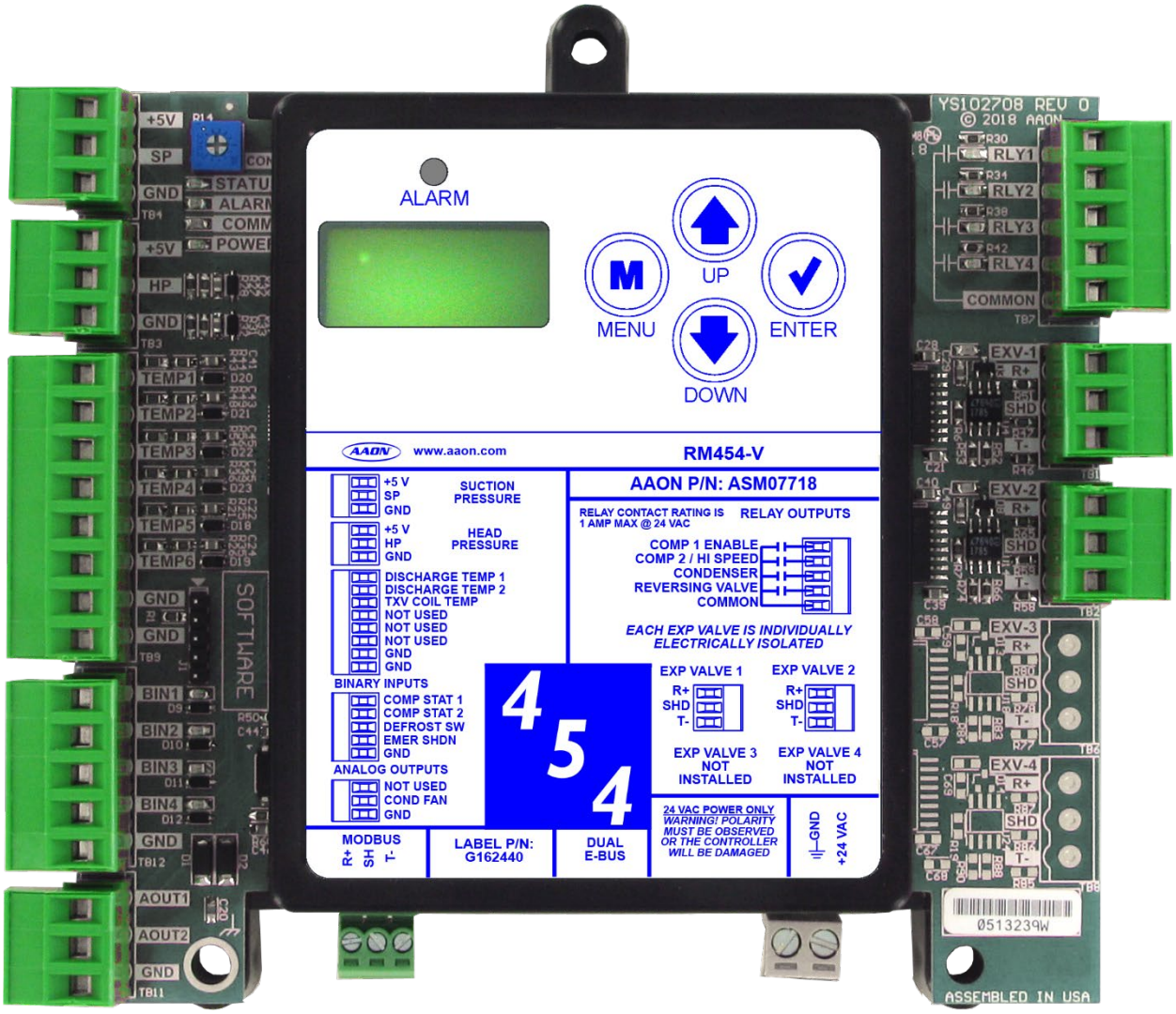
Compatible with VCCX-454 Series

RM454-V Module Technical Guide

ASM07718

Software SS1195



RM454-V PARTS REFERENCE

Table 1: RM454-V Parts Reference

RM454-V Parts Reference	
Part Description	**Part Number**
RM454-V Module	ASM07718
VCCX-454 Controller	ASM07503
RM454-SC (Subcool Monitor)	ASM07719
Reheat Expansion Module	ASM01687
E-BUS Cable Assembly E-BUS Power & Comm 1.5 ft., 3 ft., 10 ft., 25 ft., 50 ft., 75 ft., 100 ft., 150 ft., 2050 ft., and 1000 ft. Spool.	G029440 (1.5 ft.), G012870 (3 ft.), G029460 (10 ft.), G045270 (25 ft.), G029510 (50 ft.), G029530 (75 ft.), G029450 (100 ft.), G029470 (150 ft.), V36590 (250 ft.), G018870 (1000 ft. Spool)
E-BUS Adapter Hub with 1.5 ft. E-BUS Cable	ASM01635
E-BUS Adapter Board	ASM01878

TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

1. NOTES, CAUTIONS, AND WARNINGS

Note: Notes are intended to clarify the unit installation, operation, and maintenance.

CAUTION

Caution statements are given to prevent actions that may result in equipment damage, property damage, or personal injury.

WARNING

Warning statements are given to prevent actions that could result in equipment damage, property damage, or serious personal injury.

DANGER

Danger statements are given to prevent actions that will result in equipment destruction, property damage, and severe personal injury or death.

2. OVERVIEW

CAUTION

This module is intended to function with units operating with R-454B refrigerant.

2.1. Features

The ASM07718 Refrigerant System Module for VFD Compressors with Independent Electronic Expansion Valve (EXV) Control (RM454-V) monitors and controls the refrigeration circuits of the AAON unit. It connects to a superheat controller and is used with the VCCX-454 controller.

The RM454-V is for units with the following configurations:

- Must have at least one VFD compressor on the first circuit of the first module connected using Modbus. The second module, if used, can use a non-VFD compressor.
- Must have at least one EXV.
- One or two circuits with no reheat, or reheat on the second circuit.

This module automatically configures condensers, EXVs, and compressors based on unit selection.

The RM454-V uses an E-BUS cable to connect to the VCCX-454 Controller. Up to four RM454-V Modules can be connected. There are two E-BUS expansion ports which allow connection to the VCCX-454 Controller, communicating sensors, and other E-BUS modules.

The RM454-V is configured using Prism 2 software.

The RM454-V provides five analog inputs, four binary inputs, four relays, and one analog output. See Figures 2 and 3, pages 6 and 7, for wiring.

The RM454-V provides the following:

- Modulates the compressors or controls staging to satisfy the Suction Coil (Saturated) Temperature during Cooling Mode. During Dehumidification Mode, it controls the compressors to the Suction (Saturation) Temperature Setpoint.
- Modulates the condenser fan(s) to maintain the Head Pressure Setpoint.
- Monitors the performance of the superheat controller to maintain the Superheat Setpoint of each evaporator coil.
- Provides alarms and safeties for the compressor and condenser operation.
- Provides a 2 x 8 LCD character display and four buttons that allow for status of system operation, system setpoints, system configurations, sensors, and alarms.

3. INSTALLATION

3.1. Electrical and Environmental Requirements

3.1.1. General

Correct wiring of the AAON unit controller and its modules is the most important factor in the overall success of the installation process. The AAON unit controller and modules are installed and wired at the AAON factory. Some of the following information may not apply if the unit was pre-wired at the factory. However, if troubleshooting of the controller or modules is required, it is a good idea to be familiar with the system wiring.

3.1.2. Wiring

The modules must be connected to an 18-30 VAC power source of the proper size for the calculated VA load requirements. All transformer sizing should be based on the VA ratings listed in the table below.

Table 2: RM454-V Electrical and Environmental Requirements

Control Device	Voltage	Va Load	Operating Temperature	Humidity (Non-condensing)
RM454-V	18-30 VAC	18	-22°F to 158°F -30°C to 70°C	0-95% RH
	Inputs		Resistive Inputs require 10KΩ Type 3 Thermistor	
			24 VAC Inputs provide 4.7kΩ Load	
	Outputs		Relay Outputs: 1 Amp maximum per output.	

Note: If the temperature at the controller is below -4°F (-20°C), the display refresh rate could be less responsive.

WARNING

When using a single transformer to power more than one controller or expansion module, the correct polarity must always be maintained between the boards. Failure to observe correct polarity will result in damage to the AAON unit controller, RM454-V, and any associated module.

