Description

This full-featured CPU based device is ideal for the detection of Air Contaminants. In residential and commercial environment, the Figaro Sensor has a high sensitivity to volatile organic compounds (VOC) and odorouless gases. This unit comes with an LCD display with back lighting for easy viewing. It comes standard with humidity and temperature reading capabilities, which are vital when managing air quality. With use of a manual jumper output selection, your readings can be extremely precise.
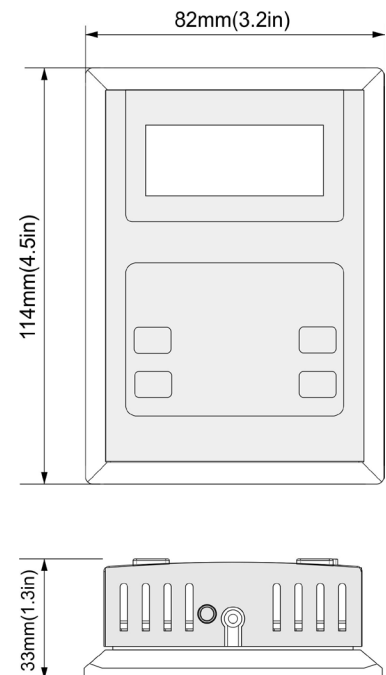
Highlights:

- High sensitivity to VOCs and odorousless gases
- High impact plastic enclosure provides durability in commercial environments
- Low energy consumption
- Back-lit LCD Display
- Temperature and Humidity readings all in one
- RS485 Network connection, Modbus RTU at 19.2k and 9600 baudrate
- Three selectable transducer outputs, 4-20mA, 0-5V or 0-10V
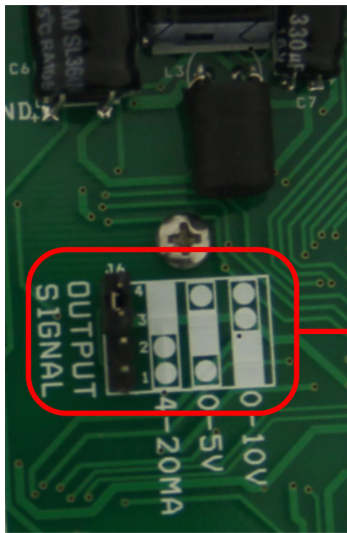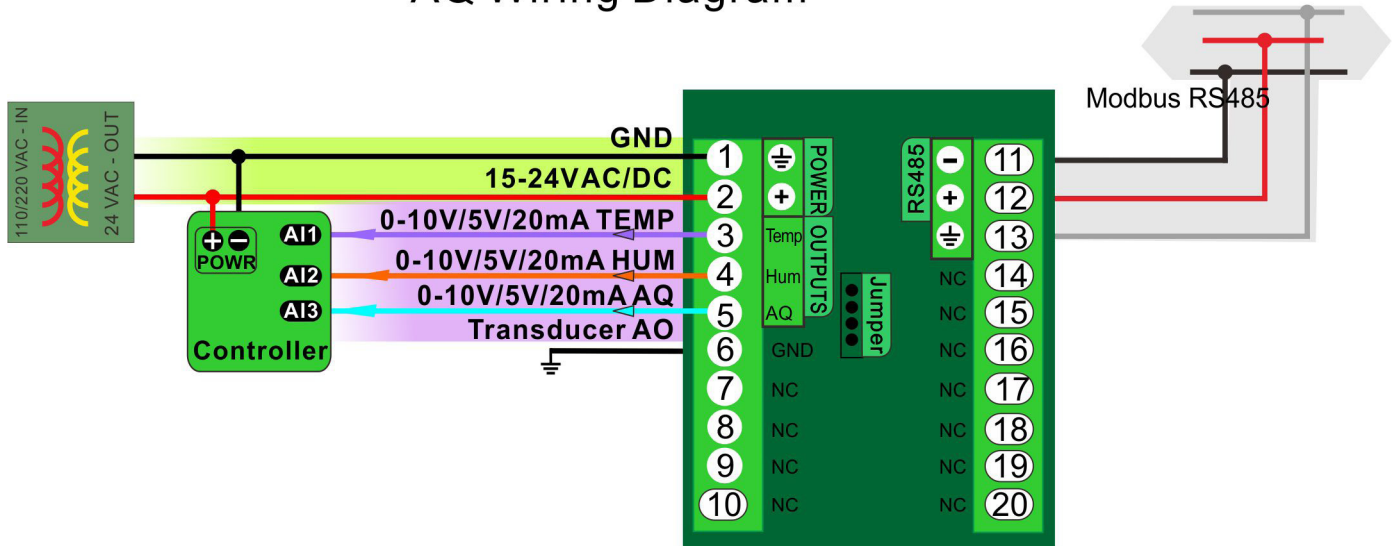- Dew point and enthalpy can be configured by register list

