SPECIFICATION

Product Name: DLCO Gas Sensor

Item No.: Gasboard-2050

Version: V0.1(Preliminary)

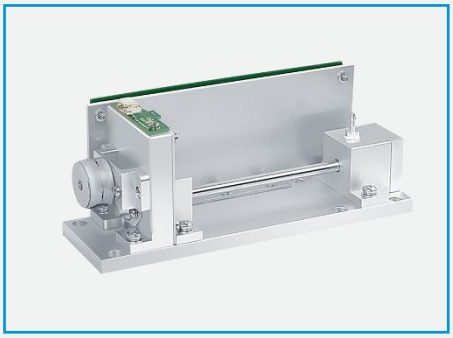
Date: 2021-6-30

Revision

No.	Version	Content	Date
	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 sensor for CO, CH4 and CO2 concentration measurements which is based on non-dispersive infrared technology and with the advantages of high precision and fast response. Gasboard-2050 sensor uses an ultra-fast modulation frequency and a special detection circuit to improve the accuracy, stability and anti-interference ability 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 for the light source with excellent stability
- Four-channel detector for CO2, CO, CH4 and reference channel
- Fast response (T90 < 300 ms @ 1L/min flow rate)
- Excellent stability, high accuracy (±1%FS)
- Simple structure, easy maintenance

Working Principle

Non-dispersive Infrared (NDIR) Spectroscopy Technology

The gas to be measured produces strong absorption of infrared at a specified 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 which passes through the measured gas in the optical path and a narrow band filter, then reaches the infrared detector. By measuring the intensity of the infrared light arriving at 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:

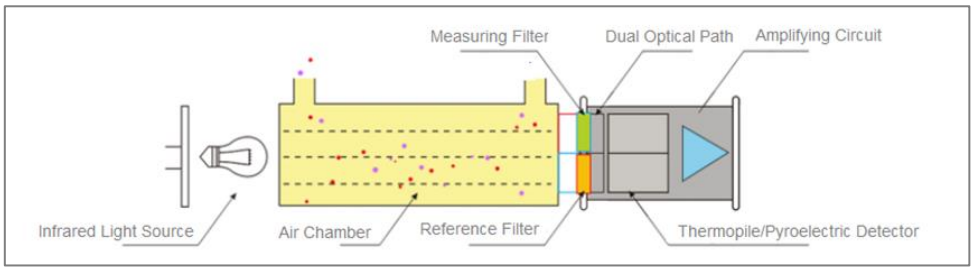


Figure 1 Non-dispersive Infrared (NDIR) Technology

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 and high signal-to-noise ratio.

Specification

General Performance			
Operating Principle	NDIR		
Measuring Target [1)]	CO	CH4	CO2
Measurement Range	0~3500ppm(0~0.35%vol)	0~3500ppm(0~0.35%vol)	0~10%vol
Accuracy [2)]	±1%FS	±1%FS	±1%FS
Resolution	1 ppm	1 ppm	10 ppm
Warm-up Time	30 min		
Response Time	T90 < 300ms @ 1L/min T90 < 450ms @ 500mL/min		
Output Frequency	16Hz		
Digital output Serial interface	UART (TTL and RS232)		
Dimension	W183*H65.6*D70(mm)		
Environmental Condition and Power Supply			
Working Condition	0~+45℃,0-90%RH (non-condensing)		
Working Pressure	750mBar ~1150mBar		
Power Supply	12V DC		

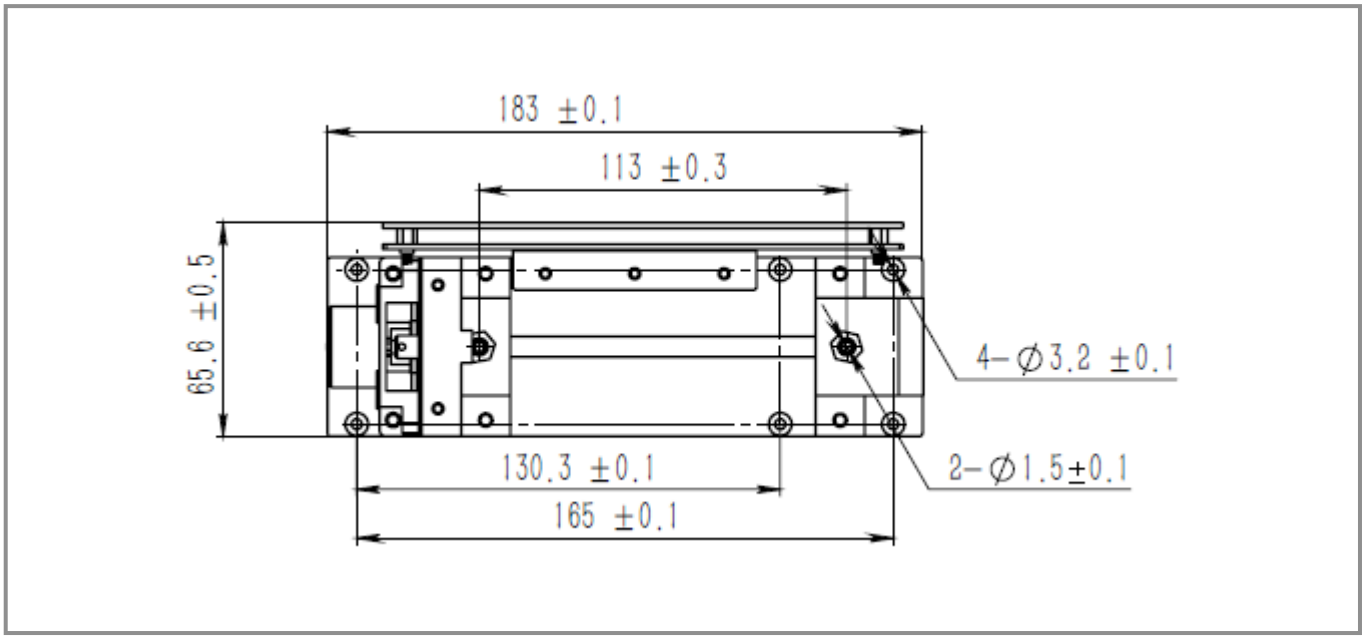
Note:

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.

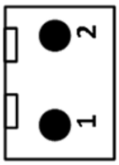
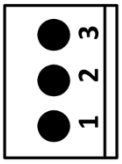
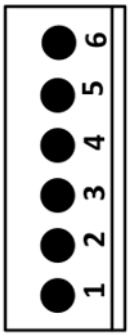
2) Calibration is required before every test. Before the test, the sensor needs to be warmed up for at least 30 minutes. After warming up completed, perform zero point and span point calibration by sending commands according to the communication protocol.

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	J4	 1: RX(RS232) 2: TX(RS232) 3: GND	RS232 Serial Interface
3	P9	 1: +3.3V 2: MUL1 3: MUL2 4: TX(TTL) 5: RX(TTL) 6: GND	TTL Serial Interface

Dimensions and Connector

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(J4)	640454-3	2.54 mm	TE
Matching Connector(J4)	1375820-3	2.54 mm	TE

Communication

1. Summary of Protocol

1) Serial port baud rate: 115200, Data Bits: 8, Stop Bits: 1, Parity: No. Please note that the sensor does not send data to host computer actively and only sends response data to host computer when it receives correctly commands.

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 ahead of low byte.

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).

2. Communication Format

2.1 Message Frame

Host computer send:

START	LENGTH	CMD	DATA	CS
IP	LB	CMD	DF	CS

Sensor response:

START	LENGTH	CMD	DATA	CS
ACK	LB	CMD	DF	CS
NAK	LB	CMD	EC	CS

2.2 Description of Message Frame

Send	[IP] [LB] [CMD] [DF] [CS]
[IP] = 0x11	Sensor address, fixed to 0x11
[LB]	Length of bytes. The followed byte length does not include CS
[CMD]	Command Number
[DF]	The parameters of the command, optional parameter
[CS]	Checksum. CS=256－[(START+LENGTH+CMD+DATA)%256]

1) When the command is executed correctly,

Response	[ACK] [LB] [CMD] [DF] [CS]
[ACK] = 0x16	Command is correctly
[LB]	Length of bytes. The followed byte length does not include CS
[CMD]	Command Number
[DF]	The parameters of the command, optional parameter
[CS]	Checksum. 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	Length of bytes. The followed byte length does not include CS
[CMD]	Command Number
[EC]	Error code in which the command was not executed
[CS]	Checksum. CS=256－[(START+LENGTH+CMD+DATA)%256]

Error Codes:

Status Value	Description
0x01	Checksum error
0x02	Command incorrect.
0x03	Data length incorrect
0x04	Data out of range or type of data not exist

3. Function Table

Function	CMD	Function Description
Read Data		
Read Measurement Results	0x01	
Active Data Mode	0x07	
Gas Calibration		
Zero Point Calibration	0x4B	
Span Point Calibration	0x4C	
Information Query		
Query Software Version	0x1E	
Query Instrument Number	0x1F	

4. Detail Description

4.1 Read Data

4.1.1 Read Measurement Results

Send: 11 01 **01** ED

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

Function: read 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 as the signed bit. Negative numbers, such as "0xFF, 0xFF" (decimal: -1), may appear as zero drift may occur during use of the sensor. The zero drift might be positive or negative. If the drift does not exceed the allowable range, the negative number can be considered as "0". If the drift exceeds the allowable range, it indicates the sensor needs to be carried out "user calibration". The negative number here only be used as a "gas calibration" indicator.

Identification	Decimal System	Value
(CO)	0 - 3000	0–3000 ppm
(CH4)	0 - 3000	0–3000 ppm
(CO2)	0 - 5000	0-5% vol

2) The actual concentration of CO2 is 10 times of the indicated 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 Active Data Mode

The sensor can be set into active data mode in which the sensor will send active data continuously.

Send: 11 02 **07 [TVM]** CS

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

Function: Set the sensor into active data mode

Explain:

[TVM]: enable or disable the active data mode. The message format of active data is the same as the sensor's response when sending command 11 01 01 ED.