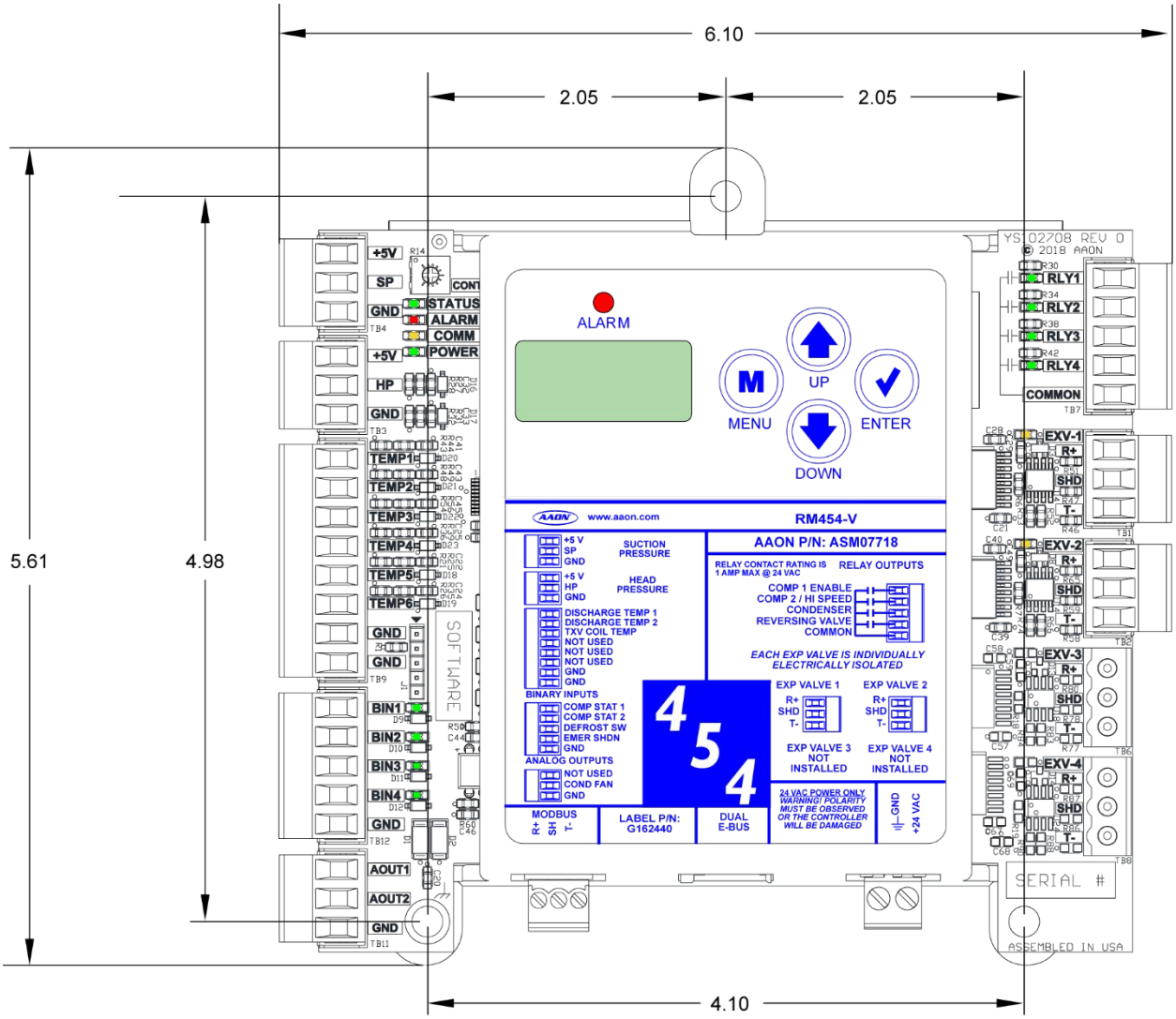
Please carefully read and apply the following information when wiring the unit controller, RM454-V, and any associated module.

1. All wiring is to be in accordance with local and national electrical codes and specifications.
2. All 24 VAC wiring must be connected so that all ground wires remain common. Failure to follow this procedure can result in damage to the controller and connected devices.
3. Minimum wire size for 24 VAC wiring should be 18-gauge.
4. Minimum wire size for all sensors should be 24-gauge. Some sensors require two-conductor wire, and some require three- or four-conductor wire.
5. Minimum wire size for 24 VAC thermostat wiring should be 22-gauge.
6. Be sure all wiring connections are properly inserted and tightened into the terminal blocks. Do not allow wire strands to stick out and touch adjoining terminals which could potentially cause a short circuit.
7. When communication wiring is used to interconnect AAON unit controllers together or to connect to other communication devices, all wiring must be plenum-rated, minimum 18-gauge, two-conductor, twisted pair with shield. AAON can supply communication wire that meets this specification and is color coded for the network or local loop. Please consult your AAON distributor for information. If desired, Belden #82760 or equivalent wire may also be used.
8. Before applying power to the AAON unit controller, RM454-V Modules, and any associated modules, be sure to recheck all wiring connections and terminations thoroughly.

3.1.3. Powering Up

When the controller and modules are first powered up, the POWER LED should light up and stay on continuously. If it does not light up, check that the 24 VAC is connected to the controller, the wiring connections are tight, and it is wired for the correct polarity. The 24 VAC power must be connected so all ground wires remain common. If after making all these checks, the POWER LED does not light up, please contact AAON Controls Support for assistance.

3.2. Dimensions



Note: All dimensions are in inches.

Figure 1: RM454-V Dimensions

3.3. Wiring

3.3.1. Inputs Wiring

The RM454-V uses an E-BUS cable to connect to the VCCX-454 Controller. Up to four Rm454-V Modules can be connected. Two E-BUS expansion ports allow connection to the VCCX0454 Controller, communicating sensors, and other E-BUS modules.

The RM454-V uses five analog inputs, four binary inputs, four relays, and one analog output. See Figure 2 below for inputs wiring and Figure 3 for outputs wiring.

WARNING

Observe polarity! All boards must be wired with GND-to-GND and 24 VAC-to-24 VAC. Failure to observe polarity will result in damage to one or more of the boards. Expansion modules must be wired so the expansion modules and the controller are always powered together. Loss of power to the expansion module will cause the controller to become inoperative until power is restored to the expansion module.

