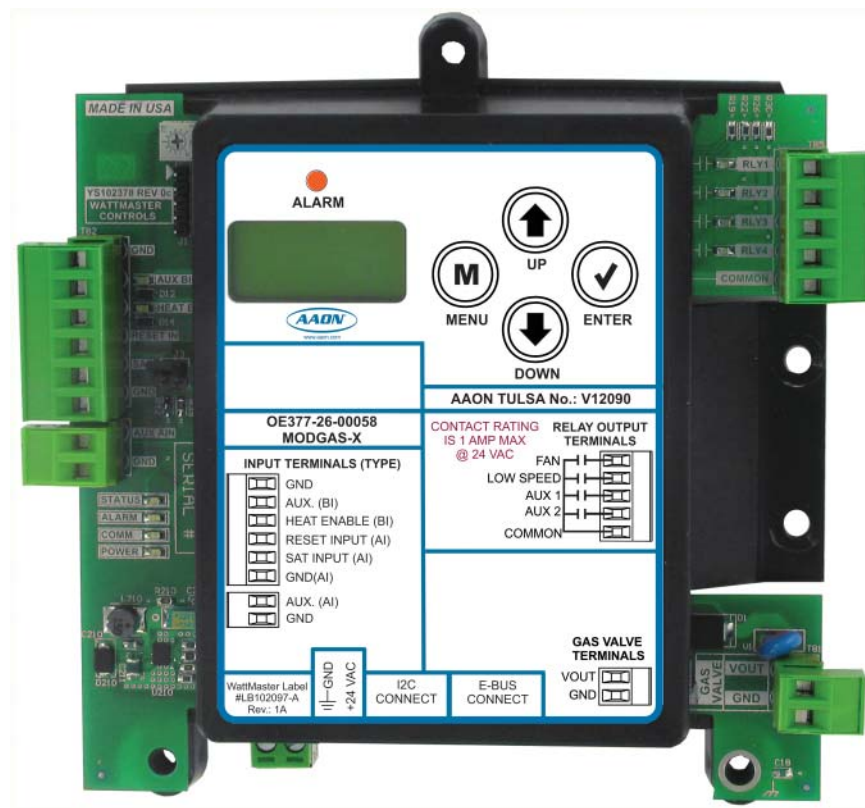




# Factory Packaged Controls

## OE377-26-00058 (AAON Part No. V12090) MODGAS-X Controller Field Technical Guide



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PART NUMBER CROSS REFERENCE TABLE		
PART DESCRIPTION	ORION	AAON TULSA
MODGAS-X Controller	OE377-26-00058	V12090
VCB-X Controller	OE335-23-VCBX	V04740
MHGRV-X Controller	OE377-26-00059	V12100
MHGRV II Controller	OE377-00-00042	R12190
MHGRV III Controller	OE377-00-00054	R71830
Supply Air Temperature Sensor	OE231	P87140
EBC E-BUS Cables - varying lengths	EBC-XXXF	N/A



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 WattMaster Form : AA-MODGASX-FIELD-TGD-01A

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Overview

The OE377-26-00058 MODGAS-X Controller (AAON Part No. V12090) is designed to modulate up to (2) gas valves to maintain a desired Discharge Air Temperature. See **Figure 1**.

The MODGAS-X Controller also controls the speed of the induced draft fan to maintain proper combustion in the heat exchanger. The controller can be used as a stand-alone unit or be connected to a VCB-X Controller (OE335-23-VCBX; AAON Part No. V04740) as an expansion board using a modular cable.

Features

The MODGAS-X Controller provides the following:

- Can control two gas valves wired in parallel
- Monitors Supply Air Temperature and Supply Air Reset and modulates gas valves to maintain Setpoint
- Provides active relays to control the Fan and Auxiliary Heat
- Contains a 2x8 LCD character display and 4 buttons that allow for status display, setpoint changes, and configuration changes

NOTE: The MODGAS-X Controller contains no user-serviceable parts. Contact qualified technical personnel if your MODGAS-X Controller is not operating correctly.

