SPECIFICATION

Product Name: DLCO Gas Sensor

Item No.: Gasboard-2050

Version: V0.1(Preliminary)

Date: 2021-6-30

Revision

No.	Version	Content	Date
1	V0.1	Preliminary Version	2021-6-30

DLCO Gas Sensor

Gasboard-2050

Applications

▪ Pulmonary Diffusion Function Test

▪ Lung Function Analyzer, including Animal Lung Function Diagnosis

▪ Laboratory and Medical Equipment Analytical Instrument

Description

Gasboard-2050 is a gas concentration detection sensor based on non-dispersive infrared technology, which has the characteristics of high precision and fast response. Gasboard-2050 sensor uses ultra-fast modulation frequency and special detection circuit to improve the accuracy, stability, and anti-interference of the measurements. With microcontroller processing, it achieves the functions of gas sampling signal processing, sensor calibration, and measurement output. It realizes the fast and accurate measurement of the ultra-low range gas CH4 ,CO and meets the requirements of the automatic volumetric DLCO measurement.

Features

▪ Mechanical chopper modulation

▪ Fast response (T10~T90 <300 ms @ 1L/min flow rate)

▪ Excellent stability, high accuracy ($\pm$1%FS)

▪ Anti- interference (5%CO2 impact on CO is±1%FS, 5%CO2 impact on CH4 is±2%FS)

▪ Pressure sensor optional for CH4 signal output pressure compensation

▪ Simple structure, easy maintenance

■ 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:
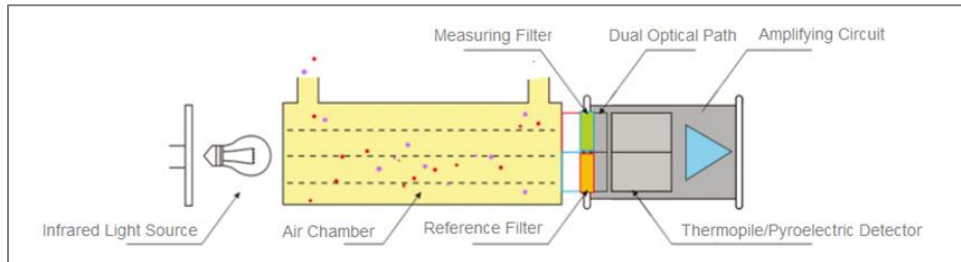

Figure 1 Non-dispersive Infrared (NDIR) Technology

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.
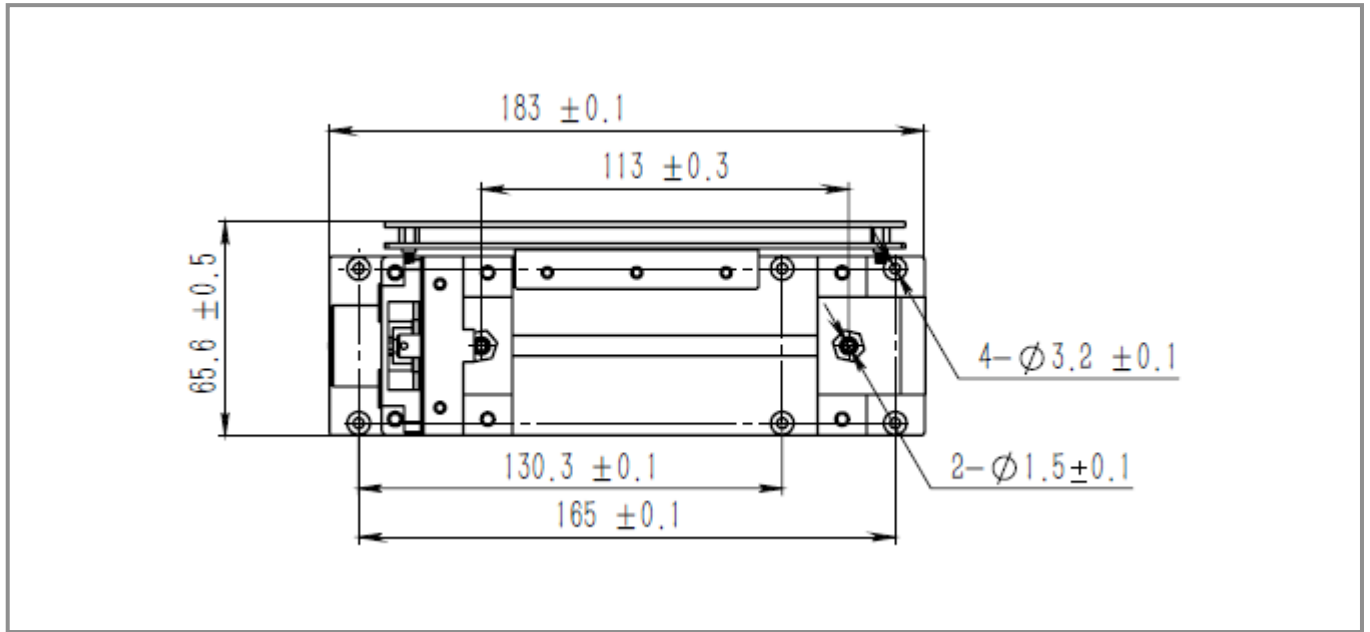
Specification

