SIEMENS

Technical Instructions
Document No. CE1N1962
February 18, 2016

QPM Series

Indoor Air Quality Duct Sensors

Description

The QPM Series Room Carbon Dioxide (CO_2) and Air Quality Duct Sensors are designed for applications where precise, stable carbon dioxide or air quality sensing is required.

Several models are available with either CO_2 only, or with Volatile Organic Compounds (VOC) (also known as mixed gas), relative humidity and/or temperature sensing. All units deliver a 0 to 10 Vdc signal for all outputs and have a CO_2 measuring range of 0 to 2000 ppm.

Features

- Maintenance-free, Non Dispersive Infrared (NDIR) CO_2 sensing element is ideal for use in spaces that are occupied 24/7.
- Combination units enable a single sensor to take the place of up to three individual sensors.
- No recalibration required.
- 24 Vac or 15 to 35 Vdc operating voltage
- Signal outputs 0 to 10 Vdc or 0 to 5 Vdc (field selectable)

Application

For use in air ducts of ventilation and air conditioning applications to enhance room comfort and to optimize energy consumption by providing demand-controlled ventilation. The sensor acquires:

- CO_2 concentrations as an indication of occupancy in rooms where smoking is prohibited.
- VOC concentrations as an indication of odors in the duct air, such as tobacco smoke, body odor, or material fumes.
- The relative humidity of the duct air.
- The duct air temperature.

QPM2102 models measure both CO2 and volatile organic compounds (VOC) for optimized indoor air quality. A single 0-10V or 0-5V (selectable) output signal is automatically adjusted to reflect the higher of the two values. This enables the combination CO2 + VOC sensor to be easily substituted for a CO2 sensor in any demand control ventilation control system.

The QPM21 Series Sensors can be used as:

- Control sensors in the supply or exhaust air duct.
- Transmitters for building automation and control systems and/or display units.

Application, Continued

Typical use:

- Acquisition of CO_2 and VOC concentrations:
  In party rooms, lounges, fair pavilions and exhibition halls, restaurants, canteens, shopping malls, sports gymnasiums, sales rooms, and conference rooms.
- Acquisition of CO_2 concentrations:
  In ventilation applications of rooms with varying occupancy levels where smoking is prohibited, such as museums, theaters, movie theaters, auditoriums, office spaces and school rooms.

NOTES:
- The QPM Series Sensors are not designed for use as safety devices, such as gas or smoke warning devices.
- Do not install outdoors.

Product Numbers

Table 1.

Product Number	CO_2 Measuring Range	VOC Sensitivity	Temperature Measuring Range	Humidity Measuring Range	Measured Value Display
QPM2100	0 to 2000 ppm	—	—	—	No
QPM2102		Low (R1) Normal (R2) High (R3)	—	—	No
QPM2102D					Yes
QPM2160		—	32°F to 122°F/-31°F to 95°F (0 to 50°C/-35 to 35°C)	—	No
QPM2160D					Yes
QPM2162		—		0 to 100%	No
QPM2162D					Yes

Ordering

The sensor is supplied complete with mounting flange and cable entry gland M16.

Equipment Combinations

The QPM Series Air Quality Sensors are suited for use with all types of systems and devices capable of acquiring and handling the 0 to 10 Vdc output signal delivered by the sensor.

Mode of Operation

CO_2 Concentrations

The QPM Series Air Quality Sensors acquire the CO_2 concentration by infrared absorption measurement (NDIR). Due to an additional integrated reference light source, the measurement is always accurate. This reduces service costs as no service or recalibration is needed.

The resulting output signal of 0 to 10 Vdc or 0 to 5 Vdc is proportional to the CO_2 content of the ambient air.

