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WCES SERIES

All-In-One Quality Sensor

INSTRUCTION AND MAINTENANCE MANUAL (IOM)

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WCES All-In-One Air Quality Sensor

PRODUCT OVERVIEW

The WCES Series comprehensive air quality sensor uses high-precision components combined with high-performance digital circuit technology, enabling simultaneous detection of multiple environmental parameters including: Temperature, Humidity, TVOC, PM2.5, PM10, CO, CO2, CH2O (Formaldehyde), H2S, NH3 (Ammonia), O2, O3 (Ozone), and more. The product features a compact size and attractive appearance, and users can configure an LCD display.

Widely used in intelligent buildings, underground utility tunnels, underground parking garages, stations, control rooms, laboratories, electronics factories, smart restrooms, waste incineration stations, and other intelligent building environments for measurement and control, ventilation system monitoring, and effective reduction of energy consumption.

TECHNICAL SPECIFICATIONS

Output Signal: RS485 (MODBUS-RTU protocol)
Operating Power: 24VAC/DC (24VDC recommended)
Max Power Consumption: < 2W
Response Time: T90 ≤ 60 s
Warm-up Time: < 600 s
Operating Environment: −20–50°C (−4 to122°F) & 0–95%RH, non-condensing

Housing Material: ABS + PC
Protection Rating: Indoor IP30 / Duct-mount IP65 (main unit)
Fire Rating: V-0 (per UL94 standard)
Product Certification: CE

DETECTION PARAMETERS AND ACCURACY

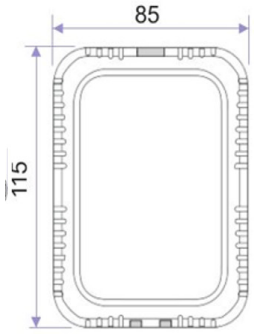
Detection Type	Measurement Range	Measurement Accuracy
Temperature	-20~80°C (-4 to 176°F)	±0.3°C (@25°C / 77°F)
Humidity	0~100%RH	±3%RH (@25°C / 77°F & 50%RH)
PM2/5	0~1000 μg/m³	±(10μg/m³ + 10% of reading)
PM10	0~1000 μg/m³	±(10μg/m³ + 10% of reading)
CO2	0~5000 ppm	±(50ppm + 5% of reading)
CH2O (Formaldehyde)	0~2000 ppb	±5% FS
TVOC	0~2000 ppb	±10% FS
CO	0~1000 ppm	±5% FS
O2	0~30% VOL	±5% FS
O3	0~5 mg/m3	±(0.5mg/m3 + 5% FS)
NH3	0~50 ppm	±(5ppm + 5% FS)
H2S	0~100 ppm	±(10ppm + 5% FS)

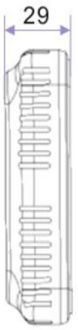
Notes:

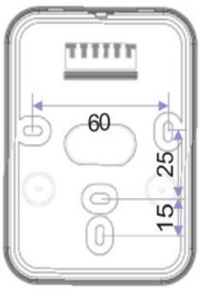
- All accuracy values above are measured in indoor environments at 25°C / 77°F & 50% RH.
- The product must be installed in an open space with good ventilation; otherwise measurement accuracy will be reduced.
- Due to housing space constraints, not all parameter combinations are freely available. Please consult our sales team to confirm the specific combination type required.

INDOOR AIR QUALITY SENSOR - DIMENSIONS AND WIRING

DIMENSIONS (MM)







15 mm = 0.591”
25 mm = 0.984”
29 mm = 1.142”
60 mm = 2.362”
85 mm = 3.346”
115 mm = 4.528”

WIRING DIAGRAM - INDOOR MODEL

Terminal layout (terminals 1–6 from left to right):

Detection Type	Measurement Range	Measurement Accuracy
Temperature	PWR	Power positive (+)
1	COM	Power negative / common ground
2	—	
3	—	
4	A	RS485 output +
5	B	RS485 output −
6	0~2000 ppb	±10% FS

Notes: The WCES Series air quality sensor theoretically supports 24VAC/DC operating power; 24VDC is recommended for actual use do to more efficient energy consumption.

