

PS1&PS4-VOC-10-MOD

# Total Organic Volatile Module Datasheet

Small size | Low cost | Long life | Fast response | High accuracy | Low power consumption





T: +48 (0) 32 438 4778

E: sales.is@sgxsensortech.com www.sgxsensortech.com

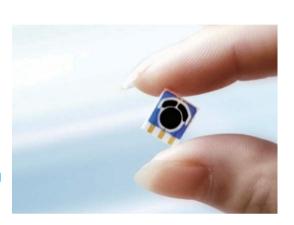
### **Product note**

The PS1&PS4-VOC-10-MOD series TVOC gas module is the perfect combination of our sensor with an advanced printed circuit board. SGX Sensortech gas sensors are using a revolutionary 'Solid Polymer Electrolyte' technology that is based on the principle of catalytic reaction. The target gas to be measured generates a very small current, proportional to the gas concentration. Our technology offers a stable, high quality and cost-effective manufacturing process.

The module is equipped with a standard UART digital output, allowing operation by anyone without knowledge or understanding of the sensor application and the tedious work of calibration.

### **Features**

- Sleeping function good for low power request IOT applications
- Combined with intelligent algorithms, it has stronger adaptability to the environment, more accurate detection, and stable zero point
- Good anti-toxicity, no consumption of chemical materials, more than 5 years Life time
- New micro circuit design, strong anti-electromagnetic interference ability
- Fast response, fast return to zero, plug and play
- Independent temperature and humidity digital sensor output
- The smallest size and lowest power consumption in the electrochemical field
- RoHS Eco-friendly design





# **Application**

- Commercial VOC emissions monitoring
- VOC monitoring of industrial exhaust emissions
- Monitoring of harmful gas released by home decoration materials
- Indoor and outdoor ambient air quality monitoring
- · Air purification treatment efficiency monitoring
- Air quality monitoring of office buildings and public spaces
- VOCs monitoring of landfill and disposal environment
- Sewage treatment plant air quality monitoring
- VOC gas release from school plastic runway
- Monitoring of non-methane total hydrocarbons in rubber products workshop





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# **Cross Sensitivity**

Gas	Formula	Test Concentration	Sensor Reading	
Acetic acid	CH₃COOH	5ppm	1.1ppm	
Acetylene	$C_2H_2$	1	Responded well	
Acrylonitrile	$C_3H_3N$	1	Responded well	
Ammonia	NH <sub>3</sub>	5ppm	1.5ppm	
Benzene	$C_{_6H_{_6}}$	5ppm	1.1ppm	
Butadiene	$C_4H_6$	1	Responded well	
Carbon disulfide	CS <sub>2</sub>	5ppm	1.23ppm	
DS-0423-PS1&PS4- VOC-10-MOD	CO	5ppm	3.38ppm	
Dimethyl Disulfide	$C_2H_6S_2$	2ppm	6.8ppm	
Dining lampblack (dimensionless)	Unsaturated hydrocarbons	1	Responded well	
Ethanol	$C_2H_6O$	5ppm	1.83ppm	
Ethylene	$C_2H_4$	5ppm	3.16ppm	
Ethylene oxide	$C_2H_4O$	5ppm	3.83ppm	
Formaldenhyde	HCHO	5ppm	6ppm	
Formic acid	HCOOH	5ppm	5.36ppm	
Gasoline volatilization (dimensionless)	Aliphatic hydrocarbons, cycloalkanes, aromatic hydrocarbons	1	Responded well	
Hydrogen	$H_{_{2}}$	5ppm	1.15ppm	
Hydrogen chloride	HCI	5ppm	0.27ppm	
Hydrogen cyanide	HCN	5ppm	0.36ppm	
Isobutene	$C_4H_8$	5ppm	5ppm	
Methanol	CH <sub>3</sub> OH	5ppm	5.95ppm	
Methyl mercaptan	CH₄S	5ppm	7ppm	
Methyl sulfide	C <sub>2</sub> H <sub>6</sub> S	5ppm	8.97ppm	
Nitrogen dioxide	NO <sub>2</sub>	5ppm	1.86ppm	
O-xylene	C <sub>8</sub> H <sub>10</sub>	5ppm	0.58ppm	
Styrene	C <sub>8</sub> H <sub>8</sub>	0.5ppm	7.5ppm	
Toluene	C <sub>7</sub> H <sub>8</sub>	5ppm	0.81ppm	
Trimethylamine	C <sub>3</sub> H <sub>6</sub> N	5ppm	0.65ppm	

Note: 1) The above interference factors may be different due to different sensors and service life, please refer to the actual test results.

