SPECIFICATION

Product Name: Battery Thermal Runaway Monitoring Sensor

Item No.: ATRS-1011

Version: V0.3

Date: April 28, 2024

Revision

No.	Version	Content	Date
1	V0.1	Preliminary Version	2021/8/12
2	V0.2	Expand CO2 measurement range; add CAN information	2021/9/25
3	V0.3	Modification accuracy, delete the low-power mode	2024/4/28

Battery Thermal Runaway Monitoring Sensor

ATRS- 1011

Applications

- Safety Early Warning and Monitoring of Lithium-Ion Battery Thermal Runaway in New Energy Vehicles
- Safety Early Warning and Monitoring of Energy Storage Power Station

Description

ATRS- 1000 series sensors can effectively monitor CO_2+CO released before the thermal runaway trigger of lithium-ion batteries, as well as temperature and pressure, and transmit the measurement signal via CAN communication to new energy battery management system (BMS), to formulate safer early warning strategies. Cubic has mastered a variety of gas sensing and detection technologies. In view of the performance requirements of sensors for thermal runaway monitoring, such as fast response time, accurate measurement, less cross interference, long service life and low power consumption, Cubic innovatively combines non-dispersive infrared (NDIR) spectroscopy and MEMS metal oxide semiconductor technology (MOX), an integrated sensor solution integrating a variety of core sensor technologies is introduced, which can effectively and accurately measure combustible gas.

Features

- Adopting non-dispersive infrared (NDIR) spectroscopy technology with independent intellectual property rights:
  a. The accuracy for CO_2 can reach ± (200ppm or 20% reading, larger value as criteria) in the range of 0-10000ppm
  b. Response time T90 $<$ 15s
  c. No gas cross interference
  d. Lifetime up to 15 years
- Fully self-developed MEMS metal oxide semiconductor (MOX) technology and electronic nose technology is utilized to ensure high-selectivity on CO measurement:
  a. Anti-interference to temperature and humidity
  b. Stable measurement signal output
  c. The sensor measurement range can be expanded to variety of gases depending on vehicle manufacturer's battery thermal runaway research
- Vehicle-level circuit design can be suitable to the harsh vehicle environment
- CAN real-time communication; protection rate can reach IP65

Working Principle

Non-dispersive Infrared (NDIR) Spectroscopy Technology

The gas to be measured produces strong absorption of infrared at a particular wavelength, and according to Lambert-Bill's law, spectrum absorption has high correlation with gas concentration, commonly referred to as non-dispersive infrared (NDIR) technology. The infrared light source radiates infrared light, and the infrared light passes through the measured gas in the optical path and the narrow band filter, then reaches the infrared detector. By measuring the intensity of the infrared light entering the infrared detector, the concentration of the measured gas can be calculated. The basic principle and structure of the sensor are shown in the figure 1 below:

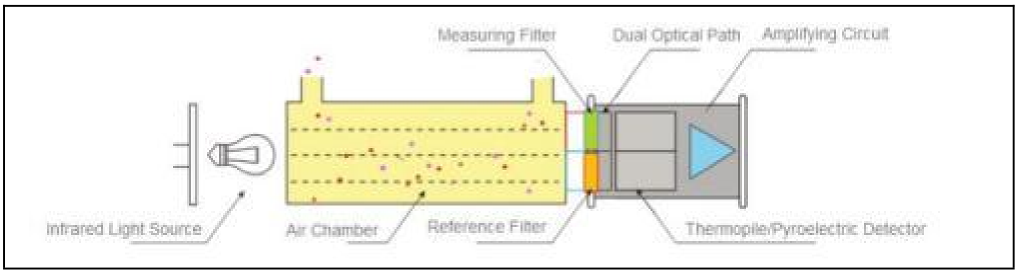


Figure 1 Non-dispersive Infrared (NDIR) Technology

Compared with electrochemical, catalytic combustion, solid electrolyte, semiconductor gas sensor technology, NDIR sensor has the following advantages: good selectivity, anti-aging against harmful gas poisoning, fast response, good stability, high signal-to-noise ratio.