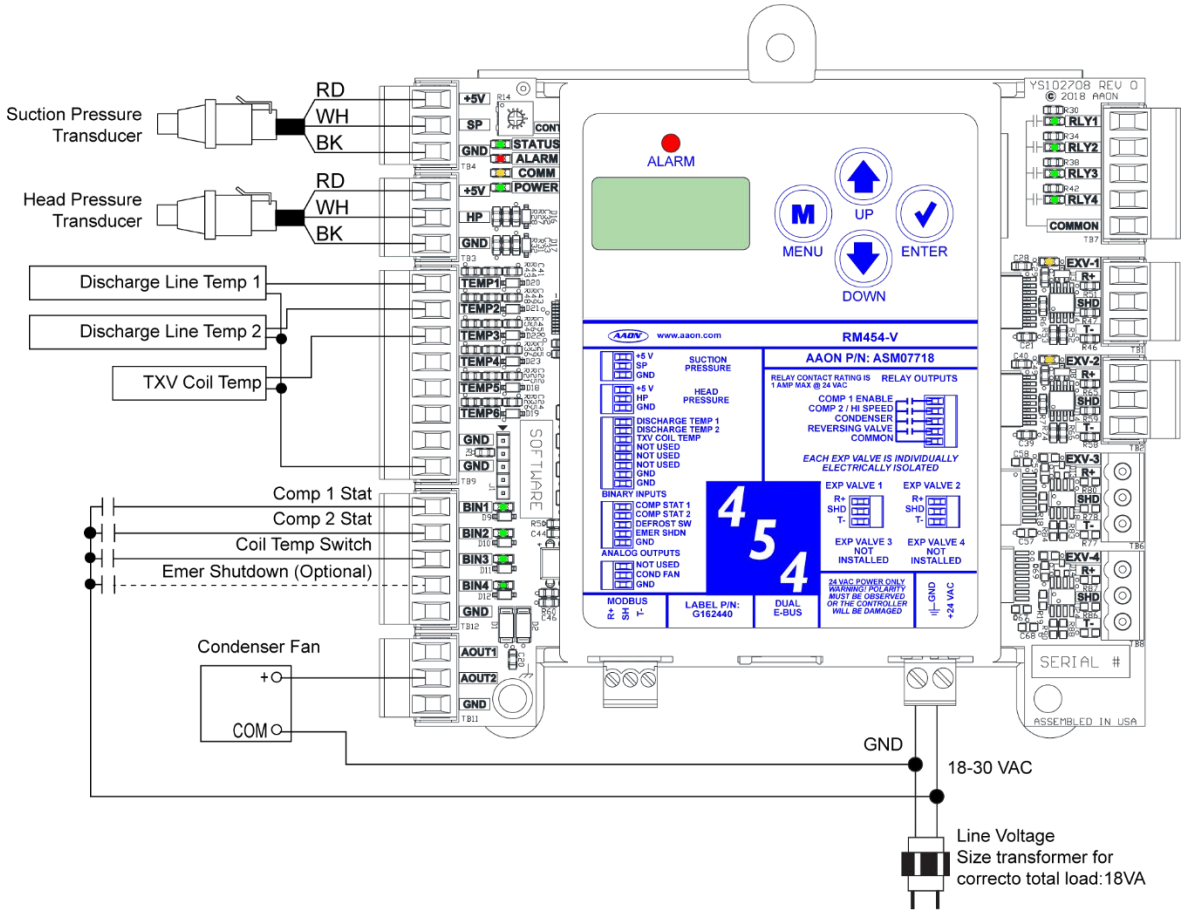


Figure 2: RM454-V Inputs Wiring

3.3.2. Outputs Wiring

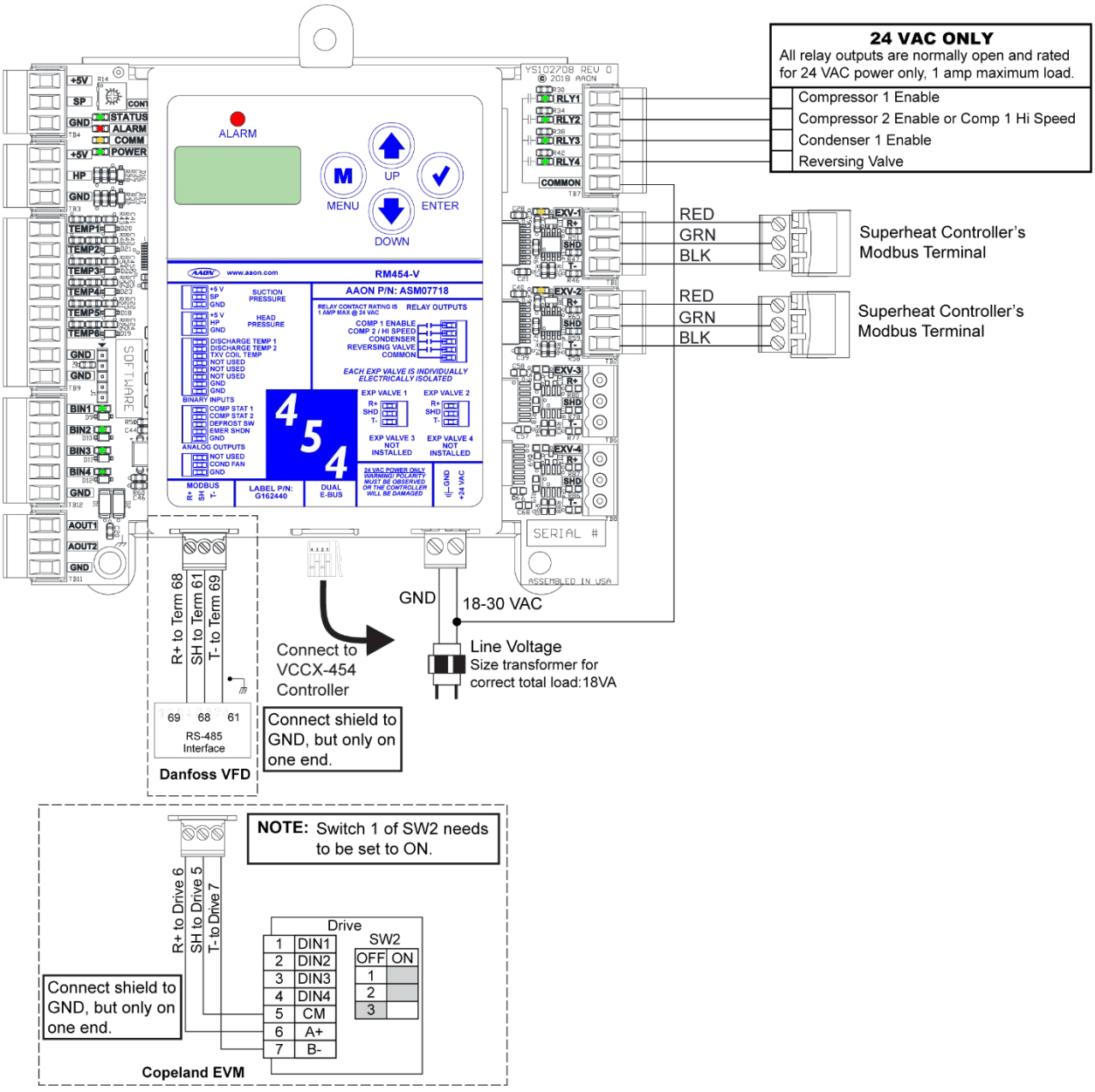


Figure 3: RM454-V Outputs Wiring

3.4. Inputs and Outputs

3.4.1. Inputs/Outputs Map

See Table 3 below for the RM454-V inputs and outputs.

Table 3: RM454-V Inputs and Outputs

RM454-V Inputs and Outputs	
Analog Inputs	
SP	Suction Pressure Transducer
HP	Head Pressure Transducer
TEMP1	Discharge Line Temperature 1
TEMP 2	Discharge Line Temperature 2
TEMP3	TXV Coil Temperature
TEMP4	Not Used
TEMP5	Not Used
TEMP6	Not Used
Binary Inputs	
BIN1	Compressor 1 Status
BIN2	Compressor 2 Status
BIN3	Coil Temperature Switch
BIN4	Emergency Shutdown (optional)
Analog Outputs (0-10 VDC)	
AOUT1	Not Used
AOUT2	Condenser Fan 1
EXV COMM Ports	
EXV-1	EXV Controller 1
EXV-2	EXV Controller 2
EXV-3	Not Used
EXV-4	Not Used
Binary Outputs (24 VAC)	
RLY1	Compressor 1 Enable
RLY2	Compressor 2 Enable or Compressor 1 High Speed Enable
RLY3	Condenser 1 Enable
RLY4	Reversing Valve
Communication Terminals	
DUAL E-BUS	E-BUS Communication Loop Ports
MODBUS	VFD Compressor

3.4.2. Descriptions

+5 – VDC Power

This output is a 5 VDC output that supplies power to the Suction or Head Pressure Transducer.

SP – Suction Pressure Transducer

The Suction Pressure Transducer is used on modules that do not have VFD compressors wired to them. Units have two options to obtain suction pressure/saturation temperature/superheat.

1. Through MODBUS communications to the superheat controller.
2. From onboard sensors, suction pressure, and coil temperature sensors

HP – Head Pressure Transducer

The Head Pressure Transducer is used to measure head pressure at the discharge line. This head pressure is used to drive the condenser fan to maintain a given head pressure setpoint.

TEMP1 – Discharge Line Temperature 1

This sensor is the Discharge Line Temperature Sensor for Circuit 1. It is strapped to the discharge line immediately after the VFD compressor and is used as a safety against high compressor temperatures.

TEMP2 – Discharge Line Temperature 2

This sensor is the Discharge Line Temperature Sensor for Circuit 2. It is required on all ASHP and WSHP with a second compressor on the module.

TEMP3 – TXV Coil Temperature

If the unit does not have a communicating EXV/superheat controller, then the coil temperature sensor is wired to this input to calculate superheat.

BIN1 – Compressor 1 Status

A wet contact closure (24 VAC) on this input indicates Compressor 1 is running. Typically, the source for this is a relay output from the auxiliary contact on the compressor contractor. If BIN1 opens, the Compressor 1 Enable Relay de-energizes, and a compressor alarm is generated.

If compressor 1 on the module is a VFD, then the compressor status is validated through VFD communications, and wiring to this input is not necessary.

BIN2 – Compressor 2 Status

A wet contact closure (24 VAC) on this input indicates Compressor 2 is running. Typically, the source for this is a relay output from the auxiliary contact on the compressor contactor. If BIN2 opens, the Compressor 2 Enable relay de-energizes and a compressor alarm is generated.

Note: The binary inputs require wet contact (24 VAC only) to recognize an active input. Contact closure will not be recognized if dry contacts are used.

BIN3 – Coil Temperature Switch

A wet contact closure (24 VAC) on this input indicates the condenser coil is frozen or has frost build-up, and a defrost is needed.

BIN4 - Emergency Shutdown Contact

If configured, when this wet contact input is open, the RSM operation is disabled.

AOUT2 - Condenser Fan VFD Signal

This is a direct acting output signal that is used to modulate the Condenser Fan VFD (0-10 VDC signal) on an air cooled unit.

Description (Continued)

EXV-1 - EXV Controller 1

The EXV-1 is the MODBUS port for EXV Controller 1's setpoints and status communications.

EXV-2 - EXV Controller2

The EXV-2 is the MODBUS port for EXV Controller 2's setpoints and status communications.

RLY1 - Compressor 1 Enable

This relay turns on Compressor 1.

RLY2 - Compressor 2 Enable / Compressor 1 High Speed Enable

This enables Compressor 2 when there are tandem compressors. If Compressor 1 is a two-step compressor, this relay enables high speed.

RLY3 - Condenser 1 Enable

This relay enables Condenser Fan 1.

RLY4 - Reversing Valve Enable

This relay enables the reversing valve.

4. SEQUENCE OF OPERATIONS

4.1. Modes of Operation

4.1.1. Cooling and Heating Modes

Staging of the compressors is determined by the Supply Air Temperature setpoint not being satisfied. Staging is met by turning the VFD compressors and on/off compressor on or off, or the two-step compressor to low speed (two-thirds, 67%, capacity) or to high speed (full, 100%, capacity).

During Cooling Mode, the VFD compressor modulation is determined from the Saturation Temperature.

Compressor envelope and/or electrical current protections also affect the VFD compressor modulation by limiting the minimum and maximum RPM speed.

4.1.2. Dehumidification Operation

Dehumidification Mode control staging and VFD modulation is determined using the Saturation Temperature from each circuit. Circuit 1 uses Superheat Controller Saturation Temperature and Circuit 2 uses the Saturation Coil Temperature Sensor (TEMP3 input) mounted after the TXV.

Note: Compressor 2 cannot be turned off in Dehumidification Mode unless it shuts down because of an alarm fault.

4.2. Staging

Note: Slight changes may occur based on the minimum run times and off times.

Note: The RM454-V will transition to the most appropriate state depending on the configuration and environmental conditions.

CAUTION

If compressors are operating in a configuration not shown, it could be due to environmental conditions, compressor availability, or alarm conditions.

CAUTION

Initial transitions between states may lower capacity during the transition.