2) This table is not complete for all gases, and the sensor may be sensitive to other gases.

# **Order Informations**

	Part Number	Range	Resolution
TVOC Gas Module	PS1-VOC-10-MOD	0-10ppm	0.01ppm
TVOC Gas Module	PS4-VOC-10-MOD	0-10ppm	0.01ppm
4Pin Cable	Module 4 PIN cable		



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# **Specification**

Principle	Solid Polymer Electrochemical Sensing Technology
Detection of gas	TVOC organic volatile gas
Detection Range	0-10ppm; Resolution: 0.01ppm
Lowest Detection Limit	0.05ppm
Full-scale accuracy error	± 5% F.S
Repeatability	<2%
Cattling time	The first power-on under storage in clean air <120 seconds
Settling time	The first power-up under storage in non-clean air <240 seconds (except in the presence of high concentrations of polluted gas)
Response time	T90: <20 seconds
	<80 seconds
Zero return time	Note: The module is separated from the measured gas environment, in clean air, the displayed value returns to 0.03ppm or less
0.111	Isobutene standard gas 5ppm
Calibration Gas	Note: The gas distribution standard uses clean air as the background gas, the humidity is 50%, and the normal temperature environment
	>3 years
Sensor expected life time	Note: Temperature (0-25) °C, Humidity (30-70)% RH, the measured gas concentration is within the range, and there is no gas environment that affects the warm-up time mentioned above
	The standard output is: 3.3V UART digital signal (see below for communication protocol); Optional custom Modbus protocol
Output	Interface definition: VCC- Red, GND- Black, RX- Yellow, TX- Green;
	Baud rate: 9600 Data bits: 8 bits Stop bits: 1 bit
	The communication is divided into active uploading and Q $\&$ A. The default is Q $\&$ A mode after power-on. You can use instructions to switch between the two modes.
Get data command	Return to Q & A mode after power off or switch power mode
	See next page for details
Working Voltage	3.3-5.5V DC
Working Current	< 5mA
Power Consumption	25mW @ 5V DC
Working temperature	(-40 - 55) °C
Optimal working temperature	(20 - 35) ℃
Working humidity	(15-95 ) %RH. (Non-condensing)
Optimum working humidity	50% RH.
Working pressure	Atm ± 10%
Circuit board size	40X30X5.6 (mm)
Module size	With PS1 sensor: 40X30X12 (mm); With PS4 sensor: 40X30X22.45 (mm)
Weight	PS1-VOC-10-MOD < 15g; PS4-VOC-10-MOD < 25g
Tomporature and humidity concer Data	Temperature Range: (-40~85) °C Relative error: ± 0.2 °C
Temperature and humidity sensor Data	Humidity measurement range: (10 ~ 95)% RH non-condensing Relative error: ± 2%
Warranty	12 months from the date of shipment



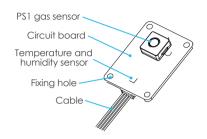
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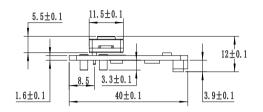
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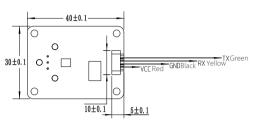
# Structure Diagram (unit in mm)