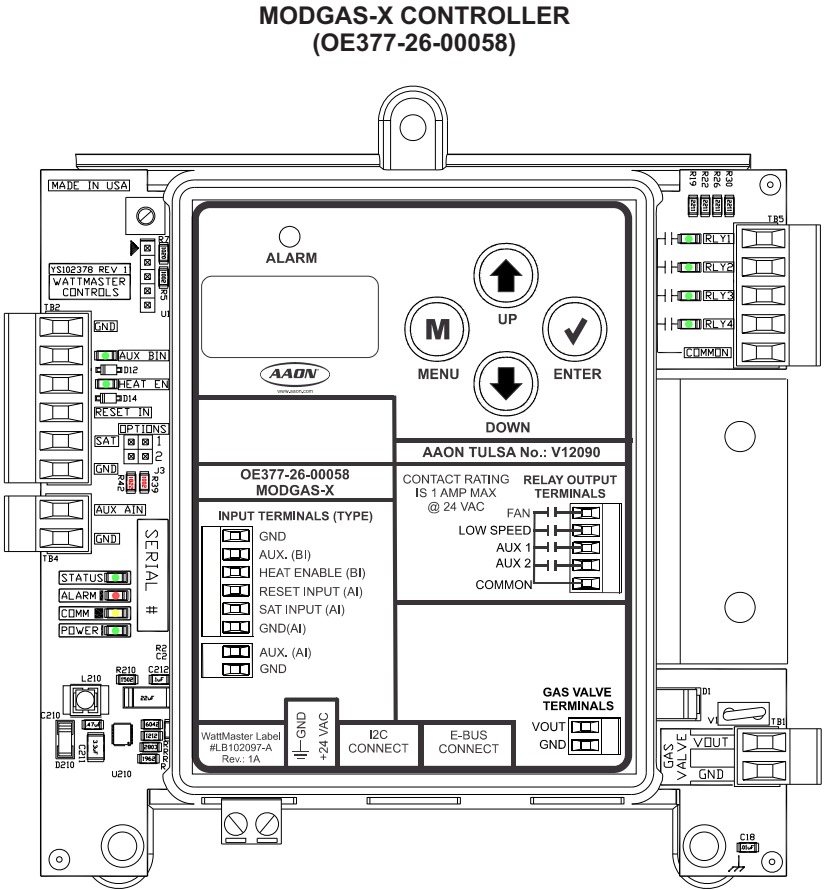


Figure 1: OE377-26-00058 MODGAS-X Controller

## Supply Air Temperature Sensor Installation

### Mounting the Supply Air Temperature Sensor

The Supply Air Temperature (SAT) Sensor should be located in the ductwork downstream of the unit supply air connection. Locate the sensor in the center of the widest part of the duct. Use the supplied template and a 5/16" drill to make a hole for the sensor. Install the gasket over the probe and mount securely to the duct using the supplied sheet metal screws. Be sure the gasket is compressed to provide an air tight seal. For best accuracy, apply insulation on the outside of the duct, over the sensor. This will help prevent thermal gradients from affecting the sensor.

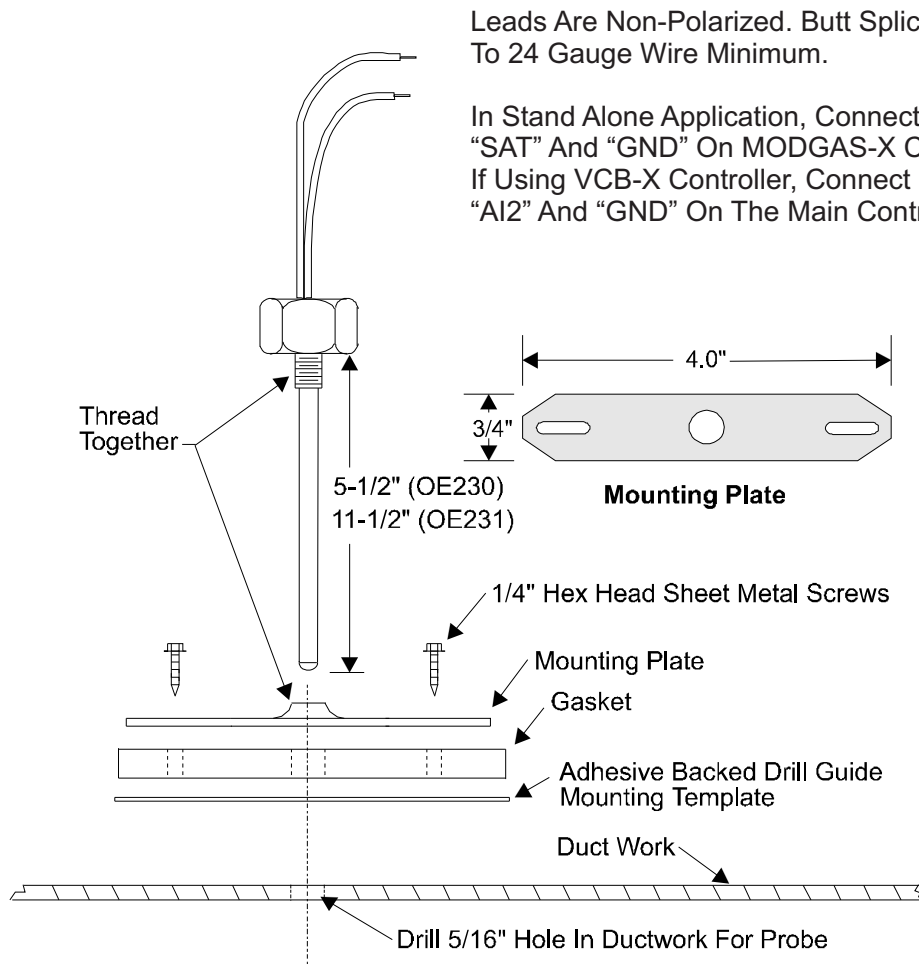
**WARNING:** Make sure your Supply Air Temperature Sensor is mounted and wired according to these instructions prior to testing the unit or else the modulating valve will not control properly and may damage your equipment.

### Stand-Alone Mode

If using the SAT Sensor in Stand-Alone Mode, the Sensor is connected to the MODGAS-X Controller. If the MODGAS-X is used in conjunction with a Reheat Controller, the SAT Sensor is shared between the two controllers. See **Table 1** for SAT Options Jumper Settings and see **Figure 3** for wiring.

### Communication Mode

If using the SAT Sensor in Communication Mode, the Sensor is connected to the Main Controller. See **Figure 4** for wiring.



**Figure 2: Supply Air Temperature Sensor Installation**

Important Wiring Considerations

SAT Options Jumper Settings

The SAT OPTIONS jumper settings are only used in Stand-Alone Mode. Refer to **Table 1** to determine the settings.

STAND-ALONE MODE SAT OPTIONS JUMPER SETTINGS*	
CONDITION	SETTING
MODGAS-X Only	1
MODGAS-X with MHGRV-X**	1
MODGAS-X with MHGRV II	2
MODGAS-X with MHGRV III	2
* For SAT Sensor testing, use Table 6 for jumper setting 1 and Table 7 for jumper setting 2.	
** In this situation, also set MHGRV-X SAT Option to MODGAS-X. See the <i>MHGRV-X Technical Guide</i> for more information.	