Table 4: Staging - 2 RM454-V 2 Circuit: VFD, 2-Step Cooling States

2 RM454-V Circuit: VFD, 2-Step Cooling					
Circuit	Compressor Type	Stage 0	Stage 1	Stage 2	Stage 3
1	VFD	OFF	ON (Modulating)	OFF	ON (Modulating)
2	Two Step	OFF	OFF	LOW	HIGH

Table 5: Staging - 2 RM454-V 2 Circuit: VFD, 2-Step Secondary (Second Circuit) Reheat States

2 RM454-V 2 Circuit: VFD, 2-Step Secondary (Second Circuit) Reheat					
Circuit	Compressor Type	Stage 0	Stage 1	Stage 2	Stage 3
1	VFD	OFF	OFF	OFF	On (Modulating)
2	Two Step	OFF	LOW	HIGH	HIGH

Table 6: Staging - 4 RM454-V 2 Circuit: VFD, 2-Step, VFD, 2-Step Cooling States

4 RM454-V 4 Circuit: VFD, 2-Step, VFD, 2-Step Cooling					
Circuit	Compressor Type	Stage 0	Stage 1	Stage 2	Stage 3
1	VFD	OFF	ON (Modulating)	ON (Modulating)	ON (Modulating)
2	VFD	OFF	ON (Modulating)	ON (Modulating)	ON (Modulating)
3	Two Step	OFF	OFF	LOW	HIGH
4	Two Step	OFF	OFF	LOW	HIGH

Table 7: Staging - 4 RM454-V 2 Circuit: VFD, 2-Step, VFD, 2-Step Secondary (Second Circuit) Reheat States

4 RM454-V 4 Circuit: VFD, 2-Step, VFD, 2-Step Secondary (Second Circuit) Reheat					
Circuit	Compressor Type	Stage 0	Stage 1	Stage 2	Stage 3
1	VFD	OFF	OFF	OFF	ON (Modulating)
2	VFD	OFF	OFF	OFF	On (Modulating)
3	Two Step	OFF	LOW	HIGH	HIGH
4	Two Step	OFF	LOW	HIGH	HIGH

4.3. Envelope Protection

4.3.1. Envelope Protection

Compressor manufacturer specifications require the compressor to operate within its given operating envelope to maintain the life and longevity of the compressor. Some envelopes also have areas within that limit the minimum/maximum operating speeds. Min/max speeds may also be limited based on the requirement of the unit's total capacity. The Prism 2 interface allows the ability to see real time envelope plotting while the compressor is running.

The minimum operating speed reference is read from the VFD and can change depending on where the compressor is operating within its envelope.

The VFD compressor is set to 67% at any stage event. Therefore, whenever a staging event occurs, the VFD compressor position is reset to the middle point of the modulation range. This allows the compressor enough modulation time before making another staging event to try to avoid cycling between staging events.

See Figure 4 below for an example of a compressor envelope.

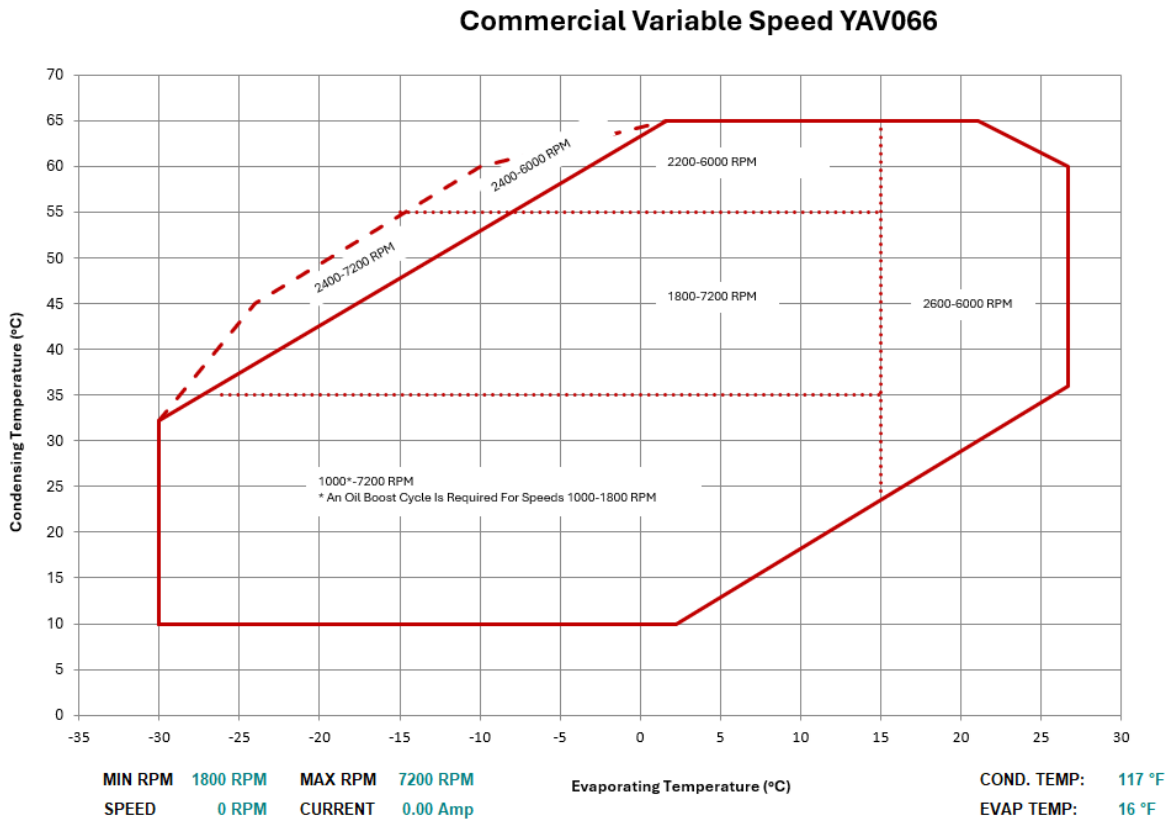


Figure 4: Example - Prism 2 Envelope Protection Graph

4.4. Component Operation

4.4.1. Electronic Expansion Valve Operation

EXV operation is fully integrated into the superheat controller. The superheat controller measures suction pressure and temperature to determine superheat and automatically modulates the EXV to maintain the configured superheat. The RM454-V communicates with the superheat controller to set the desired Superheat Setpoint and to retrieve operational data for display and trending purposes.

4.4.2. Head Pressure Control

The RM454-V can monitor a head pressure transducer and control a condenser fan to maintain a Head Pressure Setpoint.

The condenser fan starting speed varies based on outside air temperatures. At 40°F or colder, the fan starts at 10%; at 70°F or warmer, the fan starts at 100%. Starting speed adjusts linearly between 40°F and 70°F.

In Cooling Mode, the condenser fan modulates speeds to target the discharge pressure setpoint based on the highest running circuit it is controlling. This is also true for Dehumidification Mode and has a separate discharge pressure setpoint adjustable in Prism 2.

In Heat Pump Heating, the outside fan modulates speeds to target the outside approach temperature setpoint, which is outside temperature minus the lowest saturation temperature of the running circuit it is controlling.

If the pressure exceeds 575 psig, the circuit shuts down in an attempt to fail before the mechanical high pressure switch opens. The circuit is allowed to restart after five minutes.

If no head pressure is detected on a circuit, the compressor is disabled and not allowed to run. If the head pressure reading is lost while the circuit is on, the condenser signal goes to 100% until the compressor shuts down.

5. LCD SCREENS

5.1. LCD Display Screen and Navigation Keys

The LCD display screens and buttons allow you to view status and alarms, and enable force modes. See Figure 5 below and refer to Table 8 below for key functions.

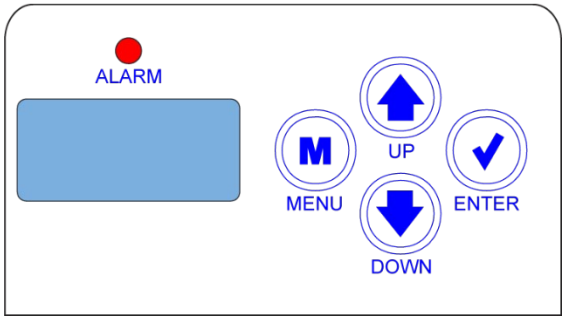
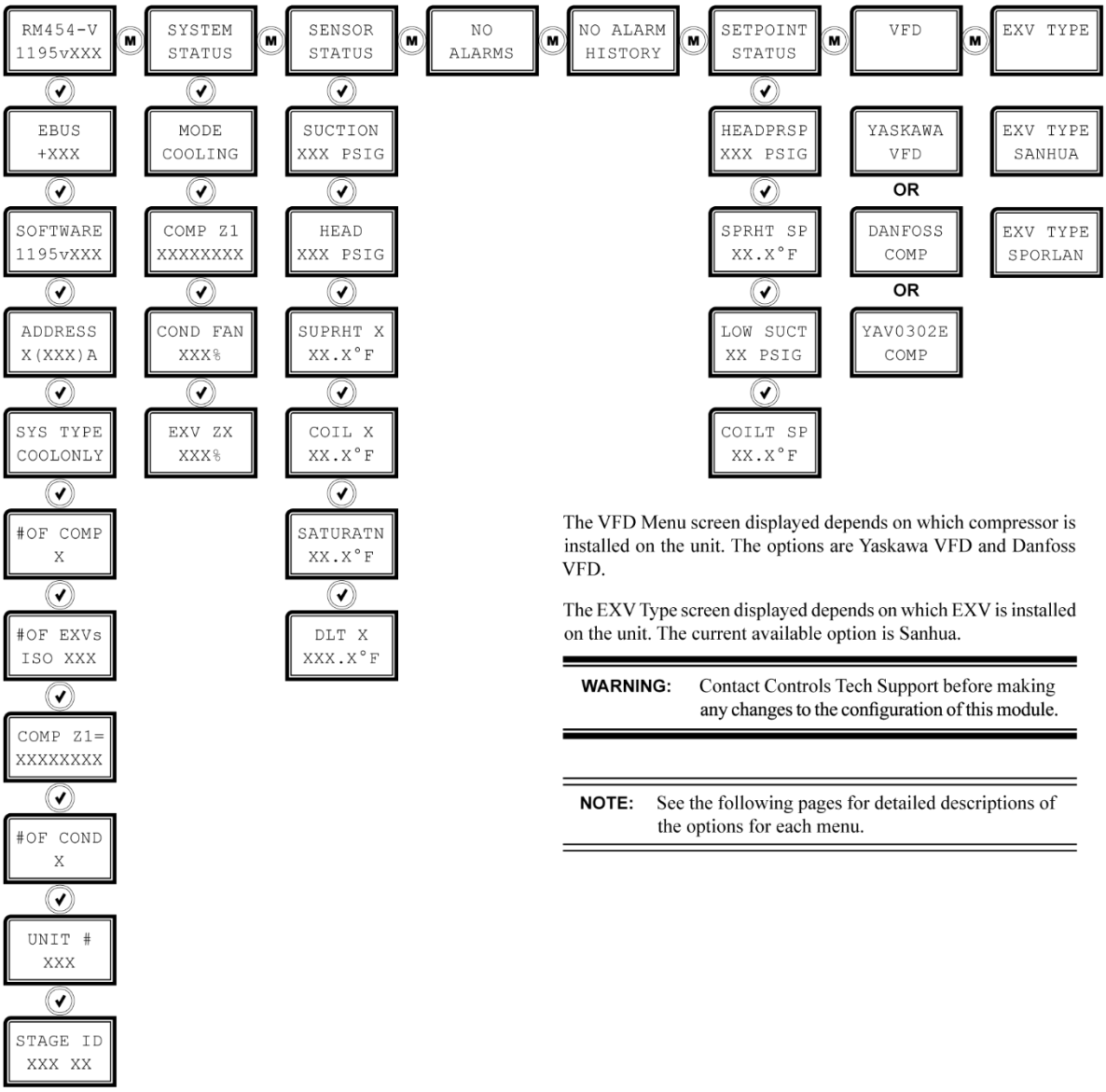


