



# Stox

## Smart Gas Sensor Device

### Manual

## General Information

This manual applies to Stox Smart Gas Sensor Device.

## Safety

Be sure to read and understand this instruction manual before power on and operation of this product. Use it in accordance with the relevant industry standards. In the event of an unrecoverable malfunction, the instrument must be taken out of service and prevented from accidental commissioning.

Failure to follow these instructions may result in equipment damage to the instrument, abnormal detection, or system failure.

The product can be used in most environmental conditions. However, during storage, assembly and operation, due to the principles and characteristics of solid-state polymer electrochemical sensors, users should strictly follow this article and the general type of gas detector application to ensure normal use. Illegal application will not be covered under warranty. Although our products are very reliable, we recommend checking the module's response to the target gas before use to ensure field use.

Before undertaking any work, be sure to follow local regulations and procedures.

Do not disassemble any circuit components or the sensor in any way.

Do not expose the sensor to temperatures outside the recommended range.

To prevent the sensor's air inlet from being blocked by dust in the environment, keep the air inlet facing down during installation.

At the end of the product's service life, do not dispose of any product components in household waste, but in accordance with local government e-waste recycling regulations. Electrochemical sensors should not be incinerated, as this action may cause the battery to release toxic substances and smoke.

## Warning

- ❶ The product must be operated and used by appropriately trained personnel.
- ❷ If, after the first use, an error that cannot be resolved is detected, send the product back to the manufacturer for repair or replacement. Permanent damage to the sensor caused by forced opening is not within the warranty range.
- ❸ It is strictly prohibited to open this product in dangerous environments.
- ❹ It is strictly forbidden to change the model, specifications and parameters of the product circuit and related components.
- ❺ The company's accessories must be used for key components concerning the safety performance. The use of components other than provided by EC Sense is strictly prohibited.
- ❻ Do not paint the sensor unit or the detector.
- ❼ Regular calibration is recommended once every 3-6 months.
- ❽ No use of the instrument in high concentrations of volatile fuel or chemical environments.
- ❾ Prolonged exposure to toxic gases may require recalibration of the sensors.

## » Product Overview

Stox is an intelligent gas sensor device which simultaneously outputs a two-wire 4-20mA and a RS485 Modbus-RTU signal. A 4-20mA or RS485 output can be selected for communication. By using Solid Polymer Electrochemical Gas Sensing Technology and intelligent algorithm design, gas, temperature and humidity measurement are combined to meet the gas safety monitoring requirements in industrial application.

Intelligent gas sensor performance and self-test without the need for a target gas. With the help of a warning signal, Stox provides excellent safety and reliability. The user can obtain information about the operating status of the sensor immediately when the RS485 output is selected (sensor is working well, prepare to change sensor, change sensor).

It is pre-calibrated and can be used directly by the user. The calibration information is stored in the flash chip. Users requiring recalibration can use the calibration software provided by EC Sense or calibrate by correcting the controller data. If secondary calibration is needed, the user can use the RS485 output to connect the sensor with the calibration software provided by EC Sense or by communication protocol. When using the 4-20mA output, the calibration can perform data correction by a PLC or other system.

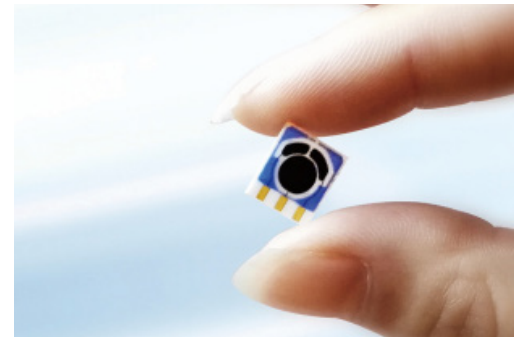
The Stox Gas Sensor Device uses the standard 4-20mA or RS485 Modbus-RTU industrial signal mode, which are easier to connect to standard HMI touch panels, LED/LCD displays, controllers, DCS, PLC and other systems.

The design is based on EN 61326-1:2013 Part 1: General requirements

## » Detection Principle

The intelligent Stox Sensor Device is a durable product that converts the sensors to a standard 4-20mA or RS485 Modbus-RTU output by transforming the original low current signal through a digital circuit.

