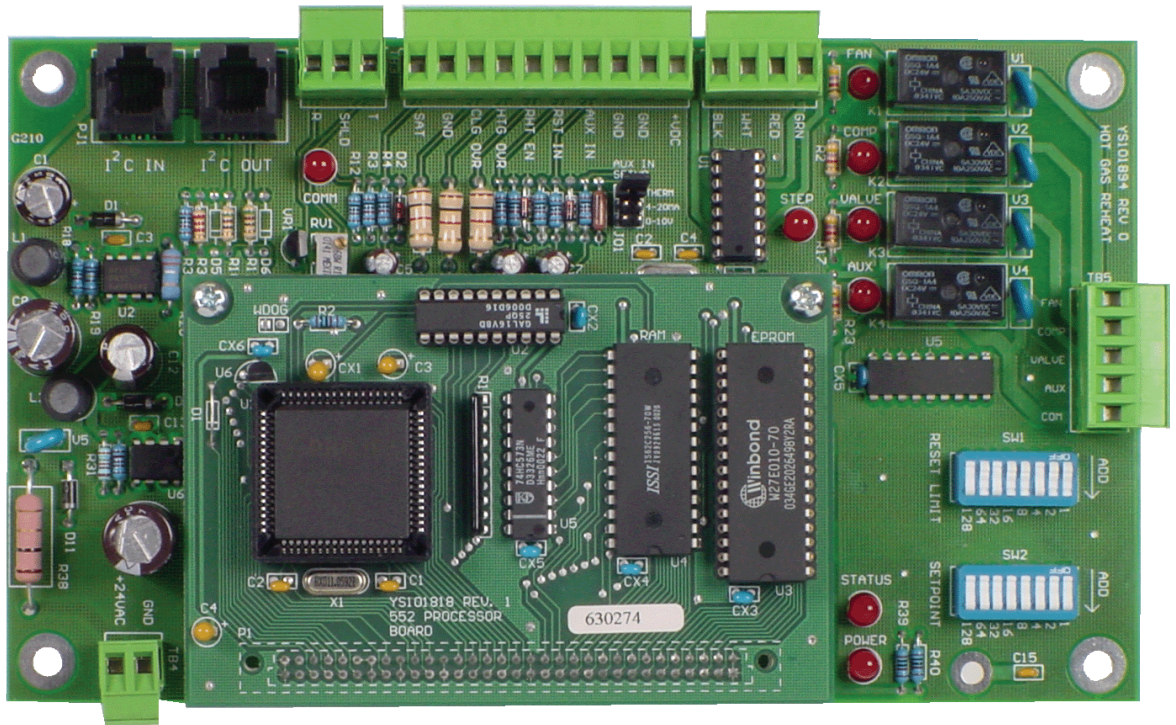




# MHGRV II Controller Technical Guide



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## Controller Overview

### General

The MHGRV II Controller is designed to control a Modulating Hot Gas Reheat Valve to maintain a desired Supply Air Temperature and Humidification setpoint. The controller can be used as a stand-alone controller or it can be connected to and used in conjunction with the AAON Factory Packaged HVAC unit controller. The MHGRV II controller is connected to the HVAC unit controller via a modular expansion cable and corresponding connectors on the controllers.

### Features

The MHGRV II provides the following features.

- Can Be Operated as a Stand-Alone Controller or Integrated with the HVAC Unit Controller
- Provides for Supply Air Temperature Setpoint Reset when Required
- Second Stage Reheat Capability When Using 2 Hot Gas Reheat Valves
- Control of Reheat Solenoid Valve to Provide Coil Flushing for Positive Refrigerant Oil Return

### Operation

When used in a stand-alone application (not connected to an HVAC unit controller board) the MHGRV II controller will control the Modulating Hot Gas Valve to maintain the Supply Air Setpoint based on the Supply Air Temperature Sensor connected to the MHGRV II controller. The MHGRV II controller is activated by a 24 VAC wet contact closure

signal connected to the H1 (RHT EN) input terminal on the controller. Heating Override and Cooling Override are also controlled by 24 VAC wet contact closure signals connected to the HTG OVR and CLG OVR input terminals on the controller. The Supply Air Setpoint is set by configuring a DIP switch on the MHGRV II controller board. Supply Air Temperature Reset is also available and is set by configuring a DIP switch on the controller board. When Supply Air Temperature Reset is used it is reset by a 0-10 VDC signal supplied to the RST IN terminal on the MHGRV II controller.

When the MHGRV II controller is connected to an HVAC unit controller board via its modular cable it will operate exactly as the stand-alone controller except the following information will be passed between the MHGRV II controller and the HVAC unit controller.

