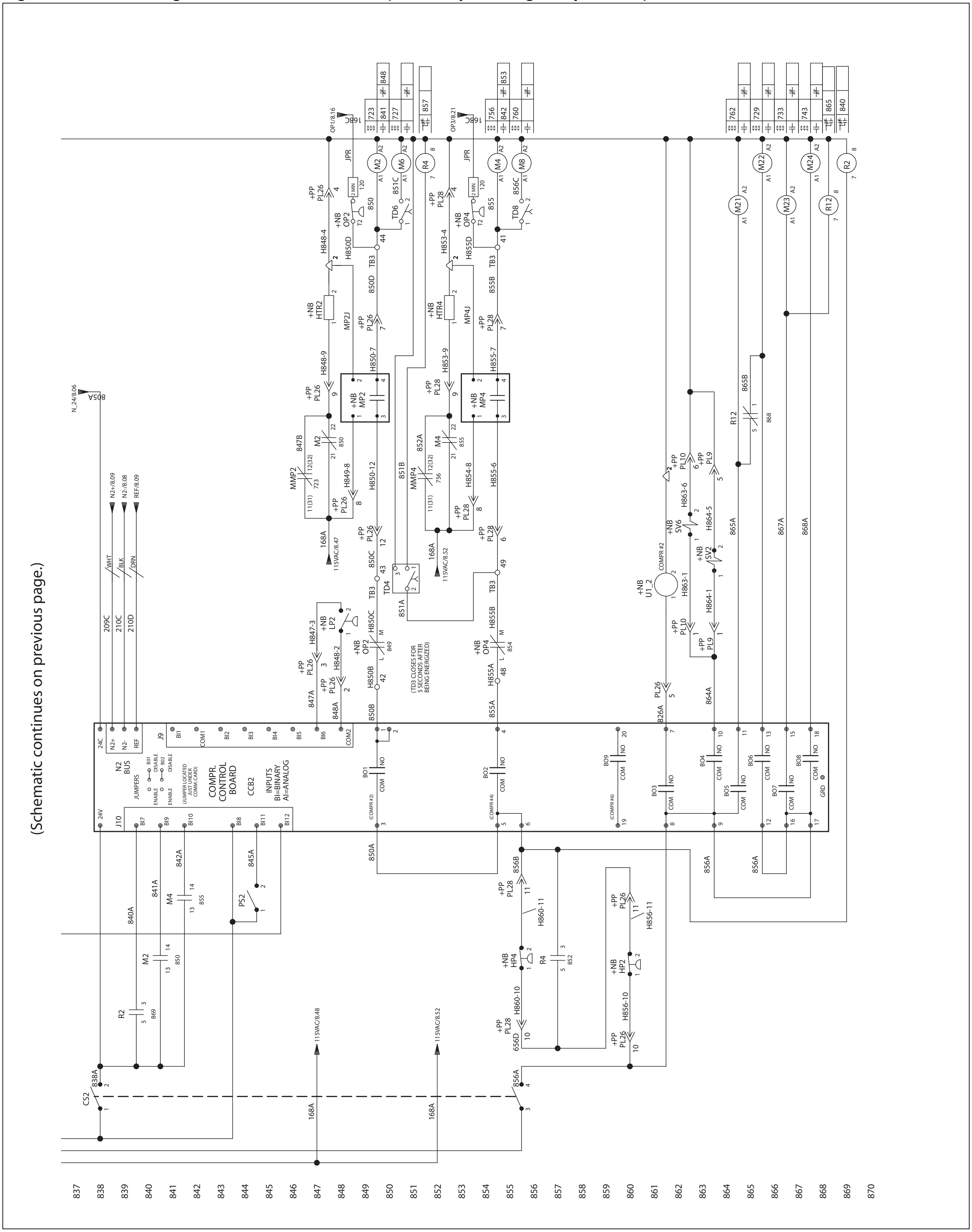
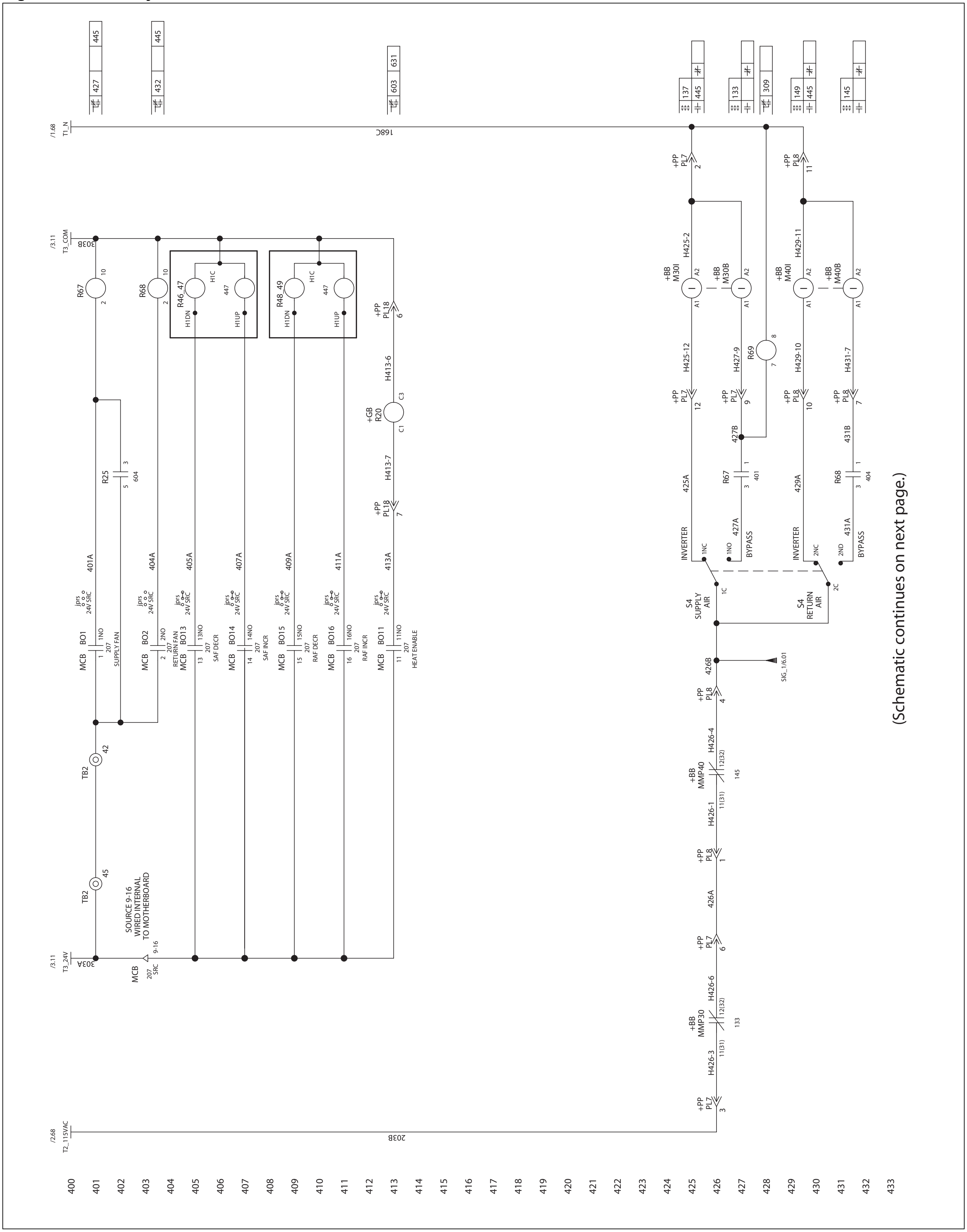
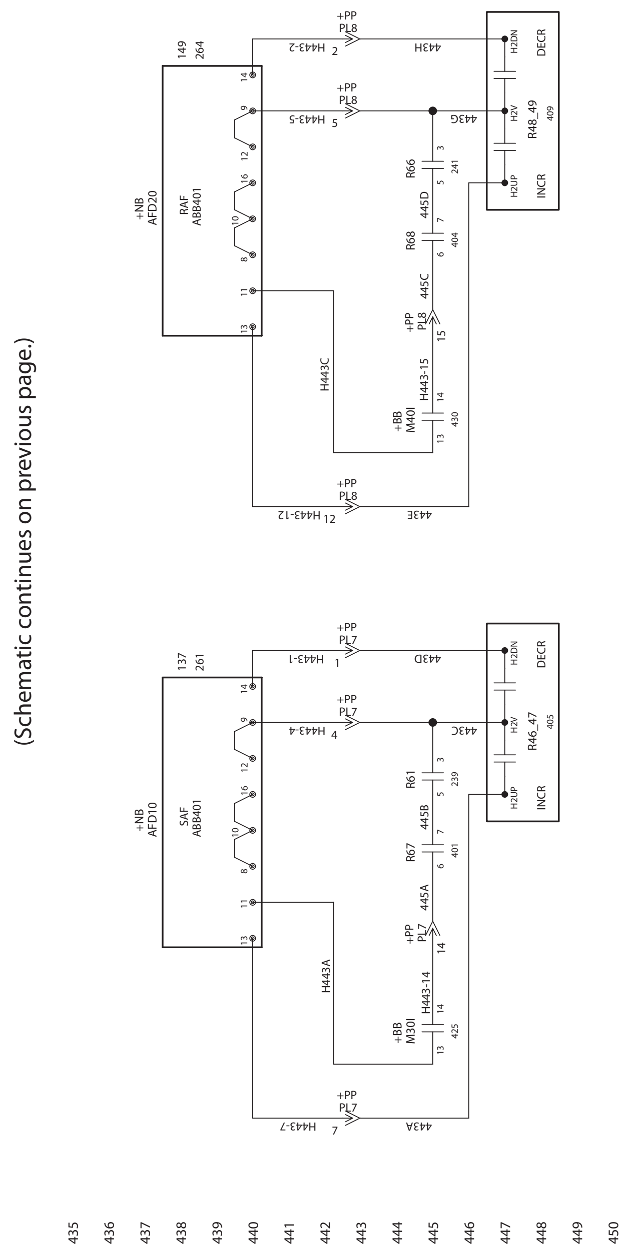


Figure 22: Auxiliary VFD control



(Schematic continues on next page.)

