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EP5000Z datasheet

Flush mounted ZigBee Indoor Air Quality Probe

CO2

VOC

Particles

Temperature

Humidity

Noise

Light

Atmospheric pressure

Content

1. Keynote

To comply with in force regulations on buildings energy efficiency, ventilation must be automatically on demand controlled.

2. Measuring indoor Air quality for HVAC control

Energy losses by air renewal in a conventional building are estimated to 30% of the heating and air conditioning cost. Losses become predominant for very isolated buildings even with heat exchanger. The increasing airproofing of buildings also imposes on demand air renewal based on IAQ to ensure productivity, comfort and health.
By controlling the ventilation on human occupancy materialized by the expiration of CO2 (meeting rooms, offices, bedroom) and air quality (VOC, toxic compounds and odors, particulate maters), significant energy savings can be achieved without talking about gains of productivity, health benefits and wellbeing.

3. Multi sensors probe.

This probe is the most comprehensive on the market and can combine the following measurements:

- CO2
- Total VOC
- PM1, PM2.5, PM10
- Humidity
- Temperature
- Light intensity
- Color temperature
- Audible Noise
- Flickering (optional)

4. Easy ecosystems Integration

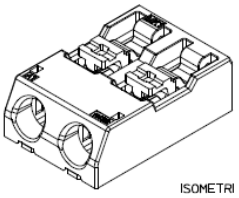
Easy commissioning: there is no need to open the probe to access to a registration button. Registration is done by approaching a smartphone with his NFC activated (Android or IOS).

5. Power supply

Voltage	12V to 36VDC, 24V nominal
Average current	15mA
Pic current	40mA
Average power consumption	360mW

6. Connection

Power supply:	2 pins (polarized)
Modbus:	2 pins (polarized)
Connector type:	Push In
Release:	Push button
Type of cable:	Solid or Stranded
Diameter of cable:	AWG 18-24 (Solid), 22-26 (Stranded)



7. Maintenance free

Each component of the IAQ probe has been selected and are managed in order to achieve at least 10 years' life span without any maintenance or recalibration.

This probe is designed to work in a ventilated area where sensors have the opportunity to see outdoor CO2 and VOCt concentration at least every 15 days. In the contrary the NDIR dual band CO2 sensor option shall be selected.

The automatic baseline calibration is set on a 2 weeks' period. In order to get a good auto calibration after commissioning, it is recommended to open windows for at least 5 minutes with the probe powered.

8. Durability index

Some countries require indicating the Durability index but calculation is not yet harmonized among counties. As a consequence, we provide raw and detailed information as follow:

The design of the probe is made for a durability of at least 30 years
PM, CO2 and VOC sensors have a 10 years' life span but can be replaced (plug and play) by end user without special tool. See reparability for details.

9. Reparability index

Some countries require indicating the Reparability index but calculation is not yet harmonized among counties. As a consequence, we provide raw and detailed information as follow:

The design of the probe is made of a stack of 5 PCB as follow (mounting order from rear to top)

- Power supply board
- PM sensor
- Inter board interface
- Main board with the following sensors: CO2 (pluggable), TVOC (pluggable), Atmospheric pressure, noise.
- The front board with NFC antenna and ship, ZigBee antenna and transceiver and the following sensors: T°, RH, light.

The main board has a built in test feature for each FRU (**F**ield **R**eplaceable **U**nit) with a status report through the digital communication and LED interface.
Each above board is designed to be a FRU and each FRU is a SKU.
In case of failure each board can be ordered and changed by skilled end user according to the Maintenance and repair manual.
Each above board is designed to be an FRU and each FRU is a SKU, (**S**tock-**K**eeping **U**nit).
In the event of a failure, each board can be ordered and changed by a qualified end user in accordance with the maintenance and repair manual.

Most of sensors are SMD digital sensor with small drift along the life span of the probe.
Sensor with 10 years' lifespan are pluggable and considered as FRU: PM, CO2, TVOC.
FRU only requires a simple screwdriver for replacement operation. FRU are SKU that can be ordered separately.

Plastic parts are SKU and can be ordered separately in the frame of the reparability and sustainability policy. Details on FRU/SKU part numbers are given in the “Maintenance and repair manual”.