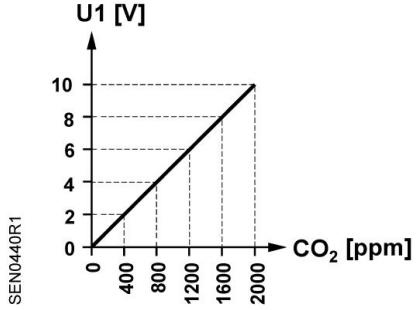

Figure 1. Function Diagram CO_2 (Output U1).

CO_2/VOC Concentration (QPM2102 and QPM2102D Only)

The sensor acquires and evaluates the CO_2/VOC concentration and converts it to a ventilation demand signal.

It represents the result of maximum selection of the CO_2 measuring signal and the filtered VOC measuring signal. With maximum selection, the two demand signals are compared and – depending on the result and the selected VOC sensitivity – delivered as the common air quality demand.

The ventilation demand signal is delivered via output U2 as a 0 to 10 Vdc or 0 to 5 Vdc signal to be fed to the ventilation controller.

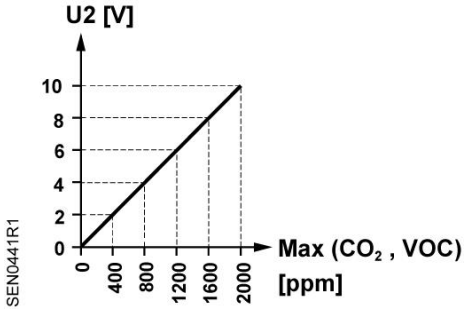

Figure 2. Ventilation Demand Diagram (Output U2).

VOC Sensitivity

Using the jumper on the setting element for the measuring range, the impact of VOC ventilation demand on maximum selection against CO_2 ventilation demand can be changed.

The position in the middle (R2) produces normal sensitivity of the VOC signal (factory setting). The other two positions are used for increasing (R3) or decreasing (R1) VOC sensitivity See Figure 3.

Response Time VOC Signal

Before the processor handles a change of the measured VOC value for maximum selection, there is a delay in response time of three minutes for every Volt the signal value changes.

Relative Humidity (QPM2162 and QPM2162D Only)

The sensor acquires the relative humidity in the room with a capacitive humidity sensing element whose capacitance changes as a function of the relative humidity.

An electronic measuring circuit converts the signal from the sensing element to a continuous 0 to 10 Vdc signal, corresponding to a relative humidity range of 0 to 100%.

Temperature (QPM2160, QPM2160D, QPM2162 and QPM2162D Only)

The sensor acquires the air duct temperature with a sensing element whose electrical resistance changes as a function of the temperature.

The change is converted to an active 0 to 10 Vdc output signal (≙ 32°F to 122°F [0°C to 50°C] or -31°F to 95°F [-35°C to 35°C]).

Mechanical Design

The duct air quality sensor consists of housing, printed circuit board, connection terminals, mounting flange and immersion rod with measuring probe.

The two-sectional housing is comprised of base and removable cover (without display: snap-on design, with display: screwed fastening). The measuring circuit and the setting elements are located on the printed circuit board inside the cover, the connection terminals on the base.

The humidity and temperature sensing elements are located at the end of the measuring probe and are protected by a filter cap.

Immersion rod and housing are made of plastic and are rigidly connected.

The sensor is fitted with the mounting flange supplied with the sensor. The flange is placed over the immersion rod and then secured at the required immersion length.

Setting Elements

NOTE: The setting elements are located inside the cover.

