Air Quality Sensor

Descriptions

Features:

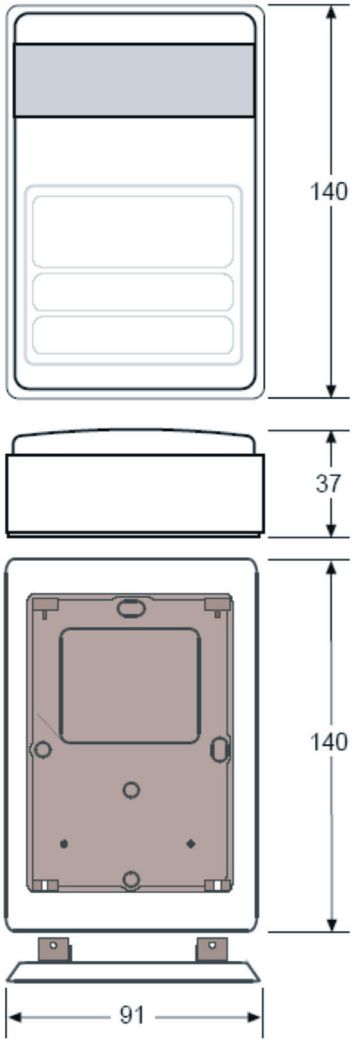
This full-featured CPU based device is ideal for the detection of Air Contaminants. In residential and commercial environment, the sensing element has high sensitivity to VOCs and odorous gases. The unit provides humidity and temperature readings, all of which is useful for increased Air Quality control.

Highlights:

- High Sensitivity to VOCs and Odorous Gases.
- High Impact Plastic Enclosure provides Durability in Commercial Environments.
- Low Power Consumption.
- Temperature and Humidity readings all in one.
- Optional Network RS485 Communication.
- Optional Analog Output Signal.

Technical Data

Operating temperature	-30~70°C (-22~158°F)
Supply Voltage	12~24Vac±20%, 50~60Hz
	12~24Vdc±20%, 50~60Hz
Power Consumption	55mA @ 24Vdc
Ambient Humidity Range	0~100%RH
Humidity Sensor Element	Humirel HS1101
Air Quality Sensor Element	Figaro TGS2600
	Figaro TGS2602
Material, Enclosure	Flame Proof Plastic
Enclosure Rating	IP31
Temperature Sensor	10K thermistor ±0.5°C
Color	White / Off-white
Weight	200g



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 constant possible.

Humidity monitoring is done with the Humirel HS1101 sensor element.

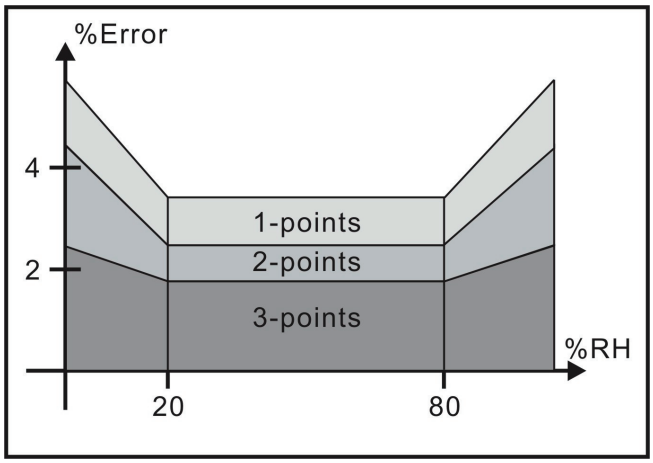
Air Quality monitoring is done with the Figaro TGS2602 sensor element.

Temperature monitoring is done with a 10K Thermistor.

Humidity Calibration

The main criteria for selecting the Humirel Sensing Elelment was for its linear behavior with respect to Relative Humidity. This reduces its complexity and increasing its reproducibility and reliability to an overall 2% accuracy. Nonetheless, with error induced in PCB production and associated chips production, accuracy may be compromised.