TVM	Description
00	Disable active data mode
01	Enable active data mode

For example:

Send: 11 02 07 01 E5

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

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

To disable active data mode, send the command 11 02 07 00 E6

4.2 Gas Calibration

Due to changes of environmental conditions over a period of time, it is necessary to calibrate the sensor regularly.

4.2.1 Zero Point Calibration

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

Response: 16 01 **4B** 9E

Function: Calibrate the zero point for the sensor

Explain:

1) [TVM] indicates the index of the gas to be calibrated

TVM	Description
00	Calibration for CO
01	Calibration for CH4
02	Calibration for CO2

2) [DF1] [DF2] is the concentration value of calibration gases. [DF1] *256+[DF2] constitutes a 16-bit signed integer. For zero-point calibration, [DF1] [DF2] is 0.

3) Before sending this command, zero gas must be fed into the sensor until the indicated gas concentration is stable.

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: Calibrate the span point for the sensor

Explain:

1) [TVM] is the index of the gas to be calibrated. 0 represents the calibration of the first compound (CO), 1 represents the calibration of the second compound (CH4) and 2 represents the calibration of the third compound (CO2).

TVM	Description
00	Calibration for CO
01	Calibration for CH4
02	Calibration for CO2

2) [DF1] [DF2] is the concentration value of calibration gases. [DF1] *256+[DF2] constitutes a 16-bit signed integer.

Identification	TVM	[DF1] [DF2]	Value
(CO)	00	2500-3000	2500-3000 ppm
(CH4)	01	2500-3000	2500-3000 ppm
(CO2)	02	4000-5000	4.000-5.000% vol

3) Before sending this command, the sensor must be filled with calibration gases with same concentration.

4) Zero-point calibration should be carried out before span point calibration.

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

Communication

Explain:

[DF1] [DF2], [DF3] [DF4], [DF5] [DF6], [DF7] [DF8], [DF9] [DF10], combined into high and low bytes respectively, convert to 4-bit decimal number, total 5 groups, forming 20-digit number.

For example

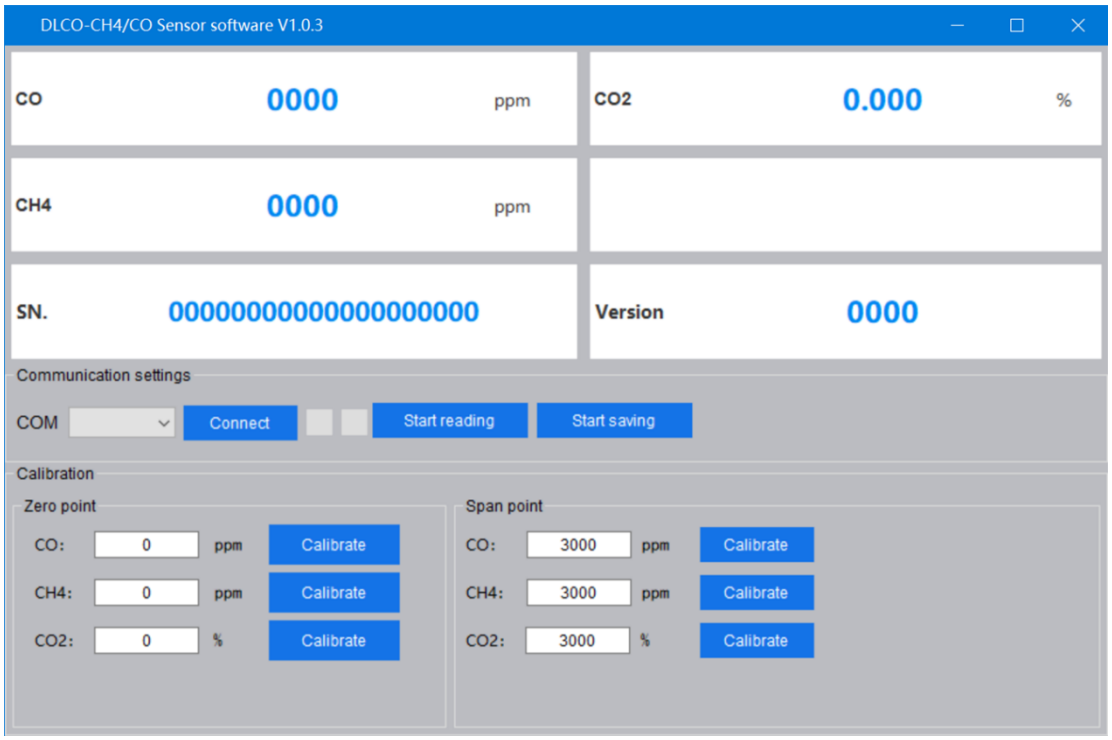
Send: 11 01 1F CF

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

5. Testing Software

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.

Consultancy & After-sales Service

Tel: 86-(0)27-81628827 Fax: 86-(0)27-87401159

Address: Fenghuang No.3 Road, Fenghuang Industrial Park, Eastlake Hi-tech Development Zone, Wuhan, China

Postal Code: 430205

Website: http: //www.gassensor.com.cn

E-mail: info@gassensor.com.cn