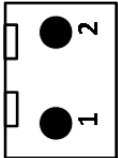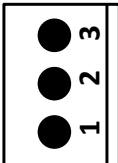| General Performance			
Operating Principle	NDIR		
Measuring Target[1]	CO	CH4	CO2
Measurement Range[2]	0~3500ppm(0~0.35%vol)	0~3500ppm(0~0.35%vol)	0~5%vol (up to 10% available)
Accuracy[3]	±1%FS	±1%FS	±1%FS
Resolution	1ppm	1ppm	10ppm
Warm-up Time	>30 min		
Response Time	T_{10}-T_{90}<300ms @ 1L/min T_{10}-T_{90}< 450ms @ 500mL/min		
Output Frequency	16Hz		
ADC Sampling Frequency	10K Hz for four channels, each channel is 2.5K Hz		
Digital output	Serial interface UART (TTL or RS232 level)		
Dimension	W183*H65.6*D70(mm)		
Environmental Condition and Power Supply			
Working Condition	0~+45℃,0-90%RH (non-condensing)		
Working Pressure[4]	750mBar ~1150mBar		
Power Supply	±12V DC		

Notes:

[1]   Gas pretreatment requirements: Soot and dust size after filtration < 0.5μm.

Moisture separation: Condensed water should be fully separated, and the condensed water cannot be allowed to enter the sample gas chamber and the associated gas pipeline.

[2]   CO effective measurement range is 0~3000ppm, CH4 effective measurement range is 0~3000ppm.

[3]   Calibration is needed before every test. Before the test, the sensor needs to be warmed up for more than 30 minutes, and after the warm-up completed, perform zero calibration and span point calibration according to the communication protocol.

[4]   Pressure sensor optional for CH4 signal output pressure compensation

Dimensions and Connector

1. Dimensions (Unit mm)

2. Pin Definition

No.	Location	Pin No.		Description
1	J1		1: GND 2: +12V	DC±12V Power Supply
2	J5		1: RX(RS232) 2: TX(RS232) 3: GND	Serial Output Interface

3. Connector Specification

Item	Part Number	Pitch	Recommended Manufacturer
Connector (J1)	1-1123723-2	3.96 mm	TE
Matching Connector(J1)	2132781-2	3.96 mm	TE
Connector(J5)	640454-3	2.54 mm	TE
Matching Connector(J5)	1375820-3	2.54 mm	TE

Communication

1. Summary of Protocol

1) Serial port baud rate: 115200, DataBits: 8, StopBits: 1, Parity: No. In this protocol, the model will not send data to host computer actively, only respond with the corresponding data after the host computer sends command.

2) The data herein are in hexadecimal. For example, [46] is the decimal 70.

3) [XX] is single-byte data (unsigned, 0-255); (xx) is double-byte data, signed (-32768 to +32767), with the higher byte in front of low byte. "--" is followed by annotation.

4) All data are integers, and may have a corresponding relationship of (100, 10, 1) times with the actual displayed data (related to specific benches).

5) Byte length of the entire command [LB]+3.

6) Gas refers to the name of gas, such as CO, CH4, CO2, etc., which is filled in according to the actual test gas of the product

2.Communication Format

Send： [IP] [LB] [CMD] [DF] [CS]

[IP] = 0x11   Address（Fixed is 11）。

[LB]   The followed byte length does not include CS

[CMD]   Command Number

[DF]   The parameters of the command, optional parameter

[CS]   CS=256－[(START+LENGTH+CMD+DATA)%256]

Response：

1) When the command is executed correctly, response

[ACK] [LB] [CMD] [DF] [CS]

[ACK] = 0x16   Command is correctly

[LB]   The followed byte length does not include CS

[CMD]   Command Number

[DF]   The parameters of the command, optional parameter

[CS]   CS=256－[(START+LENGTH+CMD+DATA)%256]

2) When the command is not executed correctly, response

[NAK] [LB] [CMD] [EC] [CS]

[NAK]= 0x06   Command is not executed correctly

[LB] = 2   The followed byte length does not include CS

[CMD]   Command Number

[EC]   Incorrect code in which the command was not executed

[CS]   CS=256－[(START+LENGTH+CMD+DATA)%256]

[EC]