The sensor device uses Solid Polymer Electrochemical Sensing Technology. It employs a three-electrode arrangement- the working, counter and reference electrodes - in which concentration measurements can be performed continuously and the sensor operates at a fixed potential. The gas of interest (target gas) diffuses through a diffusion barrier, such as a capillary, into the cell to the working electrode, where an electrochemical reaction occurs. Oxidation and reduction reactions take place. The current flowing through the cell is direct proportional to the concentration of the target gas. A reference electrode keeps the potential constant together with a potentiostat.



## » Technical Parameters

### Gas Sensor Parameters

Principle	Solid Polymer Electrochemical Sensing Technology
Accuracy	± 5% F.S
Repeatability	< 2%
Long-Term Drift	< 1% / month
Sensor Life Expectancy	> 3 years
Warranty	12 months

## » Technical Parameters

### Temperature and Humidity Sensor Parameters

Parameters	Range	Resolution	Accuracy	Response Time	Long-Term Drift
Temperature	-40 to 85°C	0.01°C	± 5% F.S	< 5s to 30s @ t63%	< 1% / year
Humidity	0-100% RH	0.01% RH	± 5% F.S	8s @ t63%	< 1% / year

Note: The temperature and humidity sensor is located inside the Stox housing. If the temperature parameters are to be used for external environmental measurements, please calibrate the measured value. The ambient gas cannot be exchanged with the gas inside the Stox housing, so the humidity is only used for the measurement inside the enclosure. This parameter cannot be obtained when the 4-20mA output is selected. It is only applicable to the RS485 output.

### Electrical Parameters

Output Signal Interface	Two-wire 4-20mA (gas sensor signal output, without temperature and humidity sensor output) Or RS485 Modbus-RTU (gas + temperature and humidity sensor signal output to detect housing temperature and humidity)
Fault Output	3.5mA Fault Signal: Sensor signal weak 3mA Fault Signal: Sensor failure or sensor disconnected RS485 Modbus-RTU output with sensor life and performance detection and early sensor failure warning
Supply Voltage	12 to 24V DC
Supply Current	3 to 22mA
Power Consumption	< 0.6W
Maximum Loop Resistance	< 500R @ 24V DC

### Environmental Parameters

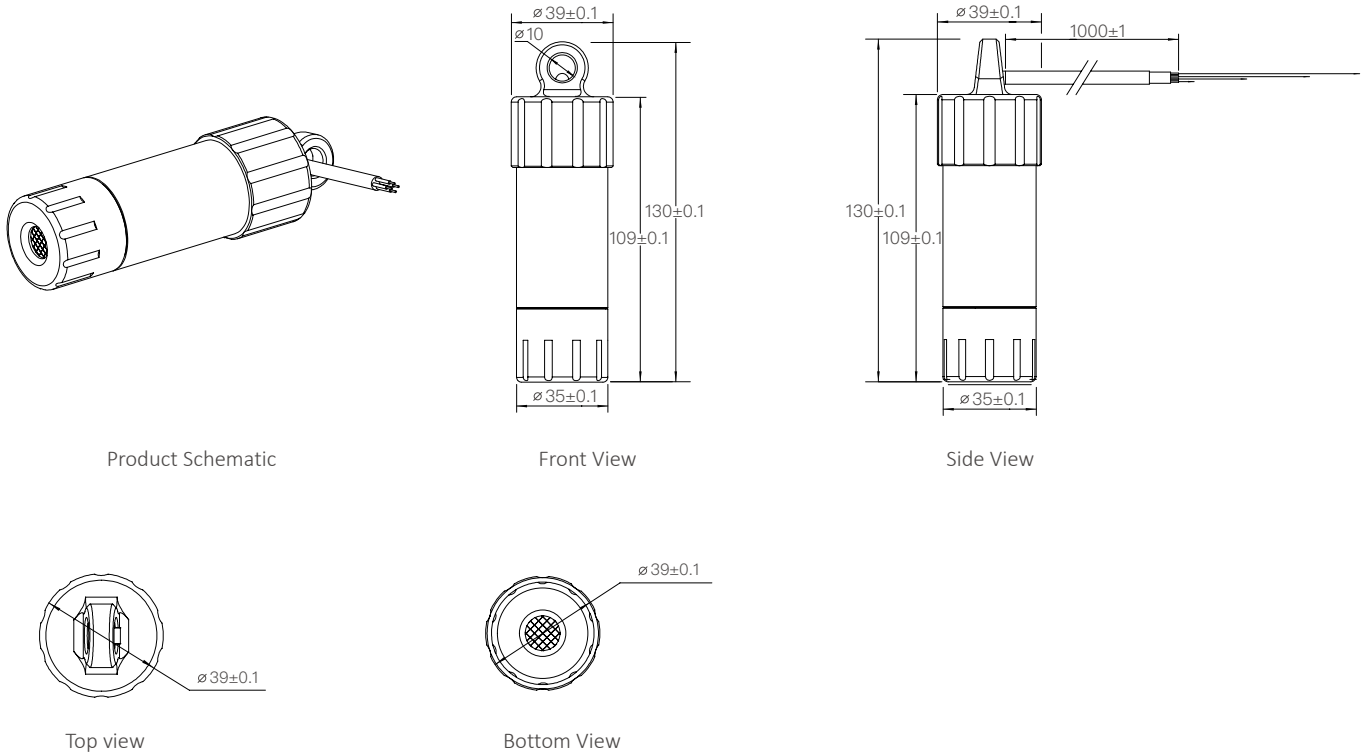
Operating Temperature	-40 to +55°C
Operating Humidity	15-95% RH. Non-condensing
Working Pressure	Air pressure ± 10%
Storage Temperature	0 to 20°C