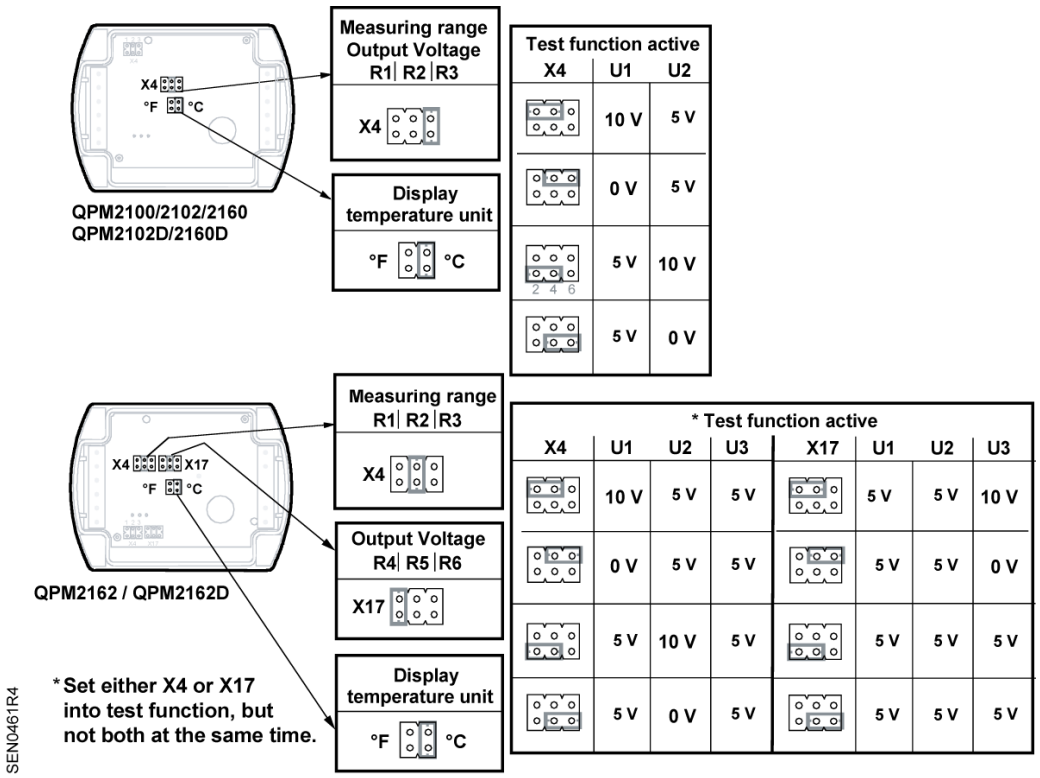

Figure 3. Setting Elements.

Measuring Range QPM2100

Meaning of the different jumper positions:

- For CO_2 Only:
  Jumper in the middle position (R2) = 0 to 2000 ppm (factory setting).
  R1 and R3 are not used.

QPM2102/QPM2102D

- For CO_2/VOC, jumpers determine VOC Sensitivity:
  - Jumper in the left vertical position (R1) = VOC sensitivity "low".
  - Jumper in the middle position (R2) = VOC sensitivity "normal" (factory setting).
  - Jumper in the right vertical position (R3) = VOC sensitivity "high".

QPM2160/QPM2160D, QPM2162/QPM2162D

- For the CO_2 and temperature, jumpers determine temperature range:
  - Jumper in the upper position (R1) = -31°F to 95°F (–35 to 35°C).
  - Jumper in the positions (R2 or R3) = 32°F to 122°F (0 to 50°C) (R2, factory setting).

Active Test Function

Jumper for the measuring range in the horizontal position:
The signal output delivers the values according to table "Test function active".

Temperature Display Changeover

Meaning of the different jumper positions:

- Jumper in the right vertical position = °C (factory setting).
- Jumper plug in the left vertical position = °F.

Troubleshooting

QPM2100/QPM2100D
QPM2102/QPM2102D

- In the event of CO_2 failure, 10 Vdc or 5 Vdc will be present at signal output U1 (after 60 seconds).
- In the event of CO_2 or VOC failure, 10 Vdc or 5 Vdc will be present at signal output U2 (after 60 seconds).

QPM2160/QPM2160D
QPM2162/QPM2162D

- If the temperature sensor becomes faulty, 0V will be present at signal output U2.
- If the temperature sensor becomes faulty, 0V will be present at signal output U3, and the humidity signal at signal output U2 will increase to 10 Vdc or 5 Vdc (after 60 seconds).
- If the humidity sensor becomes faulty, 10 Vdc or 5 Vdc will be present at signal output U2 (after 60 seconds), and the temperature signal will remain active.