COMMUNICATION ADDRESS SETTING

The product node address supports two methods: software modification or DIP switch setting. Set the address code before installation based on site requirements.

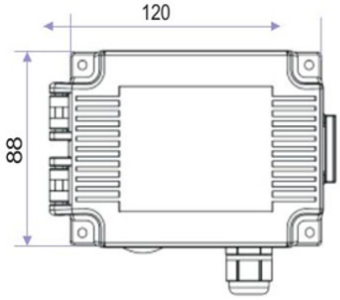
Note: For products equipped with a DIP switch, the factory default is all switches in the OFF position. In this state, the node address is the value stored in software register 0x0016, which defaults to 1. To change the address using the DIP switch, refer to Communication Protocol Section 3.3.

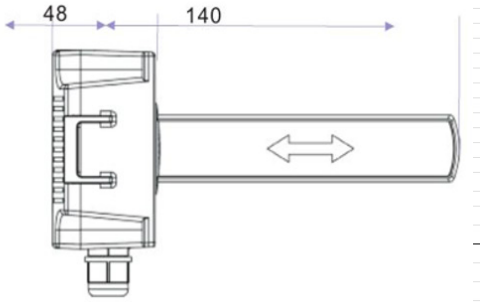
WCES All-In-One Air Quality Sensor

INSTALLATION PRECAUTIONS - INDOOR

- Install ONLY after interior construction is complete and the space has been fully ventilated.
- Install in an area with uniform airflow, free from strong air currents, vibration, and electromagnetic interference (motors/transformers). Keep at least 2 m / 6.6’ away from heat and cold sources.
- Install the transmitter where it can effectively reflect the gas concentration in the monitored area (mounting height: 1.2–1.8 m / 3’11” – 5’11” above floor level).
- Installation personnel must wear anti-static gloves and disconnect power before installation and wiring. Do NOT work with power on.
- Before connecting power, confirm that the controller’s analog input (AI) matches the transmitter’s signal
- output.
- Under normal use, perform regular performance maintenance and testing annually to maintain product performance.

DUCT-MOUNT AIR QUALITY SENSOR - DIMENSIONS AND WIRING





48 mm = 1.890”
88 mm = 3.465”
120 mm = 4.724”
140 mm = 5.512”

WIRING DIAGRAM - DUCT MODEL

Terminal	Defintion
PWR	DC+ (Power positive)
COM	DC− (Common ground)
A	RS485 +
B	RS485 −

Notes:

- This product theoretically supports 24VAC/DC; 24VDC is recommended for actual use.
- The product supports daisy-chain (hand-in-hand) communication topology. Observe A+/B− polarity when wiring.
- The note address can only be changed via RS485 software. Set the address code before installation

INSTALLATION PRECAUTIONS - DUCT MODEL

- This product must be installed after the duct insulation layer construction is complete and after purging and cleaning. If installed too early, dust and debris will contaminate the sensor probe, and high-velocity airflow during duct purging may directly damage internal components.
- The cable entry hole must face downward. The cable should form a U-bend before entering the sensor to prevent external moisture from flowing into the sensor along the cable and causing circuit board short circuits or corrosion.
- Install on a straight section of ductwork, avoiding dead zones with unstable airflow. Keep away from elbows, valves, and reducers. Recommended minimum installation distance: 10 diameters upstream and 5 diameters downstream.
- Avoid interference sources during installation. Maintain at least 3m / 9.8' from condensate pipes and humidifiers. Avoid areas with drastic temperature and humidity changes such as steam vents and air outlets.
- If the product is powered off for an extended period (≥48 hours), measurement values may drift. After restarting, continuous power-on for a period (e.g., 3–10 days) is required to restore to rated accuracy.
- Installation personnel must wear anti-static gloves and disconnect power. Do NOT work with power on.
- Before connecting power, confirm that the controller's analog input (AI) matches the transmitter's signal output.
- Under normal use, perform regular performance maintenance and testing annually.