Figure 22: Auxiliary VFD control



(Schematic continues on previous page.)

Figure 23: Modulating gas heat control (standard mod)

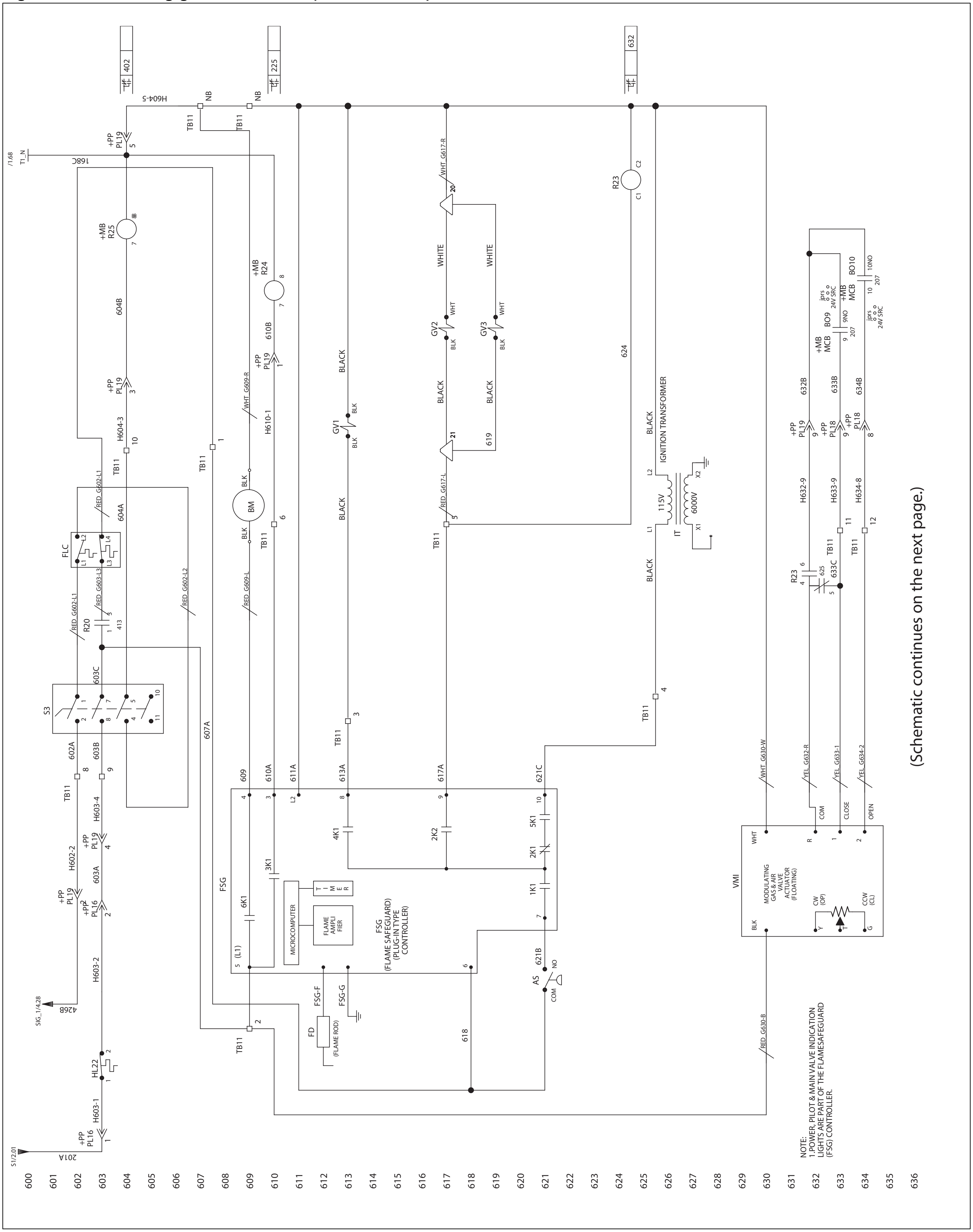


Figure 23: Modulating gas heat control (standard mod), continued

(Schematic continues on the previous page.)

SEQUENCE OF OPERATION

WHEN THE ROOFTOP UNIT IS ENERGIZED 120 VOLT POWER IS SUPPLIED TO THE SYSTEM ON-OFF SWITCH (S1), TO BURNER ON-OFF SWITCH (S3) AND 24 VOLTS TO THE (BO#11) CONTACTS ON THE MAIN CTRL BRD (MCB). BURNER ON-OFF SWITCH (S3) WILL POWER THE MODULATING GAS VALVE ACTUATOR (VM1) AND TERMINAL #5(L1) ON THE FLAME SAFEGUARD (FSG). UPON A CALL FOR HEAT, THE CONTROL SYSTEM WILL CLOSE (BO#11) ON THE MAIN CTRL BRD (MCB), THUS ENERGIZING RELAY (R20). WHEN 120 VOLT POWER IS FURNISHED THROUGH THE SYSTEM ON-OFF SWITCH (S1), THROUGH THE BURNER ON-OFF SWITCH (S3), THROUGH RELAY (R20) CONTACTS, THROUGH THE HIGH LIMIT CONTROL (FLC) AND TERMINAL #6 ON THE FLAME SAFEQUARD (FSG) IS POWERED. THE FLAME SAFEGUARD THEN ENERGIZES ITS TERMINAL #4, WHICH POWERS THE BURNER COMBUSTION AIR BLOWER MOTOR (BM). WHENEVER POWER IS RESTORED TO THE FLAME SAFEGUARD, THE FLAME SAFEGUARD WILL GO THROUGH A 10 SECOND INITIATION PERIOD BEFORE THE PREPURGE PERIOD WILL BEGIN.

BLOWER OPERATION IS SENSED BY THE AIR SWITCH (AS), WHICH MAKES TERMINAL #6 TO #7. AFTER A 90 SECOND PREPURGE PERIOD, TERMINAL #8 (FIRST GAS VALVE (PILOT)--GV1) AND TERMINAL #10 (IGNITION TRANSFORMER--IT) WILL BE ENERGIZED. THE PILOT FLAME WILL IGNITE AND BE DETECTED BY THE FLAME SAFEGUARD THROUGH THE FLAME ROD (FD). UPON DETECTION OF PILOT FLAME, TERMINAL #10 (IGNITION TRANSFORMER--IT) WILL BE DE-ENERGIZED AND TERMINAL #9 (MAIN GAS VALVES--GV2 & GV3) WILL BE ENERGIZED AND THE MAIN FLAME WILL COME ON. ALSO, THE FLAME SAFEGUARD CONTAINS "LED'S" (LOWER LEFT CORNER) THAT WILL GLOW TO INDICATE OPERATION.

LOW FIRE START IS PROVIDED BY RELAY (R23). THE RELAY DRIVES THE GAS VALVE ACTUATOR (VM1) TO THE MINIMUM FIRING RATE POSITION WHENEVER THE FLAME IS NOT ON, AND HOLDS IT THERE UNTIL THE FLAME HAS LIT AND BEEN PROVEN.

WHENEVER THE BURNER IS IN OPERATION ITS FIRING RATE WILL BE DETERMINED BY THE "FLOATING" GAS VALVE ACTUATOR (VM1). THIS ACTUATOR POSITIONS THE BUTTERFLY GAS VALVE AND COMBUSTION AIR DAMPER AND CAN SET THE FIRING RATE BETWEEN 33% AND 100% OF NORMAL RATE. WHEN THE MAIN CONTROL SYSTEM CLOSES (BO#10) ON THE MAIN CTRL BRD.(MCB), THE GAS VALVE ACTUATOR WILL REPOSITION TOWARD A HIGHER FIRING RATE UNTIL EITHER (BO#10) OPENS OR THE ACTUATOR REACHES ITS MAXIMUM POSITION. WHEN THE MAIN CONTROL SYSTEM CLOSES (BO#9) ON THE MAIN CTRL BRD.(MCB), THE ACTUATOR WILL REPOSITION TOWARD A LOWER FIRING RATE. IF NEITHER (BO#9) OR (BO#10) ON THE MAIN CONTROL BOARD (MCB) ARE CLOSED THE ACTUATOR WILL REMAIN AT ITS PRESENT POSITION. THE HEATING CAPACITY IS MONITORED BY THE MAIN CONTROL BOARD (MCB) THROUGH (AI#10) VIA A POSITION FEEDBACK POTENTIOMETER ON THE ACTUATOR (VM1).

IN THE EVENT THE PILOT FAILS TO IGNITE OR THE FLAME SAFEGUARD FAILS TO DETECT ITS FLAME WITHIN 10 SECONDS, TERMINALS #4, 8, 9, AND 10 WILL BE DE-ENERGIZED, THUS DE-ENERGIZING THE BURNER. THE FLAME SAFEGUARD WOULD THEN BE ON SAFETY LOCKOUT AND WOULD REQUIRE MANUAL RESETTING. THE HEAT ALARM RELAY (R24) WOULD THEN BE ENERGIZED AND WOULD THEN ENERGIZE THE REMOTE "HEAT FAIL" INDICATOR LIGHT AND SEND A FAIL SIGNAL TO BINARY INPUT #5 ON THE MICROTECH II MAIN CONTROL BOARD (MCB).

IF THE UNIT OVERHEATS, THE HIGH LIMIT CONTROL (FLC) WILL CYCLE THE BURNER, LIMITING FURNACE TEMPERATURE TO THE LIMIT CONTROL SET POINT.

