SensorsX

SX-GMFA Series

Four-in-One Gas Sensor Module Carrier

Industrial Gas Detection | Modular Multi-Gas Platform

4 Channels SX-GMKA Module Slots	**DC 5–24 V** Supply Voltage	**≤ 2 W** Power Consumption
−20 to +50 °C Operating Temperature	**10–95 %RH** Humidity Range	**UART / Modbus-RTU** Communication

■ PRODUCT OVERVIEW

The SX-GMFA Series is a four-channel gas sensor module carrier designed to accommodate four SX-GMKA-series gas sensor modules simultaneously. An internal analog switch alternately communicates with the installed modules, enabling one device to monitor up to four different gas types. Communication is provided via TTL-level UART / Modbus-RTU. The module carrier uses a high-strength aluminum-alloy housing, and the wiring entry is sealed with epoxy resin to help ensure gas-tightness.
Typical applications include gas alarm instruments, industrial gas detection, mine gas detection, ambient air-quality monitoring, and research or academic applications.

■ KEY FEATURES

◆ **Standardized — connects to a wide range of SX-GMKA-series gas sensor modules**	◆ **Output terminal: 2.0 mm pitch, 6-pin (default); customizable**
◆ **Factory-calibrated and ready to use; no additional calibration or secondary development required**	◆ **Output signal uses UART (TTL-level) protocol**
◆ **Compatible with infrared, electrochemical, catalytic, and other sensor types**	◆ **High accuracy, fast and stable response**
◆ **Short warm-up time, low power consumption, high resistance to interference**	

■ TYPICAL APPLICATIONS

- Smart public-restroom gas detection
- Smart-agriculture gas detection
- Smart utility-tunnel and tunnel
- Smart manhole-cover gas detection projects
- Highway / road tunnel gas detection projects
- Smart-livestock-farming gas detection

- Smart-granary gas detection projects
- Underground parking-garage gas detection projects
- Research projects, environmental-monitoring projects
- Industrial intelligent gas detection projects (e.g. inspection robots)
- Automotive electronics, smart firefighting, and test & measurement instruments

■ WORKING PRINCIPLE

The SX-GMKA-series modules amplify and filter the signal from each gas sensor, after which an onboard microprocessor performs the concentration calculation and outputs a digital signal. The SX-GMFA carrier then multiplexes the signals from the four installed SX-GMKA-series modules onto a single communication line, using an analog switch to select which module is being addressed.

■ PERFORMANCE SPECIFICATIONS

General	
Model	SX-GMFA series
Detection Method	Natural diffusion
Detected Gases	See Appendix — Gas Name Codes / Detected Gas Parameter List (determined by installed SX-GMKA-series modules)
Detection Range	See Appendix — Detected Gas Parameter List
Resolution	See Appendix — Detected Gas Parameter List
Sensing Technology	Electrochemical / catalytic combustion / semiconductor / infrared / photoionization (PID) / thermal conductivity, etc.
Warm-up Time	30 s – 60 s
Service Life	Electrochemical: 2 years Infrared: 5 years Semiconductor: 5 years Catalytic combustion: 2 years

■ ELECTRICAL SPECIFICATIONS

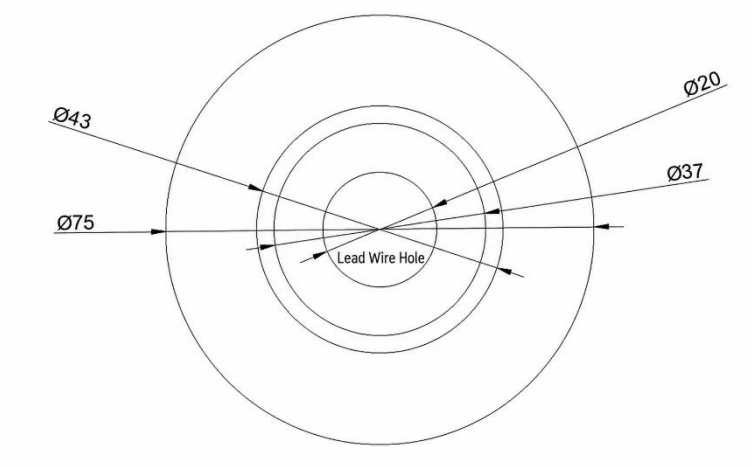
Power	
Supply Voltage	DC 5 – 24 V
Power Consumption	≤ 2 W
Communication	
Interface	UART (TTL level)
Protocol	Modbus-RTU
Baud Rate	9600 bps
Data Bits	8
Stop Bits	1
Parity	None