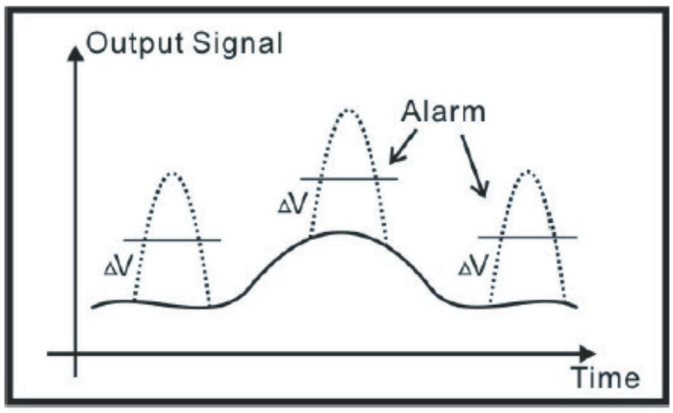
Performing a three point calibration procedure under a controlled humidity environment can be implemented to give an accuracy of 2% between the range of 10 to 90%.



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 hazardous air is 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 teh shortest time constant possible. Calibration of the sensor is possible through the controller's internal menu at any time.

Installation

Terminal Block Connections

1 ..... 24VAC live

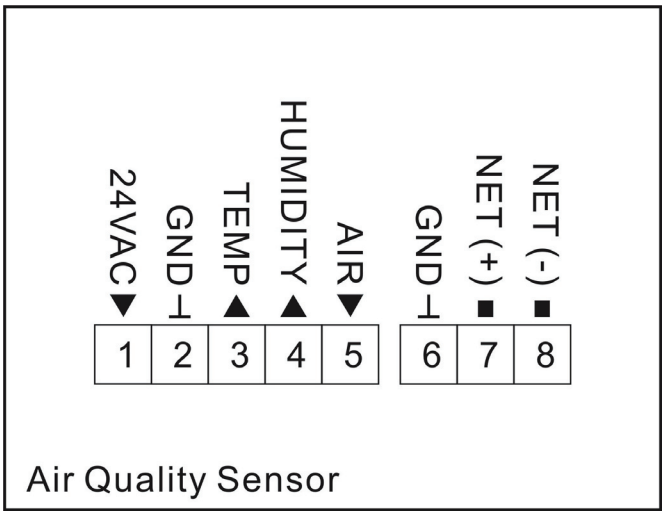
2 ..... Measurement neutral

3 ..... Temperature Analog Output 0-5V/10V

4 ..... Humidity Analog Ooutput 0-5V/10V

5 ..... Air Quality Analog Output 0-5V/10V

6, 7, 8 ..... Network communication



Mounting

External wiring is connected to a terminal block on the circuit board.

The enclosure comprises a base section and a cover. The base section can be mounted directly on a wall or a wall box. If mounted on a wall box, the cables should enter the enclosure via the hole in the base section.

If mounted directly on a wall, the cables should enter from above.

Length of cables Max 200m area 0.5mm^2.

Calibration of Temperature

To calibrate the temperature shown on the Air Quality Sensor display, you will need a handheld mercury thermosmeter or digital thermometer. Hold the meter close to the thermostat and allow it to come to equilibrium. Connect Air Quality Sensor to the PC via a RS485 cable. And then, run a Modbus Tool to show and modify the registers. After temperature comes to equilibrium, write a correct temperature to the Register 101, you can repeat writing if necessary till the readings on the thermostat and meter agree. Note that the written value should be ten times of actual temperature to avoid point, 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.

• The sensor inside teh thermostat is a digital chip capable of resolving down to 0.06^{O}C so the weak link in calibrating is usually the procedure used rather than the AQ accuracy.

• Make sure the AQ is mounted in a location free of drafts.

Calibration of Humidity

To calibrate the Humidity shown on the Air Quality Sensor display you will need a humidostatic chamber.

There are three steps to do calibration.

1. Set the humidity at a middle point which ≥ 40% and ≤ 70%, it also should be a multiple of 5%, such as 40%, 45%, 50%, 55%.....

After humidity has come to equilibrium, write the setting point to the Register 304. Then the setting point and sampling data will be recorded in Register 309 and 310.

2. Set the humidity at a low point which ≤ 35%, it should also be a multiple of 5%. Repeat above procedure1. The setting point and sampling data will be recorded in Register 311 and 312.