PIPING DIAGRAM

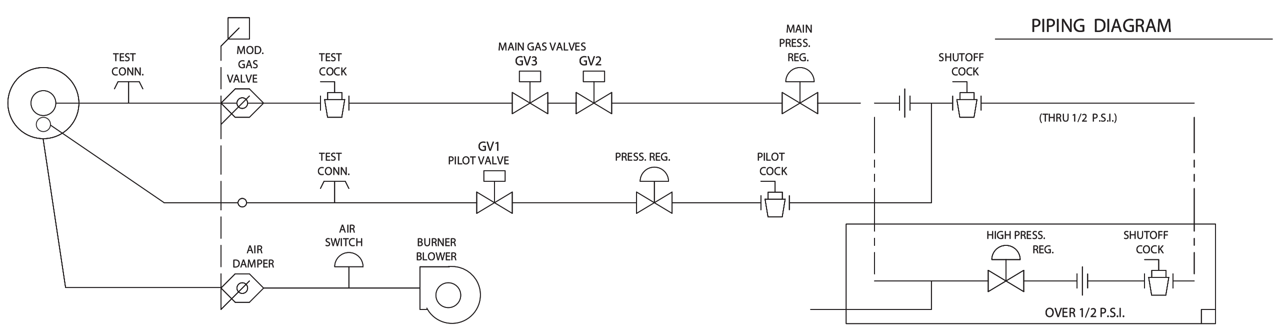
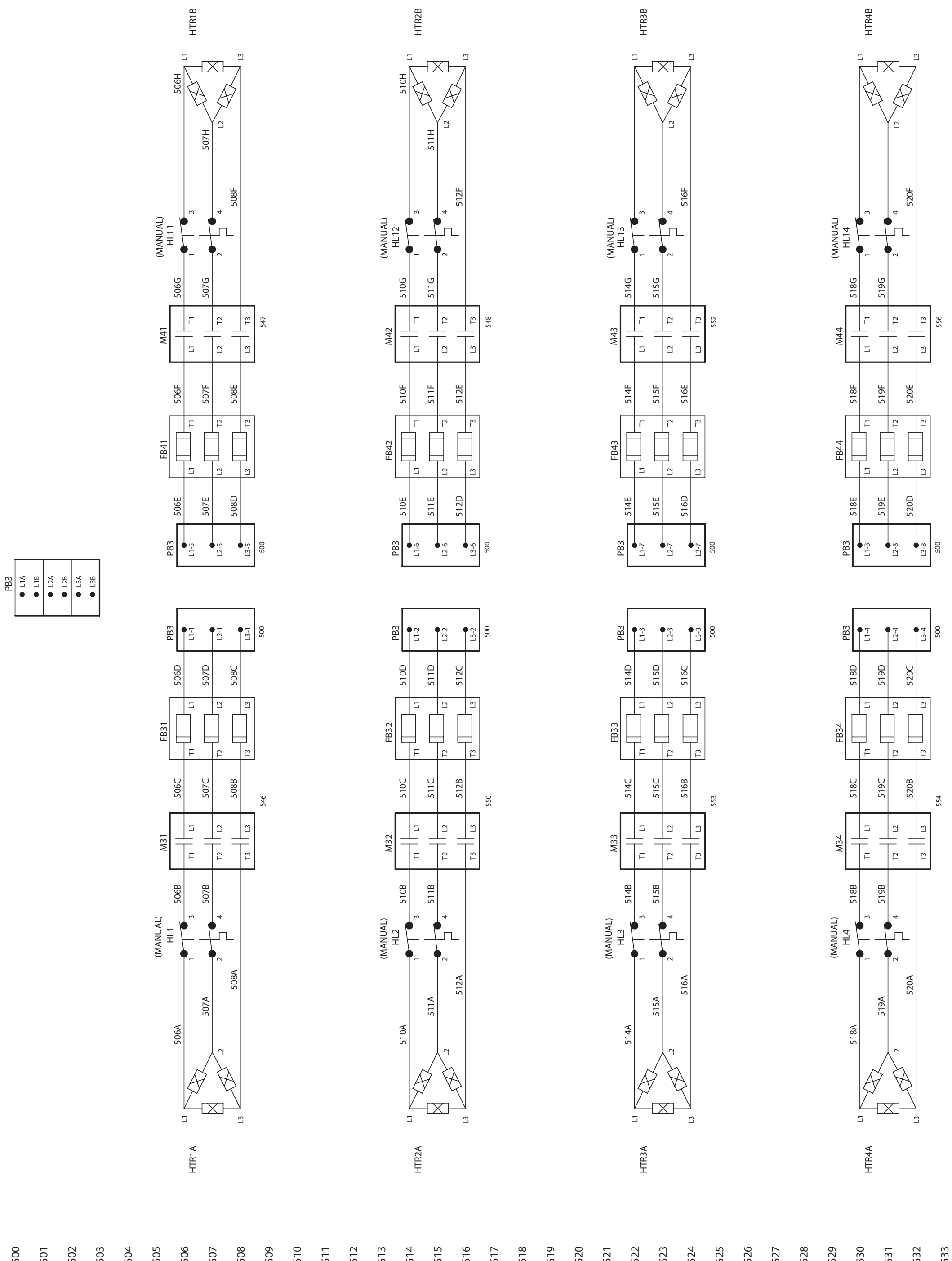


Figure 24: Multistage electric heat control (4 stage)



(Schematic continues on next page.)

Figure 24: Multistage electric heat control (4 stage), continued

(Schematic continues on previous page.)

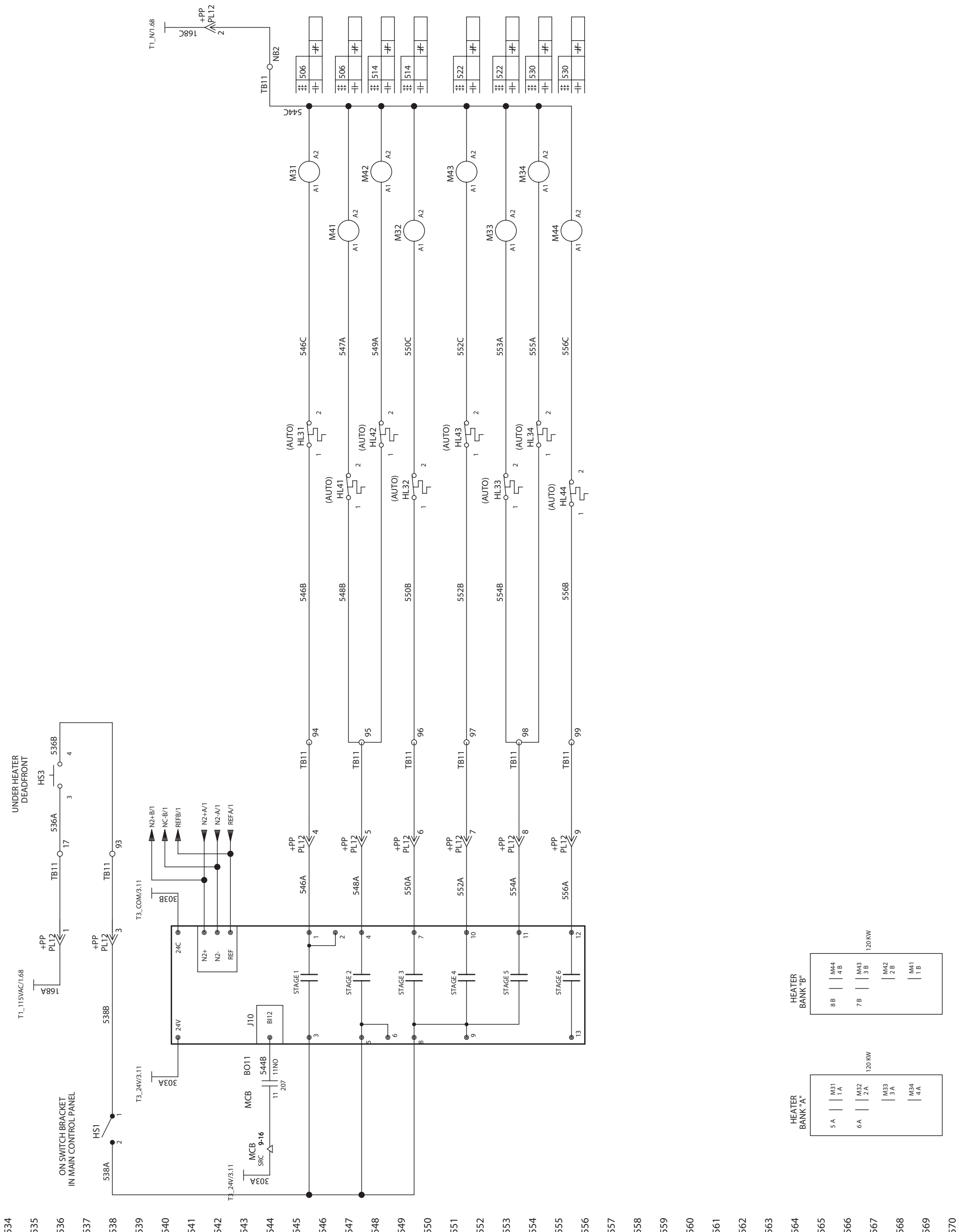
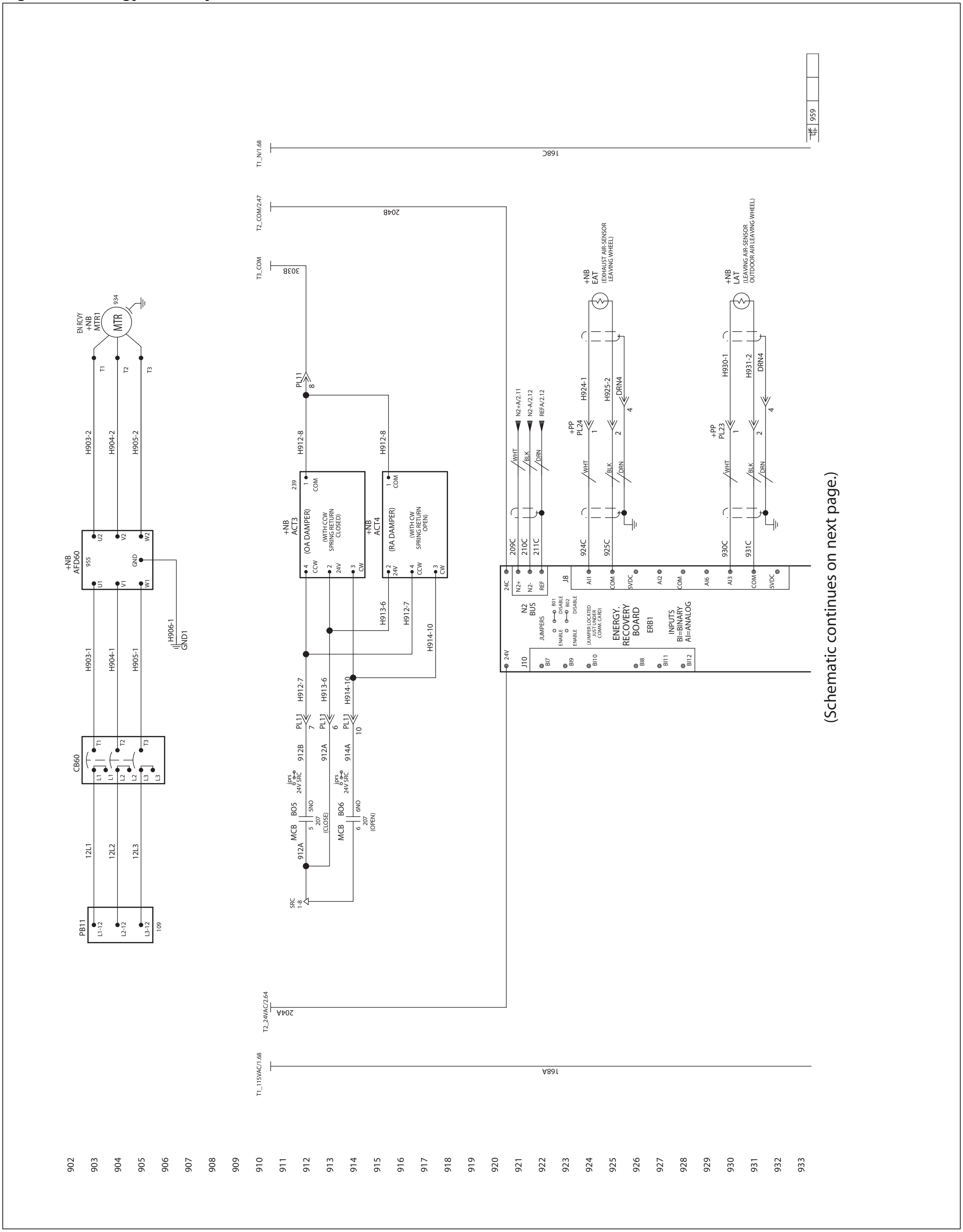