■ ENVIRONMENTAL SPECIFICATIONS

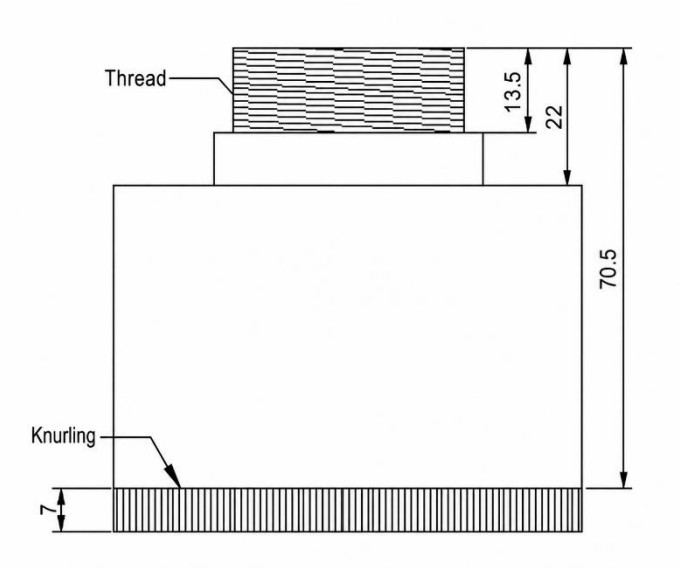
Temperature & Humidity	
Operating Temperature Range	−20 to +50 °C (−4 to +122 °F)
Operating Humidity Range	10 – 95 %RH (non-condensing)

■ MECHANICAL DIMENSIONS

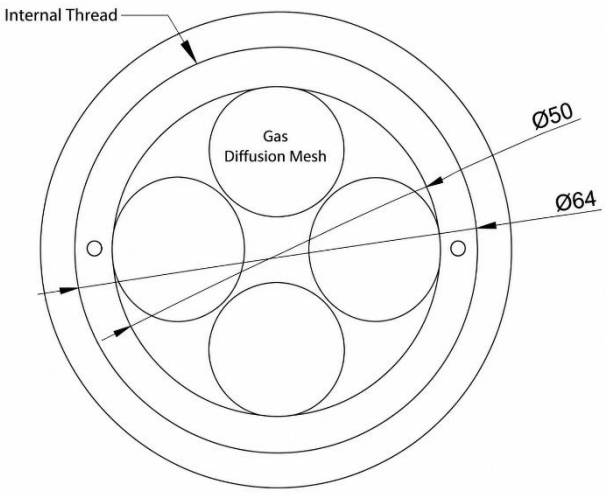
Mechanical	
Outer Dimensions	Ø75 × 77.5 mm (round sleeve / cartridge form)
Weight	< 600 g