3. Set the humidity at a high point which ≥ 75%, it should also be a multiple of 5%. Repeat above procedure1. The setting point and sampling data will be recorded in Register 307 and 308. The main point to keep in mind when calibrating is to let everything come to equilibrium. The thermostat should be pwoered up for 5 minutes prior to any calibration.

Air Quality

The number on the displays means the output voltage of teh sensor, the range of the number is 0-1024, corresponding to 0-5V/10V.

The bigger the number is, the denser the toxic gas presents.

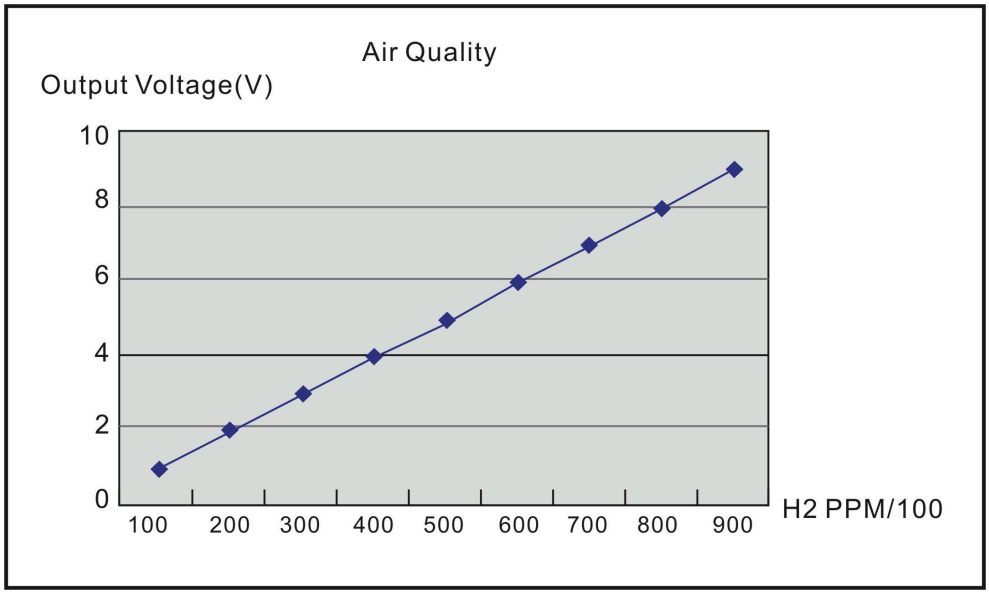
There are three LEDs at the bottom of the display, they are blue, yellow and red, which give users visual evaluation of air quality. The blue represents excellent, yellow represents normal, red represents bad. You can modify the criterion of air quality evaluation through changing the registers of modbus.

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.