Figure 25: Energy recovery wheel control



(Schematic continues on next page.)

Figure 25: Energy recovery wheel control, continued

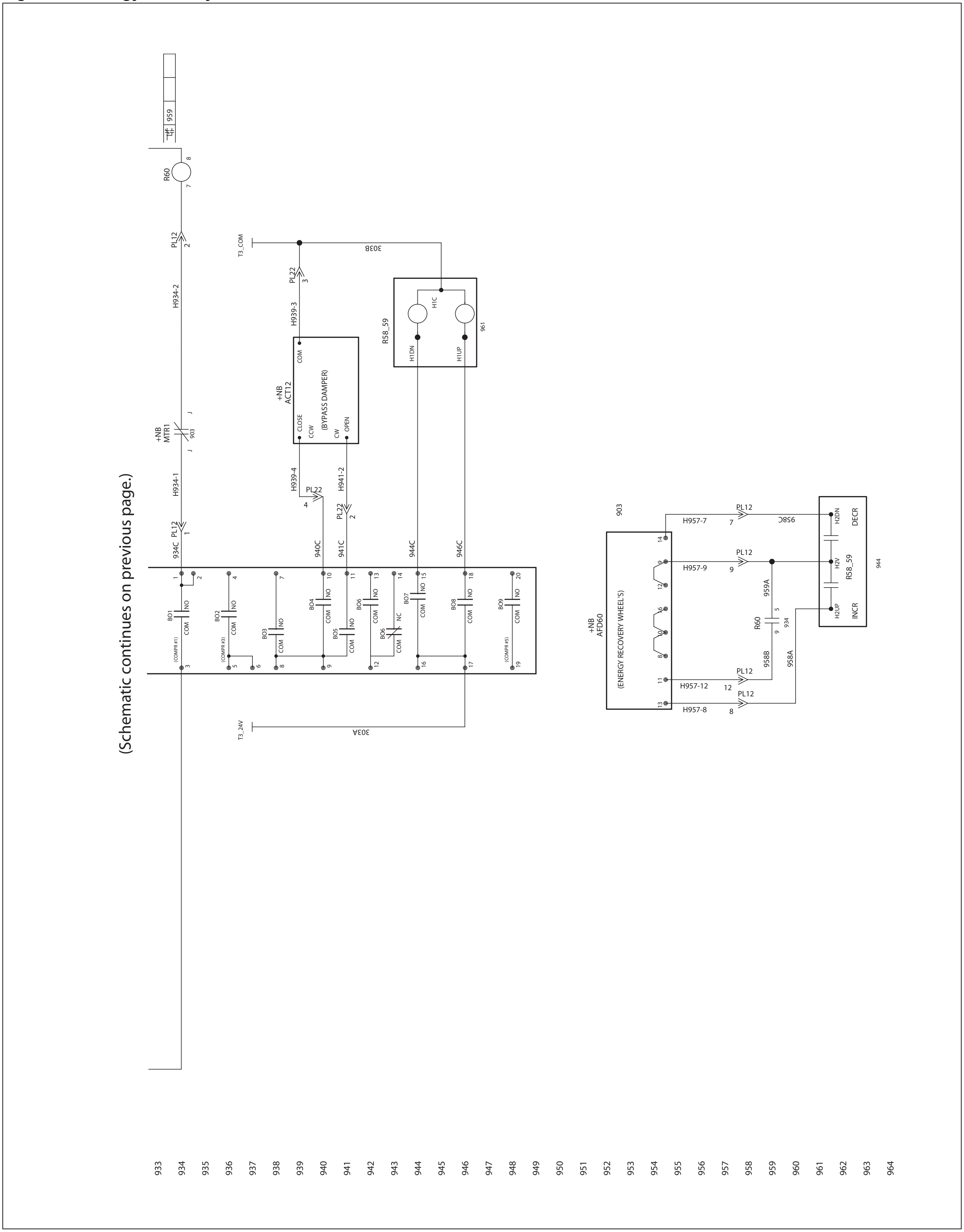
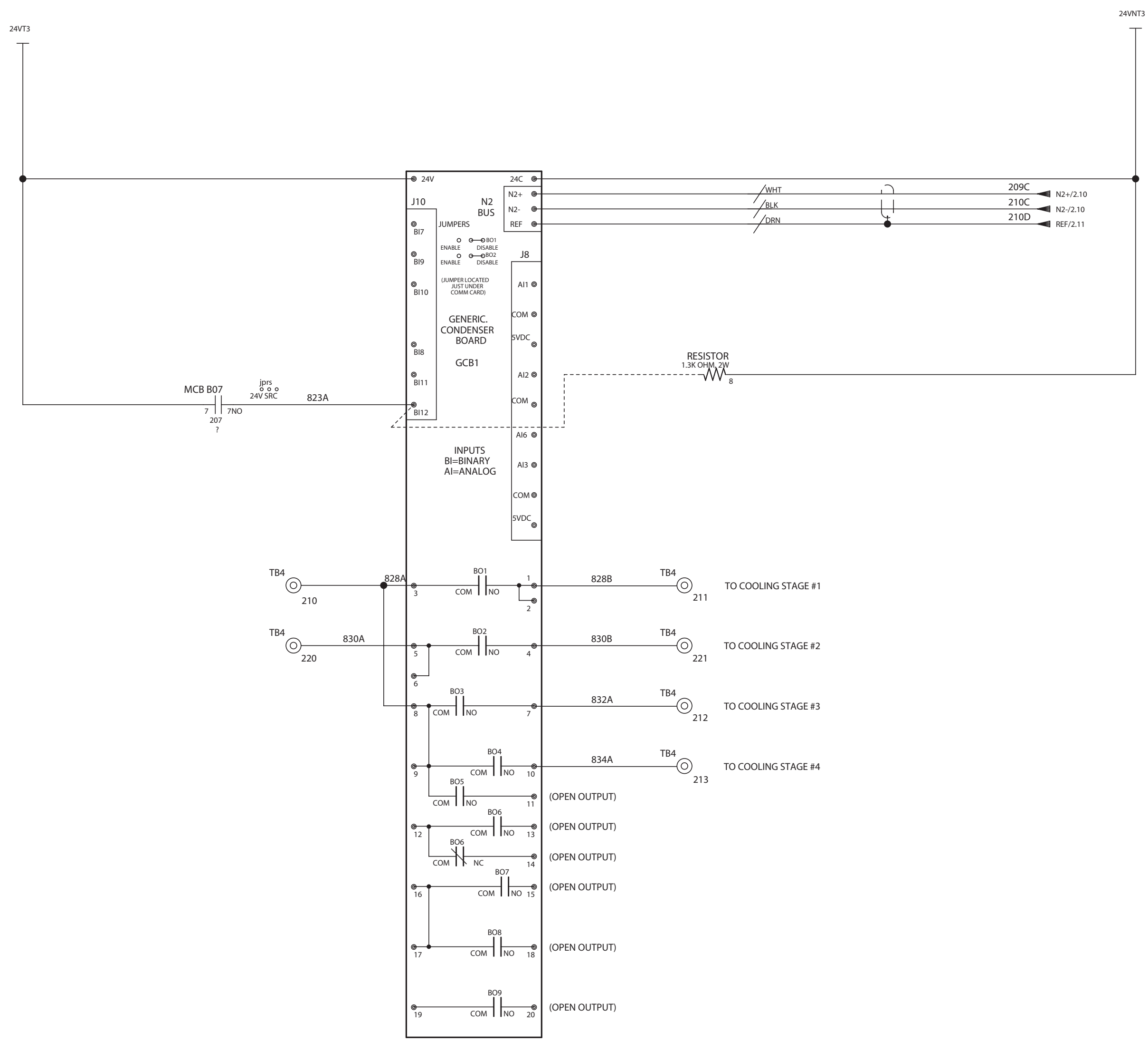