Display of Measured Values

With sensors QPM2102D, QPM2160D and QPM2162D, the measured values can be read on an LCD. The following measured values are displayed:

- CO_2: In ppm
- CO2 + VOC: As a bar chart (4 bars ≙ U2 = 2V, 20 bars ≙ U2 = 10V)
  More bars = higher VOC
- Temperature: In degrees C or F
- Humidity: In % rh

Disposal

The major plastic components bear the material references in compliance with ISO/DIS 11 469 for environment-friendly disposal.

Accessories

AQF3101 Filter cap (for replacement)

Engineering Notes

- The sensor must be powered by a transformer for Safety Extra Low-Voltage (SELV) with separate windings, suited for 100% duty. It must be sized and fused in compliance with local safety regulations.
- When sizing the transformer, the power consumption of the sensor must be taken into consideration. For information about wiring, see the Technical Instructions of the devices with which the sensor is used.
- Observe maximum permissible cable lengths.

Cable Routing and Selection

- When laying the cables, it should be considered that electrical interference increases the longer the cables run parallel and the smaller the distance between them.
- Use shielded cables on applications with EMC problems.
- For the secondary power lines and signal lines, use cables with twisted pairs.

Mounting Notes

Mounting Location and Orientation

- To ensure degree of protection, mount the sensor with the cable entry pointing downward.
- Mount the sensor in a location where it can be easily accessed for service.
- If used in connection with steam humidifiers, the distance to the humidifier must be a minimum of 9.8 feet (3 m). If permitted by the installation, the distance should be as great as possible, but no more than 32.8 feet (10 m).
- Handle carefully; the sensing elements in the immersion rod are susceptible to impact and shock.
- The sensor must not be mounted in a ventilation application on top of a building (impact of solar radiation). To ensure correct operation, the sensor's ambient temperature must be between 23°F to 113°F (–5°C to 45°C).

Commissioning Notes

Check the sensor's functions 30 minutes after applying power.

- Checking the CO_2 function:
  In well-ventilated spaces, the sensor shows the CO_2 concentration of the outside air. Typically, this is 360 ppm (depending on the sensor's measuring accuracy). Also, a basic functional check can be made by exhaling on the sensor. Note that the sensor's rate of response has been purposely delayed (time constant t_{90} = 5 minutes).
- Checking the VOC function:
  Touch the sensor with a cotton ball dowsed in alcohol.
- Ventilation should start when the preset switching level of the connected controller is reached.
- After applying power to sensors with display, **Init** will appear for approximately six seconds.

Specifications

Power supply	Operating voltage (SELV)	24 Vac ±20%
	Frequency	50/60 Hz at 24 Vac
	Power consumption	≤2 VA
Functional data, CO_2	Measuring range (MV = measured value)	0 to 2000 parts per million (ppm) *
	Measuring accuracy @ 73°F (23°C) and 1013 hPa	≤ ± (50 ppm + 2% MV)
	Temperature dependency in 23°F to 113°F (-5°C to 45°C) range	± 2 ppm/°C typically
	Long-time drift	≤ ± 5% measuring range/5 years
	Time constant t_{90}	<5 minutes
	Output signal, linear (terminal U1)	0 to 10 or 0 to 5 Vdc ≙ 0 to 2000 ppm
	Recalibration	Not required for 8 years
	* Allow up to 96 hours for unit to reach published accuracy.	
Functional data, maximum selection of CO_2 and VOC with QPM2102/QPM2102D	Measuring range VOC	0 to 2000 ppm
	VOC sensitivity	See Table 1
	Output signal, linear (terminal U2)	0 to 10 or 0 to 5 Vdc ≙ 0 to 2000 ppm
	Response time, VOC signal t_{voc}	3 minutes/V