**Table 1: SAT OPTIONS Jumper Settings**

Important Wiring Considerations

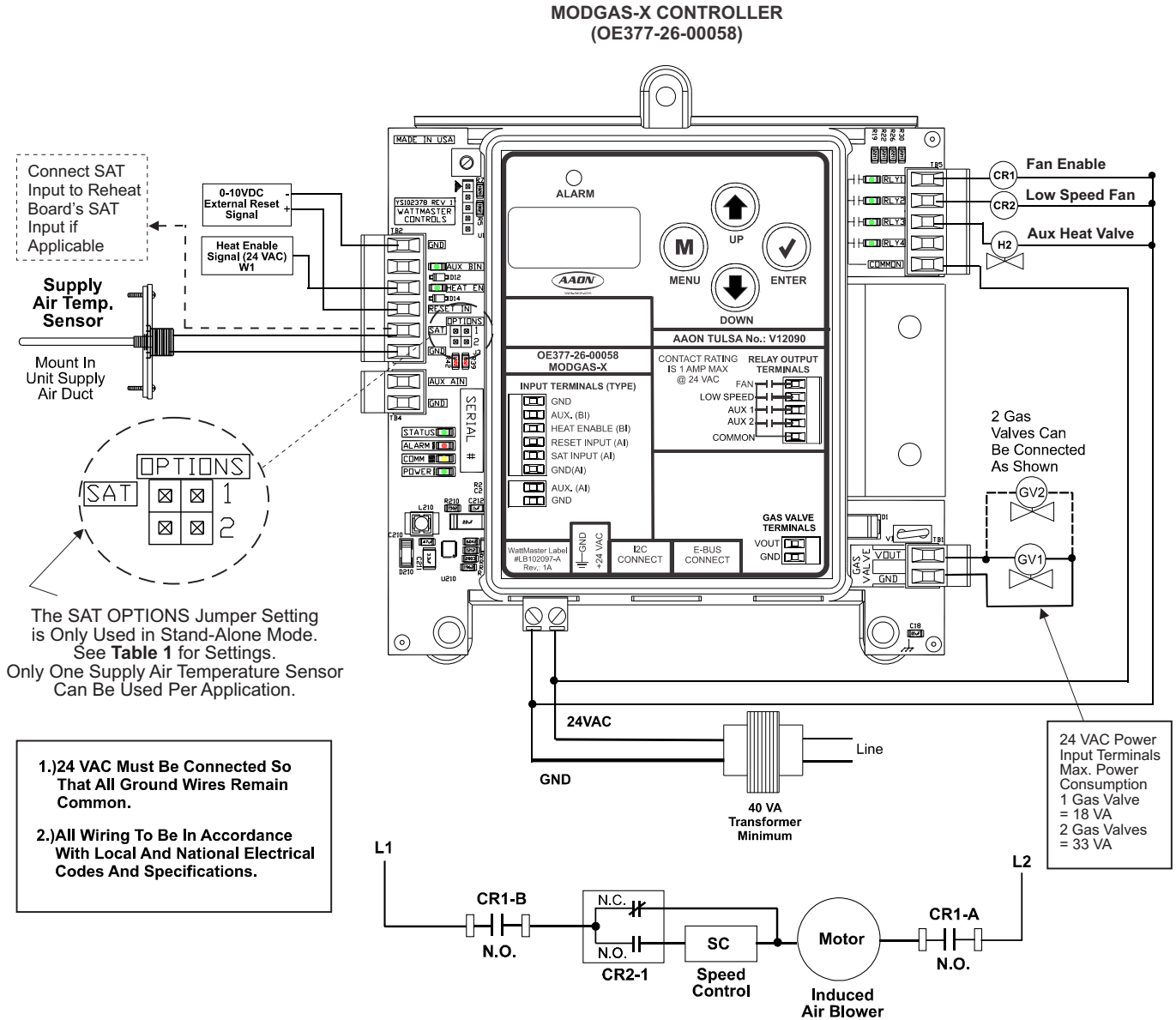
Please read carefully and apply the following information when wiring the MODGAS-X Controller. The MODGAS-X Controller requires the following electrical connections:

1. 18 gauge minimum wire unless otherwise noted.
2. 24 VAC power connection with an appropriate VA rating.
3. Supply Air Temperature Sensor and Heat Enable must have 24 gauge minimum wire.
4. 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 module and connected devices.
5. All wiring is to be in accordance with local and national electrical codes and specifications.
6. Check all wiring leads at the terminal block for tightness. Be sure that wire strands do not stick out and touch adjacent terminals. Confirm that all transducers required for your system are mounted in the appropriate location and wired into the correct terminals.

**WARNING:** Observe polarity! All boards must be wired GND-to-GND and 24 VAC-to-VAC. Failure to observe polarity could result in damage to the boards.