### Mechanical Parameters

Size	39 x 130mm
Weight	135g
Power Cable Length	1m
Warranty	12 months
Package Measurement	185 x 150 x 108mm

## » Mechanical Diagram

Stox Smart Gas Sensor Device Mechanical Drawing unit: mm



## » Installation

### 1 Installation Site Selection

- The sensor surface of the sensor device is at the bottom and the detector is overall preferred perpendicular to the ground, which can maximize the protection against ingress of water and dust. If this is not possible due to field conditions, it is possible to tilt the sensor down or install the detector horizontally.
- The installation position should be as close as possible to the source of the leakage.
- Installation position if there is a natural wind or fan: The detector should be installed in the lower air outlet or in the area of possible gas accumulation.
- The installation position should be determined according to the density of the target gas. Outdoors, it is recommended to install the sensor device about 30 cm above the level of the potential gas leakage point. For gases heavier than air, it is recommended to install the sensor device at 30 cm below the leakage point. The gas equal to the air density is installed 1.5 meters vertically from the ground. Indoors, in addition to the above installation locations, the sensor device can also be installed on the wall closest to the leakage source. According to the above three situations, the sensor device can be installed 30 cm from the top of the building, 30 cm from the floor and 1.5 meters from the floor.

### 2 Installation Precautions

- Avoid installing the sensor device directly over water, solvents, reagents and other liquids.
- Possible liquid splashing should be considered, e.g. if installed near the floor, the mud splash may be coated with a gas diffusion film, resulting in blockage of the air inlet.
- It is not recommended to point the sensors upwards.
- Installation should consider not only the best location for the leakage point, gas properties and ventilation associated with the potential gas leak, but also the potential mechanical damage and how this situation can be avoided or reduced.
- Do not install the sensor in direct sunlight.

## » Electrical Wiring

Installation must be carried out by qualified personnel with the power supply disconnected.

### 1 Cable

Two-wire 4-20mA output: it is recommended to use the 2 x 1.0mm<sup>2</sup> RVVP cable

Four-wire RS485 signal output: it is recommended to use the 4 x 1.0mm<sup>2</sup> RVVP cable

### 2 Cable Description

The sensor device is supplied with a one meter four-wire cable for power and output.

**Red:** Connection to the power supply is positive

**Black:** Connection to the power supply is negative

**Green:** RS485 A+

**White:** RS485 B-

## WARNINGS

The Stox Smart Gas Sensor Device is designed for installation and use in many hazardous areas.