- Reheat Enable command
- Supply Air Temperature Setpoint. This replaces the setpoint that is set with the Supply Air Temperature DIP switch on the MHGRV II controller.
- The Reset Supply Air Temperature Setpoint. This replaces the setpoint that is set with the Supply Air Temperature Reset DIP switch on the MHGRV II controller. The Supply

Air Temperature Reset Signal is also supplied from the HVAC unit controller.

- If the communication is interrupted between the MHGRV II controller and the HVAC unit controller, the MHGRV II controller will revert to stand-alone operation.

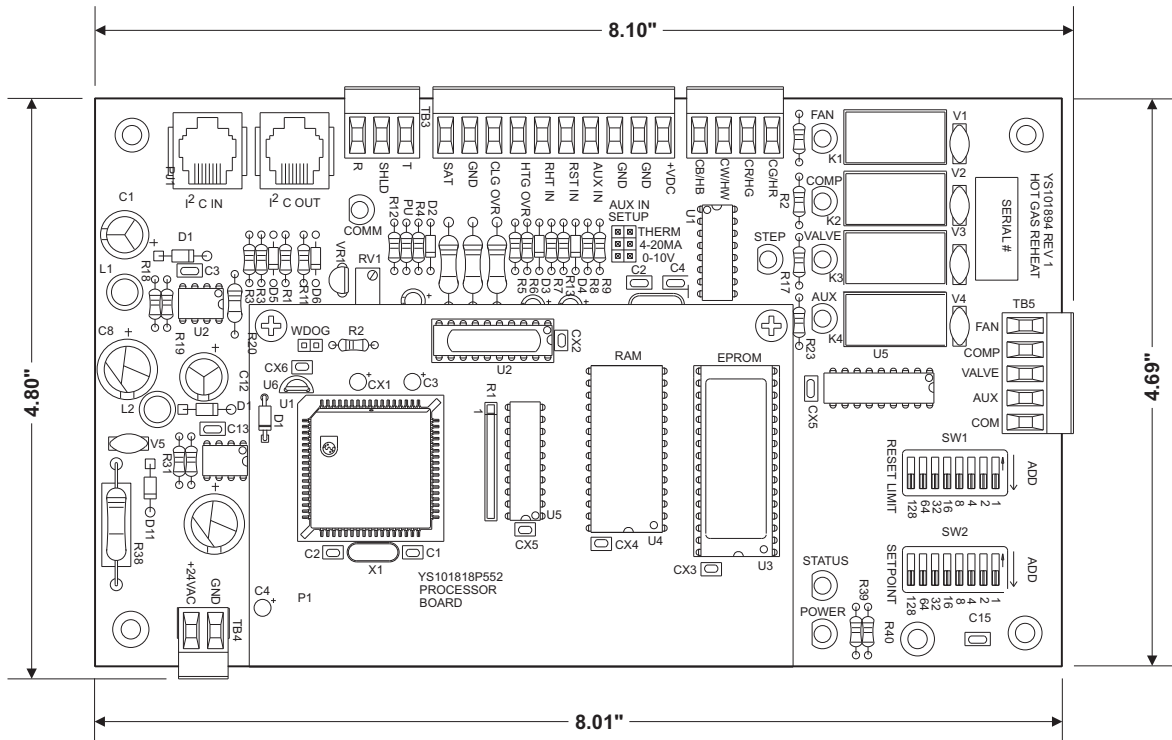


Figure 1: MHGRV II Controller Dimensions

# Controller Inputs and Outputs

## General

The following inputs and outputs are available on the MHGRV II controller. For component locations of the inputs, outputs and wiring, see **Figure 3** and **4**.

## Analog Inputs

### SAT: Supply Air Temperature Sensor

The Supply Air Temperature Sensor is the main control input. This sensor has to be installed for the unit to operate. The Supply Air Temperature Sensor is located in the discharge air stream and monitors the HVAC units Supply Air Temperature to maintain the Supply Air Temperature Setpoint.

### RST IN: Reset Signal

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.

### AUX IN: Not Used

## 24 VAC Contact Closure Inputs:

### RHT EN: Dehumidification

When a call for dehumidification is initiated by another controller this interlocked 24 VAC wet contact closure is used to enable the MHGRV II controller.

### HTG OVR: Heating Override

When a call for heating is initiated by the HVAC unit, this interlocked 24 VAC wet contact closure is used to override the MHGRV II controller dehumidification mode.

### CLG OVR: Cooling Override

When a call for cooling is initiated by the HVAC unit, this interlocked 24 VAC wet contact closure is used to override the MHGRV II controller dehumidification mode.