PS1-VOC-10-MOD Dimension diagram

### PS1 gas sensor



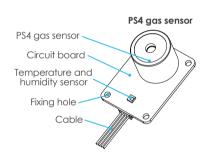


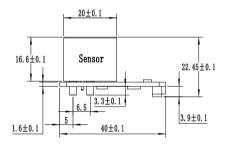


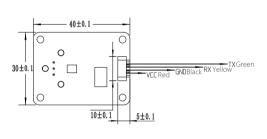
Product Schematic Side View Bottom View

### PS4-VOC-10-MOD

### Dimension diagram





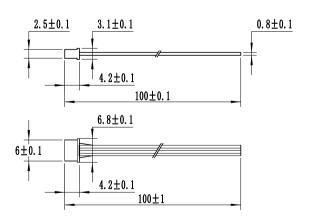


Product Schematic

Side View

Bottom View

# 4Pin cable size diagram



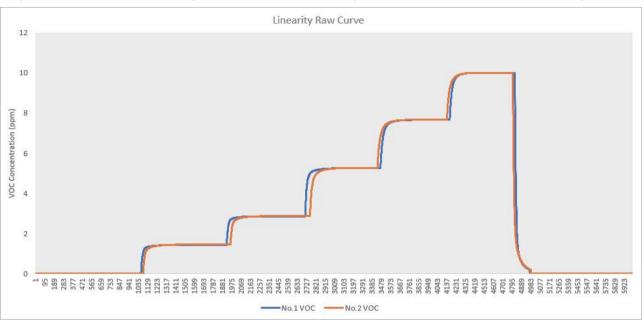


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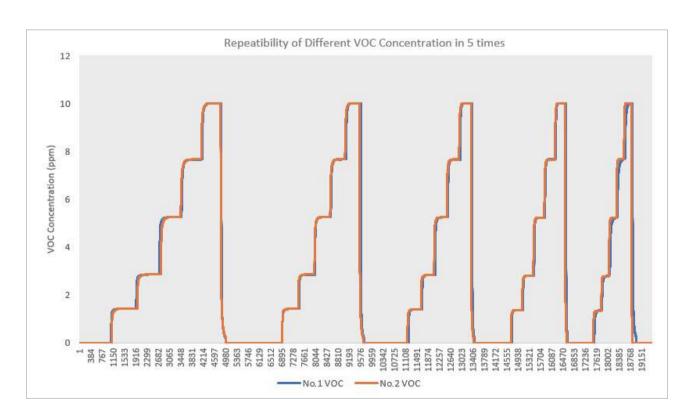
# Linearity

Temperature environment: 26 °C; Humidity environment: 55%; Air chamber space: 0.03m³; Ventilation flow of air distribution system: 3000sccm



# Repeatability

Temperature environment: 26 °C; Humidity environment: 55%; Air chamber space: 0.03m³; Ventilation flow of air distribution system: 3000sccm



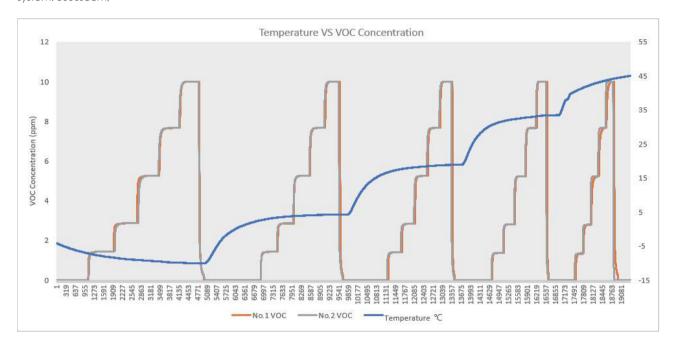


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# **Temperature**

Temperature environment: -15, -5, 5, 15, 25, 35, 45, 55° C; air chamber space: 0.03m³; ventilation flow of gas distribution system: 3000sccm,





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### **User Guide**

Thank you for choosing SGX Sensortech module. Before using it, please read this document in detail in order to use our products correctly and effectively.

### Storage

- 1. The best storage environment is: temperature (-5~30) °C, relative humidity 50% RH (non-condensing);
- 2. The storage environment should keep the air clean, no pollution gas, no acetone, no high concentration organic gas, no dust, no smoke:
- 3. Avoid storage with alcohol (ethanol), perfume, sodium silicate and polyurethane liquids or solids;
- 4. Avoid high temperature and low humidity storage.