10.Flush-mounting design

The flat design of the IAQ probe has been studied to be flush mounted in standard electric boxes. Integrated in the wall, the visible part is just few millimeters thick.
The air is sensed by the air diffusion going between the front panel and the wall (few millimeters).

11.Specifications of sensor after integration in the probe

11.1. Technologies

Protocol	ZigBee 3.0
Power supply	24V DC, Protection against transient-voltage-over 35V
Consumption	@12DC: 30mA average, 80mA pic
CO2 sensor	Single band NDIR (Dual bands NDIR in option) with auto zero
TVOC sensor	Digital Metal Oxide pulsed MEMS with auto zero
PM sensor	Laser scattering with laser source
Temperature sensor	Digital MEMS
Relative humidity sensor	Digital MEMS
Atmospheric Pressure	Digital MEMS
Noise sensor	Digital sensor
Light sensors	Digital MEMS

11.2. Lifespan and drifts

IAQ probe: 30 years (MTBF is 48 years computed according to MIL HDBK 217F).
Gas and PM sensors: 10 years under normal conditions of use. Beyond 10 years, a replacement message is activated.
Humidity: Max drift 0.5% RH / year.
Temperature: Max drift of 0.04 ° C per year.
Noise: No drift mentioned by the manufacturer
Atmospheric Pressure: +/- 1mbar/year

11.3. Measurement ranges and accuracies

11.3.1. CO2:

+/- 50ppm and 3% at 25°C and 1013mbar, measuring range: 390 to 5000 ppm, resolution 1ppm. Automatic Baseline Calibration (ABC): lowest value on 15 days forced at 400ppm. The accuracy of the CO2 measurements indicated above requires that the building be unoccupied and ventilated for some time at least once every 15 days.

11.3.2. TVOC:

+/- 0.1mg / m^3 and 15% (Total VOC according to ISO16000-29). Max 65 520 µg / m^3, resolution 28µg / m^3.
Relative measurement: The lowest possible value achievable by ventilation or air treatment becomes the zero on a 15 period.
The accuracy of the relative VOC measurements indicated above requires that the probe be associated with an active ventilation.