## Relay Outputs

### FAN: Fan Enable

When a call for Dehumidification, Cooling Override or Heating Override is received, this relay output will be closed to energize the HVAC unit Supply Fan.

### COMP: Compressor Enable

When a call for Dehumidification or Cooling Override is received this relay output will be closed to energize the Compressor(s).

### VALVE: Reheat Solenoid Valve

When a call for Dehumidification is received and reheat is required this relay output will be closed to energize the Hot Gas Solenoid Valve approximately 30 seconds after the Fan and Compressor have been enabled.

### AUX: 2 Position HGR Valve

Used on larger capacity systems that have an optional 2 Position HGR Valve in addition to the Modulating HGR Valve. When a call for Dehumidification is received and additional reheat is required beyond the Modulating HGR valves capacity, this relay output will be closed to energize the 2 Position HGR Valve, while the Reheat Solenoid Valve continues to modulate as required. This AUX (2 Position HGR Valve) Relay will energize when the Modulating HGR Valve stays at 100% for 1 ½ minutes. The AUX Relay will de-energize when the Modulating HGR Valve stays at 0% for 1 ½ minutes. The AUX Relay is not be energized during the Dehumidification Reheat Coil Flush Cycle.

## Modulating HGR Valve Outputs

### CG/HR:

This output is connected to the Condensor HGR Valve Green Wire Termination and to the Reheat HGR Valve Red Wire Termination to control their modulation.

### CR/HG:

This output is connected to the Condensor HGR Valve Red Wire Termination and to the Reheat HGR Valve Green Wire Termination to control their modulation.

### CW/HW:

This output is connected to the Condensor HGR Valve White Wire Termination and to the Reheat HGR Valve White Wire Termination to control their modulation.

### CB/HB:

This output is connected to the Condensor HGR Valve Black Wire Termination and to the Reheat HGR Valve Black Wire Termination to control their modulation.

# Controller Installation & Wiring

## Controller Mounting

It is important to mount the controller in a location that is free from extreme high or low temperatures, moisture, dust and dirt.

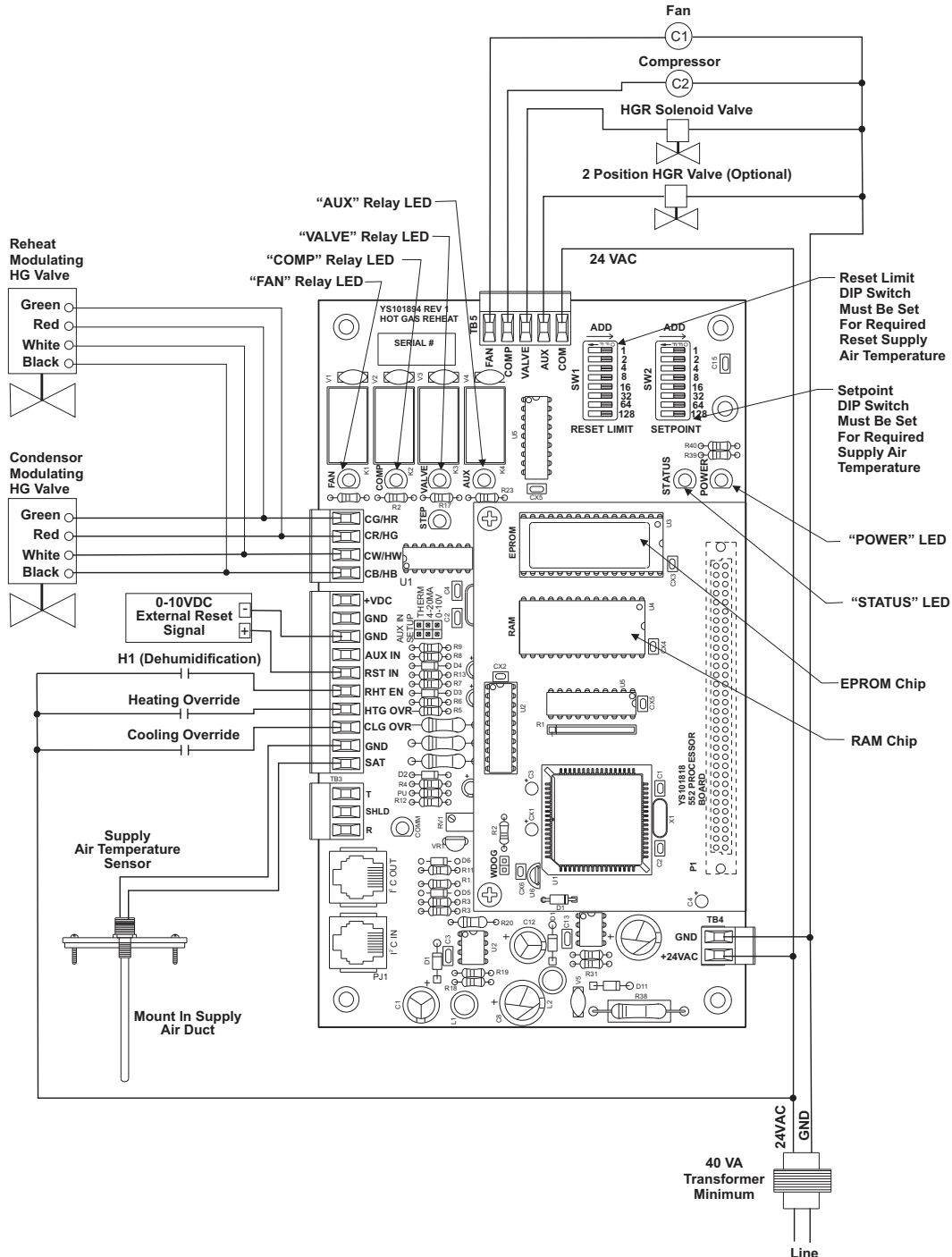
Be careful not to damage the electronic components when mounting the controller. Remove the controller from its snap track mount. Mark the control enclosure base using the snap track as a template. Drill pilot holes in the enclosure base and secure the snap track to it using sheet metal screws. Do not allow metal shavings to fall onto the circuit board. Reattach the controller to the snap track.