# MODGAS-X Controller

## MODGAS-X Stand-Alone Wiring



**Figure 3: MODGAS-X Controller Stand-Alone Wiring Diagram**

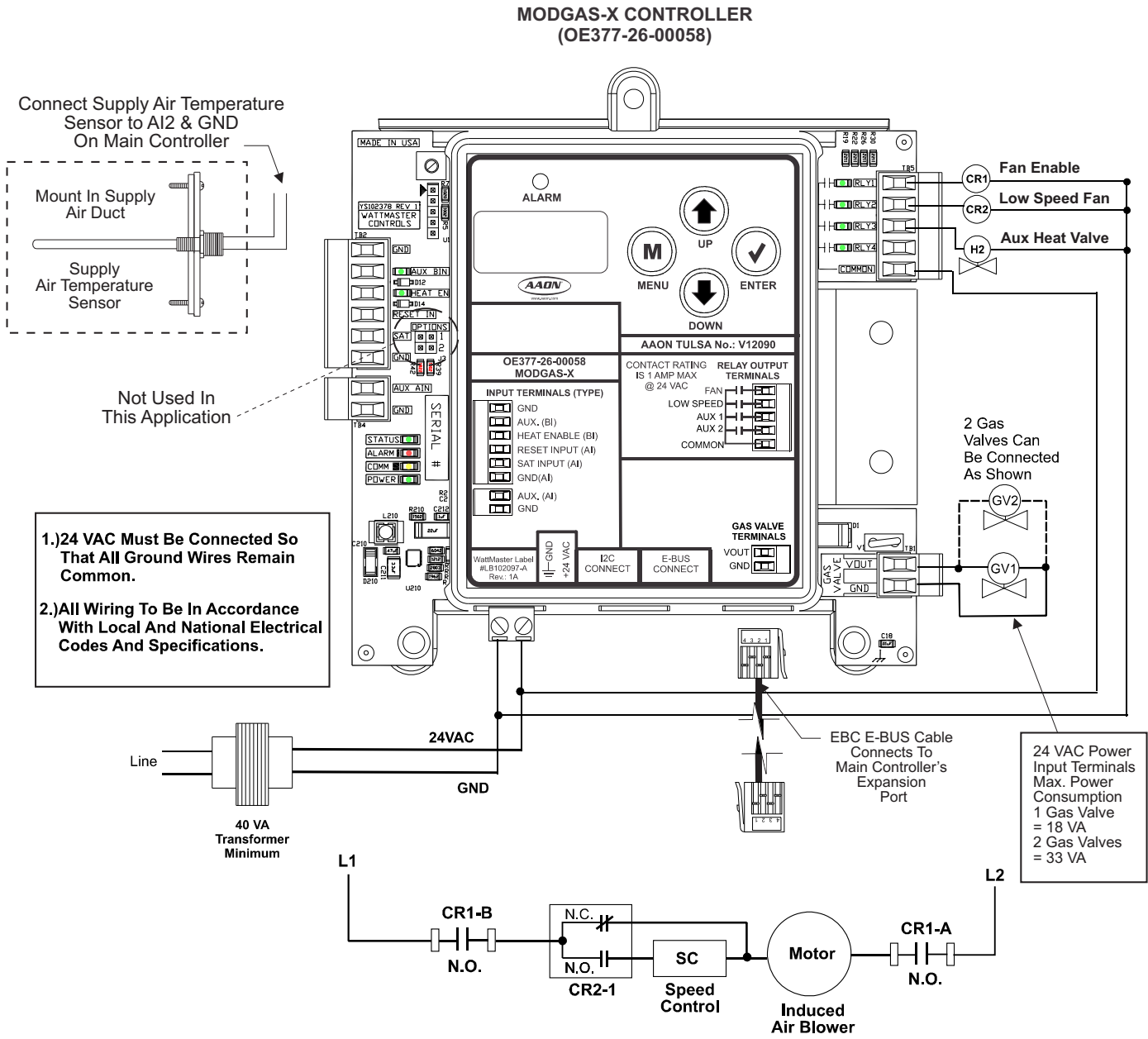


Figure 4: MODGAS-X Controller to Main Controller Wiring Diagram

## Inputs and Outputs

### I/O Map

The following inputs and outputs are available on the MODGAS-X Controller. See **Table 2** below to reference the Input/Output Map.

Analog Inputs	
1	Reset Signal (RST IN)
2	Supply Temperature (SAT)
3	(AUX AIN) - Not Used
Binary Inputs	
1	(AUX BIN) - Not Used
2	Heat Enable (HEAT EN)
Analog Output (0-20 VDC)	
1	Heat Valve (AOUT)
Relays	
1	Fan (RLY1)
2	Low Speed Fan (RLY2)
3	Auxiliary Heat (RLY3)
4	(RLY4) - Not Used

**Table 2: MODGAS-X Controller Inputs & Outputs**

### Analog Inputs

#### Reset Input (RST IN)

Used only in stand-alone operation. The Discharge Temperature Setpoint can be reset by supplying a 0-10 VDC signal to the RST IN low voltage terminal block. This reset signal is optional and need only be used if you require resetting of the discharge air temperature.

#### Supply Air Temperature Sensor (SAT)

Used only in stand-alone operation. The Supply Air Temperature Sensor is the control source. This sensor has to be installed for the unit to operate. The Supply Air Sensor is located in the discharge air stream and monitors discharge air temperature to maintain the discharge air temperature setpoint.

### Binary Inputs

#### Heat Enable Contact (HEAT EN)

This input is only required when the controller is used in stand-alone operation; it is not required when used as an expansion board to other unit controllers. The Heat Enable input is activated by a 24VAC signal supplied from a building automation system to enable the MODGAS-X Controller. The controller will not operate without 24VAC being applied to this input terminal when used in a stand-alone configuration.

### Analog Output

#### Gas Valve Output (VOUT)

This output is designed to supply a 0-20 VDC output signal for control of the modulating gas valve. Up to two gas valves may be connected to this output if required by the application. This valve is reverse acting, so high voltage means closed and low voltage means open.

**WARNING:** Do Not Connect More Than Two Gas Valves.

### Relay Outputs

#### Relay #1 - Fan Enable

This relay works in conjunction with the Low Speed Fan Relay to control the speed of the induced draft blower motor. When the MODGAS-X Controller has heat enabled, this relay closes to bring the induced draft blower on at high speed. The controller will activate the Low Speed Fan Relay to reduce the induced draft blower speed as the gas valve modulates closed.

#### Relay #2 - Low Speed Fan

Depending on the gas valve position, this relay will close to switch the induced draft blower to low speed. The controller automatically switches the blower to low speed as the gas valve modulates closed in order to maintain proper fuel to air ratios.

#### Relay #3 - Auxiliary Heat

Once the MODGAS-X Controller brings on heat, if the Supply Air Temperature rises 5°F and the valve output stays at 100% for 3 minutes, then the Auxiliary Heat Relay will activate to bring on a 2nd stage of fixed heat. The modulating valve is then able to modulate as needed to maintain the Heating Supply Air Setpoint. If the modulating valve falls to 0% for 2 minutes, the Auxiliary Heat Relay will disable.

## Operation Modes

---

The MODGAS-X Controller can be used stand-alone or connected to a Main Controller using a modular cable.

### Stand Alone Mode

When used in a stand-alone application (not connected to a Main Controller via a modular cable), the MODGAS-X Controller will modulate the gas valve(s) to maintain the DISCHARGE setpoint configured on the MODGAS-X Controller LCD display. The MODGAS-X Controller is activated by a 24VAC signal to the HEAT EN input.

The following describes the setpoints available in stand-alone mode for adjustment using the LCD display on the MODGAS-X Controller:

- **Supply Air Temperature Setpoint**
- **Supply Air Reset Temperature Setpoint**
- **Force Mode ON/OFF**
- **Force Valve Position**

### Communicating Mode

When the MODGAS-X Controller is connected to a Main Controller via a modular cable, the necessary information will be passed between the MODGAS-X and the Main Controller to properly operate in the Heating Mode.