### Packing and shipping

- 1. Avoid prolonged direct sunlight during transportation, prevent rainwater penetration;
- 2. Transport packaging should be protected with shock-proof bubble film or non-odor environmentally friendly sponge;
- 3. During long-distance transportation, the temperature inside the sensor package should be kept within 40 °C as much as possible, and the maximum temperature should not exceed 55 °C (can not be stored or used at this temperature for a long time), and the humidity should not be less than 15% RH;

### Steps for usage

- 1. Warm-up
- The TVOC module is designed to have a plug-and-play function, but due to the electrochemical nature of the TVOC sensor, after receiving the calibrated product, it still takes about 2 minutes to warm up the machine when it is first powered on. After the output signal is constant, the warm-up is complete.
  - (Note: under different storage and measurement environments, the first electrode stabilization time is different)
- When warming up, it is recommended to first warm the machine in clean air for about 2 minutes, observe whether the output of the TVOC module is 0ppm (due to storage and environmental differences, the indicated value <0.03ppm can be confirmed as normal), confirm TVOC after the module is normal, put it into the environment under test and let the sensor adapt to its environment. At this time, valid data can be obtained.</li>

### 2. Connection

Please refer to the 4Pin cable in the "Structure Diagram" above. For the power supply, see the voltage and current ranges marked in the
performance indicators. Note: incorrect wiring will cause the module to malfunction or damage the module.

### 3. Diffusion use

- When using in a closed environment, it is necessary to ensure a constant pressure and the working pressure range is within ± 10% of atmospheric
  pressure, to ensure accurate measurement data, when using under different pressure environments, re-sensitivity calibration should be
  performed according to the pressure of the use environment.
- Usually the change of pressure will cause the output signal to change.if The pressure increase, the signal will increase, the pressure change suddenly, and the sensor signal will have a sudden change in peak value.

### 4. Pump suction use

- When using the sensor in the pumping detection mode, the gas flow rate must be controlled within 500ml per minute, and the flow rate must be stable. The change of flow will cause the signal to fluctuate. When the flow is large, it will bring the change of pressure, which will cause the sensor signal value to change.
- When using the pump suction mode, it is best to add a flow sensor or an air pump control according to the product design to avoid negative
  pressure and physical damage to the sensor that cannot be recovered.
- The design of the gas path should avoid direct gas flow to the front of the sensor. An optional flow cap should be used, while the air is inlet and the air is outlet (normally small in and large out). The inlet and outlet gas is designed to be 90 degrees or straight-through with a barrier type to ensure that the gas can fully contact the TVOCne sensor.

### 5. Temperature and humidity effects

- The TVOC Gas module has been corrected for temperature compensation through an intelligent algorithm, which is suitable for the detection environment of -40 ~ 55 °C.
- The TVOC sensor module must not be used and stored for a long time in a high-temperature and low-humidity environment with a humidity below 10% or a temperature above 55 °C. Failure to do so will result in reduced sensor life. Either failure or test data is invalid.
- The frequent and rapid changes in temperature or humidity will affect the chemical material and cause an unexpected decrease in the sensor life.
- TVOC sensors are generally not affected by humidity, but during use, it is necessary to avoid condensation blocking the air inlet holes on the surface of the filter membrane, resulting in the inability of TVOC to diffuse into the sensor and no signal output.
- Impact of environmental changes on sensors: Due to the principle and characteristics of electrochemical sensors, environmental changes have
  varying degrees of influence on the chemical electrolytes inside the sensors. The TVOC detection module analyzes the changes in the current
  data of the sensor in detail through different environmental temperature and humidity effects tests, and combines the temperature and
  humidity sensor data to perform algorithmic compensation to correct the resulting deviations. Sudden changes in temperature and humidity
  will cause abnormal fluctuations in the trace data of the sensor, but generally it can fully adapt to the new environment and be stable within
  5-10 minutes.

### 6. Maintain

- The maintenance of the TVOC detection module is mainly for accuracy calibration. Generally, the solid polymer TVOC sensor does not consume chemical electrolyte, but it can be affected by temperature, humidity, dust, and other gases used in the environment. The sensitivity of the sensor will shift, and the TVOC sensor needs to be re-calibrated. The better the use environment, the longer the maintenance cycle and less maintenance workload.
- In case a calibration is needed the user may make sure that clean air is available or the module can be sent back to the factory for recalibration.