## Important Wiring Considerations

Depending on if the MHGRV II controller is to be connected to the HVAC controller or is to be used as a stand-alone controller determines how the MHGRV II should be wired. For the stand-alone wiring diagram, see **Figure 2**. For the wiring diagram to use when the MHGRV II controller is connected to an HVAC controller, see **Figure 3**. Please carefully read and apply the following information when wiring the MHGRV II controller.

Please carefully read and apply the following information when wiring the MHGRV II controller.

1. 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.
2. All wiring is to be in accordance with local and national electrical codes and specifications.
3. Minimum wire size for 24 VAC wiring should be 18 gauge.
4. Minimum wire size for all sensors should be 24 gauge.
5. Be sure that 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.



**Figure 2: MHGRV II Controller Wiring When Used As A Stand-Alone Controller**

Controller Installation & Wiring

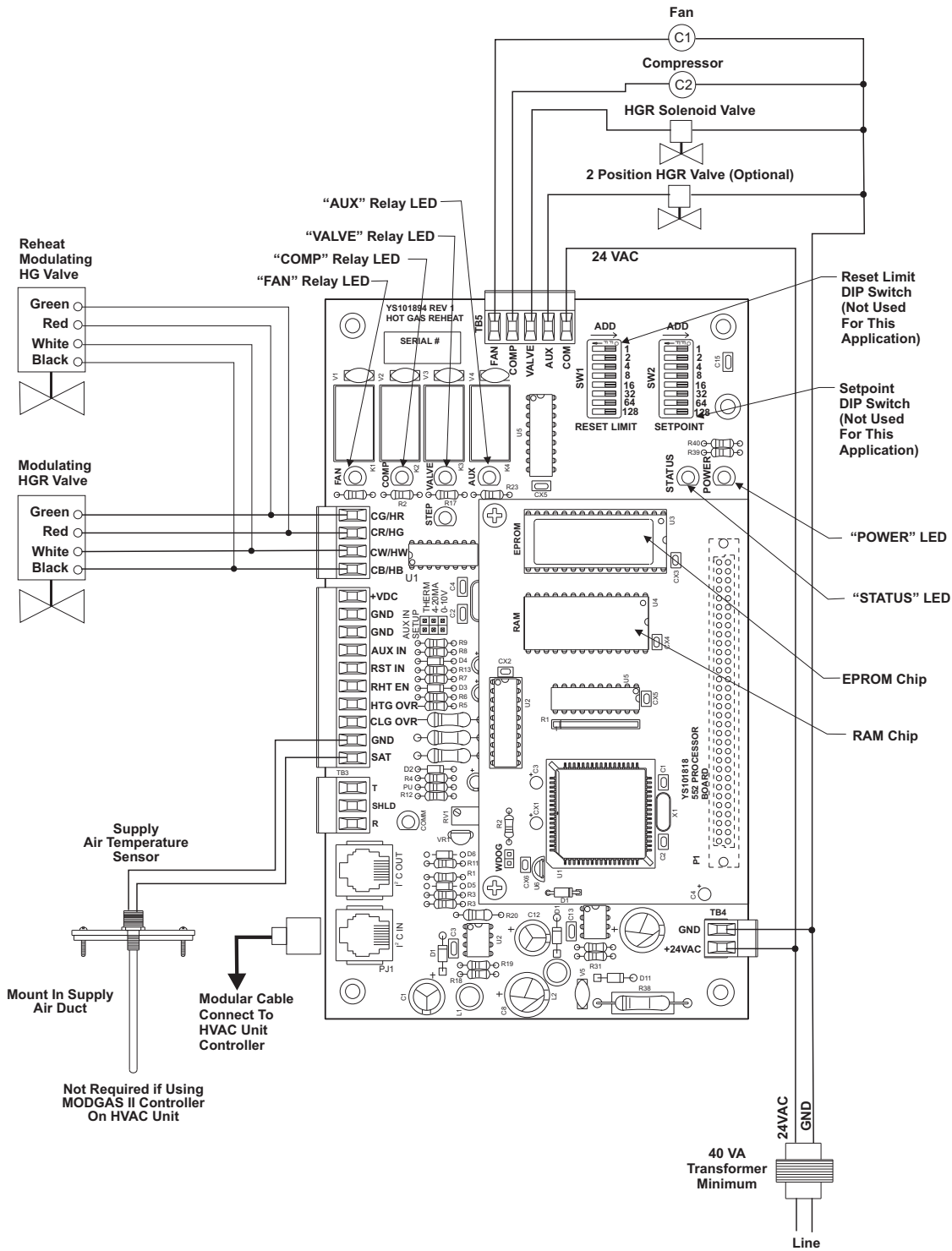


Figure 3: MHGRV II Controller Wiring When Used In Conjunction With A HVAC Controller

## DIP Switch Settings

### Supply Air Temperature

The DIP switches are only used when the controller is installed as a stand-alone controller. The main unit controller will set the Supply Air Temperature Setpoint and Reset Limit when the MHGRV II is used as an expansion device.