Figure 5: LCD Display and Navigation Keys

Table 8: Navigation Key Functions

Navigation Key Functions	
Key	**Function**
MENU 	Use the **<MENU>** key to move through screens within Main Menu categories and return to the Main Menu while at other screens.
UP 	Use this key to adjust setpoints and change configurations.
DOWN 	Use this key to adjust setpoints and change configurations.
ENTER 	Use the **<ENTER>** key to navigate through the Main Menu Screen categories.

5.2. Main Screens Map



The VFD Menu screen displayed depends on which compressor is installed on the unit. The options are Yaskawa VFD and Danfoss VFD.

The EXV Type screen displayed depends on which EXV is installed on the unit. The current available option is Sanhua.

WARNING: Contact Controls Tech Support before making any changes to the configuration of this module.

NOTE: See the following pages for detailed descriptions of the options for each menu.

Figure 6: LCD Main Screens Map

5.3. Screen Descriptions

5.3.1. Main Screens

Refer to the following table when navigating through the LCD Main Screens.

Press the <**MENU**> button to navigate between the top level screens.

Press the <**ENTER**> button to scroll through the next level screens.

Table 9: Main Screens

Main Screens	
Screen Text	**Descriptions**
RM454-V 1195vXXX	Refrigeration module screens. The second line shows the software number and its version.
SYSTEM STATUS	System status screens
SENSOR STATUS	System status screens
NO ALARMS	Alarm status screens. The screen shows NO ALARMS if no alarms are active.
NO ALARM HISTORY	Alarm history screens. The screen shows NO ALARM HISTORY if no alarms have been activated.
SETPOINT STATUS	Setpoint status screens
VFD MENU	VFD menu screens. There are two VFD menus possible. The one that appears depends on the unit's configuration. The operations are: • COPELAND • DANFOSS • YASKAWA
EXV TYPE	Expansion valve type screens. There are two EXV TYPE menus possible. The one that appears depends on the unit's configuration. The current available option is: • SPORLAN • SANHUA

5.3.2. Module Screens

Refer to the following table when navigating through the module screens. From the RM454-V screen, press <**ENTER**> to scroll through the screens.

Table 10: Module Screens

Module Screens	
Screen Text	**Description**
RM454-V 1195vXXX	Refrigeration module screens. The second line shows the software number and its version.
EBUS +XXX	E-BUS communication. XXX equals the number of COMM packets received. The number increases as packets are received.
SOFTWARE 1195vXXX	Current software version. The second line shows the software number and its version. Access the protected screens from this screen by holding the <UP> button or five seconds.
ADDRESS X(XXX)Z	Current board address Board Address (E-BUS) Address) Circuit Letter X equals the board address; (XXX) equals the E-BUS address; Z equals the circuit letter.
SYS TYPE COOLONLY	Current system type. Possible options for the second line are: • COOLONLY • AIR HP
#OF COMP X	The number of compressors configured. The X equals only 1 or 2, depending on how many compressors the system is configured for.
#OF EXVs ISO XXX	Number of expansion valves found. XXX equals 1 or 1&2
COMP Z1 XXXXXXXX	Configured compressor screens. The number of compressor menus depends on the unit's configuration. Z equals the circuit and can be A, B, C, or D. The second line shows the type of VFD or the type of compressor, if not a VFD. Possible options for the second line are: • COPE EVM • YASK VFD (for a Yaskawa VFD) • DFOS 303 (Danfoss 303 VFD) • DFOS 803 (Danfoss 803 VFD) • FIXED • 2 STAGE • ERROR! (Possible if the VCCX-454 is not communicating with the RSM)
#OF COND X	Number of condensers controlled by this module.
UNIT # XXX	Units numbered 1 through XXX. Shows which unit has been selected. Matches the unit # shown in Prism 2.
STAGE ID X X	Stage type and current stage number. The first number is the stage type number being used (1-6). The second number is the current stage that is active (0-7).

5.3.3. System Status Screens

Refer to the following map when navigating through the System Status Screens. From the System Status Screen, press <**ENTER**> to scroll through the screens.

Table 11: System Status Screens

System Status Screens	
Screen Text	**Description**
SYSTEM STATUS	System Status Screens.
MODE OFF	System mode. Options are: • MIN RUN • OFF • COOLING • HEATING • DEHUM • FORCED
COMP Z1 XXXXXXXX	Compressor operation status. Z equals the circuit and can be A, B, C, or D. The second line shows the status of the compressor on the circuit. • For a VFD compressor (YASK, DFOS, or COPE). It shows the RPM the compressor is running at. It will show OFF if the compressor is not showing. • If FIXED, it will show ON or OFF. • If 2 STAGE, it will show LOW SPD or HIGH SPD • Can also show FAIL if RSM determines the compressor is off due to an alarm.
COND FAN XXX%	Condenser fan operation status. Options are: • 0-100% • NOT USED - Condenser Fan not in use • OFF - Condenser is off
EXV ZX XXX%	Expansion valve operation status 0-100%.

5.3.4. Sensor Status Screens

Refer to the following map when navigating through the Sensor Status Screens. From the Senor Status Screen, press <**ENTER**> to scroll through the screen.

Table 12: Sensor Status Screens

Sensor Status Screens	
Screen Text	**Description**
Sensor Status	Sensor status screens.
Suction XXX PSIG	Suction pressure reading from the input. Measured in PSIG.
Head XXX PSIG	Head pressure reading from the input. Measured in PSIG.
SUPRHT X XX.X°F	Current superheat calculation. The number of screens depends on the unit's configuration. Measured in degrees Fahrenheit.
Coil X XX.X°F	Coil temperature. Measured in Fahrenheit.
SATURTN XXX.X°F	Calculated saturation coil temperature from suction pressure input. Measured in degrees Fahrenheit.
DLT X XXX.X°F	Discharge line temperature from TEMP1 input. Measure in degrees Fahrenheit.

5.3.5. Alarms Screens

If an alarm is present, the ALARM LED above the LCD display lights up red and blinks. When alarms are present, they automatically display and scroll on the Alarms screen. The alarms are as follows:

Table 13: Alarms Screens

Alarms Screens	
Screen Text	**Description**
ALARMS	Alarms Status screens.
EMERGENCY SHUTDOWN	If RSM is configured to use Binary Input 4 (BI4) as a fault indicator, this fault will show up if the input is open.
COMP X FAULT	This alarm will occur if the compressor fails to run for 45 seconds after the relay is activated or if the signal is lost after activation. This will cause an alarm and shut down the compressor (relay). The system will retry after five minutes.
EXV NOT DETECTED	This will be shown if no communication exists between the RSM and the installed EXV.
EMERGENCY SHUTDOWN	If Binary Input 4 (BI4) on the RSM is configured as an Emergency Shutdown input, the circuit will be disabled if the input is open.
HIGH DIS LINETEMP	If the discharge line temperature is above 220°F, the compressor will back off. If the temperature doesn't drop below 220°F after one minute, the compressor will turn off. Discharge line temperature needs to drop below 150°F for the compressor to come back on after it has been off for 13 minutes. If this occurs three times in two hours, the compressor will be locked out until the module is reset.
SUPRHEAT LOCKOUT	If the module fails on High Superheat twice in two hours, it will lock out the compressors.
LOW SP DETECTED	This alarm will occur if suction pressure falls below the Low Suction Pressure Setpoint for 20 seconds. The system will try to protect by lowering the compressor modulation percentage.
LOW SP FAILURE	This alarm will occur if suction pressure stays below the Low Suction Pressure Setpoint for one minute or falls below 40 psig for five seconds. This alarm will shut down the system. The system will retry after five minutes.
NO HEAD DETECTED	This alarm indicates the Head Pressure Transducer is not detected by the system. This will cause the condenser to go to 100%.
NO WATER FLOW	Proof of Water Flow
NO ALARMS	This is shown if there are no current alarms.
COIL X TEMPFAIL	This alarm will occur if the coil temperature is not within the operable range (below -32°F or above 310°F). This could be the result of a bad sensor or faulty wiring. This alarm will shut down the system. The system will reset after five minutes if the sensor is detected.
COMP VFD FAULT	This alarm will occur if the compressor's VFD communicates through E-BUS it has shut down due to a fault condition. The compressor module will attempt to reset the fault after five minutes if the compressor sends the signal that it is okay to reset the fault.
EBUS COM TIMEOUT	This alarm indicates that communication has been lost between the RM454-V and the AAON controller. This can be the result of a bad cable, a missing cable, or the module not being configured properly. This alarm will clear 5 minutes after communication is established.
ENVELOPE FAULT	If the compressor was running out of its operating envelope for too long, this fault will occur and the compressor will be turned off.
HIGH HP DETECTED	This indicates a High Head Pressure Alarm condition which is activated when the Head Pressure rises above 475 psig or 135°F. This will cause the condenser to go to 100%.