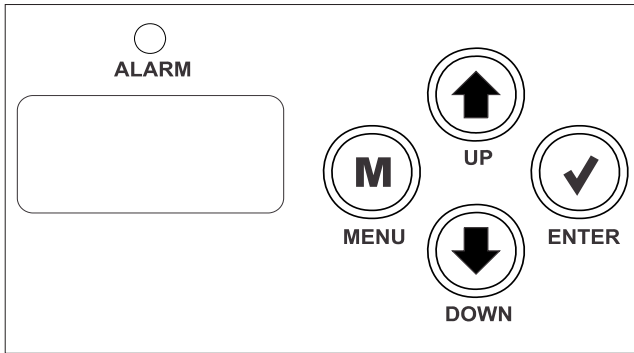
If the communication is interrupted between the MODGAS-X Controller and the Main Controller, both boards will show an alarm. When communication is restored, the alarms will go away.

In this configuration, the Supply Air Temperature Setpoint is set using the Main Controller and the Supply Air Temperature Reset is calculated by the Main Controller.





## Navigation Keys

### LCD Display Screen & Navigation Keys

The MODGAS-X Controller allows you to make configuration changes, view status, change setpoints, create force modes, and perform diagnostics using the keypad next to the LCD display. See **Figure 5** and refer to **Table 3** for descriptions.



**Figure 5: LCD Display and Navigation Keys**

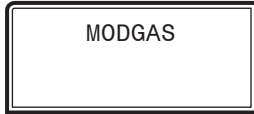
NAVIGATION KEY	KEY FUNCTION
<b>MENU</b> 	Use the MENU key to navigate through the Main Menu Screens.
<b>UP</b> 	Use this key to adjust setpoints and change configurations. This key is also used to turn Valve Force Mode on.
<b>DOWN</b> 	Use this key to adjust setpoints and change configurations. This key is also used to turn Valve Force Mode off.
<b>ENTER</b> 	Use the Enter key to move through screens within Main Menu categories. Also, use this key to save setpoints and configuration changes.

**Table 3: Navigation Key Functions**

Main Screens Map and MODGAS Screens

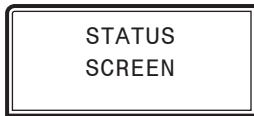
Main Screens Map

Refer to the following map when navigating through the LCD Main Screens. The first screen is an initialization screen. To scroll through the rest of the screens, press the <MENU> button.



Press to scroll through MODGAS Screens.

Press to go to STATUS Screens.



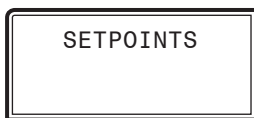
Press to scroll through STATUS Screens.

Press to go to ALARMS Screens.



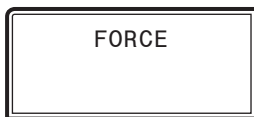
Press to scroll through ALARMS Screens.

Press to go to SETPOINTS Screens.



Press to scroll through SETPOINTS Screens.

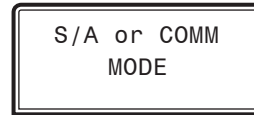
Press to go to FORCE Screens.



Press to scroll through FORCE Screens.

Main MODGAS Screens

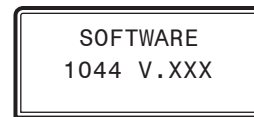
Refer to the following map when navigating through the Main Screens. From the MODGAS Screen, press <ENTER> to scroll through the screens.



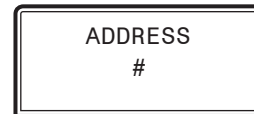
In Stand-Alone Mode, the screen will only display S/A MODE.

In Communications Mode, the screen will display COMM MODE and the items below will scroll through the screen:

1. Number of good packets being received. This will roll over after 9999. Example: +XXXX
2. Number of checksum errors. This will stop at 9999. Example: C-XXXX
3. Number of packet length errors. This will stop at 9999 until power is cycled. Example: P-XXXX



**CURRENT SOFTWARE VERSION**



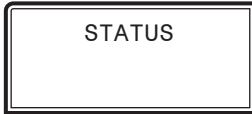
**CURRENT BOARD ADDRESS**



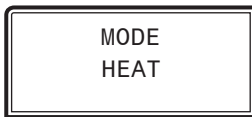
## Status & Alarm Screens

### Status Screens

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



Status Screens shown below will scroll automatically if LCD display is left on this screen for 20 seconds.



#### MODE

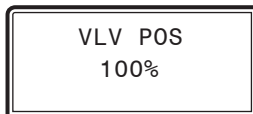
This screen displays the current mode of operation of the MODGAS-X Controller. The mode options are:

**OFF:** This mode will display when there is no call for heat and heating has been disabled.

**HIGH FIRE:** Each time Heat is activated, the unit will first go into High Fire Mode. During this mode, the unit will remain at maximum fire. The unit will leave this mode once proof of fire has been established.

**HEAT:** After High Fire, the unit will enter the Heat Mode and will begin to modulate the gas valve to maintain the Heating Supply Air Setpoint (SAT). The unit must remain in this mode for a minimum run time of 1 minute. Once the call for heat goes away, the unit will leave the Heat Mode.

**CUTOFF:** The Cutoff Mode occurs if the SAT rises above 200°F. During Cutoff Mode, the Heat will be disabled for a fixed delay period. If the SAT falls below 200°F and the delay period has expired, the unit will re-enter the Heat Mode.



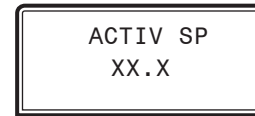
#### VALVE POSITION 0 to 100 percent



#### SUPPLY AIR TEMPERATURE 40°F to 200°F or 5°C to 93°C.

If no sensor is detected, screen will display "NO SENSR"

The SAT is set by the LCD Display in stand-alone mode and is set by the Main Controller in communicating mode.



#### ACTIVE SUPPLY AIR SETPOINT

Calculated from SAT setpoint and reset signal in stand-alone mode. In communicating mode, the Main Controller sends the setpoint.