SPECIAL NOTES BY PARAMETER TYPE

Carbon Dioxide (CO2)

- CO2 detectors are not suitable for use in enclosed spaces or environments with long-term high CO2 concentrations.
- During transport or installation, vibration affecting the measurement unit may cause inaccurate initial readings. This does not affect normal product operation — after 1–3 self-calibration cycles the product will stabilize.
- After power-on, the CO2 detector reaches optimal working state after a 10-minute warm-up. The first 3 weeks after initial power-on are a stabilization period; data is for reference only. In normal operating environments, the sensor needs at least 3 consecutive self-calibration cycles to reach the stated accuracy.
- CO2 detectors are not suitable for environments containing high concentrations of SO2, corrosive gases, organic solvents, oil mist, or dust.

Volatile Organic Compounds (TVOC)

- This product is sensitive to all kinds of volatile organic compounds, including food, perfume, air fresheners, disinfectants, alcohol, etc. Avoid the presence of such gases or substances near the installation location.
- High concentrations of chemical contamination can damage the sensor polymer layer. Store and use the product away from chemical contamination sources.
- Volatile concentrations in enclosed spaces accumulate at high levels over time. Long-term use in such environments will reduce product service life. The product is not suitable for long-term use in production workshops or similar locations with chemical volatile gases.

Particulate Matter (PM2.5 & PM10)

- To ensure long product service life, clean the filter screen regularly to prevent dust accumulation.

Formaldehyde (HCHO/CH2O)

- The formaldehyde sensor is sensitive to some gases such as methanol, ethanol, sulfur dioxide, and phenols — all of which will affect its readings. Avoid the presence of such gases or substances near the installation location.
- The waterproof breathable membrane on the sensor unit surface must NOT be removed; doing so will cause product damage.

WCES All-In-One Air Quality Sensor

Temperature & Humidity

- This product uses a high-precision detection unit with fast response and high accuracy; it is sensitive to surrounding heat and cold sources. Keep away from heat/cold sources and locations with drastic air changes (doors, windows, vents) during installation and use.
- This product has been temperature-compensated for 24VDC use. If AC24V is used instead, the measured temperature will be higher than the actual ambient temperature.
- Install in an open space. If installed in a confined space or obstructed location, product measurement error will increase.

Ozone (O3)

- Ozone easily undergoes reduction reactions. Install the product as close as possible to the source of leakage — if too far away, ozone may not be detectable.
- Keep away from ventilation outlets and fresh-air/AC outlets: excessive airflow velocity will cause measurement value fluctuations that do not reflect actual concentrations.
- Keep away from devices generating strong electromagnetic interference: frequency converters, high-power motors, wireless transmitters, etc.
- Avoid high-temperature heat sources or cold sources: drastic ambient temperature changes will affect the stability and service life of electrochemical sensors.

Ammonia (NH3)

- NH3 is commonly used for odor detection or monitoring refrigeration room leaks.
- Electrolyte leakage can cause harm — do not disassemble the sensor arbitrarily. Confirm the sensor operating environment (temperature and humidity) is within specification to avoid electrolyte leakage in extreme conditions.
- Avoid contact with organic solvents (including silicone rubber and other adhesives), coatings, chemicals, oils, and high-concentration gases. Do not use long-term in environments with corrosive gases — this will damage the sensor.
- During testing and application, avoid direct vertical gas entry into the sensor face. The sensor intake must not be blocked or contaminated. The waterproof breathable membrane on top of the sensor must NOT be removed or artificially damaged.