Alarms Screens	
Screen Text	**Description**
LOW SHX DETECTED	This alarm will be activated when the superheat is less than 4°F for two minutes during normal operation or four minutes during the first 10 minutes. The system will shut down and will retry after five minutes.
MODBUS TIMEOUT	Indicates there is no communication between the RM454-V and the compressor VFD.
NO SUCT DETECTED	This alarm indicates that the system does not detect the Suction Pressure Transducer. The system will shut down due to unsafe suction safety and will retry after five minutes.
HI SHX FAILURE	If Superheat is above 30°F for ten minutes, it will turn off the compressors. It will retry after five minutes. If it fails twice in two hours, it will lock out the compressors.

5.3.6. Alarm History Screens

The ALARM HISTORY screen displays past alarms, if any, and how long ago the last of each type occurred. From the ALARM HISTORY Screen, press <**ENTER**> to scroll through the history screens.

The ALARM HISTORY screens follow the same sequence as the ALARMS screens but are abbreviated differently to allow space to show the time since last occurrence.

The first line is the ALARM NAME.

The second line shows how long ago each alarm last occurred. The screen displays:

- Minutes for the first 60 minutes of alarm occurrence.
- Hours for the next 72 hours of alarm occurrence.
- Days for the next 30 days of alarm occurrence.

Alarms clear after 30 days. Alarm history is not stored in memory. If power is lost, the alarm will clear.

Table 14: Alarm History Screens

Alarm History Screen	
Screen Text	**Description**
NO ALARM HISTORY	No alarm history
CL TMP X	Coil Temp Failure
LOH2OTMP	Low Leaving Water Temp
COMP X FL	Compressor Not Running
HPX SENSE	No Head Pressure Sensor Detected
HIGH HP	High Head Pressure Detected
LOW SP	Low Suction Pressure Detected
LOW SHX	Low Superheat Detected
COMM T/O	E-BUS Slave Timeout
SP SENSE	No Suction Pressure Sensor Detected
UNSAFESP	Unsafe Suction Pressure Detected
NOH2OFLO	Proof of Water Flow
HI SHX	High Superheat Failure
BIN4 ALM	BI4 is open, if configured
MODBUS	MODBUS Not Detected
HDLT ALM	High Discharge Temperature Detected

5.3.7. Setpoint Status Screens

Refer to the following map when navigating through the Setpoint Status Screens. From the SETPOINT STATUS SCREEN, press <**ENTER**> to scroll through the screens.

Table 15: Setpoint Status Screens

Setpoint Status Screens	
Screen Text	**Descriptions**
SETPOINT STATUS	Setpoint Status screens.
HEADPRSP XXX PSIG	Head Pressure Setpoint. Valid range is 260-475 psig. Default is 340 psig. Measured in PSIG.
SUPRHT SP XX.X°F	Superheat Setpoint. Valid range is 1-30°F. Default is 15°F. Measured in degrees Fahrenheit.
LOW SUCT XX PSIG	Low Suction Pressure Setpoint. Default is 88 psig. Measured in PSIG.
COILT SP XX.X°F	Coil Temperature Setpoint. Valid range is 35-60°F. Default is 40°F. Measured in degrees Fahrenheit.

5.3.8. VFD Menu Screens

The VFD Menu screen displayed depends on which compressor is installed on the unit. The options are Yaskawa VFD and Danfoss VFD.

5.3.8.1. Copeland EVM Status Screens

Refer to the following map and table when navigating through the Yasakawa VFD Screens. From the COPELAND EVM status screen, press <**ENTER**> to scroll through the screens.

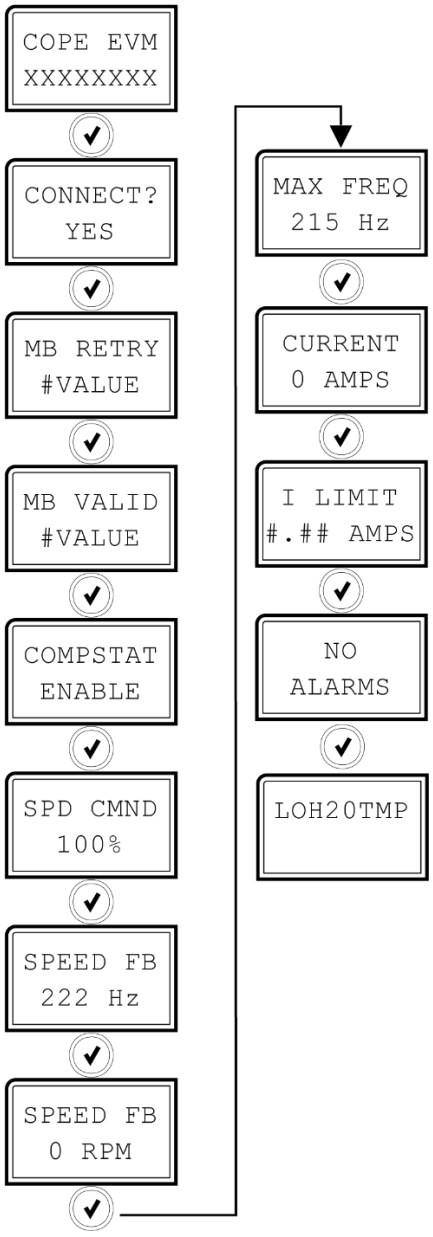


Figure 7: Copeland Screens

Table 16: Copeland EVM Status Screens

Copeland EVM Status Screens	
Screen Text	**Description**
COPELAND XXXXXXXX	Comp model #. Options are: • YAV0232E • YAV0302E • YAV0412E • YAV0471E • YAV0661E • YAV066K1E • YAV096K1E • YAV0961E
CONNECT? YES	VFD is connected and communicating. Options are: • YES • NO
MB RETRY #VALUE	Totals if it is missing communication packet information.
MB VALID #VALUE	Totals if it receives good communication packet information.
COMPSTAT ENABLE	• Enable or Off
SPD CMND 100%	• 0-100%
SPEED FB 222 Hz	Current speed in Hz
SPEED FB 0 RPM	Current speed in RPM
MAX FREQ	Value dependent on unit I.D.
CURRENT 0 AMPS	Compressor current in Amps
I LIMIT XXXAMPS	Value dependent on unit I.D., in Amps
NO ALARMS	No current alarms
LOH2OTMP	Low Leaving Water Temp

5.3.9. Danfoss VFD Screens

Refer to the following map and table when navigating through the Danfoss VFD screens. From the DANFOSS VFD screen, press <**ENTER**> to scroll through the screens.