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### **User Guide**

### **Precautions**

- 1. The main function of the gas sensor is to detect the gas composition and content. Please make sure that the sensor is not getting in touch with any liquid;
- 2. Different gas sensors have different measurement concentration ranges (ranges), and should not be exposed to overrange/high concentrations for a longer time;
- 3. The sensor is covered with a waterproof and breathable filter (on the top of the sensor), which should not be damaged, scratched or pulled of;
- 4. Please make sure that the ventilation (filter) surface of the sensor is not blocked or contaminated. Blockage of the filter may lead to a reduced sensitivity, slow response time, or no response.
- Please do not exchange the sensors of different gas detection modules, this will cause measurement errors, because all
  the parameters of each sensor and each circuit board are matched and calibrated, there will be deviations after the
  exchange;
- Once the PS1 TVOC sensor is unplugged and reinserted into the circuit board, please check that the three electrodes of PS1 correspond to the sockets on the circuit board to avoid irreversible damage to the sensor after reverse insertion;
- 7. Avoid excessive impact or vibration, such as the shell rupture, reveal the internal structure, the output will not guarantee the effectiveness.

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SGX Europe Sp. z o.o. sensors are designed to operate in a wide range of harsh environments and conditions. However, it is important that exposure to high concentrations of solvent vapours is to be avoided, both during storage, fitting into instruments and operation. When using sensors on printed circuit boards (PCBs), degreasing agents should be used prior to the sensor being fitted. SGX Europe Sp. z o.o. makes every effort to ensure the reliability of its products. Where life safety is a performance requirement of the product, we recommend that all sensors and instruments using these sensors are checked for response to gas before use.

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# Communication Protocol

### **General settings**

The sensor module uses serial communication. The communication configuration parameters are as follows:

Baud rate	9600
Data bits	8 bits
Stop bit	1 bit
Parity bit	None

Note: The communication is divided into active uploading and Q & A mode. The default mode is Q & A mode after power-on. You can use commands to switch between the two modes. After power-off or switching power consumption mode, the mode is restored.

### Transmission mode switching instruction

Command 1 Instruction one switches to active upload. The command line format is as follows:

0	1	2	3	4	5	6	7	8
Start bit	Retain	Switch command	Automatic upload	Retain	Retain	Retain	Retain	Proof test value
0 x FF	0 x 01	0 x 78	0 x 40	0 x 00	0 x 00	0 x 00	0 x 00	0 x 47

Note: This format is fixed

Command 2 Switch to passive upload. The command line format is as follows:

0	1	2	3	4	5	6	7	8
Start bit	Retain	Switch command	Answer	Retain	Retain	Retain	Retain	Proof test value
0 x FF	0 x 01	0 x 78	0 x 41	0 x 00	0 x 00	0 x 00	0 x 00	0 x 46

Note: This format is fixed

### Get module information instruction

**Command 3** Gets sensor type, maximun range, unit, unit decimal places command: 0xD1 Returned value:

0	1	2	3	4	5	6	7	8
Sensor type	Maximum range high	Maximum range low	Unit	Retain	Retain	Retain	Number of decimal places (bit[4]~bit[7]) Data sign (bit[0]~bit[3])	Parity bit
0 x 23	0 x 00	0 x CB	0 x 02	0 x 00	0 x 00	0 x 00	0 x 00	0 x 35

### Note:

Max range = (Max range high << 8) | Max range low

Units: 0x02 (ppm and mg / m³) 0x04 (ppb and ug / m³)

Signs: 0 (positive number) 1 (negative number)

Decimal places: how many decimal places to read the concentration value, the maximum number of decimal places is 3



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SGX Europe Sp. z o.o. Building 11 Ligocka St. 103, 40-568 Katowice, Poland T: +48 (0) 32 438 4778

E: sales.is@sgxsensortech.com www.sgxsensortech.com

# Communication Protocol

Command 4 Get the sensor type, maximum range, unit, and decimal places command: 0xD7

0	1	2	3	4	5	6	7	8
Command header 1	Command header 2	Sensor type	Maximum range high	Maximum range low	Unit	Number of decimal places (bit[4]~bit[7]) Data sign (bit[0]~bit[3])	Retain	Parity bit
0 x FF	0 x D7	0 x 23	0 x 00	0 x C8	0 x 02	0 x 01	0 x 00	0 x 3B