Status Value	Description
0x01	CS Check incorrect
0x02	No this CMD, the lower computer will reply this error if it receives an unrecognized CMD
0x03	Incorrect data length
0x04	The data of saved setting is out of range or the type of reading does not exist

Communication

2. **Function Table**

Function	CMD	Function Description
Read Data		
Read Real Time Data	0x01	
Auto Reading Data	0x07	
Gas Calibration		
Zero Calibration	0x4B	
Span Point Calibration	0x4C	
Information Query		
Query Software Version	0x1E	
Query Instrument Number	0x1F	

3. Detail Description

3.1 Read Data

4.1.2 Read Real Time Data

Send：11 01 **01** ED

Response：16 07 01 [DF1] [DF2] [DF3] [DF4] [DF5] [DF6] [CS]

Function：query measurement results

Explain：

1) (CO)=[DF1] *256+[DF2]; (CH4) = [DF3] *256+[DF4]; (CO2) = [DF5] *256+[DF6]. (CO) (CH4) (CO2) are signed integer of 16 bits, with the highest bit being the signed bit. In the process of using, negative numbers may appear, such as "0xFF, 0xFF" (decimal: -1). This is because zero drift may occur in the process of using the instrument, in which negative drift may also occur. When the drift does not exceed the allowable range, the negative number can be considered as "0". When the drift exceeds the range, it indicates need "user calibration". The negative number here only serves as a "gas calibration" indicator.

Identification	Decimal System	Value	
(CO)	0 - 3000	0–3000	ppm vol
(CH4)	0 - 3000	0–3000	ppm vol
(CO2)	0 - 5000	0–5.000%	% vol

2) The actual concentration of CO2 is 10 times of the uploaded concentration.

For example：

Send：11 01 01 ED

Response: 16 07 01 0B B8 0D AC 13 88 CB

(CO) = 0x0BB8，the corresponding concentration value is 3000ppm,

(CH4) = 0x0DAC, the corresponding concentration value is 3500ppm,

(CO2) = 0X1388, the corresponding concentration value is 5.000%

4.1.2 Auto Reading Data

Send：11 02 **07 [TVM]** CS

Response：16 07 01 [DF1] [DF2] [DF3] [DF4] [DF5] [DF6] [CS]

Function：set auto reading data

Explain：

[TVM] select to turn off / on data auto response, and the data format of auto response is the same as that of 01

Communication

command

TVM	Description
0	Not auto respond with real-time data (default)
1	Auto respond with real-time data

For example：

Send： 11 02 07 01 E5

Response： [18:32:41.675] receiving←◆16 07 01 0B B8 0D AC 13 88 CB

[18:32:41.875] receiving←◆16 07 01 0B B8 0D AC 13 88 CB

If need to stop the active response of data, send the command 11 02 07 00 E6

4.2 Gas Calibration

After the instrument has been used for a period of time, due to the change in environmental conditions, it is necessary to calibrate the model regularly.

4.2.1 Zero Calibration

Send： 11 04 **4B** [TVM] [DF1] [DF2] [CS]

Response： 16 01 **4B** 9E

Function： Zero calibration of the sensor

Explain:

1) [TVM] Indicates the gas calibration bit

TVM	Description
0	Calibration for CO
1	Calibration for CH4
2	Calibration for CO2

2) [DF1] [DF2] Concentration values of calibration gases. [DF1] *256+[DF2] constitutes a 16-bit signed integer. This instruction is zero calibration, [DF1] [DF2] is 0.

3) Before this command is executed, zero gas must be fed into the sensor until the gas is stable, then send this command.

For example： Calibrate CO zero point

Send： 11 04 4B 00 00 00 A0

Response： 16 01 4B 9E

Explain:

Calibration value =0x0000, convert to decimal 0, the current CO calibration gas concentration is 0ppm.

4.2.2 Span Point Calibration

Send： 11 04 **4C** [TVM] [DF1] [DF2] [CS]

Response： 16 01 **4C** 9D

Function： Span point calibration of the sensor

Explain:

1） [TVM] is the gas calibration indicator bit. 0 represents the calibration of the first component, 1 represents the calibration of the second component, and so on.

TVM	Description
0	Calibration for CO
1	Calibration for CH4
2	Calibration for CO2

Communication

2）[DF1] [DF2] Concentration values of calibration gases. [DF1] *256+[DF2] constitutes a 16-bit signed integer.

Identification	TVM	[DF1] [DF2]	Value	
(CO)	0	2500-3000	2500-3000	ppm vol
(CH4)	1	2500-3000	2500-3000	ppm vol
(CO2)	2	4000-5000	4.000-5.000 %vol	

3) Before executing the command, the sensor must be fed with the gas with the same concentration, and the command must be sent after the gas is stable.