Functional data, rh with QPM2162/QPM2162D	Range of use	0 to 95% rh (non-condensing)
	Measuring range	0 to 100% rh
	Measuring accuracy @ 73°F (23°C) and 24 Vac	
	0 to 30/70 to 95% rh	± 5% rh
	30 to 70% rh	± 3 rh (typically)
	Temperature dependency	≤ 0.1% rh/°C
	Time constant	Approximately 20 seconds
	Output signal, linear (terminal U2)	0 to 10 or 0 to 5 Vdc ≙ 0 to 100% rh
Functional data, temperature with QPM2160/QPM2160D, QPM2162/QPM2162D	Environmental temperature range for electronics	23°F to 113°F (-5°C to 45°C)
	Measuring range	32°F to 122°F (0°C to 50°C) (R2, R3) -31°F to 95°F (-35°C to 35°C) (R1)
	Measuring element	NTC 10K Ω
	Measuring accuracy at 24 Vac	
	59°F to 95°F (15°C to 35°C)	± 1.4°F (± 0.8°C)
	outside the above range, between:	
	-31°F to 59°F/95°F 122°F (-35°C to 15°C/35°C to 50°C)	± 1.8°F (±1°C)
	Time constant	<3.5 min in 2 m/s moving air
	Output signal, linear (terminal U2 or U3)	0 to 10 or 0 to 5 Vdc ≙ 32°F to 122°F (0°C to 50°C)/-31°F to 95°F (-35°C to 35°C)
Air velocity	Maximum air velocity V_{max}	10 m/second
Electrical connections	Screw terminals for	1 × 12 AWG or 2 × 16 AWG
Environmental conditions	Transport:	
	Temperature:	-13°F to 158°F (-25°C to 70°C)
	Humidity:	< 95% rh
Materials and colors	Base	Polycarbonate, RAL 7001 (silver-gray)
	Cover	Polycarbonate, RAL 7001 (light-gray)
	Immersion rod	Polycarbonate, RAL 7001 (silver-gray)
	Filter cap	Polycarbonate, RAL 7001 (silver-gray)
	Mounting flange	PA66 – GF35 (black)
	Cable entry gland	PA, RAL 7035 (light-gray)
	Sensor (complete assembly)	Silicone-free
	Packaging	Corrugated cardboard
Standards	Electromagnetic compatibility	
	Immunity (QPM2162)	EN 61 000-6-1
	Immunity (QPM2100, QPM2102, QPM2160)	EN 61 000-6-2
	Emissions	EN 61 000-6-3
	CE conformity	EMC directive 89/336/EEC
	conformity to Australian EM framework	Radio Communication Act 1992
	Radio Interference Emission Standard	AS/NZS 3548
	UL Listed	UL 873
	cUL Listed	Canadian Standard C22.2 No. 24-93
Weight	(including packaging)	Approximately 0.6 lb (0.247 kg)

Wiring Connections

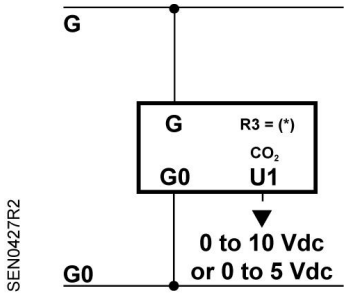

Figure 4. QPM2100, QPM2100D.

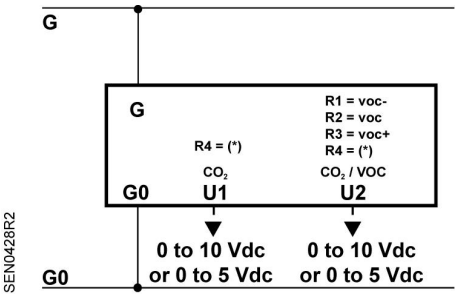

Figure 5. QPM2102, QPM2102D.