11.3.3. PM1:

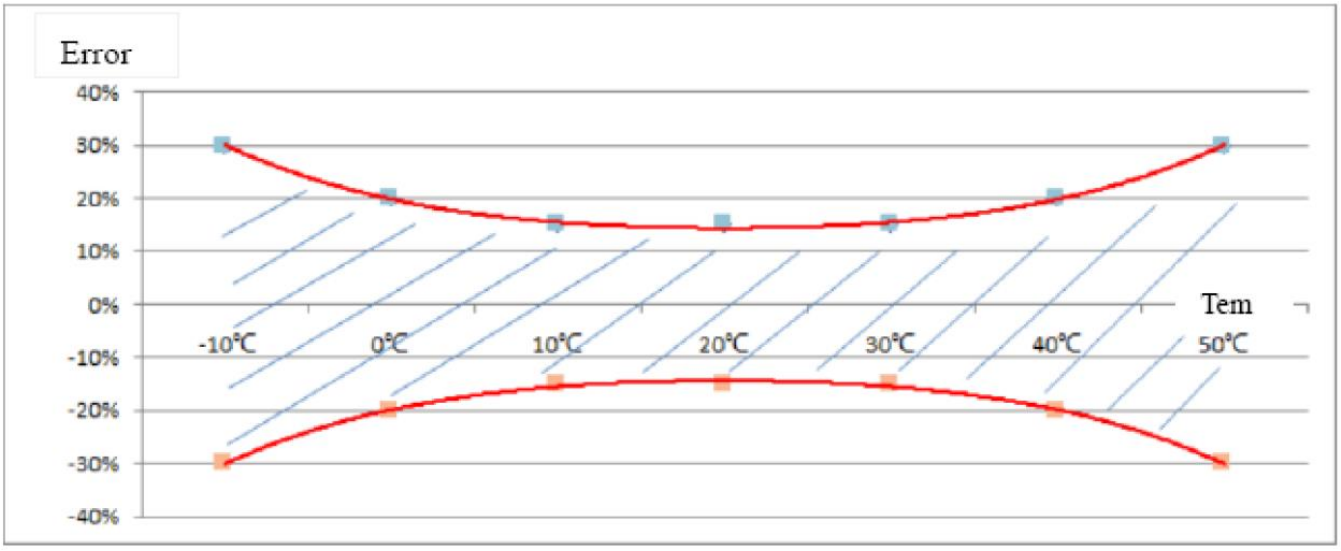
indicative, no accuracy commitment

11.3.4. PM2.5:

< 50µg/m^3: ± 10µg/m^3, 50~100µg/m^3： ± 15µg/m^3 > 100µg/m^3: ± 15% reading
Temperature influence: 0.5 to 1%/°C or 0.5 to 1µg/m^3/°C around 20°C, whichever is larger

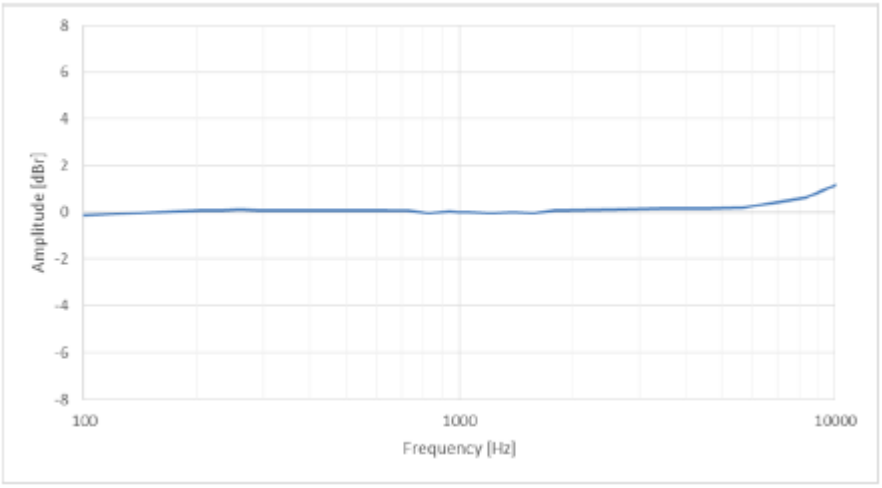
11.3.5. PM10:

indicative, no accuracy commitment.



11.3.6. Noise sensor

Range: 122.5 dBA SPL
Signal to Noise Ratio: -64 dBA
Omnidirectional sensitivity: -26 dBA FS ±3 dB sensitivity
Drift: not mentioned by sensor manufacturer.
Frequency response



11.3.7. Atmospheric pressure sensor

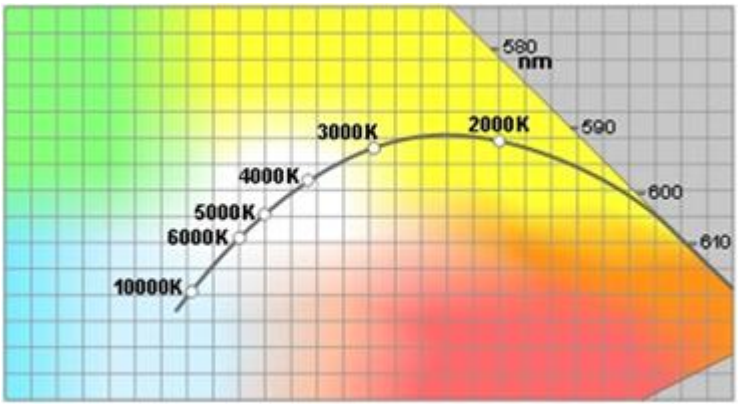
Range: 10 to 11200 mbar
Full accuracy: 300 to 1100 mbar
Resolution: 0.13 mbar
Accuracy 25°C, 750 mbar: +/- 1.5 mbar

11.3.8. Light sensor

Illuminance: Lux computed from RGB and Clear channel.
Color temperature: computed from RGB and Clear channel.
Characteristic of channels:

Parameter	Test Conditions	Red Channel		Green Channel		Blue Channel		Clear Channel			Unit
		Min	Max	Min	Max	Min	Max	Min	Typ	Max	
R_e Irradiance responsivity	$\lambda_D = 465$ nm(2)	0%	15%	10%	42%	65%	88%	11.0	13.8	16.6	counts /µW /cm^2
	$\lambda_D = 525$ nm(3)	4%	25%	60%	85%	10%	45%	13.2	16.6	20.0	
	$\lambda_D = 615$ nm(4)	80%	110%	0%	14%	5%	24%	15.6	19.5	23.4	

Notes:
1. The percentage shown represents the ratio of the respective red, green, or blue channel value to the clear channel value.
2. The 465 nm input irradiance is supplied by an InGaN light-emitting diode with the following characteristics: dominant wavelength λD = 465 nm, spectral halfwidth Δλ. = 22 nm.
3. The 525 nm input irradiance is supplied by an InGaN light-emitting diode with the following characteristics: dominant wavelength λD = 525 nm, spectral halfwidth Δλ. = 35 nm.
4. The 615 nm input irradiance is supplied by a AlInGaP light-emitting diode with the following characteristics: dominant wavelength λD = 615 nm, spectral halfwidth Δλ. = 15 nm.



11.3.9. Color T°:

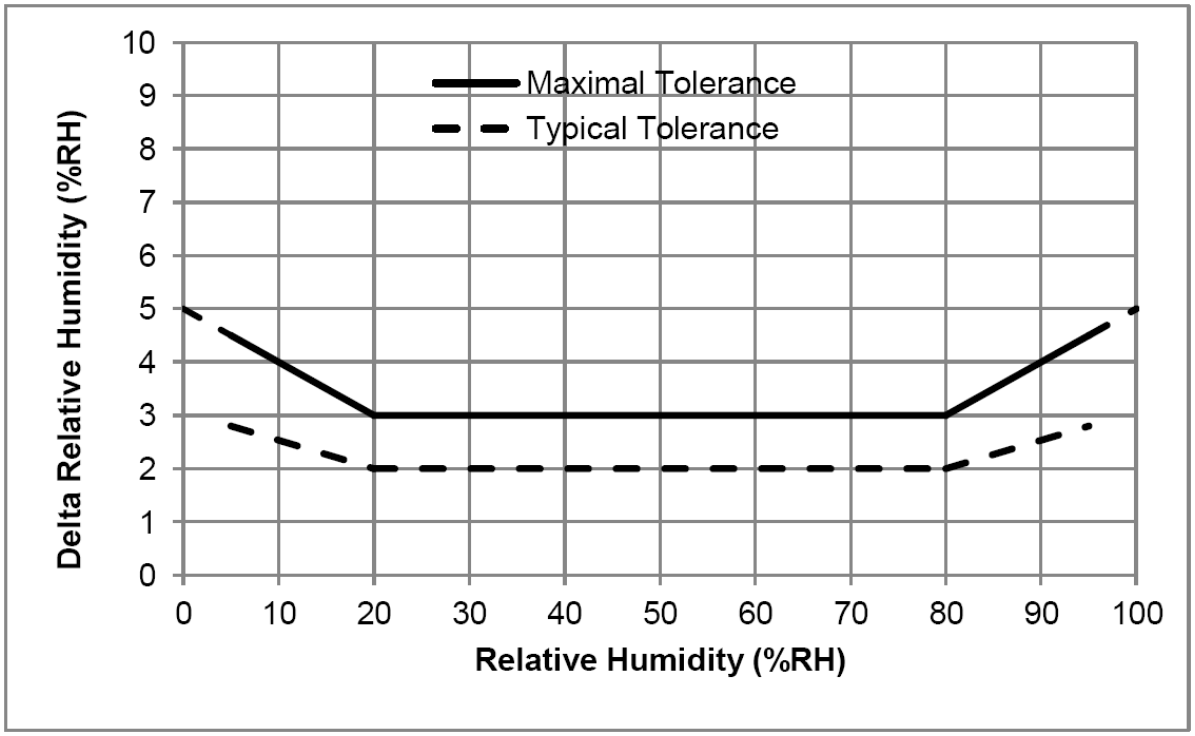
Range: 1 635°K to 7 500°K
Resolution: 23°K / LSB