The user can set the desired Discharge Air Temperature Setpoint using the DIP Switch labeled SETPOINT. See **Figure 4** for location and DIP Switch setting instructions. The MHGRV II controller will allow the user to set a Supply Air Temperature Setpoint between 50°F and 100°F. If a value of less than 50°F is set, the controller will default to a 50°F Supply Air Temperature Setpoint, a value greater than 100°F will cause the unit to default to a 100°F Supply Air Temperature Setpoint.

### Supply Air Temperature Reset Limit

The user can reset the Supply Air Temperature Setpoint by supplying a 0-10 VDC control signal to the Reset Input (RST IN) terminal on the MHGRV II controller board. The reset range is determined by the RESET LIMIT DIP Switch. See **Figure 4** for location and setting instructions. The controller will reset the Supply Air Temperature Setpoint from the value set on the SETPOINT DIP Switch to the value set on the RESET LIMIT DIP Switch, as the Reset Input (RST IN) signal is increased from 0 Volts to 10 Volts..

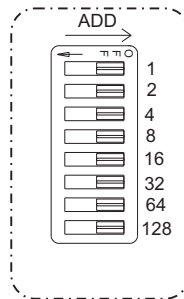
**Example:**

We want the Discharge Air Temperature Setpoint to increase from 55°F when the Reset Input signal is at 0 Volts, to 75°F when the Reset Input signal is at 10 Volts.

- Set the SETPOINT DIP Switch to 55°F
- Set the RESET LIMIT DIP Switch to 75°F

The discharge air temperature will now increase from 55°F to 75°F as the Reset Input voltage signal ramps from 0 Volts to 10 Volts.

**Note:** It is possible to create a “reverse acting” control sequence. Using the temperatures from the example above by setting the SETPOINT DIP Switch to 75°F and the RESET LIMIT DIP Switch to 55°F, the reset would be reverse acting. In this case the controller will maintain a 75°F discharge temperature when the Reset Input signal is at 0 Volts and will reduce it to 55°F when the Reset Input signal is at 10 Volts.