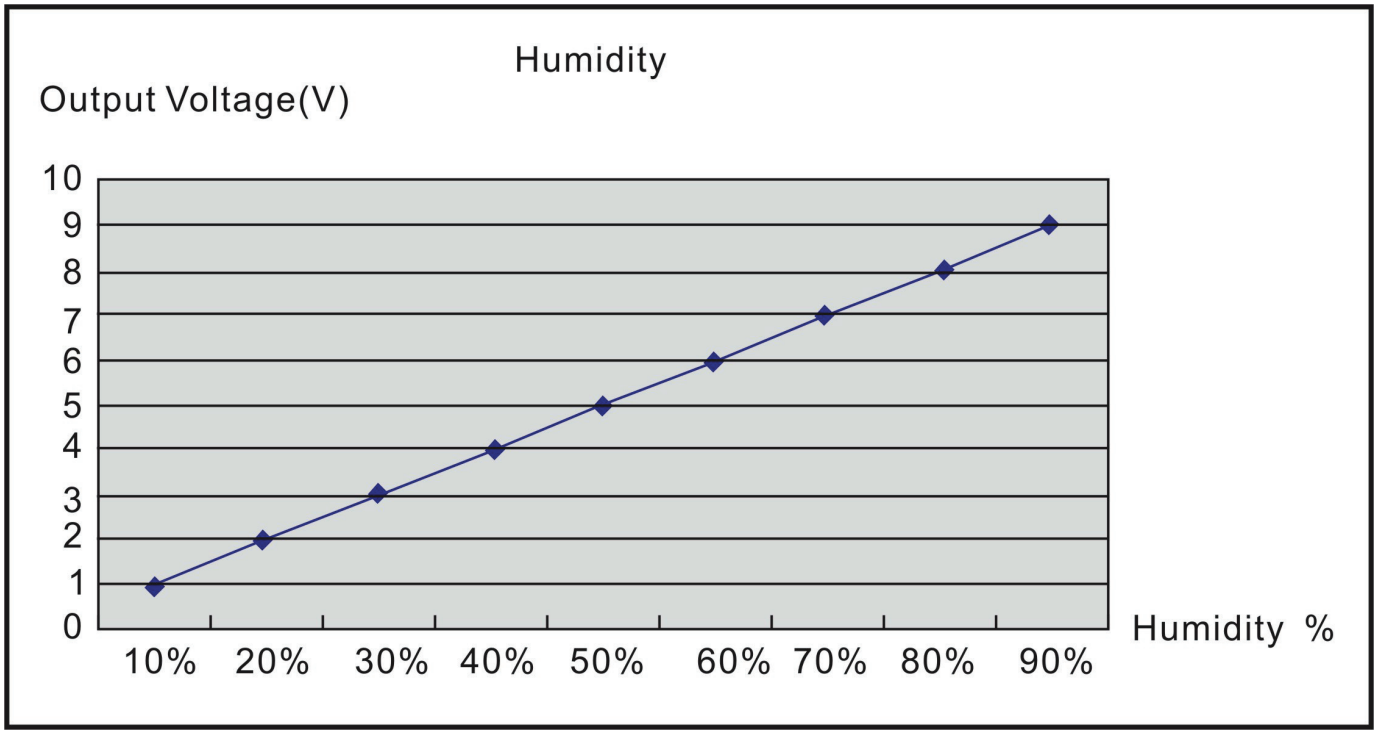
Analog Outputs

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

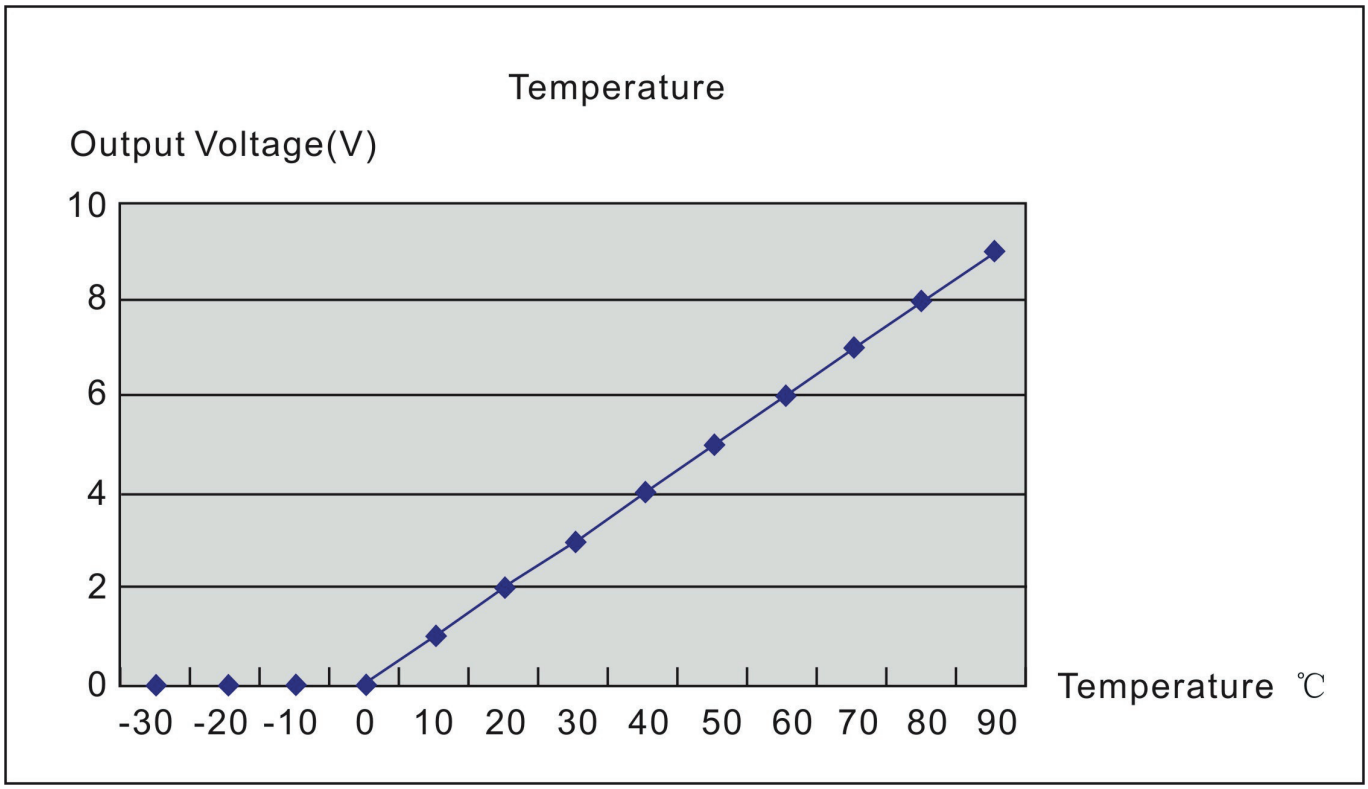
Air Quality Analog Output



Hummity Analog Output



Temperature Analog Output



Modbus Registers

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

Address	Bytes	Range	Defaults °C	Defaults °F	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	0~255	254	254	ADDRESS. Modbus device address
7	1	0~255	13	13	Product Model. This is a read-only register that is used by the microcontroller to determine the product.
8	1	0~255	-	-	Hardware Revision. This is a read-only register that is used by the microcontroller to determine the hardware rev.
9	1	0~255	-	-	PIC firmware version
10	1	0~255	-	-	PLUG_N_PLAY_ADDRESS, 'plug n play' address, used by the network master to resolve address conflicts. See VC code for algorithms.
15	1	0~1	0	0	Base address selection. 0=Protocol address, 1=PLC address.
16	1	0~255	-	-	Firmware Update Register, used to show the status of firmware updates.
17~100					Blank, for future use.
101	2	0~3000	-	-	calibrate the AQ room temperature by writing the actaul room temperature to this register (x10) For example, if your meter reads 20.0 degC, write 200 to this register and the display will now match the meter reading.
113	1	0~3	0	-	0=keypad enabled, 3 = locked keypad.
register					
185	1	0~1	1	-	Baudrate Setting: 0 = 9600bps, 1 = 19200bps
203	1	0~1	0	-	0 to disable display and beeper, 1 to enable display and beeper
