Indoor air quality sensors

temperature, humidity, CO_2, VOC, PM2.5, PM10

Indoor air quality and personal health

Maintaining adequate levels of indoor air quality in buildings is essential to ensure comfort and above all human health.

Keeping the main parameters that determine indoor air quality under control indeed guarantees:

- health;
- comfort;
- productivity of building occupants.

Finally, measuring pollutants allows occupants to recognise the quality of the air they breathe, helping them implement the technical measures needed to improve air quality and consequently quality of life.

Serial duct sensor
DPDQ*0B010

Serial room sensors, with and without display
DPWQ**B010

Studies have shown that people today spend on average **90% of their time inside buildings**, mainly in the home and office.

These buildings, especially newer ones, are extremely well-insulated so as avoid wasting energy when the heating and cooling systems are operating.

However, this also leads to a worsening in **indoor air quality**. When air changes with fresh outside air are kept to the minimum, the air becomes stagnant and the concentration of pollutants increases, jeopardising the **comfort, productivity and health** of occupants.

This is why indoor air quality monitoring and control is becoming increasingly important in commercial and residential applications. Keeping indoor air in buildings healthy is the next big **challenge in the air conditioning market**!

Serial connectivity

Simpler installation with two separate serial terminals, fewer inputs/outputs to be managed.

Multi-sensor unit

Five parameters on just one sensor, lower purchase and installation costs.

Flexibility

Available in duct or wall-mounted versions, with and without display.

Parameters for measuring IAQ

How is indoor air quality measured in practice? How do we know whether or not the air we are breathing is "good"? A series of parameters need to be considered when determining air quality.

Some of these are better known than others, with a clearly understandable effect on people, however all of them need to be kept within a certain optimal range for human occupancy. Indeed the key is an optimal range and not precise values, as different people experience different sensations even when in the same environment, depending on their clothing, activity level and other factors.

Temperature: this is a physical parameter that relates to sensations of heat and cold, and expresses the thermal energy of objects. For personal comfort, the indoor temperature should be between 67 and 82°F or 20 and 27°C throughout the year.

Relative humidity: this is the ratio of the water vapour present in the air to the maximum amount that the same air can hold before it precipitates. The human body responds best in a relative humidity range between 40 and 60%.

PM concentration: particulate matter includes a set of solid and/or liquid particles suspended in the air, and generated by activities such as cooking, cigarette smoke and other sources of combustion, as well as printers. The finest particles are able to penetrate deep into the lungs. The recommended values for indoor environments are below 10 µg/m³ for PM2.5 and below 20 µg/m³ for PM10.

CO_2 concentration: carbon dioxide is a colourless and odourless gas resulting from combustion and human respiration. It is naturally present in the air (0.03%) and is absorbed by plants through photosynthesis. It is often measured indoors as a marker of human occupancy, with high levels of CO_2 requiring an increase in ventilation. The recommended values for indoor environments are below 1000 ppm.

VOC concentration: volatile organic compounds (VOC) are the organic chemical components responsible for the presence of odours and certain pollutants. Indoor levels are usually much higher than outdoor levels, due to overuse of chemicals and detergents for cleaning. Prolonged exposure to these chemicals can cause irritation, headache and some may even be carcinogenic. The recommended values for indoor environments are below 300 ppb.

Monitoring and control of indoor air quality

There are two main architectures used for the installation of air quality sensors: the monitoring system and the monitoring and control system.

Monitoring system

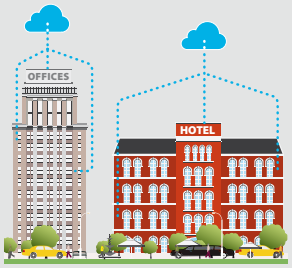
The **sensors** installed in different positions in the building **measure the parameters** that define the indoor air quality (mainly T, RH, CO_2, VOC, PM, but also others).

The **data acquired is sent to the HVAC system local and/or remote supervisor** or to a BMS, where they are displayed and processed, yet not immediately used as inputs for control of the ventilation system.

This type of installation **provides information on the trend in building air quality** over time, so as to evaluate the **behaviour of the ventilation system** and plan any subsequent changes or additions to the system.

boss - local supervisory system

Cloudgate - remote supervisory system



BMS - building management system

Control and monitoring system

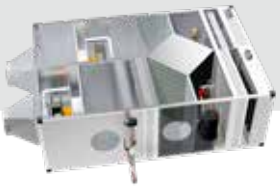
A monitoring and control system, in addition to the features described above, also includes **ventilation or air conditioning units**, such as:

- actual air handling units;
- ventilation units with heat recovery;
- rooftop units.

These units receive the signal from the sensors that measure the air quality parameters and operate based on these signals to restore the correct levels of each parameter.
In turn, these can be controlled and monitored by a supervisory system.