Figure 25: Generic condenser control (4 stage)



BINARY OUTPUT ELEC. RATINGS

277V, 5A RESISTIVE

120V, 1/10HP, 3FLA, 18LRA, 100VA PILOT DUTY

240V, 1/4HP, 2.9FLA, 17.4LRA, 250VA PILOT DUTY

277V, 1/3HP, 2.98FLA, 17.88LRA, 300VA PILOT DUTY

Figure 26: Constant volume fan control (SAF and RAF)

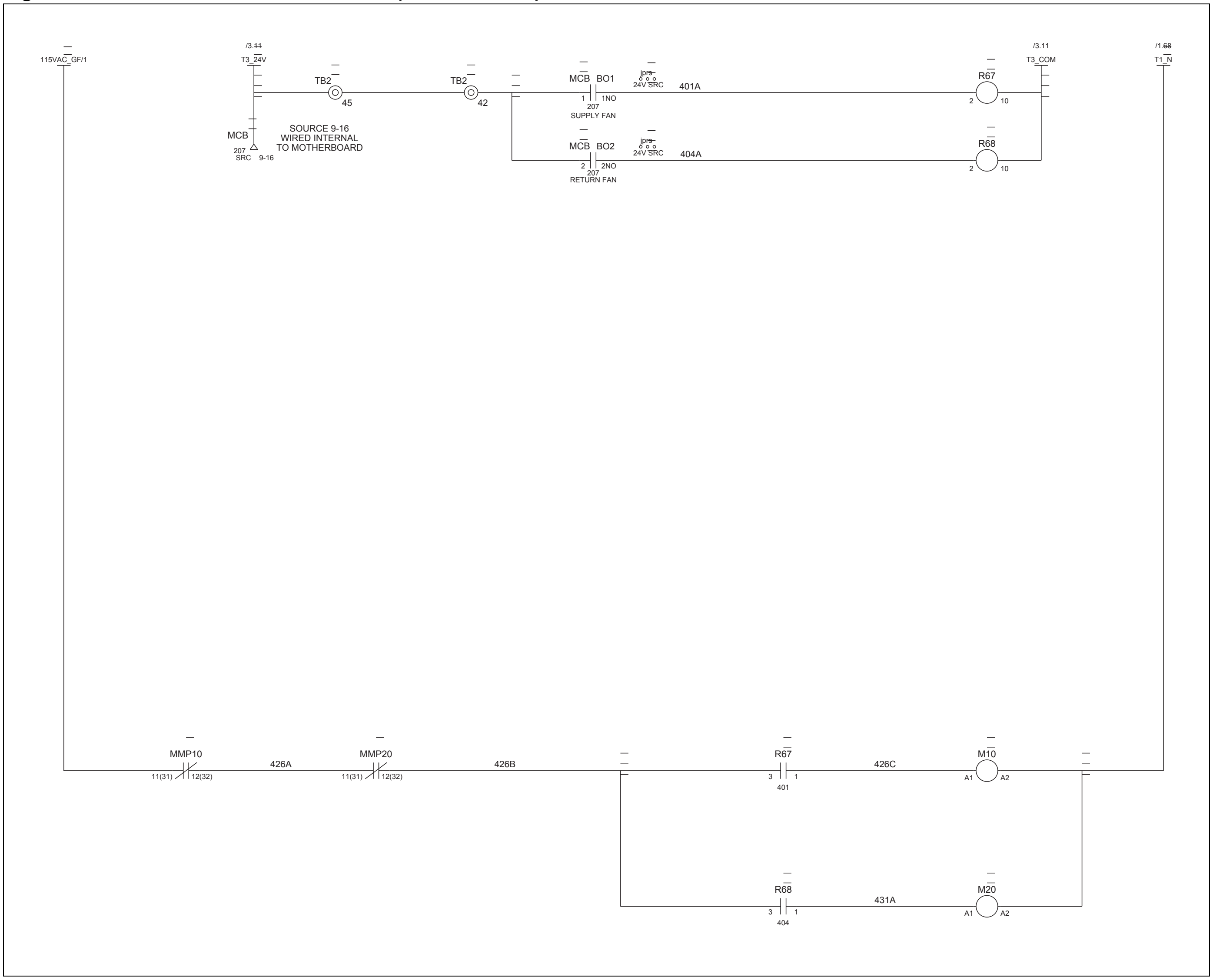
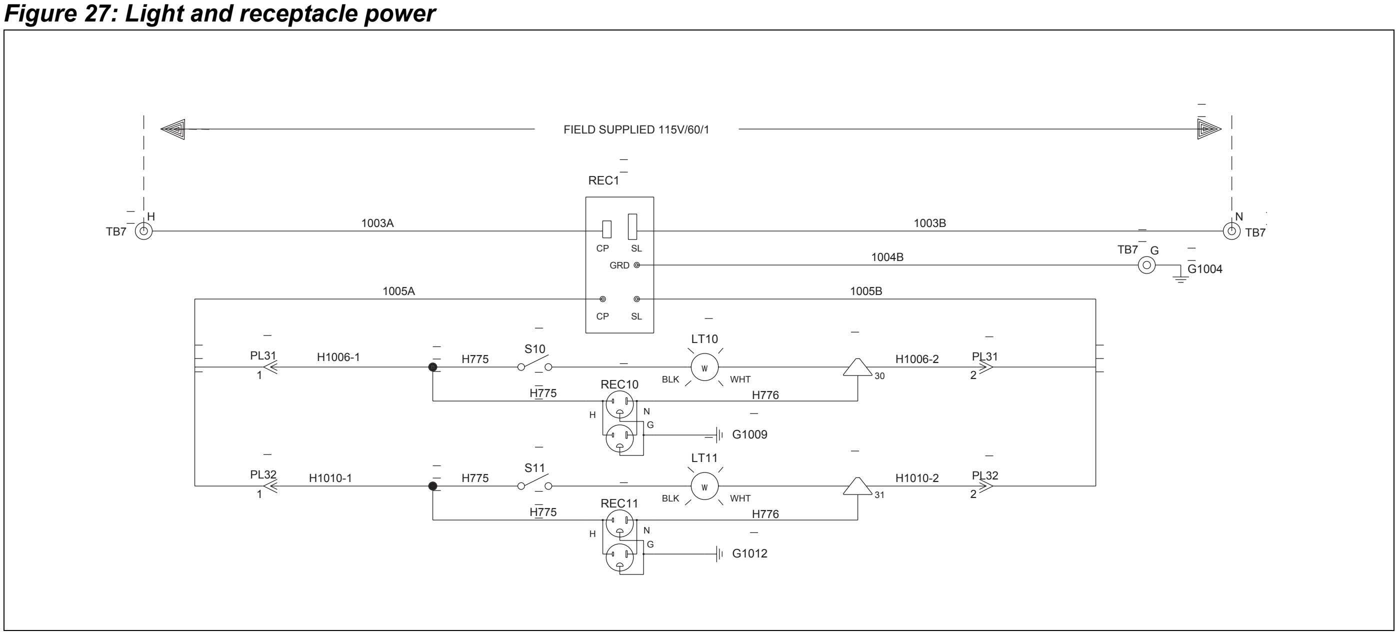


Figure 27: Light and receptacle power



Test Procedures

> Compressor pumpdown is required before removing power to the controller or unit damage could occur.

When troubleshooting the various MicroTech II components, it may be necessary to remove power to the controller by opening system switch S1 in the main control panel. Before doing this, pump down the compressors. To do this, open pumpdown switches PS1 and PS2.

The "Parts List" section at the end of this manual includes a listing of MicroTech II related part numbers.

Troubleshooting Main Control Board (MCB)

MCB Battery

Standby power is provided by a 3 VDC lithium battery, which maintains the MCB Static Random Access Memory (SRAM) and the Real Time Clock (RTC) while power is removed from the MCB.

The battery degrades with time depending on load, temperature, and the percentage of time the MCB does not have power. With an operating temperature under 25ºC, battery life expectancy is as follows:

Table 23: Battery life expectancy

	Typical life	Minimum life
1%	10 years	5 years
10%	10 years	5 years
100%	1 year	0.3 years

A battery test is performed each time the MCB power-up diagnostics are executed. The minimum voltage needed to sustain the SRAM and RTC is 2.0 VDC. A warning occurs when the battery voltage drops below approximately 2.5 VDC, which is indicated by the red MCB Error LED blinking after the Main Control Board Power-Up Sequence described below is completed. This warning signals that the battery is reaching the end of its useful life and should be replaced. Once a battery warning alarm occurs, replace the battery within 14 days to avoid complete battery failure and memory loss. Regardless of the battery status, the MCB board continues execution of the on-board program.

Note – After battery replacement, the Error LED does not revert to the normal off condition until one of the following occurs:

- Power is cycled to MCB
- The battery is tested at two minutes after midnight each day. If battery is normal then, the Error LED reverts to normal

MCB Data Archiving

All the MCB control parameters and the real time clock settings are backed up by the MCB using the SRAM. The SRAM is maintained by the MCB battery when power is removed from the MCB. To avoid losing the information stored on the board if battery failure occurs, the MCB performs a data archiving function once a day, just after midnight. At this time, all the MCB control parameter settings are archived to a file stored in the MCB FLASH memory.