217	2	0~1000	500	500	Temperature Calibration register, internal number which is automatically calculated when writing to register 101, a value of 500 = 0 Deg offset.
220	2	0~1000	-	-	Humidity Calibration, Frequency at first point.
221	2	- -	-	-	Humidity Calibration, RH at first point.
222	2	0~1000	-	-	Humidity Calibration, Frequency at second point (highest humidity reading).
223	2	- -	-	-	Humidity Calibration, RH at second point.
224	2	0~1000	-	-	Humidity Calibration, Frequency at third point.
225	2	- -	-	-	Humidity Calibration, RH at third point
226	2	0~1000	-	-	Humidity Calibration, Frequency at the fourth point
227	2	- -	-	-	Humidity Calibration, RH at the fourth point
228~239	2	- -	-	-	Additional Humidity calibration points, 10 total
304	2	0~1000	-	-	Relative Humidity reading. Writing a humidity value to the register will do calibration, for details, refer to Humidity Calibration.
305	2	- -	-	-	humidity frequency read
306	1	0~100	2	0	It is low level pollution. 2ppm H2 gas pollute, about half smoke enkindle in a 5m*5m room.
307	1	0~100	3	0	It is middle level pollution. 4ppm H2 gas pollute, about one smoke enkindle in a 5m*5m room.
308	1	0~100	5	5	It is high level pollution. 8ppm H2 gas pollute, about two smoke enkindle in a 5m*5m room, this point will beep.
312	1	3~10	4		set the humidity calibration points needed, if you need 5 point to calibration, you can set it 5.
313	1	0~2	0		register 313=1 can back up humidity calibration point register 220~227 to register 320~327. register 313=2 can read humidity back up calibration point register 320~327 to register 220~227.
320~327	2	- -	-	-	back up the humidity calibration points.