Specifications

Operating temperature	-30~70°C (-22~158°F)
Supply Voltage	15~24V AC/DC±20%, 50~60Hz
Power Consumption	55mA @ 24Vdc
Ambient Humidity Range	0~100%RH
Humidity Sensor Module	HUM-M2
Air Quality Sensor Element	Figaro TGS2600
Target Gasses	Air Contaminants (Hydrogen, Carbon Monoxide, ethanol, Methane, Iso-butane, etc.)
Enclosure Material	Flame Proof Plastic UL 94HB Plastic is halogen free
Enclosure Rating	IP31
Temperature Sensor	10K thermistor ±0.5^{O}C
Color	White
Weight	200g

82mm(3.2in)

114mm(4.5in)

33mm(1.3in)

External Inputs

AQ Wiring Diagram

Terminal	Label
GND	1
15-24VAC/DC	2
0-10V/5V/20mA TEMP	3
0-10V/5V/20mA HUM	4
0-10V/5V/20mA AQ	5
Transducer AO	6

Modbus RS485

AQ rev13 jumper settings

4-20mA   0-5V   0-10V
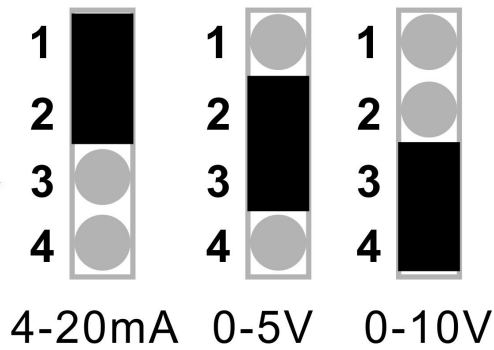
Typical Wiring Route

Registers for Reading Temperature, Humidity and Air Quality

There are 4 registers to read temperature, humidity and air quality.

Address	Bytes	Description
100	2	Temperature value in °F
101	2	Temperature value in °C
102	2	Humidity Sensor Reading in percent
103	2	Air Quality Reading : 0-1000 where 1000 is equivalent to 10ppm H_2 gas

Sensors

- The controller monitors the temperature, humidity and air quality conditions in the room. Changes in any of the mentioned elements are monitored continuously, with the shortest time interval possible.
- Humidity monitoring is done with the Temco Humidity Sensor Module HUM-M2.
- Air Quality monitoring is done with the Figaro TGS2600 sensor element.
- Temperature monitoring is done with a 10K Thermistor.

Humidity Calibration

The main criteria for selecting the Temco Humidity Sensor Module HUM-M2 was for its linear behavior with respect to relative humidity. This reduces its complexity and increases its reproducibility and reliability to an overall 5% accuracy.

In the factory, all the sensors pass a seven point calibration procedure under a controlled humidity environment to guarantee 5% accuracy. The user can also perform a single point calibration with an accurate meter for comparison by adjusting the offset.

Note: Performing a single point calibration by comparison with another meter will potentially lose the sensor's accuracy.

Air Quality Calibration

Special consideration must be made for the Air Quality Calibration to avoid false alarms. The Figaro sensing element is dependent on temperature humidity or basic environmental changes.

To counter this effect, the microprocessor of the thermostat calculates the average value of the sensor and determines if there are any air pollutants present. Any sudden change in the sensor will trigger the alarm telling the user that there is hazardous air present.
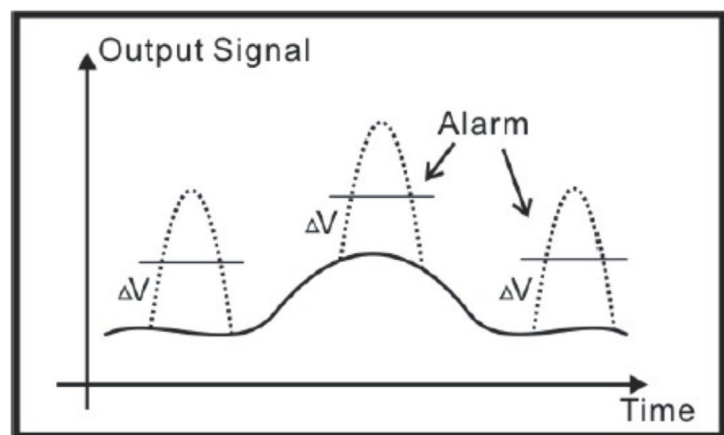
Temperature Calibration

The controller monitors the temperature conditions in the room with its built-in thermistor sensor. It is located in such a way that it is not affected by the temperature of the wall on which it is mounted, nor internal heat created in the device cavity.