Hydrogen Sulfide (H2S)

- H2S is commonly found in sewage treatment, pump stations, or livestock exhaust. It is highly toxic and corrosive.
- H2S sensors are easily damaged by high temperatures. Electromagnetic interference can cause false alarms.
- Easily affected by SO2 and other gases. In environments with mixed exhaust gases, cross-interference must be evaluated.
- Avoid contact with organic solvents (including silicone rubber and other adhesives), coatings, chemicals, oils, and high-concentration gases. Do not immerse in oxygen-free environments, as this will damage sensor performance.
- Do not use long-term in environments with corrosive gases — corrosive gases will damage the sensor.
- During testing and application, avoid direct vertical gas entry into the sensor face. The intake must not be blocked or contaminated. The waterproof breathable membrane on top of the sensor must NOT be removed or artificially damaged.

Carbon Monoxide (CO)

- Electrochemical CO sensors have cross-sensitivity to hydrogen, alcohol, and other gases. Installation locations should avoid proximity to areas using alcohol cleaning tools, fermentation environments, or battery charging areas that produce hydrogen, to prevent false alarms.
- High concentrations of vehicle exhaust can cause irreparable damage to the sensor chip. When used for CO detection in parking garages, install in open, unobstructed areas.
- Electrochemical sensors have a defined service life (typically 3–5 years). Record the activation date, calibrate regularly, and replace when due — even if readings appear normal.

Oxygen (O2)

- Oxygen sensors are used to monitor oxygen-deficient or oxygen-enriched environments. During installation, strictly avoid installing in enclosed spaces or dead corners without air circulation. Also avoid installing near combustible gas or chemical solvent release areas to prevent reading errors or sensor poisoning.
- Keep away from fan outlets, water vapor hazard areas, and strong electromagnetic interference sources. Never install at supply air inlets, exhaust outlets, ventilation fans, doors, or windows where airflow turbulence is severe. If installed in a ventilation blind spot or corner, increase sensor density appropriately.
- Users must NOT replace the sensor themselves and must not damage the front membrane of the sensor. The sensor contains acidic solution — do not disassemble. If mishandled and acidic solution contacts skin, rinse immediately with clean water.
- The theoretical service life of electrochemical oxygen sensors is typically 2–3 years. Long-term use in high-humidity, oxygen-rich, or oxygen-deficient environments will significantly reduce actual service life.

MODBUS COMMUNICATION PROTOCOL

1.) Communication Protocol

1.1 Basic Parameters

Encoding	8-bit binary
Data Bits	8 bits
Parity	None / Even / Odd
Stop Bits	1 bit
Error Check	CRC (Cyclic Redundancy Code)
Baud Rate	2400 / 4800 / 9600 / 19200 bps (selectable; factory default: 9600 bps)

1.2 Data Frame Format

Uses Modbus-RTU communication protocol. Frame structure:

- Start: ≥3.5 character times of silence
- Address Code: 1 byte — slave address of the transmitter (0–247), unique on the network (factory default: 0x01)
- Function Code: 1 byte — indicates host command function. This transmitter uses only function code 0x03 (read register data)
- Data Area: N bytes — actual communication data; note that 16-bit data is transmitted high byte first
- CRC Code: 2-byte checksum

Figure 1 - Data Frame Format

Start	Address	Function	Data	CRC Check	End
≥3.5 char	8 bits	8 bits	N × 8 bits	16 bits	≥3.5 char

1.3 Supported Function Codes

- 1.3.1 03 — Read Holding Registers
- 1.3.2 04 — Read Input Registers
- 1.3.3 06 — Preset Single Register
- 1.3.4 16 (0x10) — Preset Multiple Registers

2.) Product Register Addresses

Note: The device supports reading/writing a maximum of 16 registers at a time. Since registers 400017–400032 contain important data, it is recommended to use function code 06 when issuing modification commands for these registers.