- To reduce the risk of ignition of a hazardous atmosphere, please disconnect the device from the power supply and keep the instrument housing tightly closed during operation. Please select an intrinsically safe power supply.
- The sensor device must be grounded for electrical safety and to limit the effects of radio frequency interference. Possible grounding points are provided inside and outside the instrument.
- Refer to local or national regulations regarding installation and device location.

The Stox Gas Sensor Device has a two-wire loop and a power supply of 9-24V DC (24V DC is recommended). The output and the power supply use the same wires. Since the magnitude of the power supply voltage affects the total loop resistance of the external circuit, the voltage drop caused by the power supply voltage should be considered when selecting the power supply voltage. Make sure that at least 9V DC is measured at the Stox Smart Gas Sensor Device.

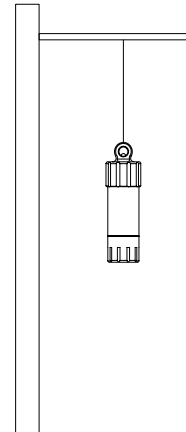
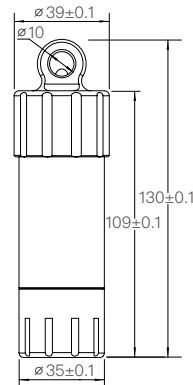
The two-wire line of the gas sensor device does not distinguish between positive and negative V+, V-.

### Cabling

It is recommended to use industrial grade cables as they are corrosion resistant.

### 3 Mounting

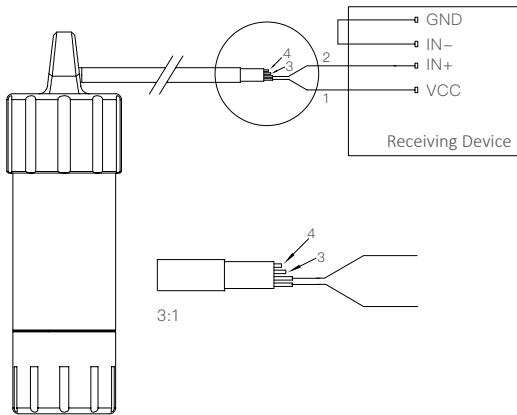
The sensor device can be suspended, which is easy for farming and large areas.



④ Wires Connection Diagram

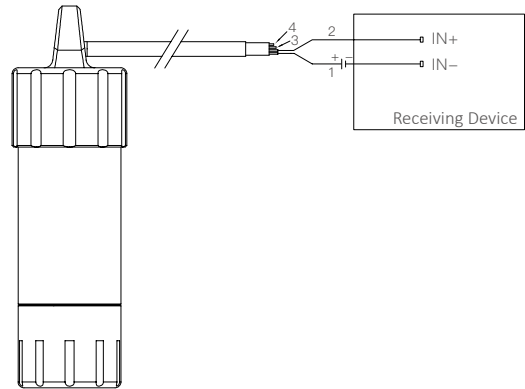
**Two-wire 4-20mA Connection**

For the signal receiving device with the external power supply interface of the detector, the wiring method is as follows:



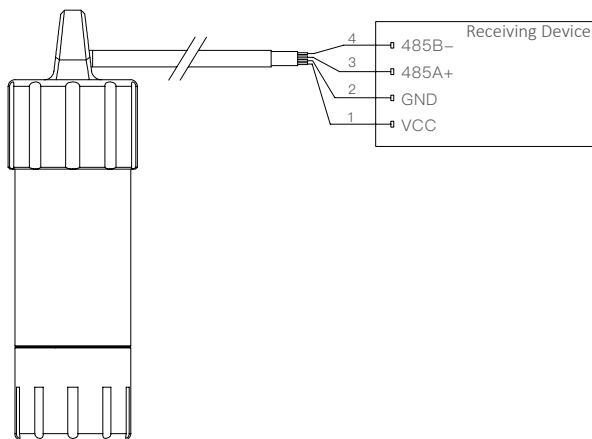
Number	Name	Pigment	Access Terminal
1	VCC	Red	DC 24V
2	GND	Black	IN+
3	485 A+	Green	No
4	485 B-	White	No