Changes in temperature are monitored continuously, with the shortest time interval possible. Calibration of the sensor is possible through the controller's internal menu at any time.

Calibration of Temperature

To calibrate the temperature shown on the Air Quality Sensor display, you will need a handheld digital or mercury thermometer. Hold the meter close to the thermostat and allow it to come to equilibrium. Connect the Air Quality Sensor to the PC via a RS485 cable and run a Modbus Tool to show and modify the registers. While the thermometer temperautature is at a steady state write the correct temperature to the register 101. If necessary repeat until the readings on the thermostat and thermometer agree. Note that the written value should be ten times the actual temperature to avoid a decimal place. For example if the temperature is 22.3 degree, then you should write 223.

The thermostat will store the calibration figures even through extended power outages and should not need to be adjusted for many years. The main point to keep in mind when calibrating is to let everything come to equilibrium. The thermostat should be powered up for 5 minutes prior to any calibration and the thermometer should be left near the thermostat for about the same amount of time.

Some Calibration Tips

• The main error in calibration comes from not waiting long enough for the handheld thermometer to come to equilibrium.
• Calibrate using the customer's thermometer, even if it is not an accurate one, so that all subsequent measurements are compared to the same benchmark.
• Make sure the Air Quality Sensor unit is mounted in a location free of air drafts.

Calibration of Humidity

• At the default condition, users can write the current humidity value, which they get from a reference humidity meter, to register 102.

Air Quality

The number on the displays means the output voltage of the sensor, the range of the number is 0-1000, corresponding to 0-5V/10V.
The bigger the number is, the denser the air contaminants.
There are three icons at the bottom of the display, which give users visual evaluation of air quality. The user can modify the criterion of air quality evaluation through changing the registers with Modbus.
If the air quality is under a certain level, the Air Stat will beep. You can set the level through changing the register of modbus, too.

Analog Outputs

Air Quality Sensor also transduce three sensors' readings to analog outputs. The range of analog outputs can be either from 4-20mA, 0-5v or 0-10v.

RANGE	ANOLOG OUTPUT VALUE & FORMULA
0-10V OUTPUT	anolog_output_value = aq_value/(high_range - low_range)*10 Volt
0- 5V OUTPUT	anolog_output_value = aq_value/(high_range - low_range)*5 Volt
4- 20Ma OUTPUT	anolog_output_value = aq_value/(high_range - low_range)*16Ma + 4Ma

ie. aq_low_range_set is 0, aq_high_range_set is 600.
temperature_low_range_set is 0, temperature_high_range_set is 1000.
humidity_low_range_set is 0, humidity_high_range_set is 1000.

Air Quality Analog Output

Air Quality

Output Voltage(V)

10									
8									
6									
4									
2									
0									

100 200 300 400 500 600 700 800 900   H2 PPM/100

Humidity Analog Output

Humidity

Output Voltage(V)

10								
9								
8								
7								
6								
5								
4								
3								
2								
1								
0								