Air handling unit

Heat recovery unit



Rooftop

c.pCO - programmable controller

pCO5+ - programmable controller

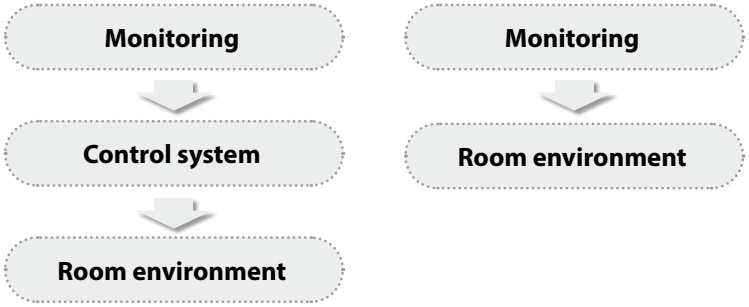
k.air - parametric controller and electrical control panel

µARIA - parametric controller

DPDQ - duct IAQ sensor

DCPD - duct differential pressure sensor

The two types of architecture available



CAREL's solutions for room installation include:

- sensors for temperature, relative humidity, CO_2, VOC, PM2.5, PM10;
- zone control terminals.

DPW - room IAQ sensor

pGDX - zone controller

Range of sensors for controlling indoor air quality

	Part number	Power supply	Display	Type of installation	
	DPPT010000	12/24 Vac/Vdc	Without display	Wall-mounted for industrial environments	
	DPPT011000	12/24 Vac/Vdc	Without display	Wall-mounted for industrial environments	
	DPPT014000	12/24 Vac/Vdc	Without display	Wall-mounted for industrial environments	
	DPPC111000	12/24 Vac/Vdc	Without display	Wall-mounted for industrial environments	
	DPPC110000	12/24 Vac/Vdc	Without display	Wall-mounted for industrial environments	
	DPPC210000	12/24 Vac/Vdc	Without display	Wall-mounted for industrial environments	
	DPPC112000	12/24 Vac/Vdc	Without display	Wall-mounted for industrial environments	
	DPPC212000	12/24 Vac/Vdc	Without display	Wall-mounted for industrial environments	
	DPPC114000	12/24 Vac/Vdc	Without display	Wall-mounted for industrial environments	
	DPPC214000	12/24 Vac/Vdc	Without display	Wall-mounted for industrial environments	
	DPWT010000	12/24 Vac/Vdc	Without display	Wall-mounted in the room	
	DPWT011000	12/24 Vac/Vdc	Without display	Wall-mounted in the room	
	DPWT014000	12/24 Vac/Vdc	Without display	Wall-mounted in the room	
	DPWC111000	12/24 Vac/Vdc	Without display	Wall-mounted in the room	
	DPWC110000	12/24 Vac/Vdc	Without display	Wall-mounted in the room	
	DPWC115000	12/24 Vac/Vdc	Without display	Wall-mounted in the room	
	DPWC112000	12/24 Vac/Vdc	Without display	Wall-mounted in the room	
	DPWC114000	12/24 Vac/Vdc	Without display	Wall-mounted in the room	
o	**DPWQ306000**	24 Vac/Vdc	Without display	Wall-mounted in the room	
o	**DPWQ402000**	24 Vac/Vdc	Without display	Wall-mounted in the room	
o	**DPWQ502000**	24 Vac/Vdc	Without display	Wall-mounted in the room	
New	**DPWQ60B010**	24 Vac/Vdc	Without display	Wall-mounted in the room	
New	**DPWQ70B010**	24 Vac/Vdc	Without display	Wall-mounted in the room	
New	**DPWQ80B010**	24 Vac/Vdc	Without display	Wall-mounted in the room	
New	**DPWQ90B010**	24 Vac/Vdc	Without display	Wall-mounted in the room	
New	**DPWQ61B010**	24 Vac/Vdc	With display	Wall-mounted in the room	
New	**DPWQ71B010**	24 Vac/Vdc	With display	Wall-mounted in the room	
New	**DPWQ81B010**	24 Vac/Vdc	With display	Wall-mounted in the room	
New	**DPWQ91B010**	24 Vac/Vdc	With display	Wall-mounted in the room	
	DPDT010000	12/24 Vac/Vdc	Without display	Duct	
	DPDT011000	12/24 Vac/Vdc	Without display	Duct	
	DPDT014000	12/24 Vac/Vdc	Without display	Duct	
	DPDC111000	12/24 Vac/Vdc	Without display	Duct	
	DPDC110000	12/24 Vac/Vdc	Without display	Duct	
	DPDC210000	12/24 Vac/Vdc	Without display	Duct	
	DPDC112000	12/24 Vac/Vdc	Without display	Duct	
	DPDC212000	12/24 Vac/Vdc	Without display	Duct	
	DPDC114000	12/24 Vac/Vdc	Without display	Duct	
	DPDC214000	12/24 Vac/Vdc	Without display	Duct	
New	**DPDQ60B010**	24 Vac/Vdc	Without display	Duct	
o	**DPDQ306000**	24 Vac/Vdc	Without display	Duct	
o	**DPDQ402000**	24 Vac/Vdc	Without display	Duct	
o	**DPDQ502000**	24 Vac/Vdc	Without display	Duct	
New	**DPDQ70B010**	24 Vac/Vdc	Without display	Duct	
	DPRC11A000	5 Vdc	Without display	Duct, compact version, 1m cable	
	DPRC13A000	5 Vdc	Without display	Duct, compact version, 3m cable	
	DPUT011000	15…36 Vdc	Without display	Outdoor	
	DPUC110000	15…36 Vdc	Without display	Outdoor	

o existing IAQ part numbers
New new IAQ sensor part numbers, with Modbus RS485 serial communication