For the signal receiving device without the external power supply interface of the detector, a separate power supply is required, and the wiring method is as follows:



Number	Name	Pigment	Access Terminal
1	VCC	Red	IN-
2	lout	Black	IN+
3	485 A+	Green	No
4	485 B-	White	No

**Four-Wire RS485 Connection**



Number	Name	Pigment	Access Terminal
1	VCC	Red	DC 24V
2	GND	Black	GND
3	485 A+	Green	485 A+
4	485 B-	White	485 B-

## » First Power On

### 1 Re-Checking Power and Output Signal

#### Re-Checking Power

Check that all electrical connections are properly disconnected. Switch on the external power supply of the gas sensor device in the safe area of the gas measurement. Control/PLC. Check the supply voltage with a digital multimeter if it is 24V DC. The supply voltage should be at least 9V DC.

#### Re-Checking Output Signal

This operation is required when the two-wire 4-20mA output is selected. It is not required when the RS485 output is selected.

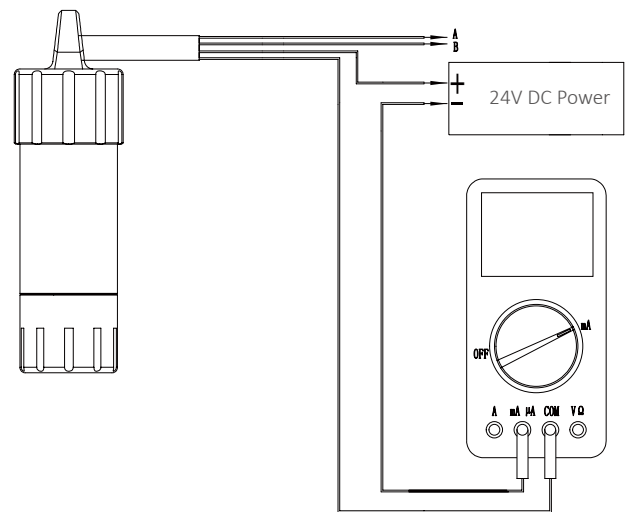
A multimeter can be used to input the 4-20mA signal output. The output value of the gas sensor device signal should be kept at 4mA in the absence of the gas to be measured. The current output signal will be higher than 4mA when there is a gas to be measured in the environment.

Before turning on the gas sensor device for the first time, make sure that the wiring is correct and the grounding is reliable. When the sensor is switched on for the first time, the stable output of the sensor is usually very short. Since the sensor is designed with a plug-and-play function, the internal circuit always keeps the sensor in the working state, which avoids the problem of long stabilization time of the gas sensor based on the traditional electrochemical principle. However, the sensors and electronics still require a short startup and equilibration time.

If the concentration of the contaminated gas is high during storage, transportation or in the work area, the stabilization time will be increased, and the higher the contamination concentration, the longer the stabilization time is required.

If the ambient air convection on site is large, the data fluctuation will also change from time to time, especially when detecting low concentrations in ppb range. Please pay close attention to the ambient conditions on site. If the environmental conditions are stable, there is no strong convection and no air exchange, such as by: Open windows, doors, fans, air conditioners, air purification systems, etc. After the output signal is stable, the sign will enter normal detection mode.

Oxygen has a longer settling time than other gases, about 5-10 minutes, mainly due to the sensor's -500 mV bias voltage and the time required for the sensor and electronics to equalize.



### 2 Gas Test

If the device is stored in the warehouse or installed on site for a long time for more than 3 months, it is recommended to operate it only after a ventilation test.

The smart gas sensor device has been calibrated by the factory gas. If gas response verification is required, special standard gas should be used, and the concentration range of 20~80% of the maximum inspection range of the sensing detector is allowed. It is recommended to use the target gas concentration of 50% of the range for testing.

For example, the carbon monoxide range is 0-1000 ppm, the test gas concentration is then 500 ppm. Oxygen can be placed in 20.9% vol. of the atmosphere or fed in to 99.99% vol. of nitrogen.