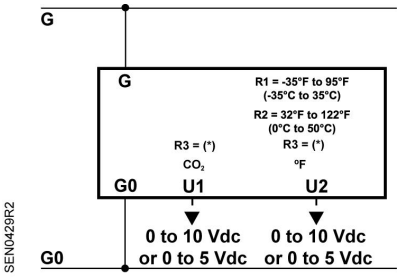

Figure 6. QPM2160, QPM2160D.

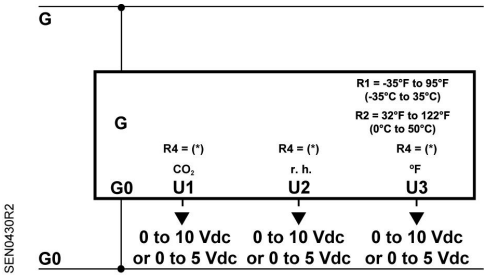

Figure 7. QPM2162, QPM2162D.

G, G0	System potential 24 Vac (SELV)
G0	System neutral and measuring neutral
U1	Signal output 0 to 10 Vdc or 0 to 5 Vdc
U2	Signal output 0 to 10 Vdc or 0 to 5 Vdc
U3	Signal output 0 to 10 Vdc or 0 to 5 Vdc
R..(*)	Signal output with R...= 0 to 10 Vdc; without R... = 0 to 5 Vdc
B, M	Passive temperature output (interchangeable)

Dimensions

In Inches (Millimeters)