Note: optional RS485-WiFi conversion module available, for installations in areas that are difficult to reach with the RS485 serial line

	Parameters measured					Range of measurement	Output signal
	T					-20 to 70°C	4 to 20 mA
	T					-20 to 70°C	NTC 10K @ 25 °C
	T					-20 to 70°C	Modbus RS485
	T					-10 to 60°C, 10 to 90%	4 to 20 mA, NTC 10K @ 25 °C
	T	RH				-10 to 60°C, 10 to 90%	4 to 20 mA
	T	RH				-20 to 70°C, 0 to 100%	4 to 20 mA
	T	RH				-10 to 60°C, 10 to 90%	0 to 10 V
	T	RH				-20 to 70°C, 0 to 100%	0 to 10 V
	T	RH				-10 to 60°C, 10 to 90%	Modbus RS485
	T	RH				-20 to 70°C, 0 to 100%	Modbus RS485
	T					-10 to 60°C	4 to 20 mA
	T					-10 to 60°C	NTC 10K @ 25 °C
	T					-10 to 60°C	Modbus RS485
	T	RH				-10 to 60°C, 10 to 90%	4 to 20 mA, NTC 10K @ 25 °C
	T	RH				-10 to 60°C, 10 to 90%	4 to 20 mA
	T	RH				-10 to 60°C, 10 to 90%	0 to 10 V, NTC 10K @ 25 °C
	T	RH				-10 to 60°C, 10 to 90%	0 to 10 V
	T	RH				-10 to 60°C, 10 to 90%	Modbus RS485
			VOC			0 to 100%	0 to 10 V, 4 to 20 mA
				CO_2		0 to 5000ppm	0 to 10 V, 4 to 20 mA
			VOC	CO_2		0-5000 ppm, 0-100%	0 to 10 V, 4 to 20 mA
	T	RH				0 to 50°C, 0 to 95%	Modbus RS485
	T	RH		CO_2		0-50°C, 0-95%, 0-5000 ppm	Modbus RS485
	T	RH	VOC	CO_2		0-50°C, 0-95%, 0-5000 ppm, 0-100%	Modbus RS485
	T	RH	VOC	CO_2	PM2.5/10	0-50°C, 0-95%, 0-5000 ppm, 0-100%, 0-100 µg	Modbus RS485
	T	RH				0 to 50°C, 0 to 95%	Modbus RS485
	T	RH		CO_2		0-50°C, 0-95%, 0-5000 ppm	Modbus RS485
	T	RH	VOC	CO_2		0-50°C, 0-95%, 0-5000 ppm, 0-100%	Modbus RS485
	T	RH	VOC	CO_2	PM2.5/10	0-50°C, 0-95%, 0-5000 ppm, 0-100%, 0-100 µg	Modbus RS485
	T					-20 to 70°C	4 to 20 mA
	T					-20 to 70°C	NTC 10K @ 25 °C
	T					-20 to 70°C	Modbus RS485
	T	RH				-10 to 60°C, 10 to 90%	4 to 20 mA, NTC 10K @ 25 °C
	T	RH				-10 to 60°C, 10 to 90%	4 to 20 mA
	T	RH				-20 to 70°C, 0 to 100%	4 to 20 mA
	T	RH				-10 to 60°C, 10 to 90%	0 to 10 V
	T	RH				-20 to 70°C, 0 to 100%	0 to 10 V
	T	RH				-10 to 60°C, 10 to 90%	Modbus RS485
	T	RH				-20 to 70°C, 0 to 100%	Modbus RS485
	T	RH				-20 to 50°C, 0 to 95%	Modbus RS485
			VOC			0 to 100%	0 to 10 V, 4 to 20 mA
				CO_2		0 to 5000ppm	0 to 10 V, 4 to 20 mA
			VOC	CO_2		0-5000 ppm, 0-100%	0 to 10 V, 4 to 20 mA
	T	RH		CO_2		-20-50°C, 0-95%, 0-5000 ppm	Modbus RS485
	T	RH				-10 to 60°C, 10 to 90%	NTC 10K @ 25 °C, 0.5…4.5 V
	T	RH				-10 to 60°C, 10 to 90%	NTC 10K @ 25 °C, 0.5…4.5 V
	T					-50 to 90°C	NTC 10K @ 25 °C
	T	RH				-35 to 80°C, 10 to 90%	4 to 20 mA, NTC 10K @ 25 °C

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