Top View

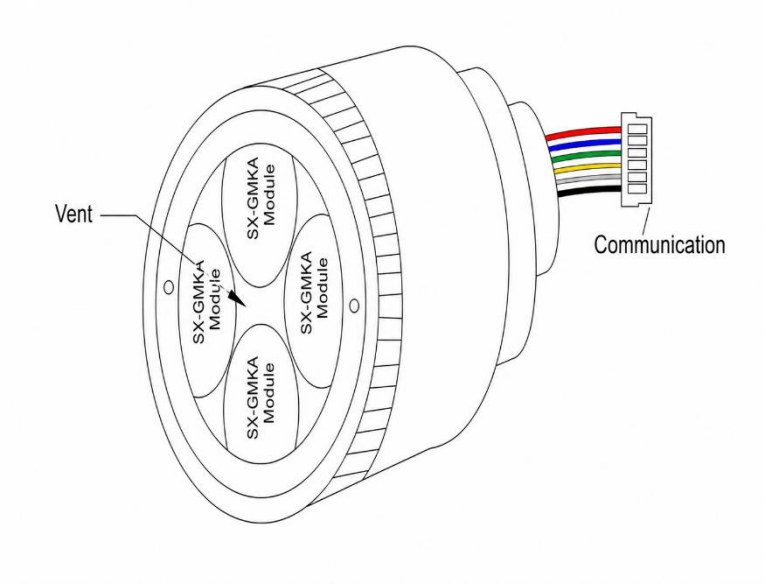


Front View

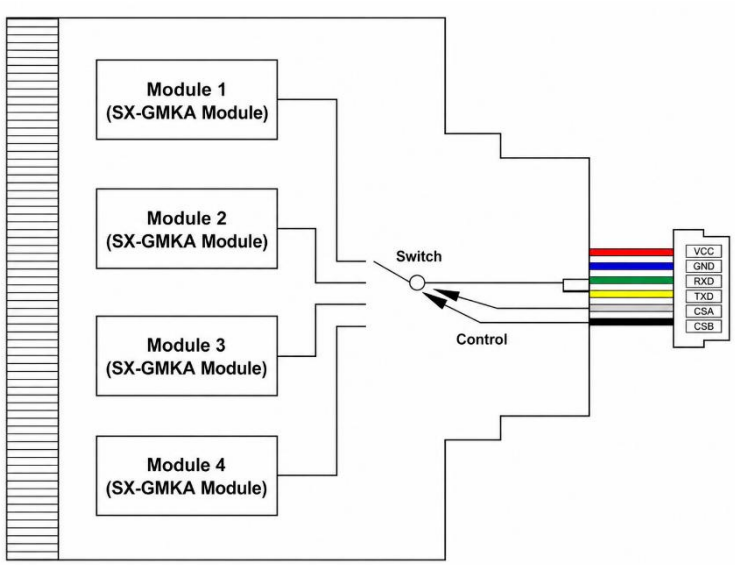


Bottom View

■ WIRING DIAGRAM



SX-GMFA Carrier Appearance & Cable Definition



Module Working-Principle Diagram

Wire Color / Pin Definition

Wire Function	Wire Color	Description	Min (V)	Typical (V)	Max (V)
VCC	Red	Power supply	5	24	36
GND	Blue	Ground	0	0.0	0
RXD	Green	Serial receive	0	3.0	—
TXD	Yellow	Serial transmit	0	3.0	—
CSA	White	Channel select A	—	—	—
CSB	Black	Channel select B	—	—	—

Module-Selection Truth Table (channel-select logic)

CSA Level	CSB Level	Selected Module No.	Module Type (example)
0	0	4	SX-GMKA-CO_2
0	1	2	SX-GMKA-CH_4
1	0	3	SX-GMKA-H_2S
1	1	1	Empty (no module installed)

■ COMMUNICATION PROTOCOLS

Serial Port Characteristics	
Baud Rate	9600
Data Bits	8
Stop Bits	1
Parity	None

Read Data — Master Request Frame

Address	Function Code	Reg. Start Addr. (Hi)	Reg. Start Addr. (Lo)	Reg. Count (Hi)	Reg. Count (Lo)	CRC (Lo)	CRC (Hi)
0xFF (default)	0x03						

Read Data — Successful Response Frame

Address	Function Code	Data Count	Data 1	Data 2	…	Data n	CRC (Lo)	CRC (Hi)
0xFF (default)	0x03							

Read Data — Error Response Frame

Address	Error Function Code	Error Code	CRC (Lo)	CRC (Hi)
0xFF (default)	0x83			

Write Data — Master Request Frame

Address	Func.	Reg. Addr.(Hi)	Reg. Addr.(Lo)	Reg.Cnt(Hi)	Reg.Cnt(Lo)	Data Cnt	Data(Hi)	Data(Lo)	CRC(Lo)	CRC(Hi)
0xFF	0x10									