### Alarm Screens

Refer to the following map when viewing Alarm Screens. These screens will display automatically when alarms are present. For more information, see [page 14](#).



#### ALARMS

The alarms are as follows:

**NO ALARMS:** This will be shown if there are no current alarms.

**SAT CUTOFF:** This indicates a Supply Air Temperature Cutoff Alarm condition which is activated if the SAT has risen above 200°F. The alarm will go away if after a fixed delay period the SAT has dropped below 200°F.

**MECH FAILURE:** The unit has been in High Fire Mode for more time than the mechanical failure delay period. This alarm will be disabled when the unit leaves High Fire Mode.

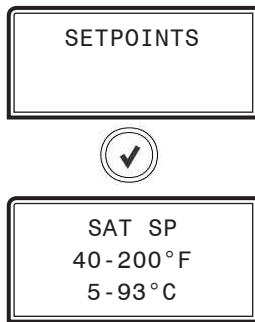
**SAT FAIL ERROR:** The Supply Air Temperature sensor has been disconnected for more than 60 seconds. This alarm will be disabled when the sensor is reconnected.

**COMM T/O ERROR:** Communications have been lost with the main controller. This alarm will disable when communications resume.

Setpoint Screens

Refer to the following map when navigating through the Setpoint Screens. From the SETPOINTS Screen, press <ENTER> to scroll through the screens and change setpoints. Use the <UP> and <DOWN> arrow keys to change your selections. Then press <ENTER> to save the new setpoint.

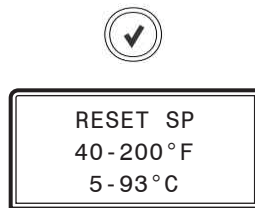
**WARNING:** When the MODGAS-X is operating in Communications Mode, these setpoints screens will not appear on the LCD display because they are controlled by the Main Controller.



**HEATING SUPPLY AIR TEMPERATURE SETPOINT**

This is the target temperature while the heating is enabled. If you are using the reset signal, this is the setpoint it will calculate to at zero volts. Will display only in stand-alone mode.

Minimum	Default	Maximum
40°F	120°F	200°F
5°C	49°C	93°C



**RESET HEATING SUPPLY AIR SETPOINT**

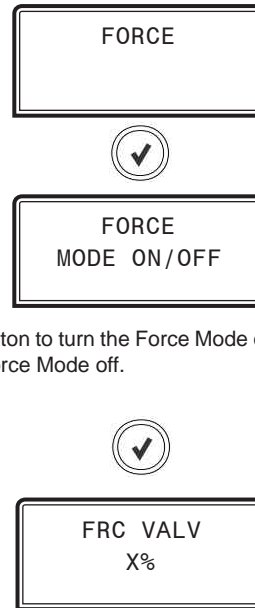
This is maximum temperature at which the Supply Air Temperature will reset to. Will display only in stand-alone mode.

Minimum	Default	Maximum
40°F	120°F	200°F
5°C	49°C	93°C



Force Screens

Refer to the following map when navigating through the Force Screens. From the FORCE Screen, press <ENTER>. At the FORCE MODE ON/OFF screen, press the <UP> arrow key to turn the FORCE MODE on and press the <DOWN> arrow key to turn the FORCE MODE off. Use the <UP> and <DOWN> arrow keys to increase and decrease the percentage.



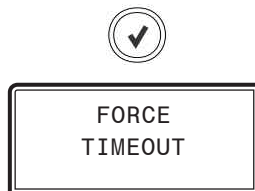
Press the <UP> button to turn the Force Mode on. Press the <DOWN> button to turn the Force Mode off.

**FORCE VALVE PERCENTAGE**

This screen only appears when Force Mode is on.

Press the <UP> button to increase the percentage. Press the <DOWN> button to decrease the percentage.

**NOTE:** When you turn the Force Mode back off or after 1 hour has elapsed, the valve will reinitialize to zero.



**FORCE MODE TIME OUT**

This screen will appear when the Force Mode times out after 1 hour.

## Troubleshooting

### LED Diagnostics

The MODGAS-X Controller is equipped with LEDs that can be used to verify operation and perform troubleshooting. There are LEDs for communication, operation modes, and diagnostic codes. The module has 10 LEDs—8 used for operation & status, and 2 used for alarms.

See **Figure 6** for the 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:

#### Operation LEDs

**POWER** - This green LED will light up to indicate that 24 VAC power has been applied to the controller.

**STATUS** - This green LED will light up and blink the board address at startup. It will then blink every 10 seconds according to what mode the controller is in. See **Table 4**.

No. of Blinks	STATUS LED
1	Off Mode
2	High Fire Mode
3	Heating Mode
4	Force Mode

**Table 4: STATUS LED Blink Codes**

#### Diagnostic LEDs

**ALARM** - This red LED located on the MODGAS-X Controller's cover above the LCD display will light up to indicate an alarm. The type of alarm(s) will be shown on the LCD display. The ALARM LED also blinks when the expansion valve is initializing at startup.

The ALARM LED on the MODGAS-X board will blink an alarm code when an alarm(s) occurs. The highest priority failure code will be indicated first. You must correct the highest priority alarm before other problems will be indicated. See **Table 5**.

No. of Blinks	ALARM LED
1	Mechanical Failure
2	Supply Air Temperature Sensor Failure
3	SAT Cutoff Mode
4	Communications Time Out Error

**Table 5: ALARM LED Blink Codes**

#### Communication LED

**COMM** - This yellow LED will light up and blink when communications are detected.

#### Relay LEDs

**RLY1** - This green LED will light up and stay lit as long as the Fan relay is active.

**RLY2** - This green LED will light up and stay lit as long as the Low Speed Fan relay is active.

**RLY3** - This green LED will light up and stay lit as long as the Auxiliary Heat relay is active.

#### Binary Input LEDs

**AUX BIN** - Not Used.

**HEAT EN** - This green LED will light up when Heat is enabled.

### Troubleshooting Alarms

#### Mechanical Failure:

- Check relay outputs on the MODGAS-X for 24 VAC output.
- Verify the SAT OPTIONS jumper settings on the MODGAS-X for Supply Air Temperature Sensor.
- Verify output voltage (VOUT and GND) to gas valve. Try forcing valves (refer to Force Screens in this guide).
- Verify that the Supply Air Temperature Sensor is connected to SAT and GND on the MODGAS-X (stand-alone mode) or to AI2 and GND on the Main Controller (communicating mode).
- Verify Supply Air Temperature Sensor probe is mounted correctly in supply duct.
- Remove SAT and GND wiring from the MODGAS-X and ohm sensor out (this may indicate open or failed wiring). Refer to chart in back of this guide for readings.

