Ultrasonic Oxygen Concentration and Flow Detection Module

BM62S5601-1

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Features

- Oxygen measurement features
  - Measurement range: 21%~95.6%
  - Resolution: 0.1%
  - Accuracy: ±1.8% @ 5℃~45℃
- Flow measurement features
  - Measurement range: 0L/min~10L/min
  - Resolution: 0.1L/min
  - Accuracy: Take the larger one between ±0.2L/min and 5% of a read value @ 5℃~45℃
- LED output interface
  - Green: 82%≤oxygen concentration
  - Yellow: 50%<oxygen concentration<82%
  - Red: oxygen concentration≤50%
- Operating current
  - Average operating current: <5mA @ 5V
  - Transient emission current: <45mA @ 5V
- Operating voltage range: 4.75V~13.2V
- Temperature range: 5℃~50℃
- Communication interface: UART 9600bps, 8-N-1
- Integrates temperature compensation
- Factory calibration

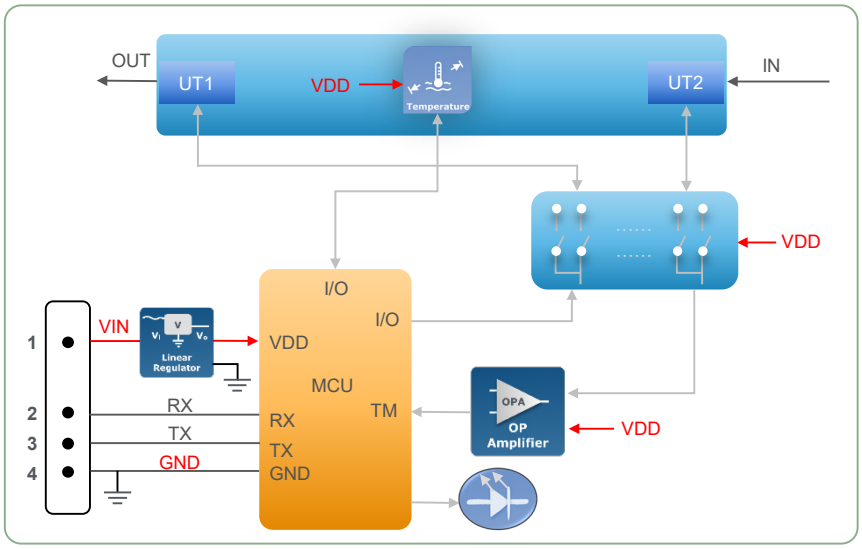
General Description

The BM62S5601-1 is a detection module for the detection of oxygen concentration and flow in binary gas mixtures based on the ultrasonic detection technology. By detecting the forward and reverse flight time of the ultrasonic signal in the airflow tube and using the relevant algorithms, the oxygen concentration and flow value are output directly via the UART interface. The module integrates a temperature compensation function used to improve the module detection accuracy. The module has the characteristics of rapid response, high accuracy, factory calibration and long life.

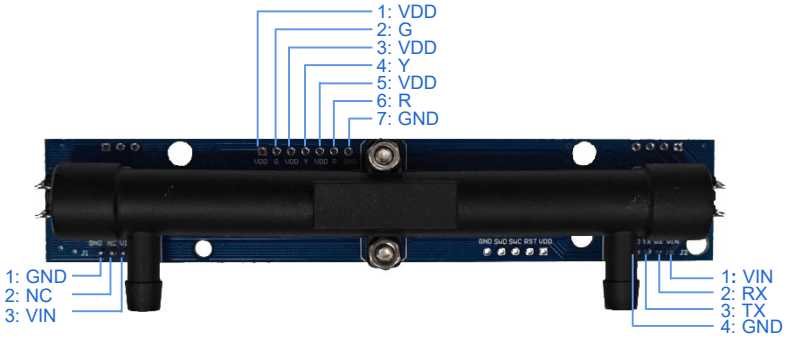
Applications

- Oxygen making machines
- Oxygen making chambers
- High-flow oxygen therapy equipments

Block Diagram



Pin Assignment



Port Description

Port No.	Type	Description
J1	PH2.0-3P	Power supply input ports
J1-0	2.54-3P	Power supply input ports
J2	PH2.0-4P	Digital signal output ports
J2-0	2.54-4P	Digital signal output ports
J3	2.54-7P	Programming ports
J4	2.54-7P	LED output portd, reserved