11.3.10. Lux:

Range: 0 to 1023 lux
Resolution: 1 Lux

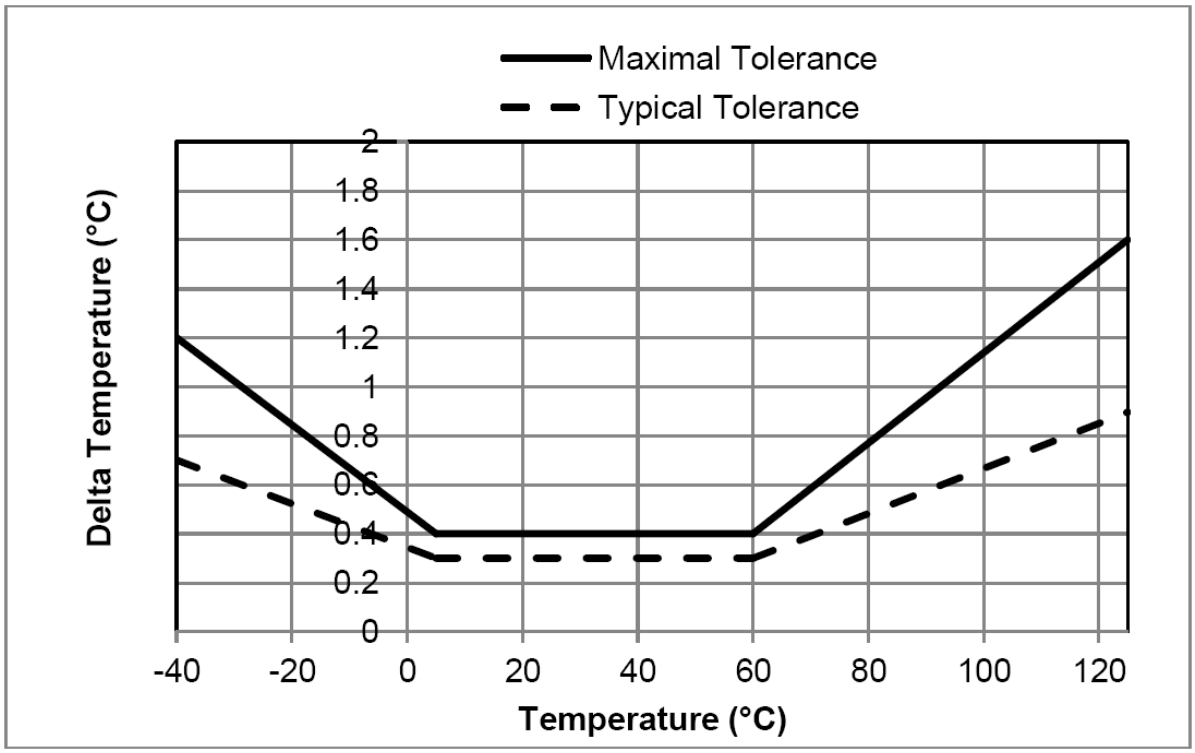
11.3.11. Humidity:

+/- 3% RH, minimum measurement range: 0% to 100% RH, resolution 1%.

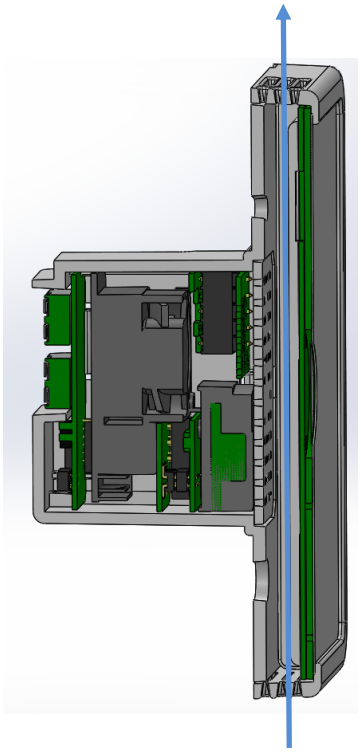


11.3.12. Temperature:

+/- 0.3°C, measuring range from 0° to + 50°C, resolution 0.1°C.