Supply Air Temperature Failure:

- Verify that the Supply Air Temperature Sensor is connected to the SAT and GND on the MODGAS-X (stand-alone mode) or to AI2 and GND on the Main Controller (communicating mode).
- Remove SAT and GND wiring from MODGAS-X and ohm sensor out (this may indicate open or failed wiring). Refer to chart in back of this guide for readings.
- Verify the SAT OPTIONS jumper settings on the MODGAS-X for the Supply Air Temperature Sensor.

Sat Cutoff Mode:

- Remove SAT and GND wiring from the MODGAS-X and ohm sensor out (this may indicate open or failed wiring). Refer to chart in back of guide for readings.

- With Supply Air Sensor disconnected from the MODGAS-X, set volt meter to DC volts and measure voltage between SAT and GND on board. Refer to chart in back of this guide for readings.
- Verify Supply Air Temperature Sensor reading in duct with 3rd party temperature testing device.

Communications Loss:

- Check COMM LED on MODGAS-X.
- Verify 24 VAC power to all interconnected WattMaster controllers.
- Verify E-BUS connection between the MODGAS-X and associated WattMaster controllers.
- In communication mode (connected to a VCB-X Controller with modular cable), confirm that VCB-X Controller's MODGAS-X status screen displays MODGAS-X's Position % and that Main MODGAS screens show COMM MODE.

MODGAS-X CONTROLLER  
(OE377-26-00058)

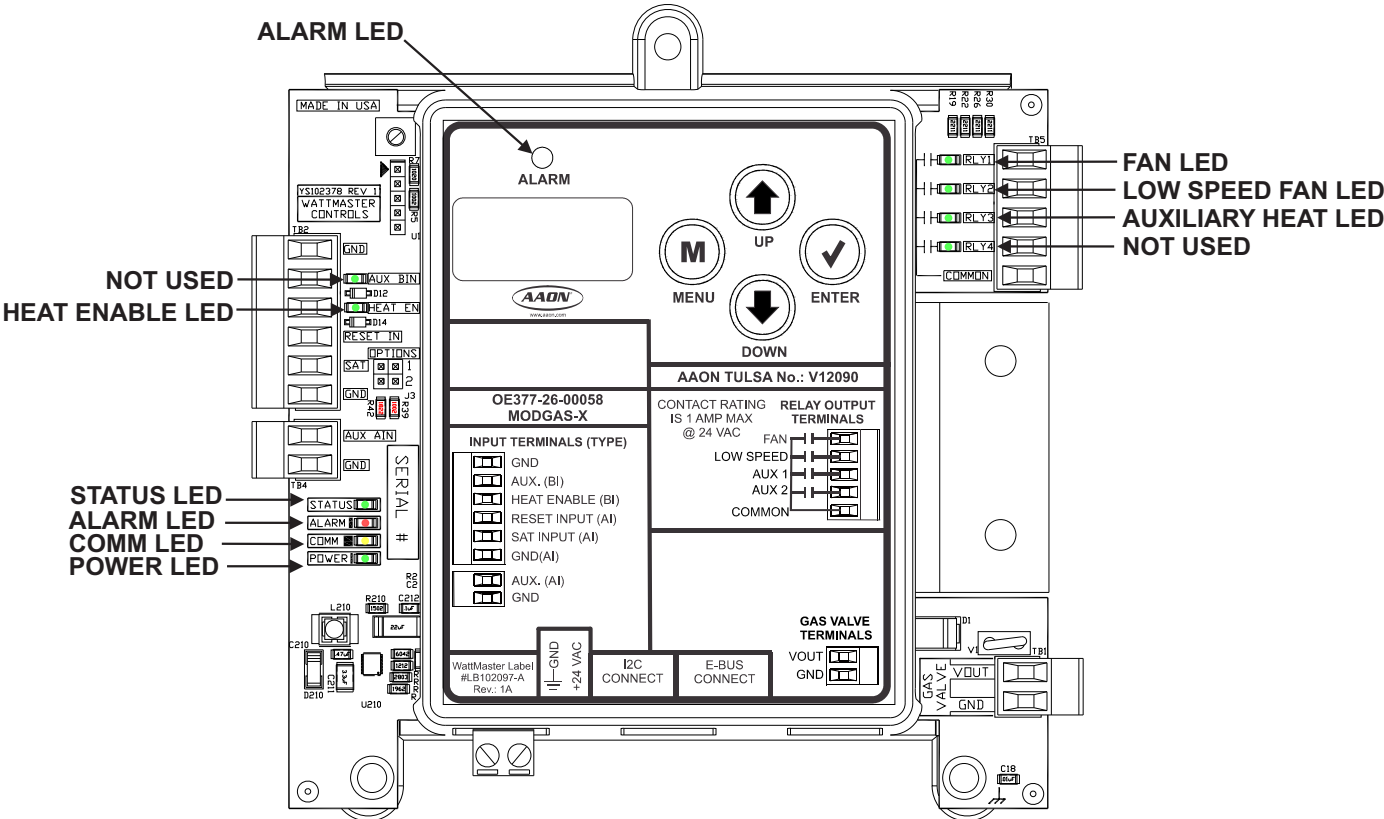


Figure 6: MODGAS-X Controller LED Locations and Descriptions

## Troubleshooting

### Other Checks

#### 0-3V (SAT OPTIONS Jumper Setting 1) & 0-5V (SAT OPTIONS Jumper Setting 2) Supply Air Temperature Sensor

If you suspect the Supply Air Temperature Sensor is not reading correctly, make sure the wiring terminal connections are tight and that any wiring splices are properly connected. You can check the operation of the Supply Air Temperature Sensor by measuring the resistance or voltage using a digital multimeter. Set the meter to DC Volts. Place the positive probe on the AIN terminal and the negative probe on the GND terminal. Read the DC Volts and find that voltage in **Tables 6 & 7**.