Typical DIP Switch Detail View

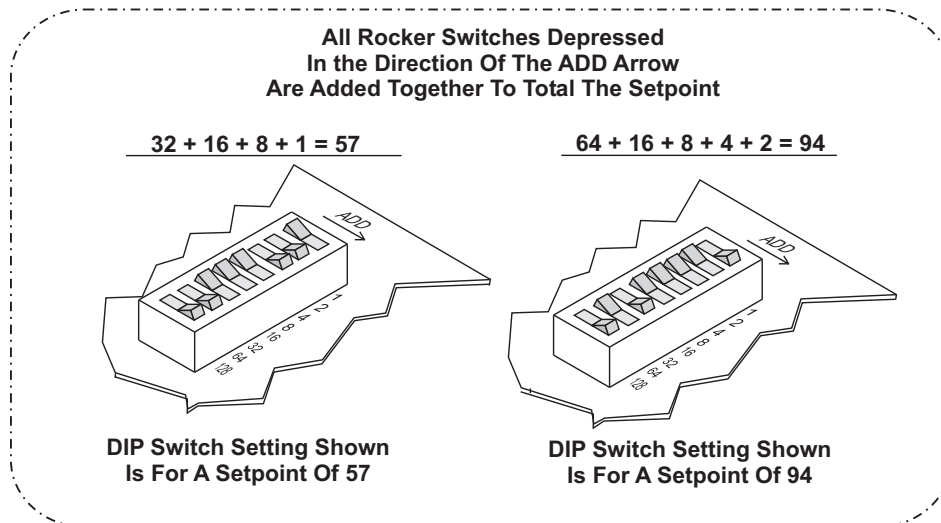


Figure 4: DIP Switch Setting Instructions

## Start-up & Commissioning

### General

In order to have a trouble free start-up it is important to follow a few simple procedures. Before applying power for the first time it is very important to run through a few simple checks.

### Power Wiring

One of the most important checks to make before powering up the system for the first time, is to confirm proper voltage and transformer sizing for the controller. Each MHGRV II controller requires 40 VA of power delivered to it at 24 VAC.

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 sensors required for your system are mounted in the appropriate location and wired into the correct terminals on the MHGRV II controller.

After all the above wiring checks are complete, apply power to the MHGRV II controller.

### Power Up And Operation

The MHGRV II Controller uses an on board LED to indicate various diagnostic conditions during power-up and operation. The LED is labeled "STATUS". Starting with power up the LED blink codes are as follows:

- One Blink
- Off for five seconds
- Blinks 30 times
- Blinks 3 times rapidly
- Status code is repeatedly blinked every ten seconds to indicate controller status

See the Troubleshooting section of this manual for LED diagnostic code information.

### Programming The Controller

#### Stand-Alone

If the MHGRV II is used as a stand-alone controller it does not require programming. It does require the Supply Air Temperature SETPOINT DIP Switch and the RESET LIMIT DIP Switch (if required) be correctly set for the required Supply Air Temperature and the Supply Air Reset Temperature

#### When Used With A HVAC Unit Controller

When the MHGRV II controller is connected to a HVAC Unit controller, the HVAC unit controller must be programmed with the desired Supply Air temperature Setpoint and Supply Air Temperature Reset Setpoint and other configuration information. In order to configure and program the HVAC unit controller you must have a central operators interface or a personal computer with the Prism computer front end software installed. Two different operators interfaces are available for programming of the HVAC unit controller. You may use either the *Modular Service Tool* or the *Modular System Manager* to access the *status* and *setpoints* of the HVAC unit controller. See the Modular Service Tool and System Manager Programming guide for programming information. If you are going to use a personal computer and the Prism computer front end software, please refer to the Orion Prism Technical Guide. No matter which operators interface you use, it is recommended that you proceed with the programming and setup of the controller in the order that follows:

1. Configure The Controller For Your Application
2. Program The Controller Setpoints.
3. Review Controller Status Screens To Verify System Operation And Correct Controller Configuration

