Version:V 2.2

PLANTOWER
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—— Beijing Plantower Technology Co.,ltd ——

Product Specification

Product : Digital universal carbon dioxide concentration sensor

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Model No. DS-CO2-20

Digital Universal Carbon Dioxide Sensor

DS-CO2-20 series data manual

Main characteristics

- NDIR
- Dual wavelength
- Industrial-grade Precision
- Minuscule Size

Overview

DS-CO2-20 is a kind of digital NDIR sensor, which can acquire and calculate the concentration of carbon dioxide in the air continuously and output them in the form of digital interface. This sensor can be inserted into variable instruments related to the concentration of carbon dioxide in the air or other environmental improvement equipments to provide correct concentration data in time.

Working principle

NDIR gas sensor principle of work is according to the different gas molecules for absorption characteristic of near infrared spectra,by gas concentration and absorption strength relationship (Lambert-Beer law) analysis and determine the concentration of the gas.

This sensor adopts the non-spectrophotometric infrared absorption principle and adopts the design structure of single air chamber and double receive channels, it has the characteristic of small structure and high detection precision.

Technical Index

Parameter	Index	Unit
Effective Range	400~3000	ppm
Maximum Range	400~5000	ppm
Resolution	1	ppm
Maximum Consistency Error	±（50ppm+5% of Reading）	
Single Response Time	＜3	Second（s）
Total Response Time	≤60	Second（s）
DC Power Supply	Typ:5.0　Min:4.5　Max: 5.5	Volt（V）
Active Current	400mA peak ,40mA average	Milliampere（mA）
Interface Level	L <0.8 @3.3 H >2.7@3.3	Volt（V）
Working Temperature Range	-10~+50	℃
Working Humidity Range	0~85% non condensed	
Storage Temperature Range	-40~+75	℃
MTTF	≥5	Year（Y）
Physical Size *	31×20×11	Millimeter（mm）
Pin Gap	2	Millimeter（mm）

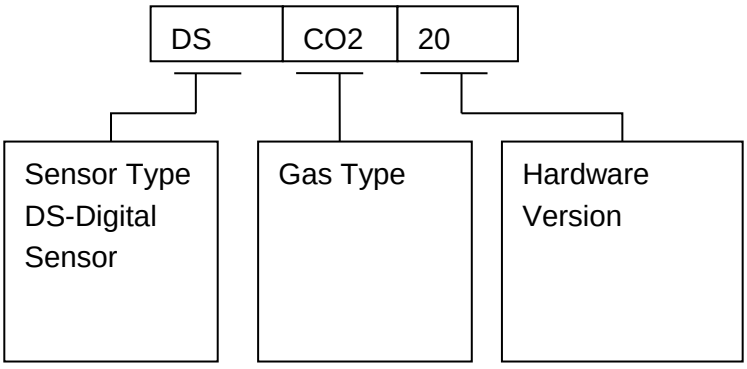
Note 1: The physical size is not including the length of pin.

Pin Definition

Figure 1 Connector Definition

PIN1	VCC	Positive power 5V
PIN2	GND	Negative power
PIN3	SDA/TX	I2C SDA with drive mode of OD Serial port sending pin/TTL level@3.3V
PIN4	SCL/RX	I2C SCL with drive mode of OD Serial port receiving pin/TTL level@3.3V
PIN5	RESET	Module reset signal /TTL level@3.3V，low reset.
PIN6	SELECT	Interface Mode Select/TTL level@3.3V High or Float: Uart Low: I2C
PIN7	PWM	1Hz， 200us high level per 1PPM

Part Number Definition



Typical Output Characteristic

Definition of axis Y:percentage error/concentration(ppm)

