

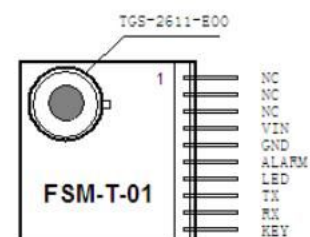
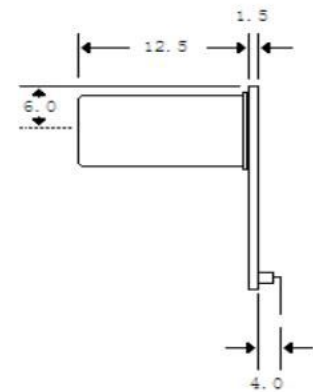
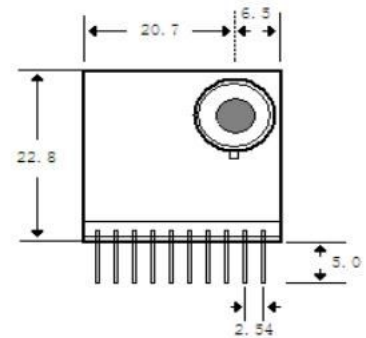
## FSM-T-01 User Manual

FSM-T-01 is a pre-calibrated module for methane gas alarm which applies TGS2611 sensor together with optimized classic circuit measuring methane gas concentration. The module is pre-calibrated by Figaro's highly accurate calibration equipment and manufactured with mature aging process. The purpose of the module design is to save the development and production cost of the user to its greatest extent, making it easier and more convenient for them to manufacture gas alarm for civil natural gas.

The module is designed with two different interfaces considering the convenience for use. TTL level's Universal Asynchronous Receiver Transmitter( UART ) allows the user to read real time gas concentrations with very simple commands;also different alarm thresholds can be set through communication programming. When the gas concentration reaches set value alarm output signal would be generated automatically from the alarm terminal. Besides, this compact sized module applies a socket type design which facilitates regular replacements of the sensors. For some main board, different modules can also be replaced simply by plugging and pulling out, fulfilling the functions of detection and alarming for methane and other gases.

### (1) Specifications:

Name	Methane gas sensor module	
Model	FSM-T-01	
Gas sensor	TGS2611-E00	
Range	0~20% LEL	
Accuracy	$\leq \pm 2.5\%$ LEL(4000ppm~5000ppm) $\leq \pm 5\%$ LEL(Full Scale)	
Response time (T90)	$\leq 30$ s	
Operating	-10°C~+55°C,25~95%RH	
Storage	-25°C~+60°C,20~95%RH	
Input Voltage	5.0±0.2V DC	
Power consumption	$\leq 0.5$ W	
Net weight	<15g	
Dimensions	27.2×22.8×17 mm	
Standard Test Conditions	Environment	20±2°C,65±5%RH
	Loop	5.0±0.2V DC
	Warming up	7 days



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## (2) Reference peripheral circuit and pin definitions

To output quantitatively the methane gas concentration through UART is the basic function of the module, meanwhile the logic signal output (user can set the alarm threshold by communication) of the concentration alarm is kept. The module is designed as a driven device in communication, so responds only when receiving reading or setting orders from the host. Considering some customers may need one-to-many communication (such as RS485), the module allows the host to distribute and save device addresses, also relevant reading or setting orders which include addresses are provided in protocol. The following figure can be regarded as a reference peripheral circuit for specific applications.

Notes:

D1: Alarm indicator (red LED) . Light out when concentration is normal, on if failure occurs and flashes once concentration exceeds limit.

D2: Work status indicator (green LED) . Flashes when sensor is being warmed up, on when accessing working state.

K1: Button for setting address. Press it to obtain the address code (see communication protocol) when the host is releasing broadcast address .

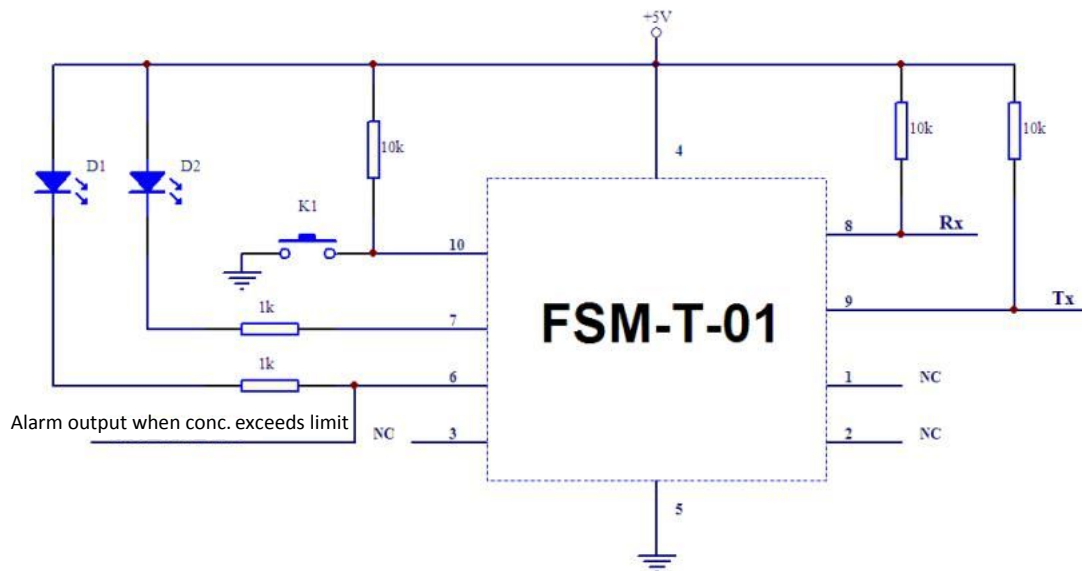
Rx: Module asynchronous communication input.