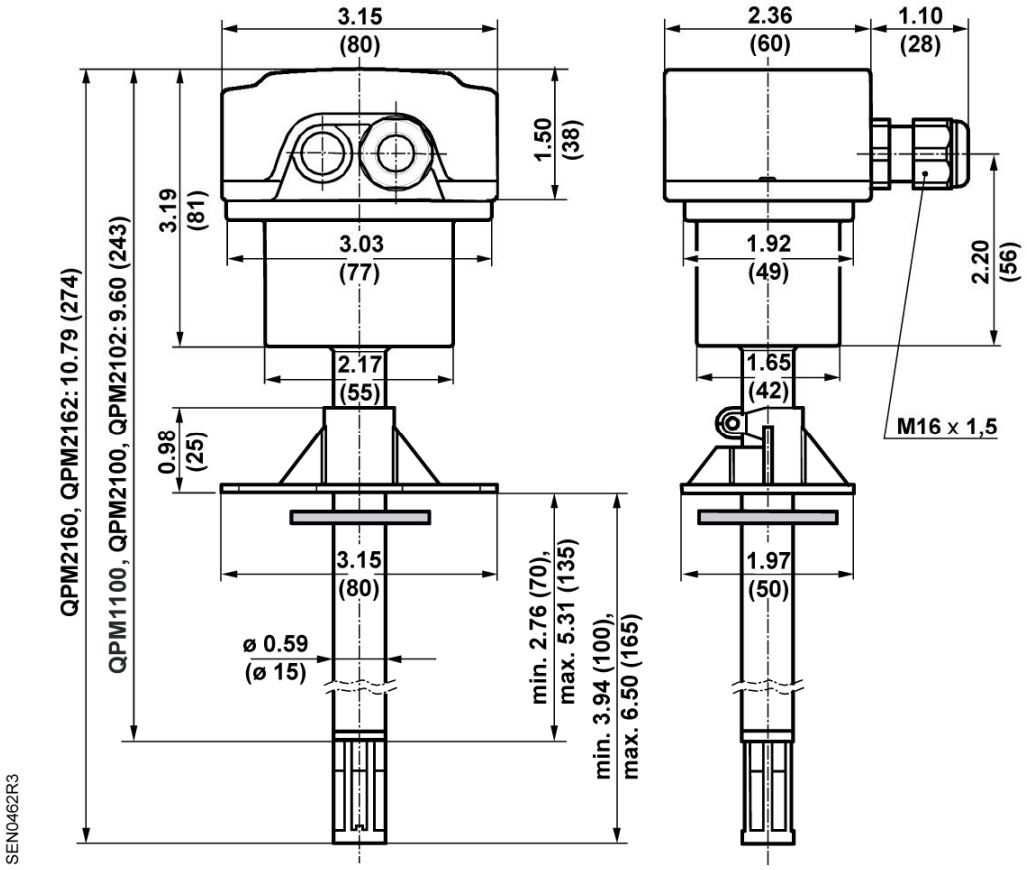

Figure 8. QPM Series Duct Air Quality Sensors Dimensions in Inches (Millimeters)

Dimensions, Continued

In Inches (Millimeters)

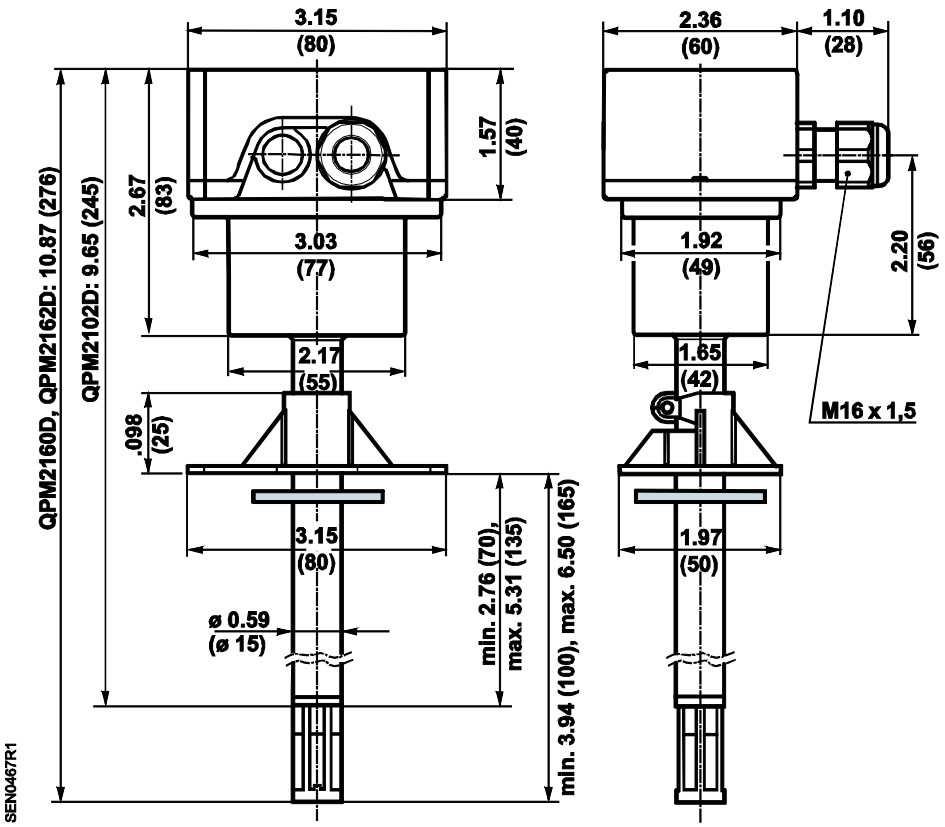

Figure 9. QPM Series Duct Air Quality Sensors with Display.

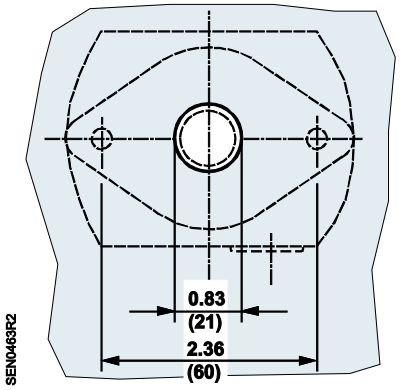

Figure 10. Drilling Pattern.

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