Write Data — Successful Response Frame

Address	Function Code	Reg. Start Addr.(Hi)	Reg. Start Addr.(Lo)	Reg. Count (Hi)	Reg. Count (Lo)	CRC(Lo)	CRC(Hi)
0xFF (default)	0x10						

Register Map

Logical Address	Register Description	Reg. Count	Remarks	Mode
0x2011	Module communication ID	1	Modbus address 0–254	R/W
0x2021	Sensor type	1	See Appendix 7	Read-only
0x2027	Gas name code	—	See Appendix 1	Read-only
0x202B	Range	1	—	Read-only
0x2030	Unit code	1	See Appendix 2	R/W
0x2031	Decimal place count	1	—	R/W
0x6000	Alarm status	1	See Appendix 4	Read-only
0x6001	Concentration value	1	—	Read-only
0x6002	AD value	1	—	Read-only
0x6006	Run status / Command parameter	1	See Appendix 5 / Appendix 6	R/W

Worked Examples

Example 1 — 0x6001: Read Concentration Value

Send Command								
	Sensor ID	Function	Reg.Addr Hi	Reg.Addr Lo	Reg.Cnt Hi	Reg.Cnt Lo	CRC Lo	CRC Hi
Send (hex)	FF	03	60	01	00	01	DE	14
	Sensor ID	Function	Data Count	Data1 (conc. Hi)	Data2 (conc. Lo)	CRC Lo	CRC Hi	
Return (hex)	FF	03	02	00	05	51	93	

Send: FF 03 60 01 00 01 DE 14 → Return: FF 03 02 00 05 51 93. The returned value is 5; concentration = returned value ÷ 10^(decimal place count). If the decimal place count read out is 1, concentration = 5/10 = 0.5; if it is 2, concentration = 5/100 = 0.05.

Example 2 — 0x2031: Read Decimal Place Count

Send Command								
	Sensor ID	Function	Reg.Addr Hi	Reg.Addr Lo	Reg.Cnt Hi	Reg.Cnt Lo	CRC Lo	CRC Hi
Send (hex)	FF	03	20	31	00	01	CB	DB
	Sensor ID	Function	Data Count	Data1	Data2	CRC Lo	CRC Hi	
Return (hex)	FF	03	02	00	01	50	50	

Send: FF 03 20 31 00 01 CB DB → Return: FF 03 02 00 01 50 50, indicating the decimal place count is 1. Note: with a decimal place count of 1, divide the read concentration value by 10; with 2, divide by 100; and so on.

Example 3 — Writing the Sensor Address

Writing the sensor address requires first sending an unlock (write-protect release) command, then the write-address command.

Step 1 — 0x4FFF unlock write-protect: Send: FF 10 4F FF 00 01 02 55 AA FB D0 → Return: FF 10 4F FF 00 01 32 F3

Step 2 — 0x2011 set sensor ID (example: set ID to 1): Send: FF 10 20 11 00 01 02 00 01 0D 77 → Return: FF 10 20 11 00 01 4F D2

Example 4 — Calibration

Calibration requires: (1) send the unlock command, (2) send the calibration command, (3) send the read-calibration-result command. Command parameters are listed in Appendix 6 (up to 6 calibration points supported).

Step 1 — unlock: Send: FF 10 4F FF 00 01 02 55 AA FB D0 → Return: FF 10 4F FF 00 01 32 F3

Step 2 — 0x6006 write calibration (zero-point example, return value not checked): Send: FF 10 60 06 00 02 04 10 00 00 00 E8 AC

Step 3 — 0x6006 read calibration result: Send: FF 03 60 06 00 01 6F D5 → Return: FF 03 02 00 01 50 50 (data value 01 = calibration succeeded; other values per Appendix 5)

CRC-16 calculation reference (as given in the source datasheet, ModbusCRC16, abbreviated 4-bit nibble table):

```
const u16 u16CrcTalbeAbs[] = { 0x0000, 0xCC01, 0xD801, 0x1400, 0xF001, 0x3C00, 0x2800, 0xE401, 0xA001, 0x6C00, 0x7800, 0xB401, 0x5000, 0x9C01, 0x8801, 0x4400 };

u16 Crc16(u8p pchMsg, u8 wDataLen) { u16 wCRC = 0xFFFF; u8 chChar; while (wDataLen--) { chChar = *pchMsg++; wCRC = u16CrcTalbeAbs[(chChar ^ wCRC) & 15] ^ (wCRC >> 4); wCRC = u16CrcTalbeAbs[((chChar >> 4) ^ wCRC) & 15] ^ (wCRC >> 4); } return wCRC; }
```