If the MCB is powered up with a low or defective battery (or no battery), the most recently archived data is restored to the controller.

Note – When this archived data restoration process occurs, it increases the controller startup and initialization period by approximately 75 seconds.

MCB "Cold" Reboot

Whenever troubleshooting of the MCB leads to the conclusion that the MCB is defective, perform a *cold* reboot before replacing it. A cold reboot consists of removing the MCB battery and cycling power to the controller.

MCB LED Power-Up Sequence

The various LEDs on the MCB are shown in Figure 28. When power is applied to the MCB, the LEDs execute a specific startup sequence, consisting of the following three main components:

- The LED Operational Check period
- The MCB Error Code Display period
- The MCB Initialization period

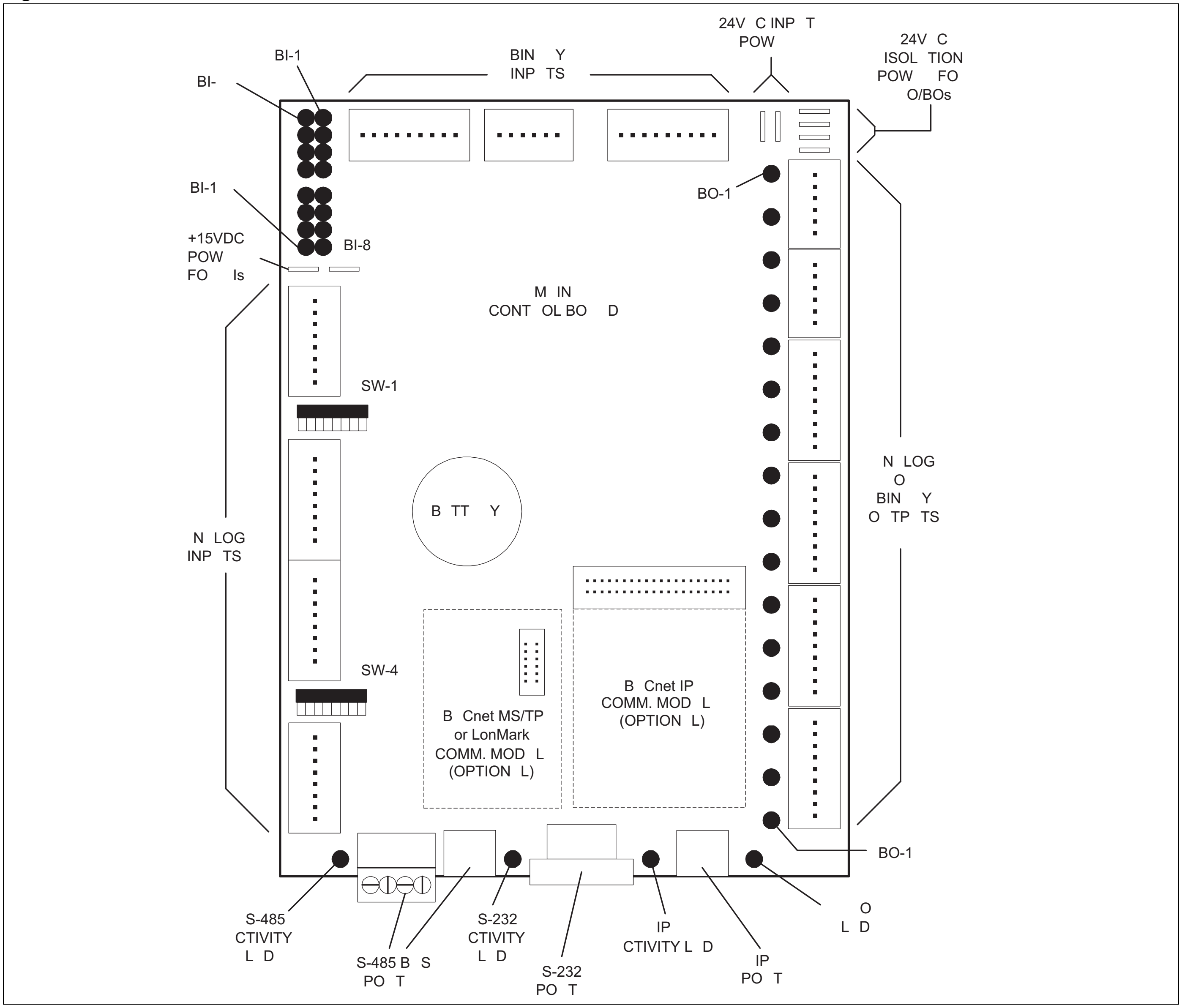
LED Operational Check Period. When power is applied to the MCB or when the MCB is reset, an operational test of the 16 Binary Input LEDs in the upper left corner and the four miscellaneous status LEDs at the bottom of the MCB is performed. This provides a visual check of the operational status of the LEDs. The following LED sequence should occur:

1. All 16 of the Binary Input LEDs and all the miscellaneous LEDs (3 green and 1 red) across the bottom of the MCB, turn ON for approximately 1–3 seconds and then turn OFF.
2. The miscellaneous LEDs across the bottom of the MCB sequence ON for one half second and then OFF from left to right (RS-485 Bus Port Activity, RS-232 Port Activity, IP Port Activity, and MCB Error).
3. Binary Input LEDs BI-1 through BI-8 are turned ON for one half second and then turned OFF.
4. Binary Input LEDs BI-9 through BI-16 are turned ON for one half second and then turned OFF.

If any of these LEDs fail to light as described, replace the MCB to correct the problem.

Note – Binary Outputs are not tested and remain off during the LED Operational Check period.

Figure 28: Main control board



MCB Error Code Display Period. After the LED Operational Check period is complete, if any MCB startup errors are detected, an error code displays. For details regarding the various LED error codes, refer to "MCB LED Startup Error Codes" below.

If no startup errors are detected, all LEDs remain OFF and the MCB Initialization period occurs as described below.

MCB Initialization Period. When the MCB Error Code Display period is complete, MCB Initialization begins. This period consists of the following LED sequence:

1. All the LEDs remain OFF for approximately 15–20 seconds (with a normal battery). If the battery is low or defective, this period lasts approximately 90 seconds during which previously archived control parameter data is restored to the controller. Refer to "Main Control Board (MCB) Data Archiving" on page 33.
2. The RS-485 Bus Port Activity Indication LED in the lower left corner of MCB begins blinking indicating activity on the RS-485 bus port, and after an approximate 1–2 second delay, the Binary Input LEDs turn ON according to the Binary Input switch conditions.
3. After a 15–20 second pause, the Binary Output LEDs on the right side of the board turn ON, according to the control program logic, and the startup sequence is complete.

Note – The elapsed time for the entire startup sequence, including the LED Operational Check, the MCB Error Code Display, and the MCB Initialization period is approximately 45 to 120 seconds depending on the network configuration and the MCB battery condition.

MCB LED Startup Error Codes

The 16 green Binary Input LEDs in the upper left corner and miscellaneous LEDs on the bottom (3 green and 1 red) of the MCB (Refer to Figure 28 on page 59) can be used to diagnose problems with the MCB.

During the MCB Error Code Display period, MCB failures are indicated by the red MCB Error LED on the bottom right side turning ON or BLINKING along with one other LED turning ON according to Table 24 on page 60. If multiple error conditions exist, each error code appears in succession, lasting approximately 3 seconds each, and then turn OFF. Non-catastrophic errors are indicated during the MCB Error Code Display period with the red MCB Error LED remaining on continuously.

All non-catastrophic errors are logged in RAM to be retrieved by the MCB operating system. Catastrophic errors are indicated during the MCB Error Code Display period with the red MCB Error LED flashing at a rate of approximately 5.9 Hz. When the MCB Error Code Display period is complete, the startup sequence continues.

The following diagnostic tests are run during the startup sequence:

- Battery Test
- Flash CRC (Cyclic Redundancy Check) Test
- SRAM (Static RAM) Test
- Communication Port Tests
- IP Register Test

The following sections provide a brief description of each of these startup tests and recommended steps to correct the problem.

Table 24: Main control board LED startup error codes

	Startup errors										
	Battery	Flash CRC startup	Flash CRC main/boot	Flash CRC config.	RAM low byte	RAM high byte	RS 485 bus port	RS 232 port	BACnet MS/TP or LonMark port (optional)	I/O expansion port	IP port
RS-485 bus port							ON				
RS-232 port								ON			
IP port											ON
MCB error	ON	Blinking	Blinking	Blinking	Blinking	Blinking	ON	ON	ON	ON	ON
BI-1	ON										
BI-2									ON		
BI-3										ON	
BI-4		ON									
BI-5			ON								
BI-6				ON							
BI-7					ON						
BI-8						ON					

Battery Test

The battery test determines the status of the MCB battery. When the battery fails the test, the error is indicated by the red MCB Error LED and the Binary Input BI-1 LED turning ON during the MCB Error Code Display period. This warning signals the battery is nearing the end of its useful life and should be replaced. Regardless of the battery status, the MCB board continues execution of the on-board program. Once the Main Control Board LED Power-Up Sequence is complete, if the battery is bad, the red Error LED blinks on and off at a rate of one second on and one second off. If the battery is good it remains off.

Note – After battery replacement, the Error LED will not revert to the normal off condition until one of the following occurs:

- Power is cycled to MCB
- The battery is tested at two minutes after midnight each day. If battery is normal then, the Error LED reverts to normal.

Flash CRC Tests

The startup Flash memory test consists of a sector by sector CRC check of the following Flash code bases:

- Startup
- Boot
- Main
- Two Flash data bases: Dictionary and Configuration.

The results of all five tests are saved in SRAM for use by the operating system. A Dictionary failure does not result in a startup error display. The following scenarios describe the possible failure modes of the flash CRC tests.