12. Air flow



EP5000 probe side view: The front PCB with T° and RH sensor is away from the wall to allow air flow in front of other sensors.

13.Operation and storage conditions

Working temperature range:	0°C to +45°C
Working humidity range:	0 to 95% non-condensing
Storage temperature range	-30°C to 60°C
Storage humidity range:	0 to 95% non-condensing

14.Noise

PM sensor fan activated 6 seconds every minutes: < 20dBA at 30cm (background noise < 16dBA)

15.Protection index

Protection class: III
Protection grade: IP 30

16.Dimensions

98x98x46mm

17.Weight

Probe anole: 120g

18.Packaging

White gift box

19.Packing list

Probe
Wall box
Card with link for online documentation

20.Product Label

The label in the back of the product identify the model.
Z termination means **ZigBee**.
The serial number is registered in the main MCU and can be read via NFC with a dedicated app for smartphone.

21.Marking

The type of connection (power supply) is indicated in front of each connector as well as polarities.

22.Applicable Standard

EN 60730-1 (electrical controls for household machines and the like)
The unit complies with European Directive 73/23/EEC (Low Voltage Directive) and 89/336/EEC (EMC Directive).

23.Flammability

Flammability class according to UL 94: V0

24.RoHS / Reach compliance

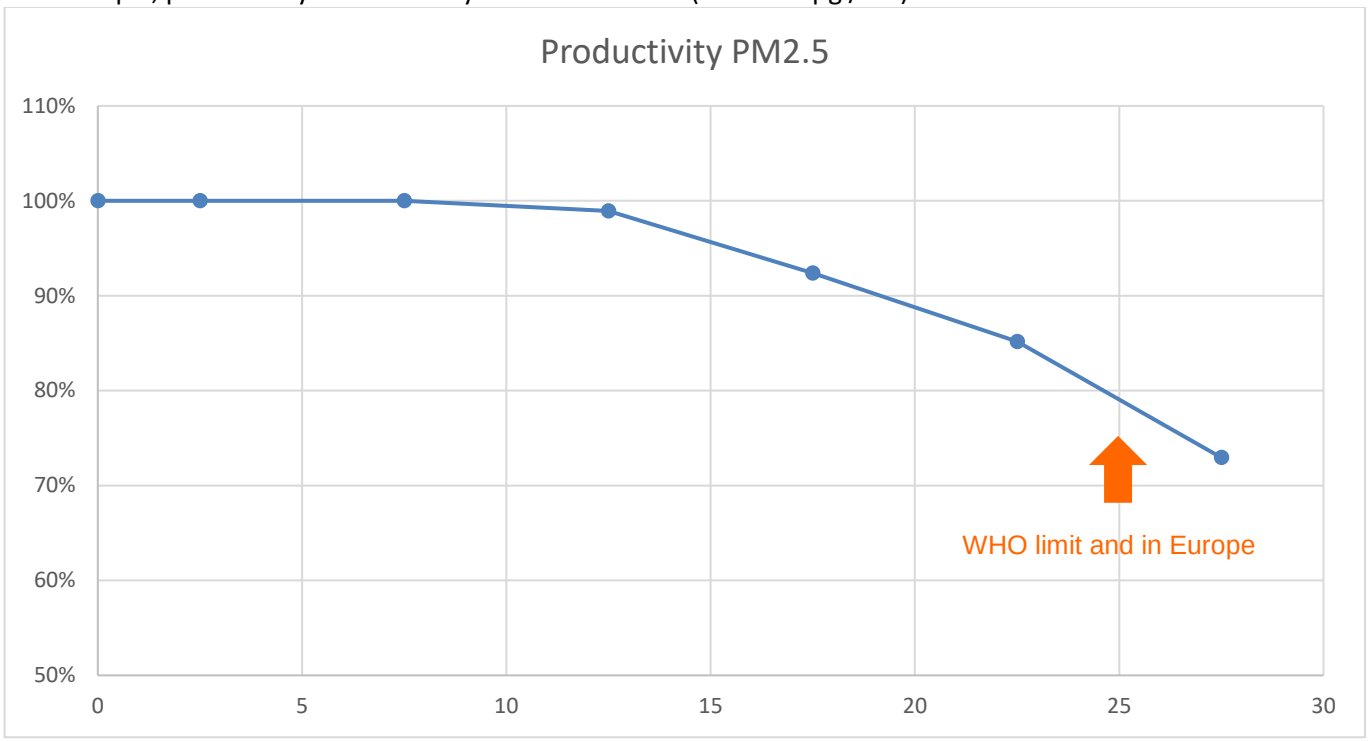
See separate certificate for details

25.Physiological effects

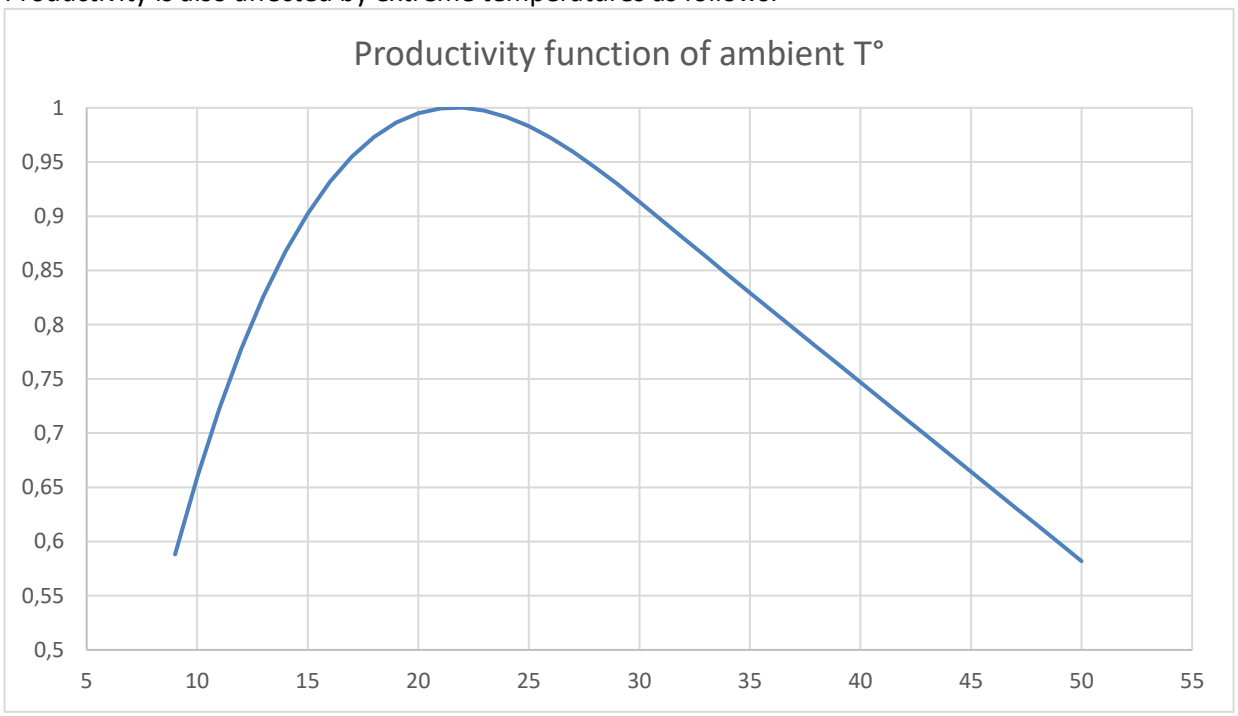
This algorithm is based on international university studies quantifying the physiological impacts of air quality on humans.
The following table shows the contributors for each physiological impact:

	CO2	COVt	PM	Formaldehyde, Benzene	Radon	Noise	Odors	T°	RH	NOX O3	Lux	Light color	Light flickering
Cognitivity / Productivity	✓	✓	✓			✓	✓	✓			✓	✓	✓
Health		✓	✓	✓	✓	✓		✓					
Quality of sleep	✓					✓		✓			✓	✓	
Asthma attack		✓	✓				✓	✓	✓	✓			
Olfactory Comfort		✓					✓						
Thermal Comfort								✓					
Sound comfort						✓							
Dry air Comfort									✓				
Respiratory tract irritation			✓						✓	✓			
Growth of mold, spores and mites									✓				