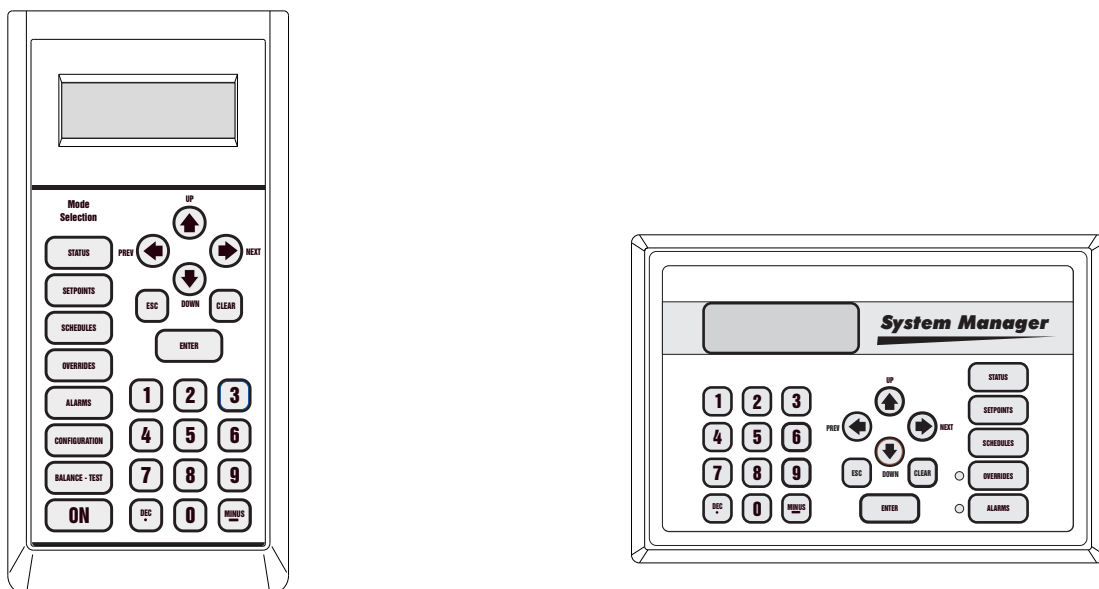


Figure 5: Operators Interfaces

## **Sequence Of Operation**

### **Initialization**

As described on the previous page under the heading “Power Up And Operation” the MHGRV II Controller uses an on board LED to indicate various diagnostic conditions during power-up and operation. Please review this information for a complete description of the controller initialization sequence.

### **Modulating Hot Gas Valves**

The MHGRV II controller utilizes two modulating Hot Gas Reheat Valves to control the flow of Hot Gas through the Hot Gas Reheat Coil. One of these valves is referred to as the Condensor Hot Gas Valve and the other as the Reheat Hot Gas Valve. The valves are wired to the MHGRV II controller Modulating Hot Gas Valve Output terminals on the controller. These valves work in concert with each other to effect a “three way valve” configuration. As one closes the other opens etc.. All modes of operation that follow referring to the Hot Gas Reheat Valve actually is a combination these two valves working together to achieve the specified sequence of operation.

### **Modes Of Operation**

The MHGRV II controller can be used in two different modes of operation. These modes behave in a similar manner; the main difference is the way they receive information to control the dehumidification process. The following is a description of these modes.

#### **Stand-Alone Operation**

As the name implies, in this mode, the controller behaves as an independent unit. The controller begins the dehumidification process when the Dehumidification Input “H1” receives a 24 VAC signal from an outside source. When the signal is received, the controller will activate the “FAN” output to energize the HVAC unit fan. At the same time the controller will initiate Cooling Mode by energizing the “COMP” output starting the HVAC unit compressor. In addition the controller will open the Hot Gas Reheat Coil by activating the “VALVE” output. At this time the MHGRV II controller will start to modulate the Modulating Hot Gas Reheat valve. The controller will modulate the MHGR valve to maintain the Supply Air Temperature Setpoint by activating the stepper motor outputs on the MHGR valve. The Supply Air Setpoint is configured by setting the SETPOINT DIP Switch on the MHGRV II controller. If Supply Air Temperature Reset is used, it will initiate when a 0-10 VDC signal is supplied to the “RST IN” input. As the voltage increases from 0 to 10 Volts at the “RST IN” input, the Supply Air Temperature will be reset towards the Supply Air Reset Temperature Setpoint. This setpoint is configured by setting the RESET DIP Switch on the MHGRV II controller. When 10 Volts input signal is received at the “RST IN” input it will be controlling at the Supply Air Temperature Reset Setpoint. The controller will conclude the Dehumidification process when input “H1” is deactivated, the input “Cool Override” is activated or the input “Heat Override” is activated.

#### **Operation As An Expansion Board**

In this mode, the MHGRV II controller behaves as an expansion board for a VAV/CAV or MUA II Unit controller. The controller begins the dehumidification process when the HVAC Unit controller makes a request to the MHGRV II controller for dehumidification. At that time

the controller will activate the “FAN” output to energize the HVAC unit fan. At the same time the controller will initiate Cooling Mode by energizing the “COMP” output starting the HVAC unit compressor. In addition the controller will open the Hot Gas Reheat Coil by activating the “VALVE” output which opens the Reheat Solenoid Valve. At this time the MHGRV II controller will start to modulate the Modulating Hot Gas Reheat valve. The controller will modulate the MHGR valve to maintain the Supply Air Temperature Setpoint by activating the stepper motor outputs on the MHGR valve. The Supply Air Setpoint is set by programming the HVAC unit controller. If Supply Air Temperature Reset is used, it will initiate when the HVAC sends a request to reset the Supply Air Temperature. The Supply Air Temperature will be reset towards the Supply Air Reset Temperature Setpoint stored in the HVAC controller. It will send a request to move towards the Supply Air Temperature Reset Setpoint based on its setpoints and configuration. The controller will conclude the Dehumidification process when the HVAC control sends a request to terminate Dehumidification or a Cooling or Heating Override request is made by the HVAC unit controller. Any DIP switch settings or signals at the inputs to the MHGRV II controller will be ignored

### **Additional Features**

The following are features which are also designed into the MHGRV II controller.