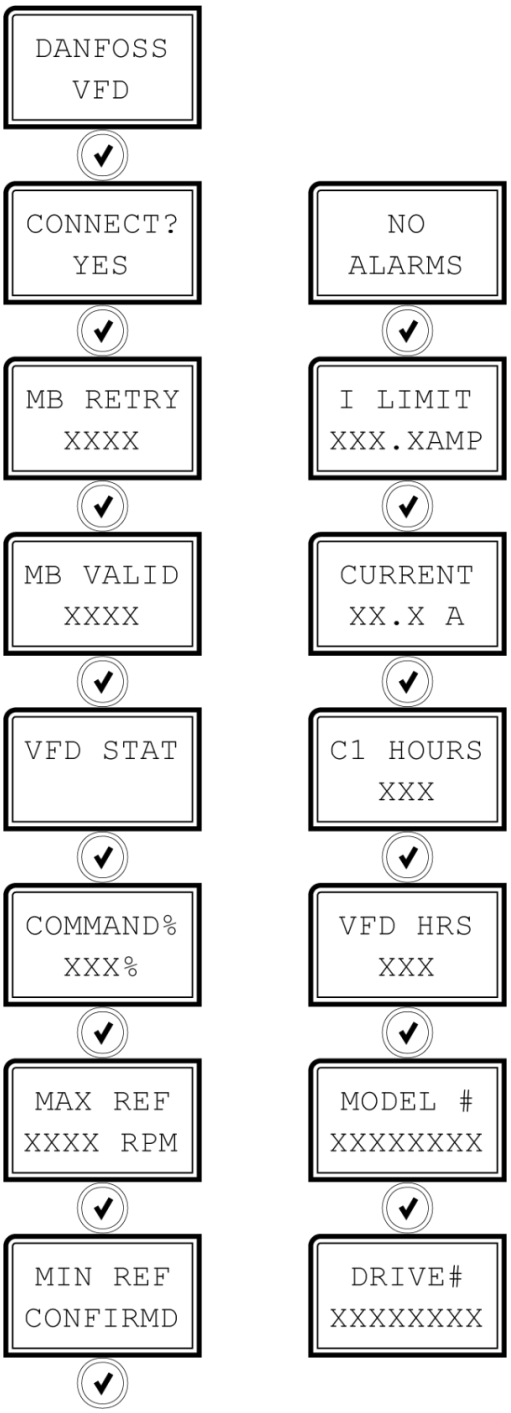


Figure 8: Danfoss Screens

Table 17: Danfoss VFD Screens

Danfoss VFD Screens	
Screen Text	**Description**
DANFOSS COMP	Danfoss VFD status screens.
CONNECT? YES	VFD is connected and communicating. Options are: • YES • NO
MB RETRY XXXX	Totals if it is missing communication packet information.
MB VALID XXXX	Totals if it receives good communication packet information.
VFD STAT	VFD compressor status. Displays a value read from the VFD showing status and configuration information. It will display each bit of information separately.
COMMAND% XXX%	Compressor percentage commanded to VFD.
MAX REF XXXX RPM	Maximum speed programmed into the VFD in RPM.
MIN REF CONFIRMED	Minimum speed programmed into the VFD. Option is: • CONFIRMD For a proper speed command, this should always say CONFIRMD, meaning it is set to zero.
NO ALARMS	Alarm codes read from the VFD. Will show NO ALARMS if no alarms have occurred or if the alarm does not code.
I LIMIT XXX.X AMP	I LIMIT Measured in amps.
CURRENT XX.X A	CURRENT Live current read from VFD in amps.
C1 HOURS 14	Compressor running hours read from the VFD.
VFD HRS 28	VFD running hours read from the VFD.
MODEL # XXXXXXXX	Compressor model number read from VFD. Options are: • VZH088 • VZH117 • VZH170 • VZH028 • VZH035 • VZH044 • VZH052 • VZH065 • UNKNOWN! If UNKOWN is shown, check that the proper unit is selected in Prism 2.
DRIVE# XXXXXXXX	Drive number. Options are: • CDS803 • CDS303

5.3.10. EXV Type Screens

The EXV Type screen displays depend on which compressor is installed on the unit. The current available option is Sanhua.

5.3.10.1. Sanhua Screens

Refer to the following map and table when navigating through the Sanhua screens. From the EXV TYPE SANHUA Screen, press <**ENTER**> to scroll through the screens.

Figure 9: Sanhua Screens

Table 18: Sanhua EXV Screens

Sanhua EXV Screens	
Screen Text	**Description**
EXV TYPE SANHUA	Sanhua EXV status screens
EXV X DETECTED	EXV detected. The number of screens shown depends on unit configuration.
EXVX PSI XXX PSIG	EXV pressure measured in PSIG. The number of screens shown depends on unit configuration.

5.3.10.2. Sporlan SH Screens

Refer to the following map and table when navigating through the Sporlan SH screens. From the EXV TYPE SPORLAN Screen, press <**ENTER**> to scroll through the screens.

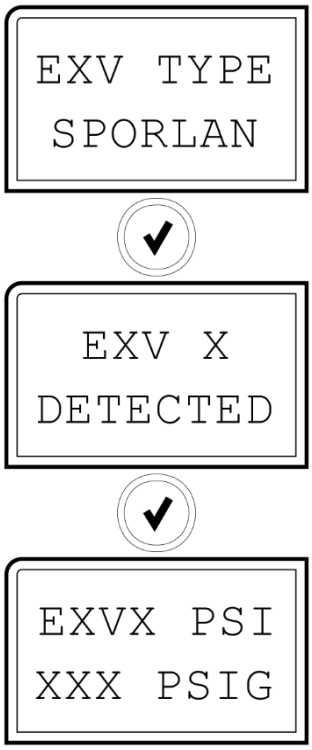


Figure 10: Sporlan Screens

Table 19: Sporlan EXV Screens

Sporlan EXV Screens	
Screen Text	**Description**
EXV TYPE SPORLAN	Sporlan EXV status screens
EXV X DETECTED	EXV detected. The number of screens shown depends on unit configuration.
EXVX PSI XXX PSIG	EXV pressure measured in PSIG. The number of screens shown depends on unit configuration.

6. TROUBLESHOOTING

6.1. LED Diagnostics

6.1.1. Using RM454-V LEDs to Verify Operation

The RM454-V is equipped with LEDs that can be used to verify operation and perform troubleshooting. There are LEDs for communications, operation modes, and diagnostic codes. See Figure 11, next page, for LED locations. The LEDs associated with these inputs and outputs allow you to see what is active without using a voltmeter. The LEDs and their uses are as follows:

Diagnostic LEDs

STATUS - If the software is running, this LED should blink at a rate of one blink per second.

ALARM (on board) - If the RM454-V Module does not receive communications for more than one minute, this LED lights up, the relays turn off, and the analog outputs go to 0 VDC.

ALARM (above LCD display) - This red LED lights up and stays lit when there is an alarm present. The type of alarm is displayed on the LCD display. The ALARM LED also blinks when the expansion valve is initializing at startup.

COMM - Every time the RM454-V Module receives a valid E-BUS request from the VCCX-454 Controller, this LED blinks on and then off, signifying that it received a valid request and responded.

POWER - This LED lights up to indicate that 24 VAC power has been applied to the controller.

Binary Input LEDs

BIN1 - This green LED lights up when the Compressor Status 1 input has 24VAC present.

BIN2 - This green LED lights up when the Compressor Status 2 input has 24VAC present.

BIN3 - This green LED lights up when the Coil Temperature input has 24VAC present.

BIN4 - This green LED lights up when the Emergency Shutdown input has 24VAC present.

Relay LEDs

RLY1 - RLY4 - These green LEDs Light up when the relays are enabled and stay lit as long as they are active.

RM454-V Stepper Motor Valve LED

EXV-1 - This yellow LED blinks to indicate communication to the Superheat Controller. If the LED is on solid, that indicates no communication to the Superheat Controller.

EXV-2 - This yellow LED blinks to indicate communication to the Superheat Controller. If the LED is on solid, that indicates no communication to the Superheat Controller.

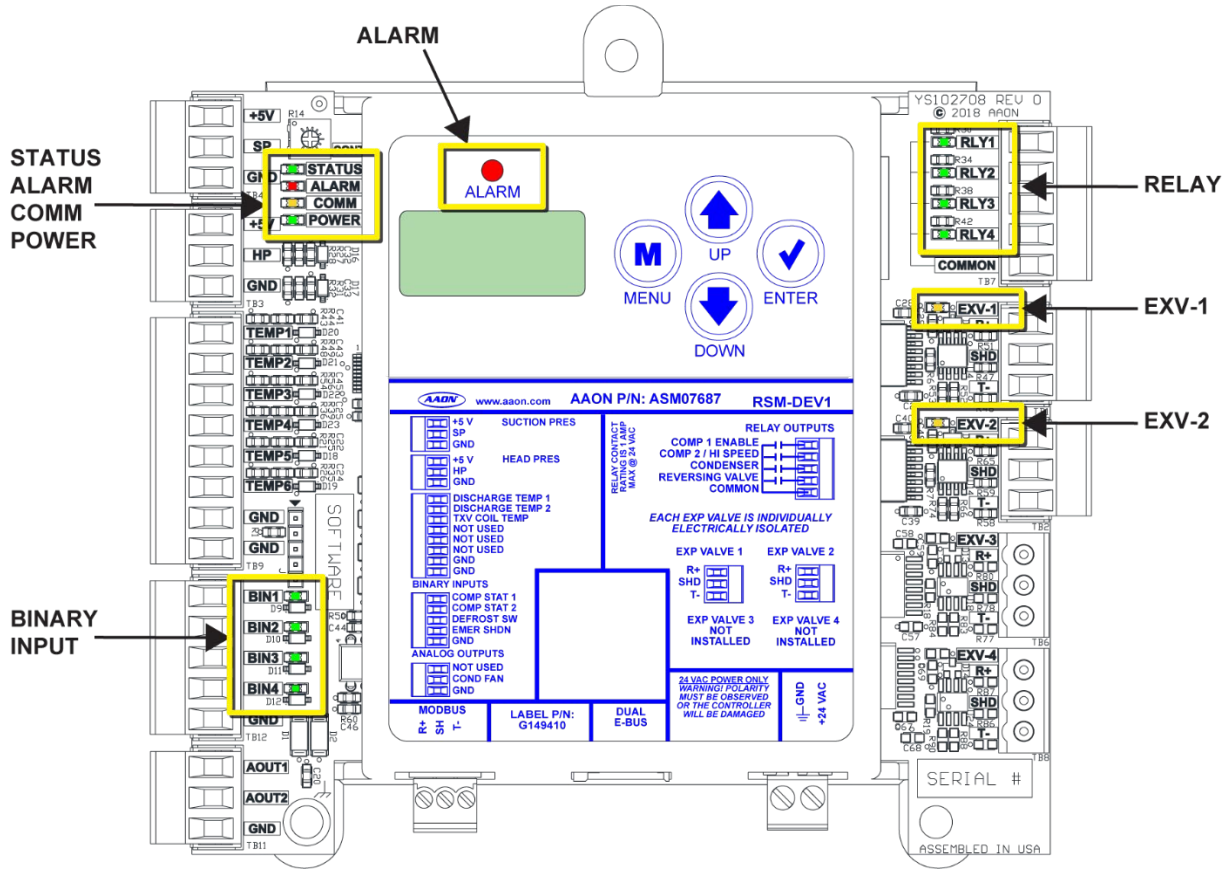


Figure 11: RM454-V LED Locations

6.2. Sensor Testing

6.2.1. TXV Coil Temperature Sensor Testing

The Temperature, Resistance, and Voltage for discharge sensors, in Table 20, are provided to aid in checking sensors that appear to be operating incorrectly. Many system operating problems can be traced to incorrect sensor wiring. Be sure all sensors are wired per the wiring diagrams in this manual.

If the sensors still do not appear to be operating or reading incorrectly, check voltage and/or resistance to confirm the sensor is operating correctly per the tables.