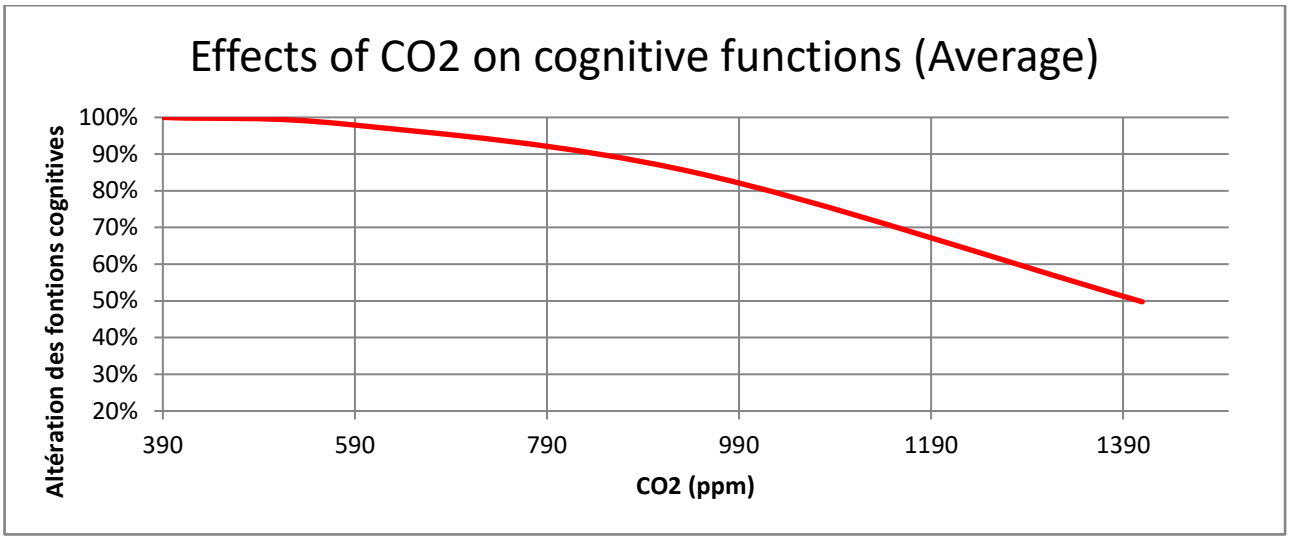
For example, productivity is affected by PM2.5 as follows (PM2.5 in µg / m^3):



Productivity is also affected by extreme temperatures as follows:



Source https://iaqscience.lbl.gov/si/performance-temp-office



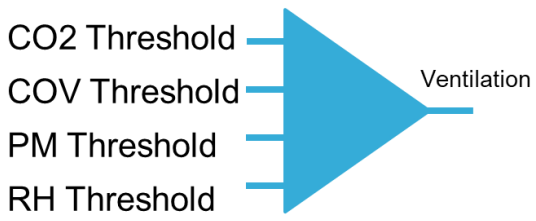
Source NIH National Institute of Environmental Health Sciences

IAQ LEDs summarize health, productivity and quality of sleep indexes and display the lowest.

The ventilation regulation loop is based on settable health, productivity and quality of sleep objectives or by exceeding conventional thresholds.

The comparison between IAQ and AAQ is based on the comparison of physiological effects. An indication by LED for windows on street and backyard.

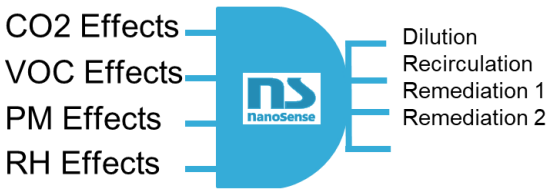
Conventional System



OR Function

Doesn't take into account the combination of effects

Smart IAQ



AND Function

The AND function symbolizes the cocktail effect