10% 20% 30% 40% 50% 60% 70% 80% 90%   Humidity %
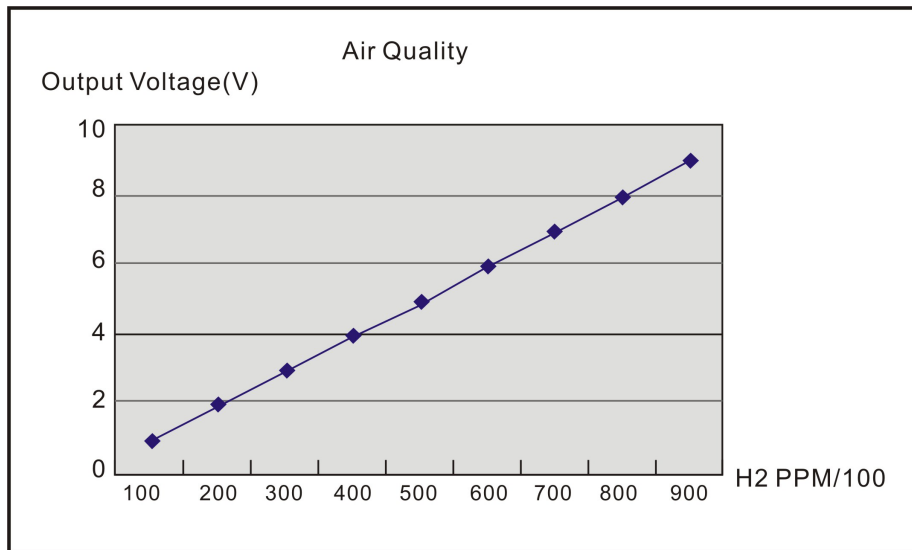
Temperature Analog Output

Temperature

Output Voltage(V)

10											
8											
6											
4											
2											
0											

-30 -20 -10 0 10 20 30 40 50 60 70 80 90   Temperature ℃
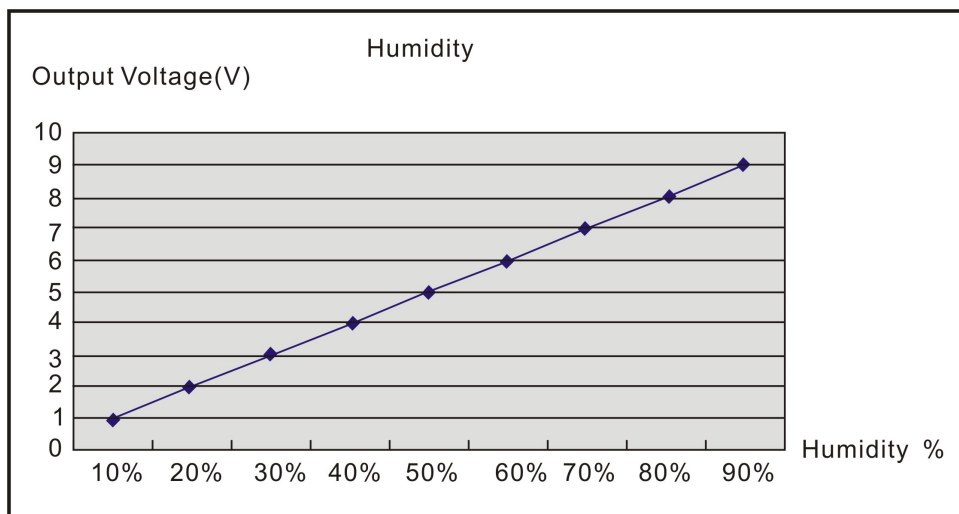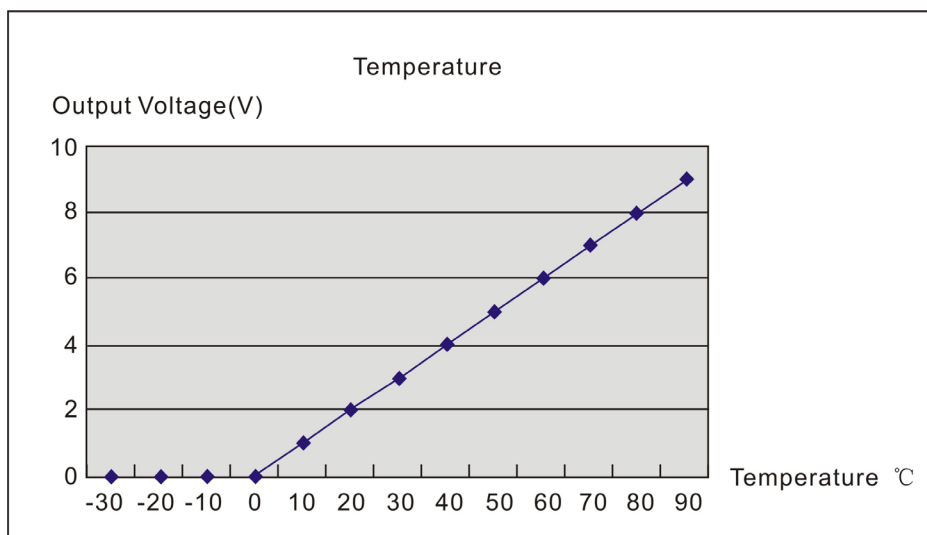
Gas Sensitivity