Tx: Module asynchronous communication output.

NC: Not connected.

Alarm output when conc. exceeds limit: Normal=logic "1", Alarm=logic "0"

Pin	Name	Description
1	NC	No connection
2	NC	No connection
3	NC	No connection
4	Vin	Voltage in
5	GND	Ground
6	Alarm	Alarm output
7	LED	Working status indicator
8	TX	Transmitting
9	RX	Receiving
10	KEY	Programming add. switch



Note: To prevent module failures from affecting the host to work properly, a Vin applying separate output short circuit protection is suggested

## (3) Communication Protocol

As described above, FSM-T-01 module (hereinafter referred to as device) appeared as a driven device in communication, thus the user end controller can be called host (or MCU)

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**(a) Attributes of communication port:**

Compatibility level	+5V
Baut rate	9600bps
Data bit	8
Check bit	NONE
Stop bit	1
Verflow control	NONE

**(b) Communication orders and responses**

**1) CMD=0xF0,0x08**

Description: Broadcast address is released, deveices contrlled by botton "K1"respond.

Host sends:

FrameStart		L	CMD		addr	FrameStop	
0xFF	0x55	0x04	0xF0	0x08	(Hex)	0xFF	0xAA

Correct responses from slave:

FrameStart		L	CMD		addr	FrameStop	
0xFF	0xAA	0x04	0xF0	0x08	(Hex)	0xFF	0x55

Exception response from salve: None

**2) CMD=0xF0,0x07**

Note: Set lower limit of alarm concentration (unit:ppm) ,"D1"will flash for several seconds once the set is done successfully.

FrameStart		L	CMD		Data		FrameStop	
0xFF	0x55	0x05	0x0F	0x07	dataL	dataH	0xFF	0xAA

Slave response: None

**3) CMD=0xF0,0x09**

Description: Set lower limit of alarm concentration (unit:ppm) per address released.

Host sends:

FrameStart		L	CMD		Addr	Data		FrameStop	
0xFF	0x55	0x06	0xF0	0x09	(Hex)	dataL	dataH	0xFF	0xAA

Correct responses from slave:

FrameStart		L	CMD		Addr	Data		FrameStop	
0xFF	0xAA	0x06	0xF0	0x09	(Hex)	dataL	DataH	0xFF	0x55

Exception response from salve: None

**4) CMD=0x0F,0x01**

Description: Specify address and read real time concentration values (Unit: ppm)

Host sends:

FrameStart		L	CMD		Addr	FrameStop	
0xFF	0x55	0x04	0x0F	0x01	(Hex)	0xFF	0xAA

Correct responses from slave:

FrameStart		L	CMD		Addr	Data		FrameStop	
0xFF	0xAA	0x06	0x0F	0x01	(Hex)	dataL	dataH	0xFF	0x55

Exception response from slave: None

## 5) CMD=0x0F,0x02

Description: Read thermistor value Rt (Unit: kΩ)。

Sensor temperature should be converted:  $^{\circ}\text{C} = 3500 * 298.15 / (3500 + 298.15 * \ln(Rt/4.7) - 273.15)$

Host sends:

FrameStart		L	CMD		FrameStop	
0xFF	0x55	0x03	0x0F	0x02	0xFF	0xAA

Correct responses from slave:

FrameStart		L	CMD		Data		FrameStop	
0xFF	0xAA	0x05	0x0F	0x02	dataL	dataH	0xFF	0x55

Exception response from slave: None

## 6) CMD=0x0F,0x03

Description: Specify address and read work status values (Unit: ppm)

Host sends:

FrameStart		L	CMD		Addr	FrameStop	
0xFF	0x55	0x04	0x0F	0x03	(Hex)	0xFF	0xAA

Correct responses from slave:

FrameStart		L	CMD		Addr	Data	FrameStop	
0xFF	0xAA	0x05	0x0F	0x03	(Hex)	status	0xFF	0x55

Exception response from slave: None

Notes: 1) status: =0, normal; =2, alarm; =8, sensor failure.

2) Data are integer binary data. Low bytes are before high bytes when transmitting.

Data = 256 \* DataH + DataL