■ PRECAUTIONS

1. Do not plug or unplug the sensor on the module.
2. Do not solder directly to the module's pins; soldering may be done on the pin header/socket instead.
3. The module should avoid contact with organic solvents (including silicone and other adhesives), paints, chemical agents, oils, and high-concentration gases.
4. The module must not be subjected to excessive impact or vibration.
5. On first power-up, allow the module to warm up for at least 5 minutes; if it has been unused for a long time, warm-up of 24 hours or more is recommended.
6. Do not leave the module in a high-concentration organic-gas environment for extended periods.
7. When selecting a module, choose a product with the appropriate range for the specific application field and use case.

■ APPENDIX 1 — GAS NAME CODES

Code	Gas Name	Formula	Code	Gas Name	Formula
0x01	Carbon Monoxide	CO	0x02	Hydrogen Sulfide	H_2S
0x03	Combustible Gas	EX	0x04	Oxygen	O_2

0x05	Sulfur Dioxide	SO_2	0x06	Methane	CH_4
0x07	Nitric Oxide	NO	0x08	Nitrogen Dioxide	NO_2
0x09	Chlorine	Cl_2	0x0A	Ammonia	NH_3
0x0B	Hydrogen	H_2	0x0C	Hydrogen Cyanide	HCN
0x0D	Hydrogen Chloride	HCl	0x0E	Phosphine	PH_3
0x0F	Ozone	O_3	0x10	Chlorine Dioxide	ClO_2
0x11	Ethylene Oxide	C_2H_4O	0x12	Carbon Dioxide	CO_2
0x13	Benzene	C_6H_6	0x14	Formaldehyde	CH_2O
0x15	VOC	VOC	0x16	Toluene	C_7H_8
0x17	Xylene	C_8H_{10}	0x18	Nitrogen Oxides	NOx
0x19	n-Hexane	C_6H_{14}	0x1A	Hydrogen Fluoride	HF
0x1B	Fluoride	xF	0x1C	Methanol	CH_3OH
0x1D	Propane	C_3H_8	0x1E	Cresol	C_7H_8O
0x1F	Ethane	C_2H_6	0x20	Diethyl Ether	$C_4H_{10}O$
0x21	Coal Gas	CH_4	0x22	Carbon Disulfide	CS_2
0x23	Silane	SiH_4	0x24	Acetylene	C_2H_2
0x25	Chloromethane	CH_3Cl	0x26	Nitrogen	N_2
0x27	Styrene	C_8H_8	0x28	Arsine	AsH_3
0x29	Ethanol	C_2H_6O	0x2A	Vinyl Chloride	C_2H_3Cl
0x2B	Dichloroethane	$C_2H_4Cl_2$	0x2C	Ethyl Acetate	$C_4H_8O_2$
0x2D	Dichloromethane	CH_2Cl_2	0x2E	Acrylonitrile	C_3H_3N
0x2F	Aniline	C_6H_7N	0x30	Natural Gas	EX
0x31	Bromine	Br_2	0x32	Phosgene	$COCl_2$
0x33	Hydrazine	N_2H_4	0x34	Formic Acid	CHOOH
0x35	Hydrogen Bromide	HBr	0x36	Methyl Mercaptan	CH_4S
0x37	Butene	C_4H_8	0x38	Ethylene	C_2H_4
0x39	Propylene	C_3H_6	0x3A	Vinyl Acetate	$C_4H_6O_2$
0x3B	Isopropanol	C_3H_8O	0x3C	Acetaldehyde	C_2H_4O
0x3D	Butadiene	C_4H_6	0x3E	Carbon Oxysulfide	COS
0x3F	Methyl Sulfide	C_2H_6S	0x40	Tetrahydrothiophene	C_4H_8S
0x41	Propylene Oxide [sic, formula as in source]	C_2H_5OCl	0x42	Chloroform	$CHCl_3$
0x43	Carbon Tetrachloride	CCl_4	0x44	Tungsten Hexafluoride	WF_6
0x45	Tin Tetrachloride	$SnCl_4$	0x46	Hydrogen Peroxide	H_2O_2
0x47	Butanone (MEK)	C_4H_8O	0x48	Hydrocarbons	CnH_2n
0x49	Sulfuryl Fluoride	SO_2F_2	0x4A	TVOC	TVOC
0x4B	VOCs	VOCs	0x4C	Methyl Isobutyl Ketone	$C_6H_{12}O$
0x4D	Fluorine	F_2	0x4E	Hydrocyanic Acid	HCN
0x4F	Dimethyl Sulfate	$(CH_3O)2SO_2$	0x50	Dimethylformamide	C_3H_7NO
0x51	Phosphorus Trichloride	PCl_3	0x52	Phosphorus Oxychloride	$POCl_3$
0x53	Acetate Ester	CH_3COOR	0x54	PM2.5	PM2.5
0x55	PM10	PM10	0x56	PM1.0	PM1.0
0x57	Hydrocarbons	HC	0x58	Hydrazine Hydrate	$N_2H_4{\cdot}H_2O$
0x59	Aldehydes	C_3H_4O	0x60 [sic, duplicate — see note]	Oil Gas	C_3H_8
0x5B	Oil Gas (LPG)	LPG	0x5C	Methacrylonitrile	C_4H_5N
0x5D	1,1-Dichloroethylene	$C_2H_2Cl_2$	0x5E	n-Butane	C_4H_{10}