Gas sensitivity characteristics to various gases
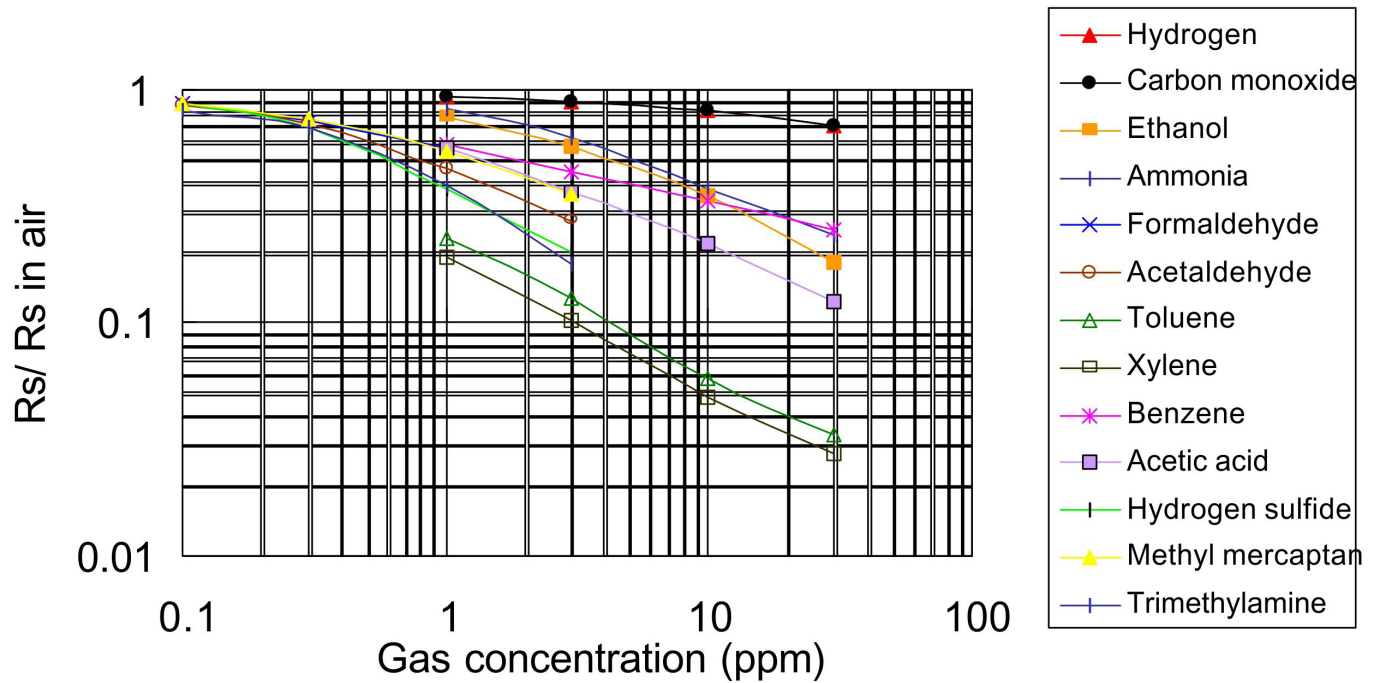
Instructions

Keys Layout

AQ value displayed/
Adjust:
AQ level 1/2/3
Temperature unit C/F
Display scrolling On/Off

Humidity value displayed/
Adjust:
AQ level 1/2/3
Temperature unit C/F
Display scrolling On/Off

AIR QUALITY

▼ ADJUST ▲

◄ MODE ►

Temperature value displayed/
Move in the menu

Enter in the menu/
Move in the menu

Menu display table
The following table displays all the possible options for your understanding.

Address Set	ID01 - ID254	
Baudrate Set	Baudrate 19200, Baudrate 9600	
Units C/F	Unit C, Unit F	
Temp Calibration	You can set the right value according to your needs	
Humidity Calibration	You can set the right value according to your needs	
Scroll ON/OFF	ON: Temp, Humidity, AQ displayed in circulation OFF: Only Temp, Humidity or AQ displayed	
AQ Level1	Fine	99-200
AQ Level2	Fair	200-400
AQ Level3	Poor	400-600
	Bad	600-1000
AQ Calibration	You can set the right value according to your needs	

The diagram on the following page shows a complete list of the menu options in the Air Quality Sensor and the methods of which to navigate throughout it.