Pin Description

J1	Function	Type	Description
1	GND	PWR	Negative power supply, ground
2	NC	—	—
3	VIN	PWR	Module positive power supply

J2	Function	Type	Description
1	VIN	PWR	Module positive power supply
2	RX	I	Module UART receive pin
3	TX	O	Module UART transmit pin
4	GND	PWR	Negative power supply, ground

J3	Function	Type	Description
1	VDD	PWR	MCU positive power supply
2	G	O	Green LED output, $O_2 \geq 82\%$
3	VDD	PWR	Positive power supply
4	Y	O	Yellow LED output, $50\% < O_2 < 82\%$
5	VDD	PWR	Positive power supply
6	R	O	Red LED output, $O_2 \leq 50\%$
7	GND	PWR	Negative power supply, ground

Legend: PWR: Power; I: Digital input; O: Digital output

Technical Specifications

Absolute Maximum Ratings

Power Supply Voltage ..... GND-0.3V~GND+13.5V

Input Voltage ..... GND-0.3V~V_{IN}+0.3V

Storage Temperature..... -20°C~65°C

Operating (Ambient) Temperature ..... 0°C~50°C

Total Current ..... <45mA @ 5.0V

Note: Here emphasises the module maximum tolerable parameters only. The “Absolute Maximum Ratings” only represents the parameter range that will not cause damage to the module, and does not represent that it can operate normally within this range. Functional operation of the devices at other conditions beyond those listed in the specification is not implied and prolonged exposure to extreme conditions may affect module reliability.

Recommended Operating Conditions

For optimum module performance, it is recommended that the module is operated within a temperature range of 5°C~50°C and that the gas in the pipeline is free of water vapour or freezing.

D.C. Electrical Characteristics

Ta=25°C, V_{IN}=5V

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
V_{IN}	Operating Voltage	—	4.75	5.00	13.20	V
V_{DD}	MCU Operating Voltage	—	—	3.3	—	V
I_{DD}	Average Operating Current	V_{IN}=5V	—	4.5	—	mA
V_{IL}	Input Low Voltage	V_{IN}=5V, V_{DD}=3.3V	-0.5	—	0.35V_{DD}	V
V_{IH}	Input High Voltage	V_{IN}=5V, V_{DD}=3.3V	0.65V_{DD}	—	V_{DD}+0.5	V
Vu	UART Interface Voltage	—	—	3.3	—	V

A.C. Electrical Characteristics

System Timing

Ta=25°C, V_{DD}=5V

Symbol	Parameter	Test Conditions	Min.	Typ.	Max.	Unit
t_{RE}	Detection Period	—	—	500	—	ms
t_{PU}	Power-on Time	Starting from V_{IN}≥4.75V to communication allowed	—	220	—	ms

Module Detection Characteristics

V_{DD}=5V

Parameter	Test Conditions	Min.	Typ.	Max.	Unit
Oxygen Concentration Measurement Range	—	21	—	95.6	%
Oxygen Concentration Accuracy	Ta=5°C~45°C	-1.8	—	1.8	%
Oxygen Concentration Resolution	—	—	0.1	—	%
Flow Measurement Range	—	0	—	10	L/min
Flow Accuracy	Ta=5°C~45°C	-0.2	—	0.2	L/min
		—	—	5%×read value	
Flow Resolution	—	—	0.1	—	L/min

Note: Take the larger one between ±0.2L/min and 5% of a read value as the flow measurement accuracy.

Functional Description

System Description

The BM62S5601-1 module includes two ultrasonic transducers, an airflow tube, an MCU, a signal processing circuit, an analog switch IC, a communication interface and a high-accuracy temperature sensor, which is used for oxygen concentration detection and flow detection. The MCU outputs a 40kHz excitation dipulse which passes through the analog switch IC and then controls two ultrasonic transducers to transmit and receive respectively. The received ultrasonic signal is amplified by the OPA and then output by the comparator. The flight time is calculated by the MCU. The temperature is measured using the high-accuracy temperature sensor. The oxygen concentration and flow are calculated using the relevant algorithms, then output via the UART interface.