0x5F	n-Pentane	C_5H_{12}	0x60	Isobutane	C_4H_{10}
0x61	DMF	C_3H_7NO	0x62	m-Diethylbenzene	$C_{10}H_{14}$
0x63	Chlorobenzene	C_6H_5Cl	0x64	Monomethylamine	CH_3NH_2
0x65	Nitrous Oxide	N_2O	0x66	TDI	TDI
0x67	Freon	freon	0x68	Sulfur Trioxide	SO_3
0x69	Nitrogen Trifluoride	NF_3	0x6A	Methyl Bromide	CH_3Br
0x6B	Sodium Cyanide	NaCN	0x6C	Epichlorohydrin	C_3H_5ClO
0x6D	Propylene Oxide	C_3H_6O	0x6E	Trichloroethylene	C_2HCl_3
0x6F	Acetone	CH_3COCH_3	0x70	Tetrachloroethylene	C_2Cl_4
0x71	LEL	LEL	0x72	Pressure	PRESSURE
0x73	ACID	ACID	0x74	Cyclohexane	C_6H_{12}
0x75	Diborane	B_2H_6	0x76	Argon	Ar
0x77	Acetic Acid	CH_3COOH	0x78	Phenol	C_6H_5OH
0x79	Sulfur Hexafluoride	SF6	0x7A	Ethanethiol	C_2H_5SH
0x7B	Allyl Chloride (Trichloropropene? as listed)	C_3H_5Cl	0x7C	Ethylamine	C_2H_7N
0x7D	Dimethylamine	C_2H_7N	0x7E	Odor Gas	—

■ APPENDIX 2 — UNIT CODES

Code	Unit	Description
1	%LEL	Lower Explosive Limit
2	ppm	Parts per million (international unit)
3	ppb	Parts per billion
4	%VOL	Percent by volume
5	umol/mol	Parts per million (domestic/China unit)
6	mg/m3	Mass per volume
7	ug/m3	Mass per volume
8	°C	Temperature
9	%RH	Humidity
10	m/s	Velocity
11	kPa	Pressure
12	lx	Light intensity
13	MPa	Pressure