#### Ventilation Time

The conventional gas should be subjected to continuous ventilation for 3 minutes.

The adsorption gas is used for 5 minutes.

The gas should be at a range below 10 ppm and continuously ventilated for 10 minutes.

Note: Strong adsorption gas, such as hydrogen chloride, chlorine gas, hydrogen fluoride, fluorine and other gases, should be discharged on the pipeline for at least 30 minutes (preferably 60 minutes) before ventilation to make the pipeline adsorption reach saturation, the detector cannot be exposed to the measured gas at this time.

#### Gas Flow Rate

The gas flow rate should be maintained at 100 ml/min and the flow should be kept stable.



### Output Current Value Calculation

When using the current mA file of the multimeter to measure the output current value directly, place the red pin of the multimeter on the terminal "V- " and connect the black pin of the multimeter to the signal line to measure the 4-20mA output signal current value.

The current calculation formula is:  $A = 4 + (20 - 4) \times (C_x \div C_f)$  mA

Note: V: The theoretical current value corresponds to the currently detected gas

Cx: Current gas concentration

Cf: Full-scale gas concentration

4: Indicates 4mA (4mA = 0 ppm of detection concentration)

20: Indicates 20mA (20mA = full-scale value of detected concentration)

For example: The range of the gas sensor device is 0-100 ppm, the standard gas concentration of 10 ppm is passed in and the output current value is:  $5.6\text{mA} = 4 + (20 - 4) \times (10 \div 100)$  mA

If the detection signal output is abnormal, please check whether the electrical wiring is correct. If the error cannot be corrected, please contact us for support.

### Warning Output

#### 3.5mA Warning:

Solution:

Prepare to replace the new sensor or check the usage environment.

Cause of issue:

- When the sensor signal is 20% ~ 10% of the new sensor.
- When the humidity in the operating environment is continuously below 30% RH for an extended period of time.

#### 3mA Warning:

Solution:

Replace it with a new sensor.

Cause of issue:

- When the sensor fails, the signal is less than 10% of the new sensor.
- The sensor falls off.
- The sensor pins do not have good contact with the circuit board.

## » Calibration

The instrument has been calibrated and reinspected before leaving the factory, it can be directly installed and used. The sensor device should be recalibrated in the following circumstances.

- The sensor device has been used continuously for more than 12 months.
- The sensor device value and the true value have a deviation beyond the normal error range.

### Calibration Description:

- Use the calibration software from EC Sense.
- Use the data correction on PLC, DCS or HMI system.
- When using the RS485 output communication protocol, commands can be used for calibration, the steps can be performed according to the "Calibration Software Manual".

Note: If you do not have any experience in the calibration operation of similar products or if you still have any questions about some functions of the supporting calibration software, please operate it carefully or contact us for support.

## » Servicing

Calibrate the device regularly.

Cleaning of the device is limited to the surface of the housing and the sensor filter. It is prohibited to disassemble the sensor device from touching the internal circuit board.

Use a dry, soft brush to remove dust on the sensor filter screen. It is prohibited to use high pressure air to directly clean the filter screen or sensor surface.

The waterproof measure of the detector is for the outlet end and the housing structure connection, it is prohibited to immerse the sensor device completely in liquid.

During any construction operation on site, avoid exposing the sensor device to fog solvent (such as fog paint), and stay away from heat and vibration source.

Avoid cleaning with alcohol.

## » Storage and Transportation

The detector should be stored in a room with 0°C ~25°C , dry ventilation and clean air, and the stacking height should not exceed 1 meter.

Before transport and during storage until installation, the detector should always be placed in a special packaging box to avoid strong vibrations or damage to the sensor device.

Avoid alcohol or ketone gases in the storage environment.