Register Address	R/W	Data Type	Register Definition	Range	Default	Notes (Basic Parameters)
40001, 00000	R	Signed	Temperature	−400~850	0xFFDA	×10 (°C), default = −55°C / −67°F
40002, 00001	R	Unsigned	Humidity	0~1000	0xFFFF	×10 (%RH)
40003, 00002	R	Unsigned	CO2	0~5000	0xFFFF	ppm
40004, 00003	R	Unsigned	CO	0~1000	0xFFFF	ppm
40005, 00004	R	Unsigned	TVOC	0~5000	0xFFFF	μg/m³ (÷1000 for mg/m³)
40006, 00005	R	Unsigned	PM2.5	0~1000	0xFFFF	μg/m³
40007, 00006	R	Unsigned	CH2O (Formaldehyde)	0~2000	0xFFFF	ppb
40008, 00007	R	Unsigned	TCO2	400~2000	0xFFFF	ppm (only valid when VOC sensor present)
40009, 00008	R	Unsigned	PM10	0~2000	0xFFFF	μg/m³
40010, 00009	R	Unsigned	NH3	0~50	0xFFFF	ppm
40011, 00010	R	Unsigned	O3	0~5000	0xFFFF	μg/m³
40012, 00011	R	Unsigned	H2S	0~100	0xFFFF	ppm
40013, 00012	R	Unsigned	PM1.0	0~1000	0xFFFF	
40014, 00013	R	Unsigned	O2	0~300	0xFFFF	×10, %VOL
40015, 00014	R	Unsigned	Reserved		0xFFFF	
40016, 00015	R	Unsigned	Reserved		0xFFFF	
40017, 00016	R/W	Unsigned	RS485 Slave Address		0x01	Modbus communication slave address
40018, 00017	R	Unsigned	Baud Rate		0x03	01: 2400; 02: 4800; 03: 9600; 04: 19200; 05: 38400; 06: 57600; 07: 115200
40019, 00018	R	Unsigned	Parity		0x00	0: None; 1: ODD; 2: EVEN
40020, 00019	R	Unsigned	Reserved		0xFFFF	
40021, 00020	R	Unsigned	O2 Single-Point Calibration		0	For single-point calibration only
40022, 00021	R	Unsigned	Reserved		0xFFFF	
40023, 00022	R/W	Signed	Temperature Single-Point Calibration Value 1		0	For single-point calibration only
40024, 00023	R/W	Unsigned	Humidity Single-Point Calibration Value 2		0	For single-point calibration only

40025, 00024	R/W	Unsigned	CO2 Calibration Value 3		0	For single-point calibration only
40026, 00025	R/W	Unsigned	CO Calibration Value 4		0	For single-point calibration only
40027, 00026	R/W	Unsigned	PM2.5 Calibration Value 5		0	For single-point calibration only
40028, 00027	R/W	Unsigned	TVOC Calibration Value 6		0	For single-point calibration only
40029, 00028	R/W	Unsigned	CH2O Calibration Value 7		0	For single-point calibration only
40030, 00029	R	Unsigned	Product Model ID		0xFFFF	
40031, 00030	R	Unsigned	System Parameters		0x5A5A	
40032, 00031	R/W	Unsigned	Restore Communication Parameters to Factory Defaults		0xFFFF	When set to 30, communication parameters are restored to factory defaults

3.) Communication Protocol

3.1 Read CO2 Value from Device Address 0x01

Query Frame:

Address Code	Function Code	Start Address	Data Length	CRC Low	CRC High
0x01	0x03	0x00 0x02	0x00 0x01	0x25	0xCA

Response Frame (example: CO2 = 3000 ppm):

Address Code	Function Code	Start Address	Data Length	CRC Low	CRC High
0x01	0x03	0x02	0x0B 0xB8	0xBF	0x06

CO2: 0x0BB8 (hex) = 3000 → CO2 = 3000 ppm

3.2 Read Temperature, Humidity and CO2 From Device Address 0x01

Query Frame:

Address Code	Function Code	Start Address	Data Length	CRC Low	CRC High
0x01	0x03	0x00 0x00	0x00 0x03	0x05	0xCB

Response Frame (example: CO2 = 3000 ppm):

Address Code	Function Code	Start Address	Data Length	CRC Low	CRC High
0x01	0x03	0x06	0xFF 0xB5	0x01 0x67	0x0B 0xB8

Temperature: When below 0°C / 32°F, temperature is transmitted in two's complement.
0xFFB5 (hex) = −75 → Temperature = −7.5°C / 18.5°F
Humidity: 0x0167 (hex) = 359 → Humidity = 35.9%RH
CO2: 0x0BB8 (hex) = 3000 → CO2 = 3000 ppm

3.3 Modify Device Address (using function code 06)

The slave address supports two methods: software modification (function code 06) or DIP switch setting (for products with a DIP switch). Customers should set the slave address based on the actual product configuration.

3.3.1 Software Modification Method - Change Note Address From 01 to 02

Query Frame:

Address Code	Function Code	Start Address	Data Length	CRC Low	CRC High
0x01	0x06	0x00 0x10	0x00 0x02	0x09	0xCE

Response Frame (example: CO2 = 3000 ppm):

Address Code	Function Code	Start Address	Data Length	CRC Low	CRC High
0x01	0x06	0x00 0x10	0x00 0x02	0x09	0xCE

3.3.2 DIP Switch Setting

For products with a DIP switch, the factory default is all switches ON. In this state, the node address is the value stored in software register 0x0016, defaulting to 1. To activate the DIP switch, configure according to the table below.

* DIP switch 1 is the most significant bit; switch 6 is the least significant bit. Binary encoding; maximum settable address is 63.

1	2	3	4	5	6	Slave Address
OFF	OFF	OFF	OFF	OFF	OFF	Software register address (default)
OFF	OFF	OFF	OFF	OFF	ON	1
OFF	ON	OFF	OFF	OFF	OFF	2
ON	ON	OFF	OFF	OFF	OFF	3
OFF	OFF	ON	OFF	OFF	OFF	4
ON	OFF	ON	OFF	OFF	OFF	5
.	.	.	.	.	.	.
OFF	OFF	OFF	ON	OFF	OFF	16
OFF	OFF	OFF	OFF	ON	OFF	32
OFF	OFF	OFF	OFF	ON	ON	33
ON	ON	ON	ON	ON	ON	63

4.) Notes

4.1

Host Data Sampling Frequency: When reading temperature/humidity data, the host polling interval must be no less than 500 ms; recommended value is 1s.

4.2

For unsupported product types (e.g., a CO2-only transmitter), the temperature/humidity register values are invalid data, typically 0xFFFF.

4.3

Address setting range: 1–254. 255 is the broadcast address; 248–254 are reserved. General usable range is 1–247.

4.4

Note the scaling multiplier: temperature and humidity have one decimal place — divide the received data by 10 to get the actual value.

- Example: Humidity returned as hex 0x0311 = decimal 785 → humidity = 78.5%RH
- Example: Temperature returned as hex 0x00FF = decimal 255 → temperature = 25.5°C / 77.9°F
- Example: Temperature returned as hex 0x8064 → most significant bit = 1 indicates negative → decimal −100 → temperature = −10.0°C / 14°F

5.) Possible Reasons The Device Cannot Connect To PLC Or Computer

- Computer has multiple COM ports and the wrong port is selected.
- Device address is incorrect, or there are duplicate addresses (all devices default to address 1 at factory).
- Baud rate, parity, data bits, or stop bits are incorrect.
- Host polling interval and response wait time are too short — both should be set to 200 ms or more.
- RS485 bus has a break, or A and B lines are reversed.
- Too many devices or wiring is too long — power locally, add a 485 signal booster, and add a 120Ω termination resistor.
- USB-to-485 driver not installed or damaged.
- Device is damaged.