Please note that by using the buttons as explained above in the 'Keys Layout" the user can directly chose to display the Temperature, the Humidity or the Air Quality. By default the "Scroll" feature is set to 'OFF', but if enabled 'ON', the Air Quality Sensor will cycle through the Temperature, Air Quality and Humidity displays as the same order shown at the top of the Menu List diagram on the following page.

Default display is temp

TEMP 63.3F	→	AQ 105 FINE	→	HUMIDITY 42.5%

Menu List

ADDRESS SET	→	ID 21	→	ID 20	→ to confirm

BAUDRATE SET	→	BAUDRATE 19200	→	BAUDRATE 9600	→ to confirm

UNITS C/F	→	UNITS F	→	UNITS C	→ to confirm

TEMP CAL	→	TEMP_CAL 68.1F	→	TEMP_CAL 69.1F	→ to confirm

HUMIDITY CAL	→	HUM_CAL 42.7%	→	HUM_CAL 41.7%	→ to confirm

SCROLL ON/OFF	→	SCROLL OFF	→	SCROLL ON	→ to confirm

AQ LEVEL1	→	LEVEL1 200	→	LEVEL1 190	→ to confirm

AQ LEVEL2	→	LEVEL2 400

AQ LEVEL3	→	LEVEL3 600

AQ CAL	→	AQ_CAL 130	→	AQ_CAL 140

Menu List | Go into Menu Item | Increase/Decrease Value Settings

Modbus Registers

Air Quality Sensor uses MODBUS protocol to communicate with others. Following is a table of MODBUS Registers.

Address	Bytes	Register and Description
0 ~ 3	4	Serial Number -4 byte value. Read-only
4 ~ 5	2	Software Version –2 byte value. Read-only
6	1	ADDRESS. Modbus device address
7	1	Product Model. This is a read-only register that is used by the microcontroller to determine the product
8	1	Hardware Revision. This is a read-only register that is used by the microcontroller to determine the hardware Rev
9	1	PIC firmware version
10	1	PIC version of Humidity module
10	1	PLUG_N_PLAY_ADDRESS, 'plug n play' address, used by the network master to resolve address conflicts. See VC code for algorithms
15	1	Base address selection. 0 = Protocol address,1 =PLC address.
16	1	Firmware Update Register, used to show the status of firmware updates
17~99		Blank, for future use
100	2	Temperature value in °F
101	2	Temperature value in °C
102	2	Humidity Sensor Reading in percent,calibrate humidity
103	2	Air Quality Reading :0-1000 is equivalent to 0-10ppm H2 gas
111	1	temperature input select,0=internal,1external
121	1	the units of temperature. 0 = C ,1=F
180	1	Sets the full scale voltage of the outputs; 1:0~10v;2:0~5v;3:4~20ma;
185	1	Baudrate 0 = 9.6kb/s, 1 = 19.2kb/s
186	1	humidity filter set
187	1	aq filter set
193	1	temperature filter set
304	1	Humidity Sensor Reading in percent
305	2	HUmidity Sensor's frequency
312	2	Humidity Calibration, Frequency at first point
313	2	Humidity Calibration, RH at first point
314	2	Humidity Calibration, Frequency at second point (highest humidity reading)
315	2	Humidity Calibration, RH at second point
316	2	Humidity Calibration, Frequency at third point
317	2	Humidity Calibration, RH at third point
318	2	Humidity Calibration, Frequency at the fourth point
319	2	Humidity Calibration, RH at the fourth point
320	2	Humidity Calibration, Frequency at fifth point

Air Quality Sensor uses MODBUS protocol to communicate with others. Following is a table of MODBUS Registers.