4) Zero crossing calibration should be carried out before calibration of range point.

5) The input value of CO2 calibration is the actual concentration value * 0.1. For example, if 5.000% CO2 is used for CO2 range point calibration, the actual input value is 5000.

For example：Calibrate the span point of CO：

Send： 11 04 4C 00 0B B8 DC

Response： 16 01 4C 9D

Explain:

Calibration value =0x0BB8 convert to decimal to 3000, the current GSA calibration gas concentration is 3000ppm.

4.3 Information Query

4.3.1 Query Software Version

Send： 11 01 1E D0

Response： 16 0C 1E [DF1] [DF2] [DF3] [DF4] [DF5] [DF6] [DF7] [DF8] [DF9] [DF10] [DF11] [CS]

Function： Query software version

Explain:

[DF1] - [DF11] is ASCLL code.

For example

Send： ： 11 01 1E D0

Response： 16 0C 1E 53 30 33 30 2E 30 31 2E 36 35 31 81

Explain:

Version number =53 30 33 30 2E 30 31 2E 36 35 31H, convert to ASCII code，

"S030.01.651", so the software version number is "S030.01.651".

4.3.2 Query Instrument Number

Send: 11 01 1F CF

Response: 16 0B 1F [DF1] [DF2] [DF3] [DF4] [DF5] [DF6] [DF7] [DF8] [DF9] [DF10] [CS]

Function: Query instrument number

Explain:

[DF1] [DF2]、[DF3] [DF4]、[DF5] [DF6]、[DF7] [DF9]、[DF9] [DF10], combined into high and low bytes respectively, Convert to 4-bit decimal number, total 5 groups, forming 20 digit number.
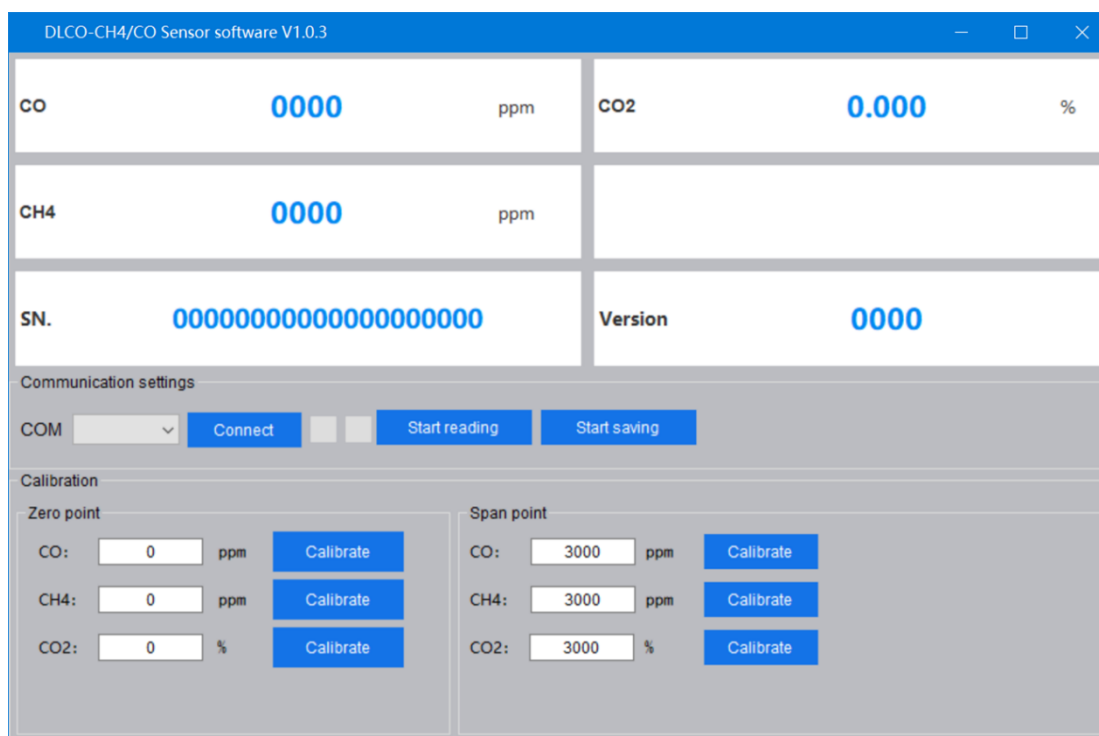
For example

Send: 11 01 1F CF

Response: 16 0B 1F 04 D2 09 29 0D 80 11 D7 1A 85 A4

The corresponding instrument number is 1234-2345-3456-4567-6789

Communication

Software for value reading, calibration and data recording is available to be offered.

Software Interface Demonstration

Please contact Cubic team to get the software at info@gassensor.com.cn.

After-Sales Services and Consultancy

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