Definition of axis X:time

1. Long running consistency curve

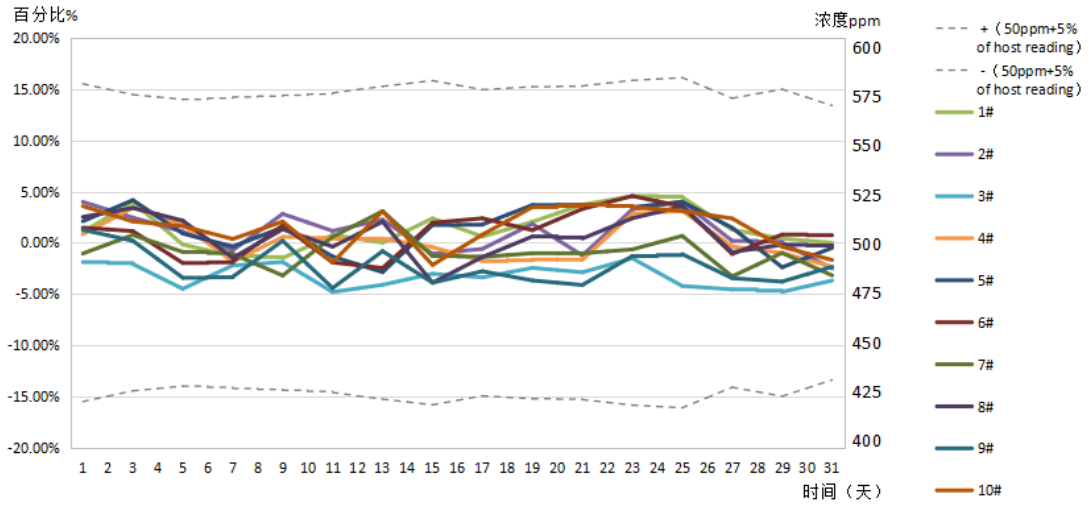


Figure 2-1 30days consistency curve

2. Stable time curve

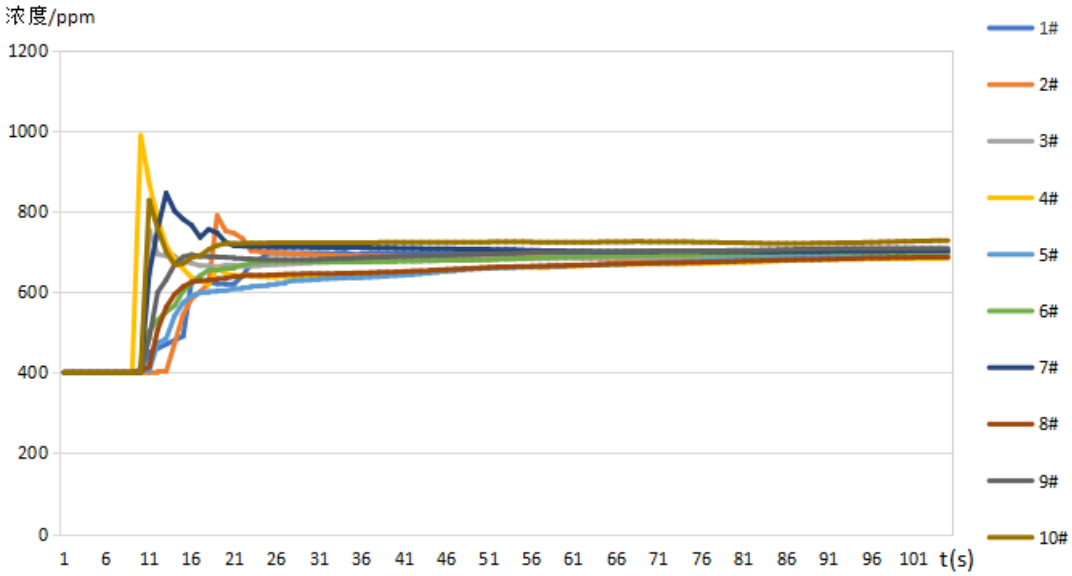


Figure 2-2 Response time curve

3. Fluctuation curve

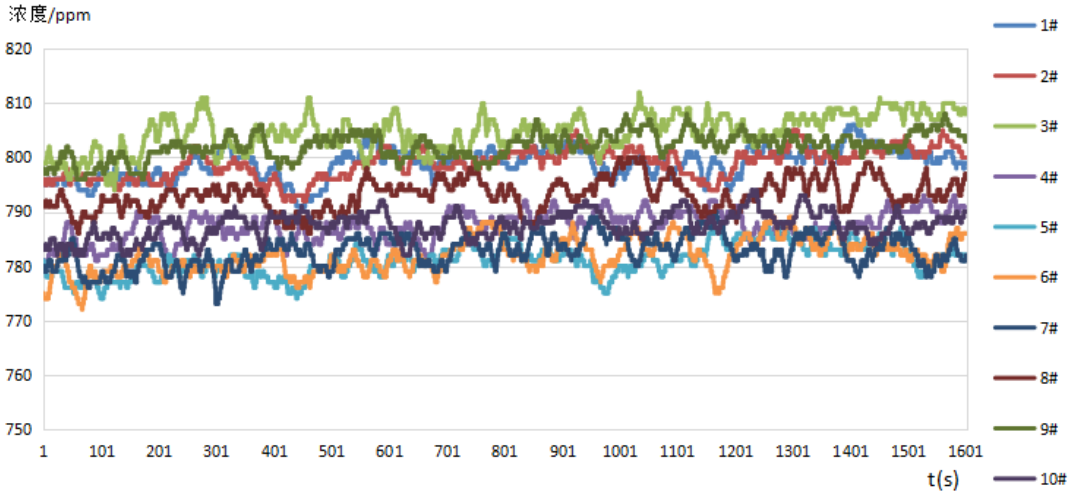


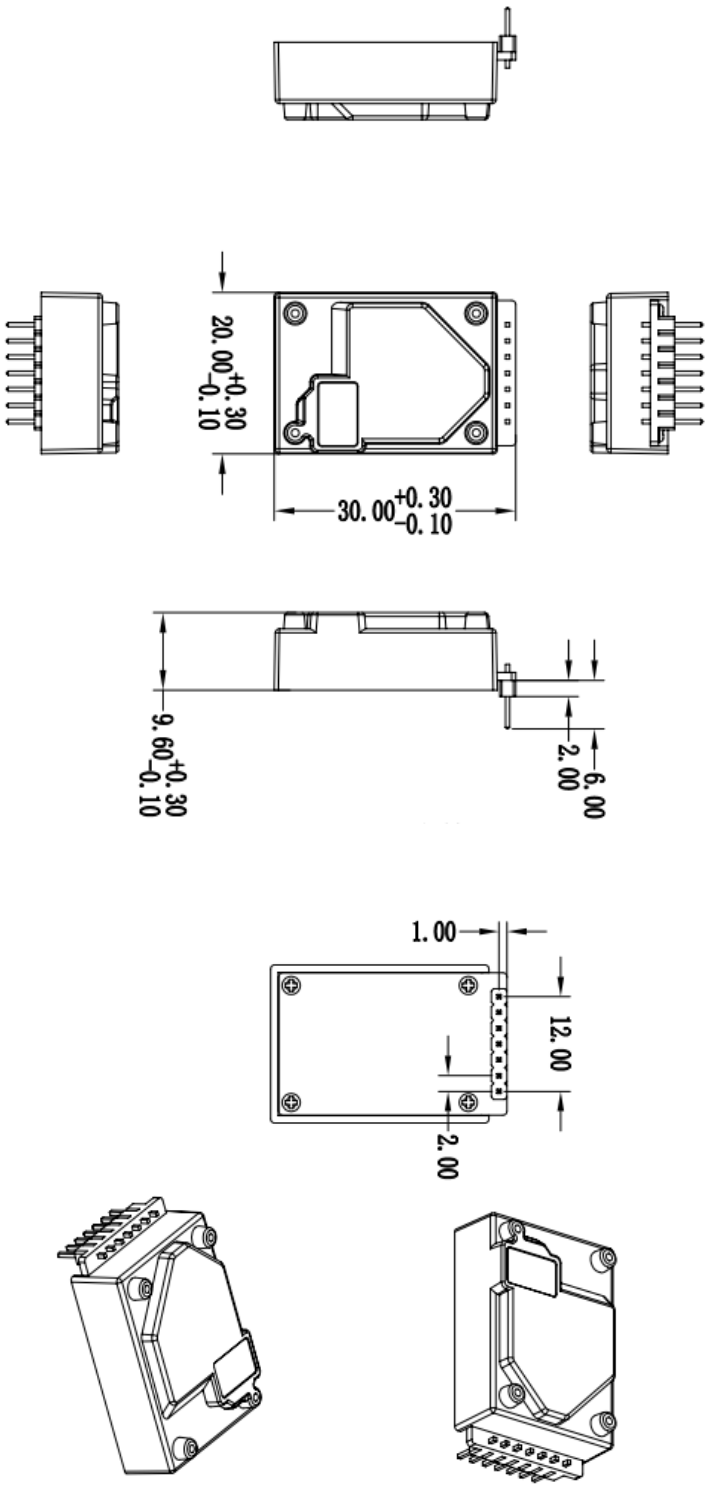
Figure 2-3 Data fluctuation curve

Endurance Characteristics

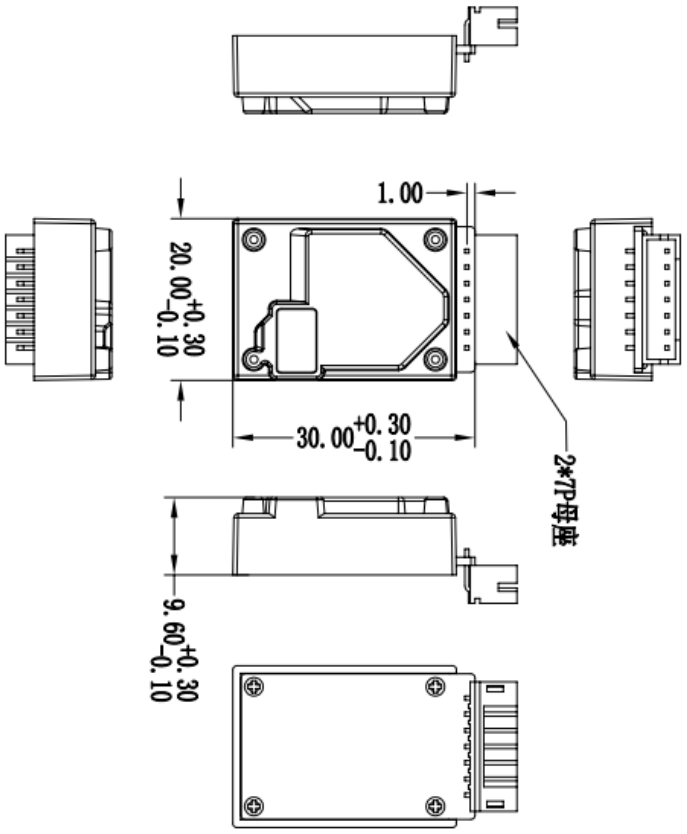
No	Item	Test Method	Characteristics	n C
1	Long Running	1. 10 ㎡ closed Lab,，20~25℃，humidity 30%~70%，Citric acid and baking soda 2. DC 5V power supply 3. Check consistency after 720 hours' running	CO2 concentration during 400~3000ppm 400~3000ppm Maximum Error≤±(50+5%)ppm	n=30 C=0