## » Ordering Information

Product	Gas Formula	Partnumber	Range	Resolution	Response Time
Smart Arsenide Sensor Device	AsH <sub>3</sub>	05-Stox-AsH <sub>3</sub> -5-01	0-5ppm	0.01ppm	< 3s (T90 < 80s) ①
Smart Borane Sensor Device	B <sub>2</sub> H <sub>6</sub>	05-Stox-B <sub>2</sub> H <sub>6</sub> -5-01	0-5ppm	0.01ppm	< 3s (T90 < 80s) ①
Smart Methyl Mercaptan Sensor Device	CH <sub>4</sub> S	05-Stox-CH <sub>4</sub> S-10-01	0-10ppm	0.01ppm	< 3s (T90 < 80s)
		05-Stox-CH <sub>4</sub> S-100-01	0-100ppm	0.1ppm	< 3s (T90 < 80s)
		05-Stox-CH <sub>4</sub> S-5000-01	0-500ppm	10ppm	< 3s (T90 < 80s)
Smart Chlorine Sensor Device	Cl <sub>2</sub>	05-Stox-Cl <sub>2</sub> -10-01	0-10ppm	0.01ppm	< 3s (T90 < 30s) ①
		05-Stox-Cl <sub>2</sub> -100-01	0-100ppm	0.1ppm	< 3s (T90 < 30s)
Smart Carbon Monoxide Sensor Device	CO	05-Stox-CO-10-01	0-10ppm	0.01ppm	< 3s (T90 < 80s)
		05-Stox-CO-100-01	0-100ppm	0.1ppm	< 3s (T90 < 30s)
		05-Stox-CO-1000-01	0-1000ppm	1ppm	< 3s (T90 < 30s)
		05-Stox-CO-10000-01	0-10000ppm	10ppm	< 3s (T90 < 30s)
Smart Ethylene Sensor Device	C <sub>2</sub> H <sub>4</sub>	05-Stox-C <sub>2</sub> H <sub>4</sub> -10-01	0-10ppm	0.01ppm	< 3s (T90 < 80s) ①
		05-Stox-C <sub>2</sub> H <sub>4</sub> -200-01	0-200ppm	0.1ppm	< 3s (T90 < 80s)
		05-Stox-ETO-10-01	0-10ppm	0.01ppm	< 3s (T90 < 30s) ①
Smart Ethylene Oxide Sensor Device	ETO	05-Stox-ETO-200-01	0-200ppm	0.1ppm	< 3s (T90 < 30s)
		05-Stox-ETO-1000-01	0-1000ppm	1ppm	< 3s (T90 < 30s)
Smart Germane Sensor Device	GeH <sub>4</sub>	05-Stox-GeH <sub>4</sub> -5-01	0-5ppm	0.01ppm	< 3s (T90 < 80s) ①
Smart Formaldehyde Sensor Device	HCHO	05-Stox-HCHO-5-01	0-5ppm	0.01ppm	< 3s (T90 < 80s) ①
		05-Stox-HCHO-100-01	0-100ppm	0.1ppm	< 3s (T90 < 60s)
Smart Hydrogen Cyanide Sensor Device	HCN	05-Stox-HCN-50-01	0-50ppm	0.1ppm	< 3s (T90 < 30s) ①
Smart Hydrogen Fluoride Sensor Device	HF	05-Stox-HF-10-01	0-10ppm	0.01ppm	< 3s (T90 < 80s)
Smart Hydrogen Sensor Device	H <sub>2</sub>	05-Stox-H <sub>2</sub> -1000-01	0-1000ppm	1ppm	< 3s (T90 < 60s)
		05-Stox-H <sub>2</sub> -4%-01	0-4%vol	0.01%vol	< 3s (T90 < 60s)
		05-Stox-H <sub>2</sub> S-10-01	0-10ppm	0.01ppm	< 3s (T90 < 30s)
Smart Sulfur Hydrogen Sensor Device	H <sub>2</sub> S	05-Stox-H <sub>2</sub> S-100-01	0-100ppm	0.1ppm	< 3s (T90 < 30s)
		05-Stox-H <sub>2</sub> S-1000-01	0-1000ppm	1ppm	< 3s (T90 < 30s)
		05-Stox-H <sub>2</sub> S-5000-01	0-5000ppm	1ppm	< 3s (T90 < 30s)