#### **Reheat Coil Flush**

During Dehumidification Mode, to ensure positive oil return, the Hot Gas Reheat Coil will be flushed of liquid refrigerant periodically by moving the Modulating Gas Reheat Valve to its maximum position for a short interval. The AUX Relay will not be energized during the Flush Cycle. There is no Flush Cycle during the Cooling Mode.

#### **Optional Second stage Reheat**

On larger systems, where more hot gas reheat capacity may be required, a 2 Position Hot Gas Reheat valve can be connected to the MHGRV II controller to be used in conjunction with the Modulating Hot Gas Reheat valve. Anytime the reheat demand moves above the Modulating Hot Gas Reheat valve capacity, this 2 position valve would be energized to supply additional hot gas to the Hot Gas Reheat coil. As the reheat demand is satisfied the MHGRV II controller will de-energize the 2 position valve and control reheat with the Modulating Hot Gas Reheat valve.

#### **Reheat Solenoid Valve Control**

The Hot Gas Reheat Solenoid valve for the Reheat Coil is activated when there is a call for Dehumidification. In this mode, the Hot Gas Reheat Solenoid will be deactivated 2 minutes after the reheat demand ceases. The Hot Gas Reheat Solenoid valve will be reactivated when a request for reheat is received by the MHGRV II controller.

## Troubleshooting

### Using LED's To Verify Operation

The MHGRV II controller is equipped with LEDs that can be used as very powerful troubleshooting tools. The MHGRV II controller board has six LEDs. Two of these LEDs are used in troubleshooting. See **Figure 12** for the LED locations. The LEDs and their uses are as follows:

#### LED Descriptions

##### “STATUS”

This is the diagnostic blink code LED. It will light up and blink out diagnostic codes.

##### “PWR”

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

##### “FAN”

This light indicates that the relay for the “FAN” output is energized and it's Normally Open Contact is closed

##### “COMP”

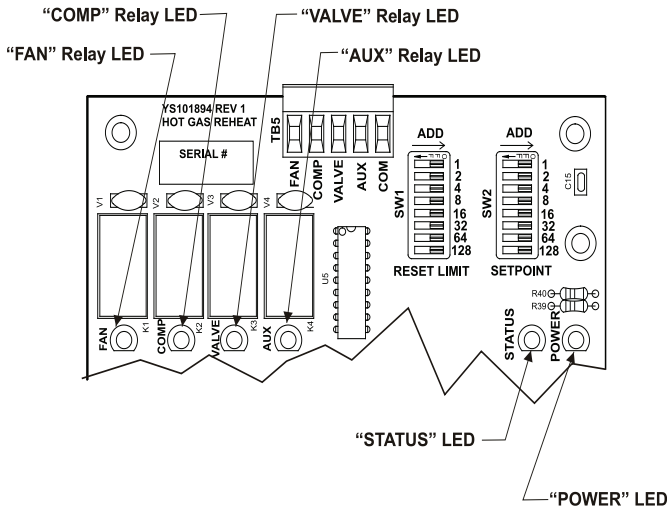
This light indicates that the relay for the “COMP” output is energized and it's Normally Open Contact is closed.

##### “VALVE”

This light indicates that the relay for the “VALVE” output is energized and it's Normally Open Contact is closed

##### “AUX”

This light indicates that the relay for the “AUX” output is energized and it's Normally Open Contact is closed



**Figure 6: LED Locations**

#### LED Diagnostics

##### “PWR” LED

When the MHGRV II Controller is powered up the “PWR” LED should light up and stay on continuously. If it does not light up, check to be sure that the power wiring is connected to the board, that the connections are

tight and the transformer is powered. If after making all these checks the “PWR” LED does not light up, the board is probably defective.

##### “STATUS” LED

As previously described when the board is first powered up the LED will do the following:

- One Blink
- Off for five seconds
- Blinks 30 times
- Blinks 3 times rapidly
- Status code is repeatedly blinked every ten seconds to indicate controller status

Priority	Number Of Blinks	Status
Lowest	1	Normal Operation
-	2	SAT Over High Limit
Highest	3	Bad SAT Sensor

**Table 1: STATUS LED Blink Codes**

Only the highest priority failure code will be shown. You must correct the highest priority alarm before other problems will be indicated.

### Other Checks

#### 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 **Table 2** on the following page. 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 **Table 2** on the following page.

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

**Table 2: Temperature Sensor - Voltage & Resistance for Type III Sensors**

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 2, cont.: 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.*



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