Address	Bytes	Register and Description
321	2	Humidity Calibration, RH at fifth point
322	2	Humidity Calibration, Frequency at sixth point (highest humidity reading)
323	2	Humidity Calibration, RH at sixth point
324	2	Humidity Calibration, Frequency at seventh point
325	2	Humidity Calibration, RH at seventh point
326	2	Humidity Calibration, Frequency at the eighth point
327	2	Humidity Calibration, RH at the eighth point
328	2	Humidity Calibration, Frequency at ninth point
329	2	Humidity Calibration, RH at ninth point
330	2	Humidity Calibration, Frequency at the tenth point
331	2	Humidity Calibration, RH at the tenth point
332	2	Temperature analog output scaling, lower end of the range for temperature. Note: multiply by 10 so to set the lower temperature to 10C or F, write a value of 100.
333	2	Temperature analog output scaling, upper end of the range for temperature Note: Multiply by 10 so to set the upper temperature to 100C or F, write a value of 1000
334	2	Humidity analog output scaling, lower end of the range for humidity. Default = 0% Note: Divide by 10, a setting of 100 means 10% for the lower humidity range
335	2	Humidity analog output scaling, upper end of the range for humidity. Default = 100% Note: Multiply by 10, a setting of 1000 means 100% for the upper humidty range.
336	2	AQ output signal range, lower limit of full scale.
337	2	AQ output signal range, upper limit of full scale. Notes: Typical AQ readings are 100 to 200 for an office with 'good' air. Don't need to multiply by 10 for this setting as with the temp and hum values. Default setting is 1000 which means 'good' air will be around 10% to 20% of the full scale signal. Adjust to suit the application.
338	2	the current value of temperature output
339	2	the current of humidty output
340	2	the current of AQ output
341	2	the voltage of temperature output
342	2	the voltage of humidty output
343	2	the voltage of AQ output
345	1	the status of scrolling.0 is off ,1 is on
346	2	the level1 set
347	2	the level2 set

Air Quality Sensor uses MODBUS protocol to communicate with others. Following is a table of MODBUS Registers.

| Address	Bytes	Register and Description
348	2	the level3 set
364	2	sensor serial number
370	2	dew point in unit C
371	2	dew point in unit F
372	2	Partial Pressure of water at saturation at given temperature, [hPa]
373	2	Mixing Ratio, the mass of water over the mass of dry gas, [g/kg]
374	2	Enthalpy of the air, [kJ/kg]

Specification

Operating temperature	-30~70°C (-22~158°F)
Supply Voltage	15~24V AC/DC±20%, 50~60Hz
Power Consumption	55mA @ 24Vdc
Ambient Humidity Range	0~100%RH
Humidity Sensor Module	HUM-M2
Air Quality Sensor Element	Figaro TGS2600
Enclosure Material	Flame Proof Plastic
Enclosure Rating	IP31
Temperature Sensor	10K thermistor ±0.5^{O}C
Color	White
Weight	200g

External Inputs

AQ Wiring Diagram

Jumper Settings

AQ rev13 jumper settings

4-20mA   0-5V   0-10V
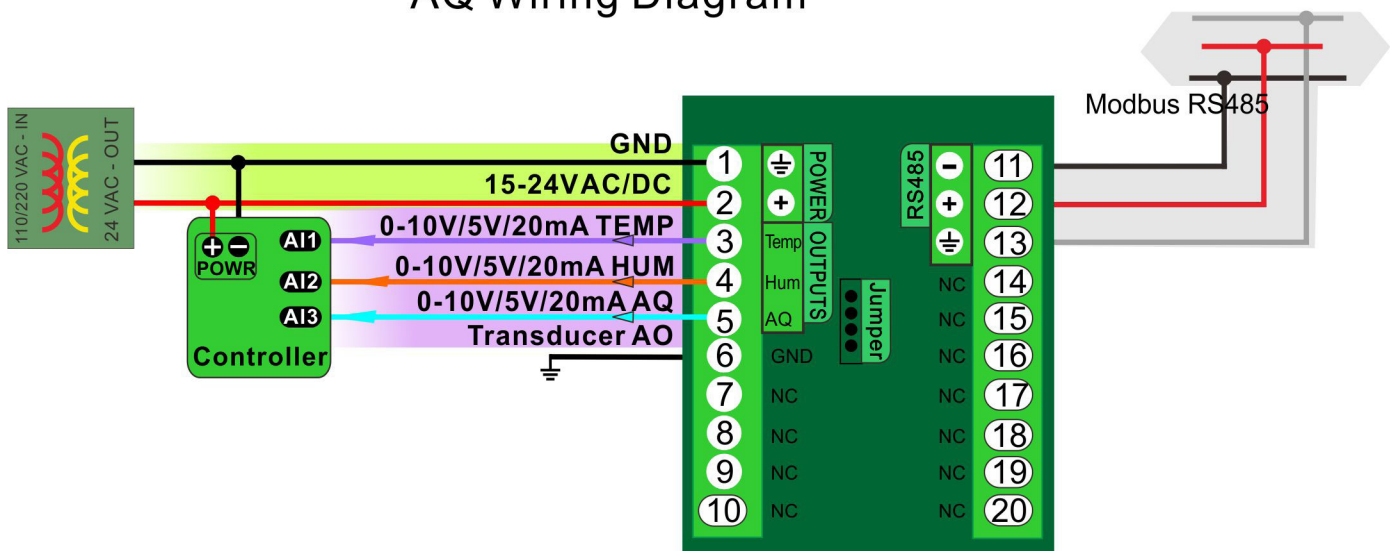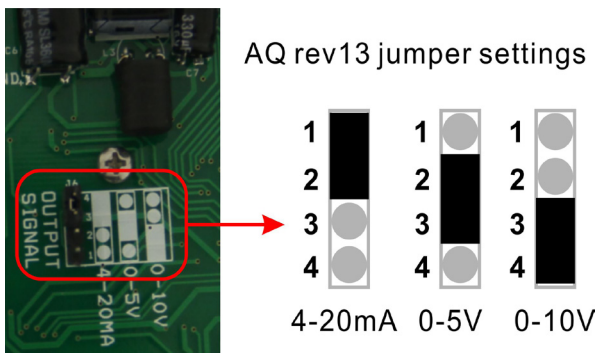
Typical Wire Routing