2	High Temperature Operation	1. 10 ㎡ constant temperature Lab 2. 43℃，humidity 70%， 3. Citric acid and baking soda 4. DC 5V power supply 5. Check consistency		n=10 C=0
3	Cold Operation	1. 10 ㎡ constant temperature Lab 2. -5℃，humidity 30%， 3. Citric acid and baking soda 4. DC 5V power supply 5. Check consistency		n=10 C=0
4	Vibration	1. 10 ㎡ closed Lab, 20 ℃，humidity 50%，Citric acid and baking soda 2. DC 5V power supply and check		n=5 C=0

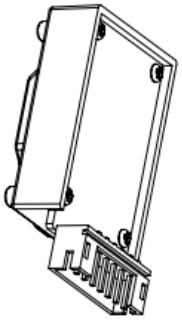
		consistency 3. Frequency：50Hz。 4. acceleration：9.8/ S^2 。 5. Direction：X、Y、Z 6. Vibration Amplitude：±2mm。 7. Time：X、Y、Z–way, Per 1 hour		
5	High Temperature and Humidity Storage	1. Constant temperature cabinet 2. 70℃，humidity 90%~95， 3. Check consistency after 500 hours' storage	10 samples during 400~3000ppm Maximum Error≤ ±(50+5%)ppm	n=10 C=0