Read the temperature corresponding with that voltage and determine if this is close to the actual temperature the sensor is exposed to. If the temperature from the chart is different by more than a few degrees, you probably have a defective or damaged sensor. You can also check the sensor resistance to determine correct operation. To read the resistance, set the meter to Ohms. Unplug the sensor connector from the board and measure the resistance across the disconnected wires. This resistance should match the corresponding temperature from **Tables 6 & 7**.

Temperature to Resistance/Voltage Chart			
Temp (°F)	Temp (°C)	Resistance (Ohms)	Voltage @ Input (VDC)
-10	-23.3	93333	2.98
-5	-20.6	80531	2.94
0	-17.8	69822	2.89
5	-15.0	60552	2.83
10	-12.2	52500	2.77
15	-9.4	45902	2.71
20	-6.7	40147	2.64
25	-3.9	35165	2.57
30	-1.1	30805	2.49
35	1.6	27140	2.41
40	4.4	23874	2.33
45	7.2	21094	2.24
50	10.0	18655	2.15
52	11.1	17799	2.11
54	12.2	16956	2.08
56	13.3	16164	2.04
58	14.4	15385	2.00
60	15.6	14681	1.96
62	16.7	14014	1.93
64	17.8	13382	1.89
66	18.9	12758	1.85

**Table 6: 0-3V Temperature Sensor - Voltage & Resistance for Type III Sensors**

Temperature to Resistance/Voltage Chart			
Temp (°F)	Temp (°C)	Resistance (Ohms)	Voltage @ Input (VDC)
68	20.0	12191	1.81
69	20.6	11906	1.79
70	21.1	11652	1.78
71	21.7	11379	1.76
72	22.2	11136	1.74
73	22.7	10878	1.72
74	23.3	10625	1.70
75	23.9	10398	1.68
76	24.4	10158	1.66
78	25.6	9711	1.63
80	27.8	9302	1.59
82	27.8	8893	1.55
84	28.9	8514	1.52
86	30.0	8153	1.48
88	31.1	7805	1.45
90	32.2	7472	1.41
95	35.0	6716	1.33
100	37.8	6047	1.24
105	40.6	5453	1.16
110	43.3	4923	1.09
115	46.1	4449	1.02
120	48.9	4030	.95
125	51.7	3656	.88
130	54.4	3317	.82
135	57.2	3015	.76
140	60.0	2743	.71
145	62.8	2502	.66

**Table 6, continued: 0-3V Temperature Sensor - Voltage & Resistance for Type III Sensors**

#### Thermistor Sensor Testing Instructions

- 1.) Use the resistance column to check the thermistor sensor while disconnected from the controllers (not powered).
- 2.) Use the voltage column to check sensors while connected to powered controllers. Read voltage with meter set on DC volts. Place the “-” (minus) lead on GND terminal and the “+” (plus) lead on the sensor input terminal being investigated.

*If the voltage is above 3.3 VDC, the sensor or wiring is “open.” If the voltage is less than 0.05 VDC, the sensor or wiring is shorted.*

Temperature to Resistance/Voltage Chart			
Temp (°F)	Temp (°C)	Resistance (Ohms)	Voltage @ Input (VDC)
-10	-23.3	93333	4.620
-5	-20.6	80531	4.550
0	-17.8	69822	4.474
5	-15.0	60552	4.390
10	-12.2	52500	4.297
15	-9.4	45902	4.200
20	-6.7	40147	4.095
25	-3.9	35165	3.982
30	-1.1	30805	3.862
35	1.6	27140	3.737
40	4.4	23874	3.605
45	7.2	21094	3.470
50	10.0	18655	3.330
52	11.1	17799	3.275
54	12.2	16956	3.217
56	13.3	16164	3.160
58	14.4	15385	3.100
60	15.6	14681	3.042
62	16.7	14014	2.985
64	17.8	13382	2.927
66	18.9	12758	2.867
68	20.0	12191	2.810
69	20.6	11906	2.780
70	21.1	11652	2.752
71	21.7	11379	2.722
72	22.2	11136	2.695
73	22.7	10878	2.665
74	23.3	10625	2.635
75	23.9	10398	2.607
76	24.4	10158	2.577
78	25.6	9711	2.520
80	27.8	9302	2.465
82	27.8	8893	2.407
84	28.9	8514	2.352
86	30.0	8153	2.297
88	31.1	7805	2.242
90	32.2	7472	2.187
95	35.0	6716	2.055

Temperature to Resistance/Voltage Chart			
Temp (°F)	Temp (°C)	Resistance (Ohms)	Voltage @ Input (VDC)
100	37.8	6047	1.927
105	40.6	5453	1.805
110	43.3	4923	1.687
115	46.1	4449	1.575
120	48.9	4030	1.469
125	51.7	3656	1.369
130	54.4	3317	1.274
135	57.2	3015	1.185
140	60.0	2743	1.101
145	62.8	2502	1.024
150	65.6	2288	0.952

**Table 7, cont.: 0-5V Temperature Sensor - Voltage & Resistance for Type III Sensors**

Thermistor Sensor Testing Instructions

- 1.) Use the resistance column to check the thermistor sensor while disconnected from the controllers (not powered).
- 2.) Use the voltage column to check sensors while connected to powered controllers. Read voltage with meter set on DC volts. Place the “-” (minus) lead on GND terminal and the “+” (plus) lead on the sensor input terminal being investigated.

*If the voltage is above 5.08 VDC, the sensor or wiring is “open.” If the voltage is less than 0.05 VDC, the sensor or wiring is shorted.*

**Table 7: 0-5V Temperature Sensor - Voltage & Resistance for Type III Sensors**







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