Note: Early releases of the units do not have this sensor. If a software update is performed, an alarm will show up for a missing sensor. This can be mitigated by contacting support.

6.2.1.1. Thermistor Sensor Testing Instructions

Use the Resistance (kOhms) column to check the thermistor sensor while disconnected from the controllers (not powered).

Use the Voltage @ Input (VDC) column to check sensors while connected to powered controllers. Read the voltage with the meter set on DC volts. Place the "-" (minus) lead on the GND terminal and the "+" (plus) lead on the sensor input terminal being investigated.

Table 20: 0-5V Temperature Sensor – Voltage and Resistance for Type III Sensors

Temperature - Resistance - Voltage for Type III 10 K OHM Thermistor Sensors							
Temp (°F)	Temp (°C)	Resistance (Ohms)	Voltage @ Input (VDC)	Temp (°F)	Temp (°C)	Resistance (Ohms)	Voltage @ Input (VDC)
-10	-23.3	93333	4.51	**72**	22.2	11136	2.635
-5	-20.6	80531	4.45	**73**	22.8	10878	2.605
0	-17.8	69822	4.37	**74**	23.3	10625	2.576
5	-15	60552	4.29	**75**	23.9	10398	2.549
10	-12.2	52500	4.2	**76**	24.4	10158	2.52
15	-9.4	45902	4.1	**77**	25	10000	2.5
20	-6.6	40147	4.002	**78**	25.6	9711	2.464
25	-3.9	35165	3.891	**80**	26.7	9302	2.41
30	-1.1	30805	3.773	**82**	27.8	8893	2.354
35	1.7	27140	3.651	**84**	28.9	8514	2.3
40	4.4	23874	3.522	**86**	30	8153	2.246
45	7.2	21094	3.39	**88**	31.1	7805	2.192
50	10	18655	3.252	**90**	32.2	7472	2.139
52	11.1	17799	3.199	**95**	35	6716	2.009
54	12.2	16956	3.143	**100**	37.8	6047	1.884
56	13.3	16164	3.087	**105**	40.6	5453	1.765
58	14.4	15385	3.029	**110**	43.3	4923	1.65
60	15.6	14681	2.972	**115**	46.1	4449	1.54
62	16.7	14014	2.916	**120**	48.9	4030	1.436
64	17.8	13382	2.861	**125**	51.7	3656	1.339
66	18.9	12758	2.802	**130**	54.4	3317	1.246
68	20	12191	2.746	**135**	57.2	3015	1.159
69	20.6	11906	2.717	**140**	60	2743	1.077
70	21.1	11652	2.691	**145**	62.7	2502	1.001
71	21.7	11379	2.661	**150**	65.6	2288	0.931

6.2.2. Discharge Line Thermistor Temperature Sensor Testing

Table 21 below is provided to aid in checking sensors that appear to be operating incorrectly. Many system operating problems can be traced to incorrect sensor wiring. Be sure all sensors are wired per the wiring diagrams in this manual.

If the sensors still do not appear to be operating or reading correctly, check voltage and/or resistance to confirm that the sensor is operating correctly per the table.

6.2.2.1. Thermistor Sensor Testing Instructions

Use the resistance column to check the thermistor sensor while disconnected from the controllers (not powered).

Use the voltage column to check sensors while connected to powered controllers. Read the voltage with the meter set on DC volts. Place the "-" (minus) lead on the GND terminal and the "+" (plus) lead on the sensor input terminal being investigated.

Table 21: Discharge Thermistor Temperature and Resistance

Discharge Line Thermistor Sensor Temperature and Resistance							
Temp (°F)	Temp (°C)	Resistance (kOhms)	Voltage @ Input (VDC)	Temp (°F)	Temp (°C)	Resistance (kOhms)	Voltage @ Input (VDC)
-40	-40	2889.60	4.98	**167**	75	12.73	2.80
-31	-35	2087.22	4.97	**176**	80	10.79	2.59
-22	-30	1522.20	4.96	**185**	85	9.20	2.39
-13	-25	1121.44	4.95	**194**	90	7.87	2.19
-4	-20	834.72	4.94	**203**	95	6.77	2.01
5	-15	627.28	4.92	**212**	100	5.85	1.84
14	-10	475.74	4.89	**221**	105	5.09	1.68
23	-5	363.99	4.86	**230**	110	4.45	1.53
32	0	280.82	4.82	**239**	115	3.87	1.39
41	5	218.41	4.77	**248**	120	3.35	1.25
50	10	171.17	4.72	**257**	125	2.92	1.12
59	15	135.14	4.65	**266**	130	2.58	1.02
68	20	107.44	4.57	**275**	135	2.28	0.92
77	25	86.00	4.47	**284**	140	2.02	0.83
86	30	69.28	4.36	**293**	145	1.80	0.76
95	35	56.16	4.24	**302**	150	1.59	0.68
104	40	45.81	4.10	**311**	155	1.39	0.61
113	45	37.58	3.94	**320**	160	1.25	0.55
122	50	30.99	3.77	**329**	165	1.12	0.50
131	55	25.68	3.59	**338**	170	1.01	0.45
140	60	21.40	3.40	**347**	175	0.92	0.42
149	65	17.91	3.20	**356**	180	0.83	0.38
158	70	15.07	3.00				

Note: If the voltage is above 4.98 VDC, then the sensor or wiring is "open". If the voltage is less than 0.38 VDC, then the sensor or wiring is shorted.

6.3. Transducer Testing

6.3.1. Suction Pressure Transducer Testing for R454-B Refrigerant

The evaporator coil temperature is calculated by converting the suction pressure to temperature. The suction pressure is obtained by using the Suction Pressure Transducer, which is connected to the suction line of the compressor.

Use the voltage column to check the Suction Pressure Transducer while connected to the RM454-V Module. The VCCX-454 and the RM454-V Module must be powered for this test. Read the voltage with a meter set on DC volts. Place the positive lead from the meter on the SP1 terminal located on the RM454-V Module terminal block. Place the negative lead from the meter on the ground (GND) terminal located adjacent to the SP1 terminal on the RM454-V Module terminal block. Use a refrigerant gauge set and/or an accurate electronic thermometer to measure the temperature or suction line pressure near where the Suction Pressure Transducer is connected to the suction line. Measure the voltage at the SP1 and GND terminals and compare it to the appropriate chart depending on the refrigerant in use. If the temperature/voltage or pressure/voltage readings do not align closely with the chart, the Suction Pressure Transducer is probably defective and needs to be replaced.

See Table 22 to the right. The chart shows a temperature range from 25.88°F to 86.11°F. For troubleshooting purposes, the DC voltage readings are also listed with their corresponding temperatures and pressures.

Table 22: Suction Pressure Transducer Chart for R454-B Refrigerant (Vapor)

Suction Pressure Transducer Chart			
Temperature (°F)	Temperature (°C)	Pressure (psi)	Signal DC Volts
25.88	-3.4	80.94	1.8
29.42	-1.4	87.16	1.9
32.81	0.5	93.39	2.0
36.05	2.6	99.62	2.1
39.16	4.0	105.84	2.2
42.15	5.6	112.07	2.3
45.02	7.2	118.29	2.4
47.79	8.8	124.52	2.5
50.47	10.3	130.75	2.6
53.06	11.7	136.97	2.7
55.57	13.1	143.20	2.8
57.99	14.4	149.42	2.9
60.36	15.8	155.65	3.0
62.65	17.0	161.88	3.1
64.88	18.3	168.10	3.2
67.05	19.5	174.32	3.3
69.16	20.6	180.55	3.4
71.23	21.8	186.78	3.5
73.24	22.9	193.00	3.6
75.20	24	199.23	3.7
77.12	25.1	205.46	3.8
79.00	26.1	211.68	3.9
80.83	27.1	217.91	4.0
82.63	28.1	224.14	4.1
84.39	29.1	230.36	4.2
86.11	30.1	236.59	4.3

6.3.2. Head Pressure Transducer

If you suspect there is a problem related to the head pressure transducer, measurements can be taken at the HP terminal. See Table 23 below for pressure readings.

Table 23: Head Pressure Transducer Chart

Head Pressure Transducer Chart			
Voltage	**Pressure**	**Voltage**	**Pressure**
0.5	0	**2.6**	350
0.6	17	**2.7**	367
0.7	33	**2.8**	384
0.8	50	**2.9**	400
0.9	67	**3.0**	417
1.0	83	**3.1**	434
1.1	100	**3.2**	450
1.2	117	**3.3**	467
1.3	133	**3.4**	484
1.4	150	**3.5**	500
1.5	167	**3.6**	517
1.6	183	**3.7**	534
1.7	200	**3.8**	550
1.8	217	**3.9**	567
1.9	233	**4.0**	584
2.0	250	**4.1**	600
2.1	267	**4.2**	617
2.2	283	**4.3**	634
2.3	300	**4.4**	650
2.4	317	**4.5**	667
2.5	334		

7. REVISION HISTORY

RM454-V Controller Technical Guide Change Log	
Revision and Date	**Change**
Rev A, November 07, 2025	Initial Release
Rev B, March 05, 2026	Updated Document Formatting

AAON Controls Support:

Support.Controls@aaon.com

Controls Support Website:

www.aaon.com/aaon-controls-technical-support

AAON Factory Technical Support:

Technical.Support@aaon.com

Phone:

866-918-1100

Monday through Friday, 7:00 AM to 5:00 PM Central Time

Before calling Technical Support, have the model and serial number of the unit available.

For replacement parts, contact your local AAON Representative.

Are you an AAON Rep? Visit My AAON to open new support tickets, communicate directly with our support teams, and track your support progress in one place.