Bad CRC in Startup Code Base. After displaying the Startup Flash CRC error during the MCB Error Code Display period, the startup process continues, if possible. Since the startup code validity is questionable, correct operation from this point is unpredictable. Daikin recommends downloading the startup code again. If this is not possible or ineffective, replace the MCB.

Bad CRC in Main Code Base and Boot Code Base. After displaying the Main/Boot Flash CRC error during the MCB Error Code Display period, the startup process continues. After the startup sequence is completed, execution is passed to the Boot code. Since the Boot code validity is questionable, correct operation after entering Boot code is unpredictable. A CRC failure in only the Boot or only the Main code base will not result in an error display. Re-downloading the Main and Boot code is recommended.

Bad CRC in Configuration Data Base. This is a fatal error that requires replacing the MCB. The configuration database contains user and factory defined configuration parameters including the device name, communication parameters, and I/O setup and calibration data. After displaying the Configuration Flash CRC error during the MCB Error Code Display period, the startup process continues. If main code is run, the MCB reboots, resulting in continuously repeating the error code and reboot cycle. If boot code is run, MCB will run with factory default values.

SRAM Test

Simply stated, the SRAM test checks each memory location by writing values to each location, reading the value back and comparing the read back value to the expected value. If a SRAM error is detected in the low byte, the RAM Low Byte failure displays during the MCB Error Code Display period. The MCB then is reset by an external "watchdog" circuit and the Main Control Board LED Power-Up Sequence begins again. If a SRAM failure is detected in the high byte, the RAM High Byte failure displays and the Serial Bus Port LED turns ON during the MCB Error Code Display period. The MCB then is reset by an external "watchdog" circuit and the Main Control Board LED Power-Up Sequence begins again. If either the RAM Low Byte or the RAM High Byte error occurs, replace the MCB.

Communication Port Tests

The various communication ports on the MCB are tested during the Main Control Board LED Power-Up Sequence. This feature allows the processor to verify the internal transmit and receive data paths of MCB data communication channels. Once in the test mode, proper operation of the various communication channels is verified by writing data to the corresponding transmit buffer of the channel under test and then reading the data back from the receive register. If read data does not match write data, the MCB displays the appropriate communication port error during the MCB Error Code Display period and then continues startup and initialization. If any of the possible communication port errors occur, replace the MCB.

IP Register Test

After determining the existence of an optional IP communication module, the MCB performs a series of read/write tests on critical registers of the IP processor. If any of the register tests fail, an IP port failure displays during the MCB Error Code Display period and then the MCB continues running startup and initialization. If the IP port error occurs, replace the IP communication module. If the problem persists after replacing the IP communication module, it is likely the MCB is defective. Refer also to the literature shipped with the IP communication module.

Troubleshooting Auxiliary Control Boards (CCB1, CCB2, GCB1, EHB1 and ERB1)

This section outlines basic functional checks of the auxiliary control boards that might be connected to the MCB via the RS-485 communication bus interface.

Hardware Check

1. Verify the auxiliary control board has been wired and terminated properly. Refer to the as-built unit wiring schematics or refer to Figure 16 on page 38 (DAC units) or Figure 17 on page 41 (SCC units).
2. Verify the RS-485 Communications module on the auxiliary control board is properly installed. Verify the address switches on the RS-485 Communication module are set to the correct address.

Note – Address switches may "appear" to be set correctly but actually may not be "seated" well. If there is a communication problem between the main control board and an auxiliary control board, try toggling the switches up and down a couple of times, reset them to the correct setting, and cycle power to the auxiliary control board. Refer to Table 4 on page 9.

3. Verify that 24 VAC power is available (CS1 or CS2 switch ON on as applicable) and properly terminated on the J1 terminal block on the auxiliary control board.

RS-485 Communication Card Status LEDs

A set of two status LEDs is located in the lower right area of the RS-485 Communication Card mounted on the auxiliary control boards (refer to Figure 7 on page 11). These LEDs provide useful trouble shooting information. The upper LED verifies that the MCB is transmitting data to the auxiliary control board. The lower LED verifies that the auxiliary control board is transmitting data to the MCB.

1. The upper LED should always blink at the same rate as the RS-485 Activity LED on the MCB (refer to Figure 30). If it is not blinking and the RS-485 Activity LED on the MCB is blinking, verify the wiring between the MCB and auxiliary board is free of defects. If the RS-485 Activity LED on the MCB is not blinking, it is likely the problem is with the MCB.
2. The lower LED should always be blinking. If it is not, perform the hardware checks listed above. If these check out correctly and the problem persists, cycle power to the entire controls system using the system S1 switch. If the problem persists, either the MCB has not been downloaded and configured correctly or the auxiliary control board or it is likely its RS-485 communication card is defective. Use the following procedure to isolate the problem component:
   - **a** Verify that the MCB download and configuration has been performed correctly and then cycle power to the entire control system using the S1 system switch. If this has been done and the problem persists, proceed to Step b below.
   - **b** Remove power from the control system and replace the RS-485 communication card on the suspect auxiliary control board with a properly functioning card. Do this by exchanging the RS-485 communication card with one of the other auxiliary control boards on the unit. If this is done, make sure to change the addresses switches on the RS-485 communication cards according to Table 4 on page 12. Apply power to the control system and check operation. If the problem follows the suspect communication card, the card is defective. If the problem remains with the suspect auxiliary control board, it is likely the auxiliary control board is defective.

Troubleshooting Keypad/Display

Keypad/Display Power Up Initialization

When the keypad/display is connected to the MCB and power is applied, the firmware in the keypad/display runs a diagnostic test of its static RAM (SRAM) and also checks the micro controller ROM for proper checksum. After these tests are completed, the keypad/display responds to a poll of its address by the MCB with an acknowledge message to the MCB. This causes the controller to start downloading display information to the keypad/display. The keypad is locked out until the tests and the download is complete.

Note – The keypad/display address is defined by a four-position dip switch block on the right side of the device. For this application, all four of these switches should be in the UP position, which defines address 32.

When the keypad/display is connected to the MCB and power is applied, the backlight and the red Alarm LED on the display are turned on. The backlight remains on until it times out (15 minutes after a key press or after power up). During the next 5 seconds, the LCD counts down from 9 to 0 in all 80 character locations. After the countdown is complete, the Alarm LED turns off and the display appears as follows:

Version xxx

Addressyy

Statuszz zzzz

Startupaaaa bbbb ccc

Where:

xxx = The version of firmware in the keypad/display

yy = The keypad/display address 32

zzzz = OK normally or NO COMM if the MCB is not communicating with the keypad/display

aaaa = OK normally or IRAM if internal RAM test failed

bbbb = OK normally or XRAM if external RAM test failed

ccc = OK normally or ROM if ROM checksum does not match stored checksum

When the MCB finishes downloading to the keypad/display it sends a "download complete" message to the keypad/display. When this message is received, the LCD shows the "main" rooftop application menu screen.

Note – A NO COMM indication on the Status line during the initialization period does not necessarily indicate a problem. A communication problem is indicated if the LCD "hangs," i.e., it does not proceed to show the "main" rooftop application menu screen.

If aaaa= IRAM, bbbb= XRAM and/or ccc= ROM, replace the keypad/display.

Note – The keypad/display can be connected to the MCB while power is on. The normal elapsed time for the "main" rooftop menu screen to appear in the LCD upon initializing is approximately 60 seconds.

Troubleshooting Temperature Sensors

The MicroTech II temperature sensor consists of a positive temperature coefficient (PTC) silicon sensing element. The resistance of this sensor increases with increasing temperature. The element has a reference resistance of 1035 ohms at 77°F (25°C). Each element is calibrated according to the graphs shown in Figure 29 (°F) and Figure 30 on page 64 (°C). Tabulated resistance vs. temperature data is shown in Table 25.

Use the following procedure to troubleshoot a suspect sensor.

1. Disconnect the sensor from the MCB.
2. Take a temperature reading at the sensor location. Be sure to allow the thermometer to stabilize before taking the reading.
3. Use the temperature reading from Step 2 to determine the expected sensor resistance from Table 25.
4. Using an ohmmeter, measure the actual resistance across the two sensor leads.
5. Compare the expected resistance to the actual resistance.
6. If the actual resistance value deviates substantially (more than 10%) from the expected resistance found in Table 25, replace the sensor.

Table 25: MicroTech II temperature sensor—temperature vs. resistance chart

	Resistance in ohms
-40 (-40)	613
-31 (-35)	640
-22 (-30)	668
-13 (-25)	697
-4 (-20)	727
5 (-15)	758
14 (-10)	789
23 (-5)	822
32 (0)	855
41 (5)	889
50 (10)	924
59 (15)	960
68 (20)	997
77 (25)	1035
86 (30)	1074
95 (35)	1113
104 (40)	1153
113 (45)	1195
122 (50)	1237
131(55)	1279
140 (60)	1323
149 (65)	1368
158 (70)	1413
167 (75)	1459
176 (80)	1506
185 (85)	1554
194 (90)	1602
203 (95)	1652
212 (100)	1702
221(105)	1753
230(110)	1804
239 (115)	1856
248 (120)	1908