Operating Principle

After the system has been powered on and initialized for about 210ms, an ultrasonic aignal detection is taken. Use the analog switch IC to respectively control two ultrasonic transducers to transmit and receive the ultrasonic signal. Detect the forward and reverse flight time of the ultrasonic signal in the airflow tube. The system performs a detection every 500ms. Using high-accuracy temperature compensation and algorithms, the current oxygen concentration and flow in the airflow tube can be calculated and output via the UART interface. By default, the module automatically sends data every 500ms.

Communication Interface

The BM62S5601-1 uses the UART interface for communication. The module automatically sends a frame of data to the outside about 0.5s by default and does not support sending an enquiry command to read data. The communication protocol details are described below.

Communication Protocol

Baud rate: 9600bps, 8-N-1 format; two-byte data is a high byte first and a low byte last.

Module Response Frame Format

Frame Header +Length+Command Code+Data 1+.....+Data n+ Checksum

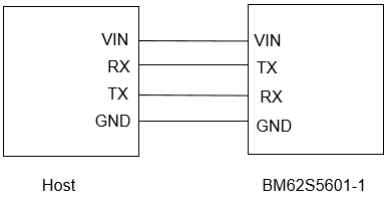
Frame Header Head	Length LEN	Command Code CMD	Data DATA	Checksum CS
0x16	0x09	0x01	—	—
1-byte	1-byte	1-byte	n-byte	1-byte

- Length (LEN)=Number bytes of Command Code (CMD) and Data (DATA)
- Checksum (CS)=0-(Frame Header+Length+Command Code+Data)
- It is recommended that the UART baud rate error of the host communicating with the module should not exceed 2%

Command Description

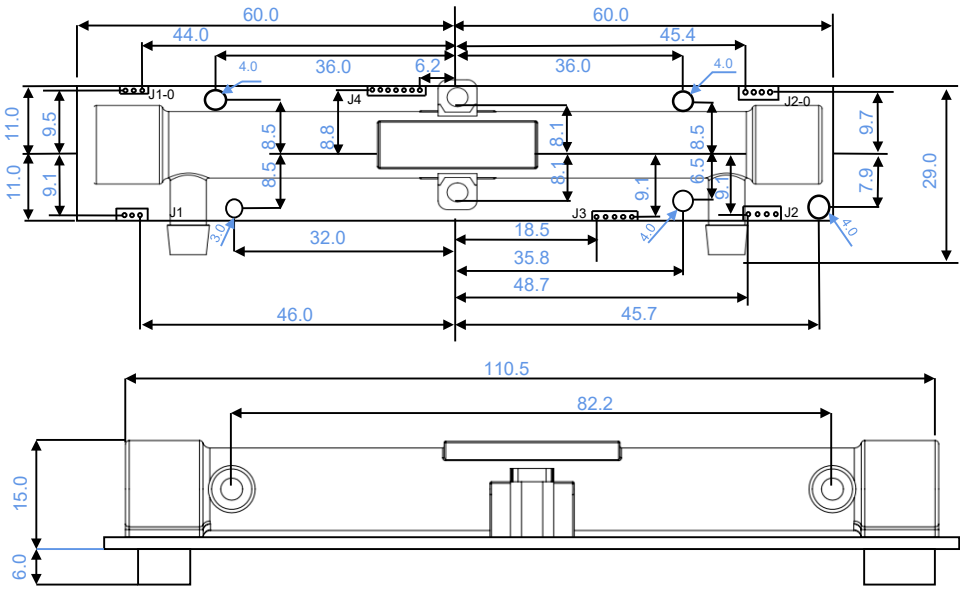
Data		Description
Module sends data automatically	DATA[0]	Oxygen concentration high byte
	DATA[1]	Oxygen concentration low byte
	DATA[2]	Flow high byte
	DATA[3]	Flow low byte
	DATA[4]	Temperature high byte
	DATA[5]	Temperature low byte
	DATA[6]	00
	DATA[7]	00
	DATA[8]	CS
Example: Receive: 16 09 01 00 D2 00 00 00 C8 00 00 46 Convert to decimal: D2 is 210; C8 is 200. The data should be divided by 10 to be a valid data. O_2 concentration=0×256+210=210 (21.0%) O_2 flow=0×256+0=0 (0L/min) O_2 temperature=0×256+200=200 (20.0°C)		

Application Circuits



Dimensions

Unit: mm, tolerance±0.2mm



Reference Information

Revision History

Date	Author	Issue	Modification Information
2024.10.17	陳美玲	V1.00	First Version

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