### Explanation:

Checksum: 1 ~ 7 bits of data are added to generate an 8-bit data.invert every bit and add 1 to the end

Decimal places bit [4] ~ bit [7]:

 $(bit[7] << 3) \mid (bit[6] << 2) \mid (bit[5] << 1) \mid bit[4] = decimal places$ 

Data sign (bit[0]~bit[3]):

(bit[3]<<3) | (bit[2]<<2) | (bit[1]<<1) | bit[0] = 0 Negative inhibition (bit[3]<<3) | (bit[2]<<2) | (bit[1]<<1) | bit[0] = 1 Positive inhibition

Unit:

0x02: unit is mg/m $^3$  and ppm 0x04: unit is um/m $^3$  and ppb 0x08: unit is 10g/m $^3$  and %

### Command 5 The format for actively reading the gas concentration value is as follows:

0	1	2	3	4	5	6	7	8
Start bit	Retain	Command	Retain	Retain	Retain	Retain	Retain	Parity bit
0 x FF	01	0 x 86	0 x 00	0 x 00	0 x 00	0 x 00	0 × 00	0 x 79
Retur	ned value:	2	3	4	5	6	7	8
Start bit	Command	High gas concentration (ug/m <sup>3</sup> )	Low gas concentration (ug/m <sup>3</sup> )	Full range high	Full range low	High gas concentraiton (ppb)	Low gas concentraiton (ppb)	Parity bit
0 x FF	0 x 86	0 x 00	0 x 2A	0 x 00	0 x 00	0 x 00	0 x 20	0 x 30

### Description:

Checksum: 1 ~ 7-bit data is added to generate an 8-bit data.invert every bit and add 1 to the end

Gas concentration value = high gas concentration \*256 + low gas concentration;

(The high and low concentrations need to be converted from hexadecimal to decimal and then brought into this formula to calculate





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# **Communication Protocol**

Command 6 Gas concentration value and temperature and humidity combined reading instruction

(		1	2		3	4	5	6		7		8
Star	t bit	Retain	Commar	nd R	etain	Retain	Retain	Ret	ain I	Retain	Par	ity bit
0 x	FF	0 x 00	0 x 87	0	x 00	0 x 00	0 x 00	0 x	00	0 x 00	0	x 79
R	eturned v	ralue:	3	4	5	6	7	8	9	10	11	12
Start bit	Command	High gas concentration (ug/m³)	Low gas concentration (ug/m <sup>3</sup> )	Full range high	Full range low	High gas concentration (ppb)	Low gas concentration (ppb)	Temperature high	Temperature low	Humidity high	Humidity low	Parity bit
0 x FF	0 x 87	0 x 00	0 x 2A	0 x 03	0 x E8	0 x 00	0 x 20	0 x 09	0 x C4	0 x 13	0 x 88	0 x DC

### Description:

Checksum: 1 ~ 11 bits of data are added to generate an 8-bit data, each bit is inverted, and 1 is added at the end.

Gas concentration value = high gas concentration \* 256 + low gas concentration;

(The high and low concentrations need to be converted from hex) adecimal to decimal and then brought into this formula to calculate

Temperature is signed data with Two decimal places (°C-Celsius) Pseudo code calculation formula:

T = (float)((int)((0x0A << 8) | 0x09))/100

Humidity is data without signs and two decimal places. The unit is (rh%). Pseudo code calculation formula:

Rh = (float)((uint)((0x0A << 8) | 0x09))/100

# **Command 7** Get the current temperature and humidity Returned value:

0	1	2	3
Temerature high 8 bit	Temperature low 8 bit	Humidity high 8 bit	Hunidity low 8 bit
0 x 0A	0 x 09	0 x 11	0 x F4

### Description:

Temperature is signed data with two decimal plac)es and the unit is (°C-Celsius)

Pseudo code calculation formula:

T = (float)((int)((0x0A << 8) | 0x09))/100

Humidity is data without sign and two decimal places, the unit is (rh%)

Pseudo code calculation formula:

Rh = (float)((uint)((0x0A << 8) | 0x09))/100



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# **Communication Protocol**

**Command 8** Get the current temperature and humidity with calibration Returned value:

0	1	2	3	4
Temerature high 8 bit	Temperature low 8 bit	Humidity high 8 bit	Hunidity low 8 bit	Checksum
0 x 0A	0 x 09	0 x 11	0 x F4	0 x E8

### Description:

Checksum: 0 ~ 3 digits of data are added to generate an 8-bit data. Each bit is inverted, plus 1 at the end

Temperature is data with a sign and two decimal places. The unit is (°C-Celsius)

Pseudo code calculation formula:

T = (float)((int)((0x0A << 8) | 0x09))/100

Humidity is data with no sign and two decimal places in units (rh%).

Pseudo code calculation formula:

Rh = (float)((uint)((0x0A << 8) | 0x09))/100

**Command 9** Get the current version number Returned value:

0	1	2	3	4	5
0 x 19	0 x 05	0 x 27	0 x 00	0 x 10	0 x 01

# Data in active upload mode

The upload data format is as follows:

0	1	2	3	4	5	6	7	8
Start bit	Command	High gas concentration (ug/m³)	Low gas concentration (ug/m³)	Full range high	Full range low	High gas concentration (ppb)	Low gas concentration (ppb)	Parity bit
0 x FF	0 x 86	0 x 00	0 x 2A	0 x 00	0 x 00	0 x 00	0 x 20	0 x 30

### Note:

Checksum: Add 1 to 11 digits of data to generate 8 digits of data, invert each bit, add 1 at the end

Gas concentration value = high gas concentration \* 256 + low gas concentration

(The high and low concentrations need to be converted from hexadecimal to decimal and then brought into this formula to calculate)

### Low power switching

### Enter sleep mode

0	1	2	3	4	5
0 x AF	0 x 53	0 x 6C	0 x 65	0 x 65	0 x 70

### Returned value:

0	1
0 x 4F	0 x 4B





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# **Communication Protocol**

# Exit sleep mode

0	1	2	3	4
0 x AE	0 x 45	0 x 78	0 x 69	0 x 74

# Returned value:

0	1			
0 x 4F	0 x 4B			

Note: after exiting sleep mode, it takes 5 seconds to recover, no data within 5 seconds

# Enter sleep mode

0	1		2	3	4		5	6
0 x A1	0 x 5	53	0 x 6C	0 x 65	0 x 65	0	x 70	0 x32
Returned	l value :							
0	1	2	3	4	5	6	7	8
0 x FF	0 x A1	0 x 00	0 × 00	0 x 00	0 x 00	0 x 00	0 x 00	5F
0	1		2		3	4		5
	1							
0 x A2	0 x 4	40	0 x 78	0	x 69	0 x 74		0 x 32
Returned	I value :							
0	1	2	3	4	5	6	7	8





T: +48 (0) 32 438 4778

E: sales.is@sgxsensortech.com www.sgxsensortech.com

# **Communication Protocol**

# Turn off the running lights

0	1	2	3	4	5	6	7	8
Start bit	Retain	Command	Retain	Retain	Retain	Retain	Retain	Checksum
0 x FF	0 x 01	0 x 88	0 x 00	0 x 77				

### Return:

0	1			
0 x 4F	0 x 4B			

# Turn on the running lights

0	1	2	3	4	5	6	7	8
Start bit	Retain	Command	Retain	Retain	Retain	Retain	Retain	Checksum
0 x FF	0 x 01	0 x 89	0 x 00	0 x 76				

### Return:

0	1
0 x 4F	0 x 4B

### Query the running light status

0	1	2	3	4	5	6	7	8
Start bit	Retain	Command	Retain	Retain	Retain	Retain	Retain	Checksum
0 x FF	0 x 01	0 x 8A	0 x 00	0 x 75				
Return:								
0	1	2	3	4	5	6	7	8
Start bit	Command	State value	Retain	Retain	Retain	Retain	Retain	Checksum
0 x FF	0 x 8A	0 x 01	0 x 00	0 x 75				

Note: Status value 1 (light on), 0 (light off)