■ APPENDIX 3 — DETECTED GAS PARAMETER LIST

Gas Name	Range (standard)	Accuracy	Resolution (standard)
Oxygen	0–30%VOL	±3%FS	0.1%VOL
Carbon Monoxide	0–1000ppm	±5ppm or ±10% (whichever is greater)	1ppm
Hydrogen Sulfide	0–100ppm	±2ppm or ±10% (whichever is greater)	1ppm
Nitric Oxide	0–250ppm	±5%FS	1ppm
Nitrogen Dioxide	0–20ppm	±5%FS	0.1ppm
Sulfur Dioxide	0–20ppm	±5%FS	0.1ppm
Carbon Dioxide	0–5%VOL	±(0.05+5% of reading)	0.01%VOL
Carbon Dioxide	0–5000ppm	±(0.05+5% of reading)	1ppm
Ozone	0–20ppm	±12%FS	0.1ppm

Ammonia	0–100ppm	±10%	1ppm
Hydrogen Fluoride	0–10ppm	±10%	0.1ppm
Hydrogen Chloride	0–50ppm	±10%	0.1ppm
Hydrogen Cyanide	0–50ppm	±10%	0.1ppm
Phosphine	0–20ppm	±10%	0.1ppm
Methyl Mercaptan	0–100ppm	±10%	1ppm
Formaldehyde	0–10ppm	±10%	0.1ppm
Benzene	0–100ppm	±10%	1ppm
Chlorine	0–50ppm	±10%	0.1ppm
Hydrogen	0–1000ppm	±10%	1ppm
Ethylene Oxide	0–100ppm	±10%	1ppm
Methane	0–5%VOL	±5%FS	0.01%VOL
Methane	0–100%VOL	±5%FS	1%VOL
Combustible Gas	0–100%LEL	±5%FS	1%VOL
Chlorine Dioxide	0–50ppm	±10%	1ppm
VOCs	0–100ppm	±10%	1ppm
VOC	0–100ppm	±10%	1ppm
Acetylene	0–100ppm	±10%	1ppm
Tetrahydrothiophene	0–50mg/m3	±10%	0.1mg/m3
Hydrogen Peroxide	0–100ppm	±10%	1ppm
Sulfuryl Fluoride	0–100ppm	±10%	1ppm
Carbon Disulfide	0–20ppm	±10%	0.1ppm

■ APPENDIX 4 — ALARM STATUS DEFINITION

Primary State	Bit State	Description
Bit15 = 0: warming up (lower 15 bits as a single integer)	Bit14–0	Output = warm-up countdown time; time = value × 0.1 s
Bit15 = 1: warm-up complete (lower 15 bits, per-bit flags)	Bit14	Reserved
	Bit13	Reserved
	Bit12	Reserved
	Bit11	Reserved
	Bit10	Reserved
	Bit9	Reserved
	Bit8	Reserved
	Bit7	Reserved
	Bit6	High-concentration protection
	Bit5	Sensor lost or damaged
	Bit4	Over-range
	Bit3	TWA alarm
	Bit2	STEL alarm
	Bit1	High alarm
	Bit0 (LSB)	Low alarm

■ APPENDIX 5 — STATE DEFINITION

Value	Description

0x0000	Module busy: warming up or executing a command
0x0001	Module idle / command executed successfully
0x0002	Execution failed
0x0003	Unsupported command
0x0004	Invalid parameter
0x0005	Execution timed out
0x0100	Executing command step 0
0x0101	Executing command step 1
0x0102	Executing command step 2
0x0103	Executing command step 3

■ APPENDIX 6 — COMMAND PARAMETERS

Value	Description
0x1000	Multi-point calibration, point 0; parameter value ignored
0x1001	Multi-point calibration, point 1; parameter = calibration concentration
0x1002	Multi-point calibration, point 2; parameter = calibration concentration
0x1003	Multi-point calibration, point 3; parameter = calibration concentration
0x1004	Multi-point calibration, point 4; parameter = calibration concentration
0x1005	Multi-point calibration, point 5; parameter = calibration concentration

■ APPENDIX 7 — SENSOR TYPE

Code	Sensor Name	Remarks
1	Catalytic combustible type	
2	Electrochemical (positive reaction)	
3	Electrochemical (negative reaction)	
4	Oxygen type	
5	Infrared type	
6	PID type	
7	Semiconductor type	
8	Thermal conductivity type	
9		