Advanced Menu Item Instructions

1) There are four buttons to operate the AQ:

Buttons		Functions
Adjust	▼	AQ value display/adjust: AQ level 1/2/3, Temperature unit C/F, Display scrolling On/Off
	▲	Temperature value displayed/ Move in the menu
Mode	◀	Humidity value display/adjust: AQ level 1/2/3, Temperature unit C/F, Display scrolling On/Off
	▶	Enter in the menu/Move in the menu

Scroll ON/ OFF	ON: Temp, Humidity, AQ displayed in circulation OFF: Only Temp, Humidity or AQ displayed	
AQ Level1	Fine	99-200
AQ Level2	Fair	200-400
AQ Level3	Poor	400-600
	Bad	600-1000
AQ Calibration	You can set the correct values according to your needs.	

a. To set your unit's address, press ▶ to enter into the menu mode. It will display "ADDRESS SET". Click ◀ to enter into editing mode. The ID screen will display. Press ▲ to increase the ID value or ▼ to decrease the ID value. Press ◀ to confirm your settings.


ADDRESS SET → ID 21
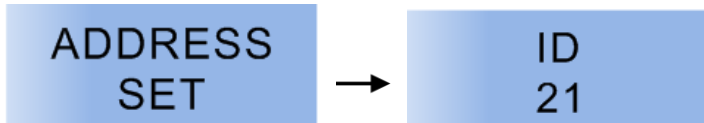
b. To set your unit's baudrate, while in the menu mode, click ▶ to switch to the baudrate screen. Click ◀ to edit the baudrate and use ▲ or ▼ to choose the baudrate 19200 or 9600. Press ◀ to confirm your settings.

c. To set the temperature calibrations enter the menu mode and click ▶ until you reach the "TEMP CAL" screen. Press ◀ to enter the edit screen. Click ▲ to increase and ▼ to decrease the value. When the setting is ok, click ◀ to confirm. Use the same procedure to adjust the humidity calibration who's screen appears as "HUMIDITY CAL".
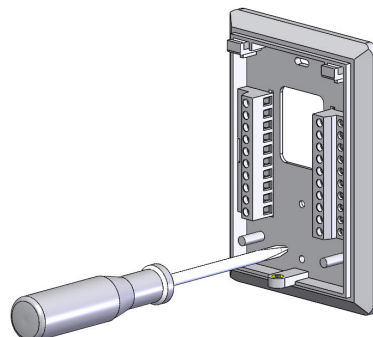

TEMP CAL → TEMP_CAL 68.1F

Mounting Installations

1)Unfasten the screw located at the base and lift off the front panel of the enclosure.
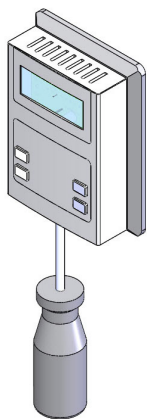
Wall Mount

2)Fasten the screws on the back panel to the wall, and re-attach the front panel to the now mounted panel. Refasten the screw at the base connecting both panels.

OR

Standard '11-10' Electrical Box

2)Fasten the screws on the back panel to the electrical box, and re-attach the front panel to the now mounted panel. Refasten the screw at the base connecting both panels.