Figure 29. MicroTech II temperature sensor—temperature (°F) vs. resistance graph

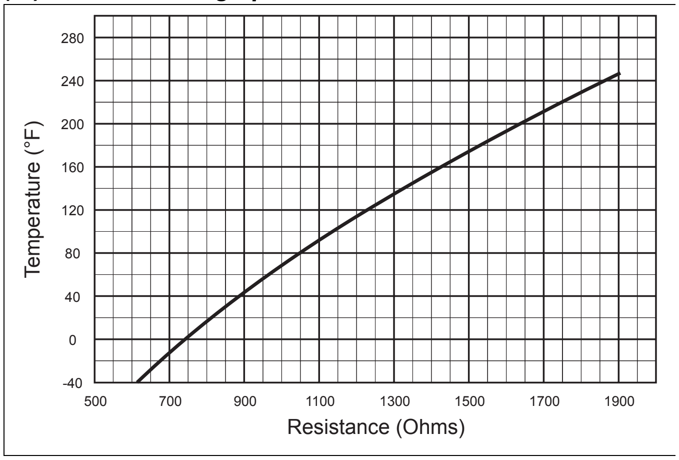
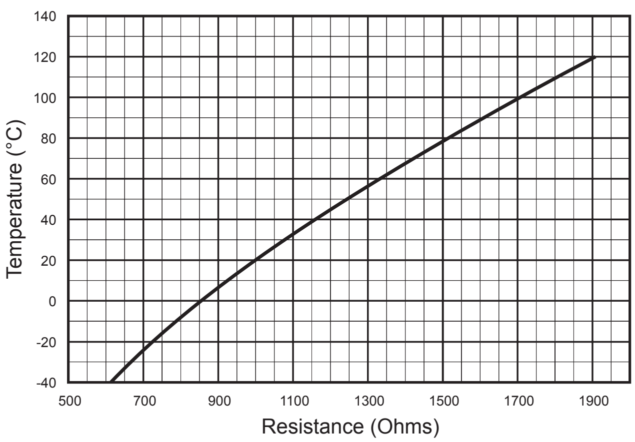


Figure 30. MicroTech II temperature sensor—temperature (°C) vs. resistance graph



Troubleshooting Communications Modules

BACnet/IP Module

For a detailed description and troubleshooting information regarding the BACnet/IP communications module, refer to installation and maintenance bulletin *IM 703, MicroTech II Applied Rooftop Unit Controller and Self-Contained Unit Controller BACnet Communications Module—BACnet/IP*. For details regarding BACnet protocol data, refer to engineering data document, *ED 15060, MicroTech II Applied Rooftop Unit Controller Protocol Information*.

BACnet MS/TP Module

For a detailed description and troubleshooting information regarding the BACnet MS/TP communications module, refer to installation and maintenance bulletin *IM 704, MicroTech II Applied Rooftop Unit Controller and Self-Contained Unit Controller BACnet Communications Module—BACnet/MS/TP*. For details regarding BACnet protocol data, refer to engineering data document, *ED 15060, MicroTech II Applied Rooftop Unit Controller Protocol Information*.

LonMark Modules

For a detailed description and troubleshooting information regarding LonMark communications modules, refer to installation and maintenance bulletin *IM 702, MicroTech II Applied Rooftop Unit Controller* and *Self-Contained Unit Controller LonWorks Communications Module*. For details regarding LonMark protocol data, refer to engineering data document, *ED 15060, MicroTech II Applied Rooftop Unit Controller Protocol Information*.

Troubleshooting Pressure Transducers

Use the following procedure to troubleshoot a suspect sensor:

1 If the duct static pressure always reads 0" WC on the unit keypad/display and the discharge inlet vane position or VFD speed is continuously ramping to 100%, check the following:

- **a** If the unit has two duct static pressure sensors (SPS1 and SPS2), verify that they both function properly following Steps 2 through 5 below. Also check for faulty wiring connections at analog inputs MCB-AI13 and MCB-AI14. The controller displays and controls to the lower of the two readings. If a sensor is defective and inputs 0 volts to the controller, the static pressure reading on the keypad/display reads 0 and the controller attempts to increase the 0 value to set point by ramping the discharge inlet vanes or VFD up.
- **b** If a second sensor (SPS2) is not installed or the pressure tubing to it is not connected, make sure the *2nd P Sensor=* parameter in the Unit Configuration menu of the keypad/display is set to “None” so that the controller ignores the second static pressure analog input MCB-AI14.
- **c** If a second sensor (SPS2) is installed, but it is a building space sensor rather than a duct static pressure sensor, make sure the *2nd P Sensor=* parameter in the Unit Configuration menu of the keypad/display is set to “Bldg.”

2 Check the 24 VAC power supply to the sensor.

- **a** If the sensor is SPS1 or SPS2 (duct static), verify that there is 24 VAC between the suspect transducer “+” and “-” terminals.
- **b** If the sensor is SPS2 (building static), verify that there is 24 VAC between the “IN” and “CM2” terminals on the SPS2 terminal block.
- **c** If 24 VAC supply reads low and/or the MCB is malfunctioning, the sensor may be drawing too much current. Disconnect the sensor and recheck the voltage and the MCB operation.

3 Using an accurate manometer or gauge, measure the same pressure that the suspect transducer is sensing. To do this, tap into the transducer high and low pressure tubing or locate the measurement device taps next to the transducer taps.

> The fittings on the pressure transducers are fragile. Splice a tee fitting into each tap tube instead of removing each tap tube from its transducer fitting. Use an airtight cap to cover the test port after the pressure measurement.

Note – If the suspect sensor is measuring duct static pressure, verify that the high and low pressure taps are properly installed. An improper pressure tap installation can cause severe fluctuations in the sensed pressure. Refer to the model-specific installation manual for pressure tap installation guidelines (see Table 2 on page 1).

4 Measure the DC voltage output from the transducer.

- **a** If the sensor is SPS1 or SPS2 (duct static), measure the voltage across the sensor “S” and “-” terminals.
- **b** If the sensor is SPS2 (building static), measure the voltage across the “OT2” and “CM2” terminals on the SPS2 terminal block.

If the measured voltage and pressure do not match, there may be a wiring problem or the transducer may be defective. Check the transducer input circuit wiring and connections for defects.

If the measured voltage and pressure match, the MCB may be missconfigured or defective.

5 Remove power from the controller by opening system switch S1. If available, swap a similar good transducer with the suspect transducer or try installing a new transducer. Restore power by closing S1 and verify whether the suspect transducer is defective.

Figure 31. Duct static pressure transducer voltage vs. pressure

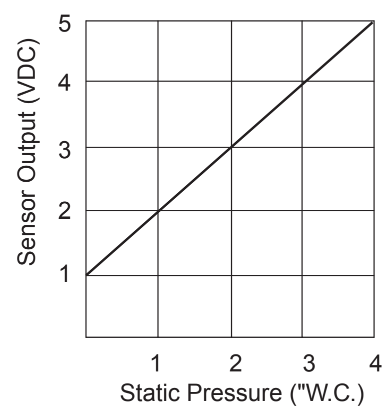
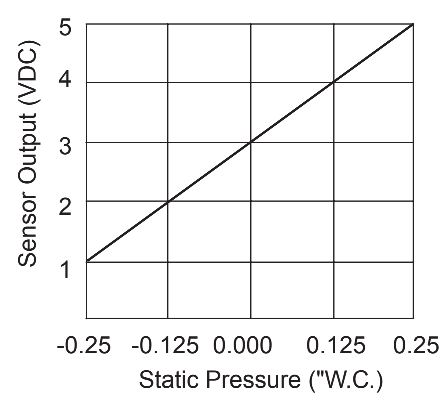


Figure 32. Building (space) static pressure transducer voltage vs. pressure



Parts List

Below is a partial list of applied rooftop unit replacement parts. Contact a local sales representative for additional information

Table 26:

Component designation	Description	Daikin part number
MCB	Main control board	060006101
CCB1	Auxiliary cooling control board (DX Circuit #1 or generic condenser)	112026101 (replaces 106102701)
CCB2	Auxiliary cooling control board (DX circuit #2)	112026101 (replaces 106102701)
EHB1	Auxiliary electric heat control board	112026101 (replaces 106102701)
ERB1	Auxiliary energy recovery control board	112026101 (replaces 106102801)
–	RS-485 communication module (for auxiliary control boards)	060006202
–	Standoffs for mounting RS-485 communication module (PN 060006202) onto auxiliary control board (PN 112026101)	048166707
–	Keypad/display	060006301
–	Keypad, main control board cable	111044601
ZNT1	Zone temperature sensor with tenant override	111048101
	Zone temperature sensor with tenant override & remote setpoint adjustment (SCC units only)	111048102
DAT	Discharge air temperature sensor (50 ft cable length-field cut to length)	060004705
ENT	Entering fan air temperature sensor (50 ft cable length-field cut to length)	060004705
OAT	Outside air temperature sensor (50 ft cable length-field cut to length)	060004705
RAT	Return air temperature sensor (50 ft cable length-field cut to length)	060004705
SPS1	Static Pressure sensor: duct, No. 1	049545007
SPS2	Static pressure sensor: duct, No. 2	049545007
	Static pressure sensor: building (space) pressure	049545006
T2	Transformer: 115/24 VAC	060004601
T3	Transformer: 115/24 VAC	060004601
T9	Transformer: 115/24 VAC	060630801
HUM1	Humidity sensor: wall mount	067294901
	Humidity sensor: duct mount	067295001
PC5	Dirty filter switch: first filter section	065493801
PC6	Dirty filter switch: final filter section	065493801
PC7	Airflow proving switch	060015801
DHL	Duct high limit switch	065493801
OAE	Enthalpy control: electromechanical	030706702
	Enthalpy control: electronic (used with RAE)	049262201
RAE	Return air enthalpy sensor (used with electronic OAE)	049262202
SD1	Smoke detector: supply air	049025001
SD2	Smoke detector: return air	049025001
–	BACnet MS/TP communication module (RS-485)	060006202
–	BACnet/IP communication module (IP cable 10BASET)	060006201
–	LONMARK space comfort controller (SCC) communication module	060006203
–	LONMARK discharge air controller (DAC) communication module	060006204
–	5 VDC precision power supply	111049610
–	Serial port ribbon cable	111047201
–	MCB battery	BR2325
–	MCB connector repair kit	300036605

Daikin Training and Development

Now that you have made an investment in modern, efficient Daikin equipment, its care should be a high priority. For training information on all Daikin HVAC products, please visit us at www.DaikinApplied.com and click on training, or call 540-248-9646 and ask for the Training Department.

This document contains the most current product information as of this printing. For the most up-to-date product information please go to www.DaikinApplied.com.

13600 Industrial Park Boulevard, Minneapolis, MN 55441 USA (612) 553-5330