Metal Oxide Semiconductor (MOX)Technology

The MOX technology detection principle is that under certain temperature, the measured gas reaches the surface of the metal oxide semiconductor gas-sensitive material and chemically reacts with the oxygen on the surface of the metal oxide semiconductor along with charge transfer, which in turn causes a change in the resistance of the metal oxide semiconductor. By measuring the change in the resistance of the oxide semiconductor can realize gas detection. The basic principle is shown in figure 2 below:

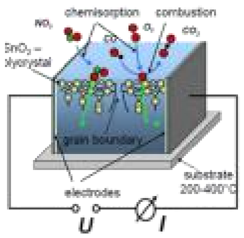


Figure 2 Metal Oxide Semiconductor (MOx)Technology

Metal oxide semiconductor gas sensitive sensors use Micro-Electro-Mechanical System technology (MEMS) film-forming process to accumulate metal oxide sensitive layers on the ceramic substrate, using platinum resistors under sensitive layers (which can be heated and for temperature measuring) as heaters, and diodes as temperature measuring elements. At present, the sensor based on the "sandwich" structure can realize the compatibility and processing of MEMS process, and solve the problems of poor compatibility, and complex device structure of traditional solid electrolyte gas sensor.

Specifications

ATRS1000 Series Sensor Specification	
Operating Principle	CO_2: Non-dispersive Infrared Spectroscopy Technology (NDIR) CO: Metal oxide semiconductor technology（MOX） Pressure: MEMS Temperature: Thermistor(NTC）
Measurement Type	CO_2、CO、Temperature、Pressure（can be customized for CH4 or H2）
Measurement Range	CO_2: 0ppm-10000ppm（can display to 60000ppm） CO：0-1000ppm（can display to 3000ppm） Pressure：80kPa~120kPa Temperature：-40˚C~125˚C
Resolution	1ppm
Working Condition	-40˚C~+85˚C； 0~99%RH（non-condensing）
Storage Condition	-40˚C~+110˚C； 0~99%RH（non-condensing）
Accuracy	CO2: ±200ppm or ±20% reading, larger value as criteria. CO: ±40ppm or ±30% reading, larger value as criteria. Pressure① : ±0.1kPa Temperature② : ±2˚C
Response time	T90＜15s
Data Refresh	≤1s
Power supply	9~16VDC, standard voltage +12VDC
Working current	≤100mA @+12VDC(24hrs on-line monitoring supportive)
Dimensions	W76.8mm*H59.2mm*D19.5mm
Signal Output③	CAN/UART/LIN/Analog Output
Design Lifetime	>15 years

Note:

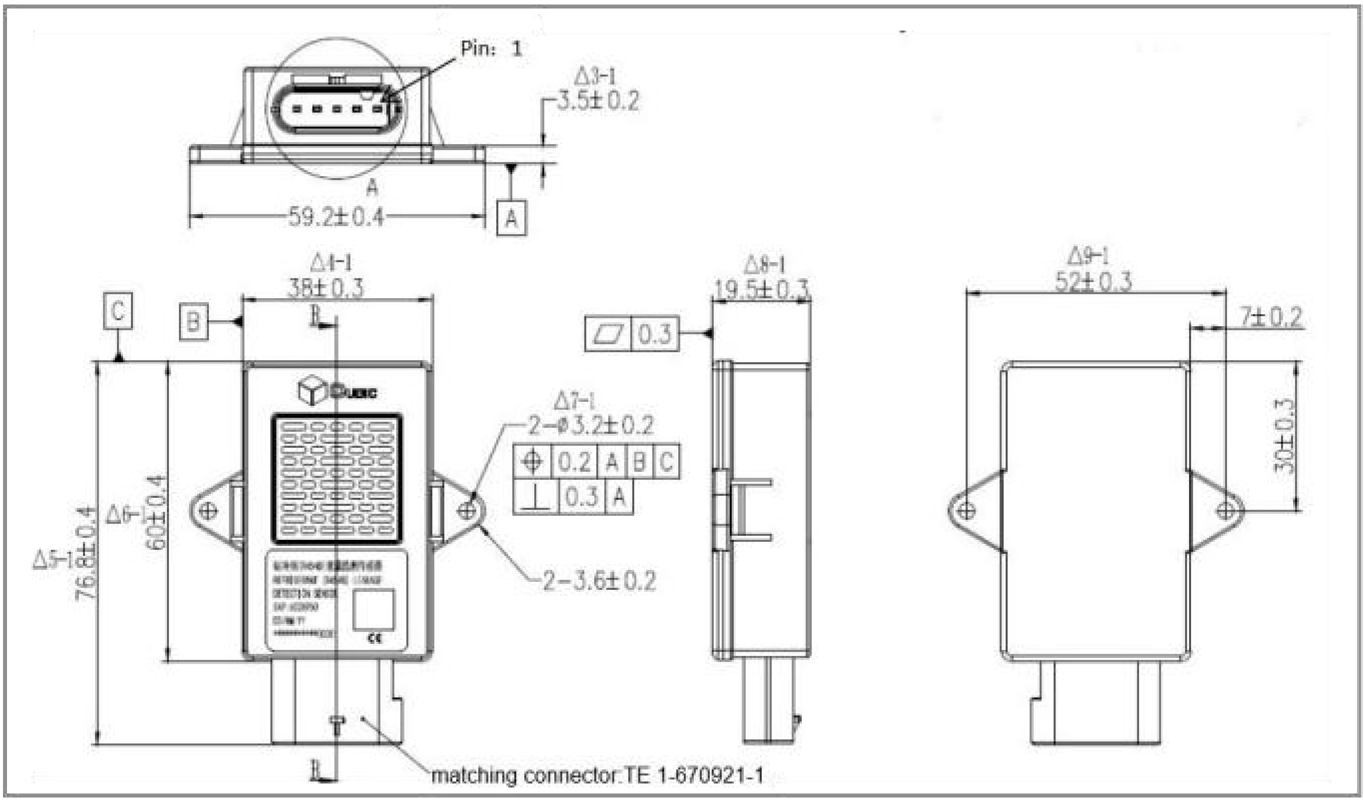
①: Sensor pressure measurement accuracy is based on 0℃~85℃ temperature range and 60kPa~165kPa pressure range, for other working condition range, accuracy is ±2kPa

②: Sensor output temperature is sensor's internal temperature, not environment temperature

③: Sensor default communication is CAN, other communication protocol can be customized

Product Dimensions and Connector

1. Dimensions (Unit mm, tolerance as below shown)



2. Pin Definition

Pin	Name	Description
1	Power	Power Input（+12V）
2	CAN_H	CAN High
3	CAN_L	CAN Low
4	GND	Power Output (Ground)
5	Reserve	Reserve

3. Connector Specification

Item	Part Number	Pitch	Recommendation Manufacturer
Matching Connector	TE 1-1670921-1	4 mm	TE

1. CAN Communication

Name	Parameter
CAN Interface	CAN ISO
CAN Version	2.0a
CAN Baud rate	500k
CAN ID	0x020

2. CAN Communication Protocol

Sensor	Message ID 11 bits	Signal name	Description	Signal Length	Min (phys,dec)	Max (phys,dec)	Resolution
ATRS-1011	0x20	CO2_concentration	CO2 concentration, which value is (Byte0*256+Byte1) ppm.	2 Byte	0	60000	1
		Pressure	Pressure value of air in sensor, which value is (Byte2*256+Byte3)/10 kPa.	2 Byte	800	1200	0.1
		Temperature	Temperature value of sensor PCB board, which value is (Byte4*256+Byte5)/100 ℃.	2 Byte	-4000	12500	0.01
		CO_concentration	CO concentration, which value is (Byte6*256+Byte7) ppm.	2 Byte	0	3000	1

After-Sales Services and Consultancy

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