## » Ordering Information

Product	Gas Formula	Partnumber	Range	Resolution	Response Time
Smart Ammonia Sensor Device	NH <sub>3</sub>	05-Stox-NH <sub>3</sub> -10-01	0-10ppm	0.01ppm	< 3s
		05-Stox-NH <sub>3</sub> -100-01	0-100ppm	0.1ppm	< 3s
Smart Nitrogen Dioxide Sensor Device	NO <sub>2</sub>	05-Stox-NO <sub>2</sub> -5-01	0-5ppm	0.01ppm	< 3s (T90 < 80s) ①
		05-Stox-NO <sub>2</sub> -100-01	0-100ppm	0.1ppm	< 3s (T90 < 30s)
Smart Oxygen Sensor Device	O <sub>2</sub>	05-Stox-O <sub>2</sub> -25%-01	0-25%vol	0.01%vol	< 3s (T90 < 30s)
Smart Ozone Sensor Device	O <sub>3</sub>	05-Stox-O <sub>3</sub> -5-01	0-5ppm	0.01ppm	< 3s (T90 < 80s)
		05-Stox-O <sub>3</sub> -100-01	0-100ppm	0.1ppm	< 3s (T90 < 30s)
Smart Phosphine Sensor Device	PH <sub>3</sub>	05-Stox-PH <sub>3</sub> -5-01	0-5ppm	0.01ppm	< 3s (T90 < 80s) ①
		05-Stox-PH <sub>3</sub> -100-01	0-100ppm	0.1ppm	< 3s (T90 < 80s)
		05-Stox-PH <sub>3</sub> -2000-01	0-2000ppm	1ppm	< 3s (T90 < 80s)
Smart Silane Sensor Device	SiH <sub>4</sub>	05-Stox-SiH <sub>4</sub> -10-01	0-10ppm	0.01ppm	< 3s (T90 < 80s) ①
Smart SMELL Sensor Device	SMELL	05-Stox-SMELL-5-01	0-5ppm	0.01ppm	< 3s (T90 < 30s) ①
		05-Stox-SMELL-200-01	0-200ppm	1ppm	< 3s (T90 < 30s)
Smart Sulfur Dioxide Sensor Device	SO <sub>2</sub>	05-Stox-SO <sub>2</sub> -5-01	0-5ppm	0.01ppm	< 3s (T90 < 80s) ①
		05-Stox-SO <sub>2</sub> -100-01	0-100ppm	0.1ppm	< 3s (T90 < 30s)
Smart Organic Volatiles Sensor Device	TVOC	05-Stox-TVOC-10-01	0-10ppm	0.01ppm	< 3s (T90 < 30s)
		05-Stox-TVOC-200-01	0-200ppm	0.1ppm	< 3s (T90 < 30s)
		05-Stox-TVOC-2000-01	0-2000ppm	1ppm	< 3s (T90 < 30s)
		05-Stox-TVOC-10000-01	0-10000ppm	10ppm	< 3s (T90 < 30s)

Note: 1) If there is a gas or range not to be found in the above list, please contact us.

2) With ①: The T90 Response Time calculates how fast the gas reaches 90% of the sensor volume.

3) With ①: Deviation from Linearity < 10% FS, within standard range.

### Disclaimer

The EC Sense performance data stated above is based on data obtained under test conditions using the EC Sense gas distribution system and AQS test software. In the interest of continuous product improvement, EC Sense reserves the right to change design features and specifications without notice. We are not responsible for any loss, injury or damage caused by this. EC Sense assumes no responsibility for any indirect loss, injury or damage resulting from the use of this document, the information contained therein or any omissions or errors herein. This document does not constitute an offer to sell. The data it contains are for informational purposes only and cannot be considered a guarantee. Any use of the given data must be evaluated and determined by the user to comply with federal, state and local laws and regulations. All specifications outlined are subject to change without notice.

### Warning

EC Sense sensors are designed for use in a variety of environmental conditions. However, due to the principles and characteristics of solid polymer electrochemical sensors and to ensure normal use, users must strictly follow this article during storage, assembly and operation of the module. General-purpose PCB circuit board application methods and illegal applications / violation of the application will not be covered by the warranty. Although our products are highly reliable, we recommend checking the module's response to the target gas prior to utilization to ensure on-site use. At the end of the product's service life, please do not discard any electronics in the domestic waste, instead follow the local governments electronic waste recycling regulations for disposal.



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