6	Cold Storage	1. Constant temperature cabinet 2. -30℃，humidity 90%~95， 3. Check consistency after 500 hours' storage		n=10 C=0
7	Variation of Power Supply	4. 10 ㎡ closed Lab,，20℃，humidity 50%，Citric acid and baking soda 5. Power varies as the cycles of 4.5V to 5.5V ,then 5.5V to 4.5V with the pace of 0.1V/min for 2 hours. 6. Check consistency during Variation		n=5 C=0
8	Power On-Off Cycle	1. 10 ㎡ closed Lab,，20℃，humidity 50%，Citric acid and baking soda 2. DC 5V power supply，keep On-Off frequency 0.5Hz for 72 hours and check consistency		n=10 C=0
9	Salt Spray	5% industrial salt water, hydrolysis spray 100 hours, clean with purified water and store for 48 hours	No rust and discoloration of metal parts	n=1 C=0

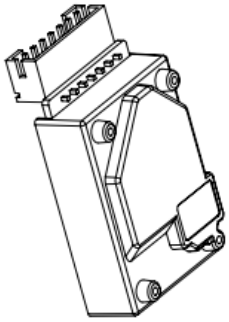
Physical Size(mm)



DS-CO2-20A







DS-CO2-20B

UART Interface

1. Base Definition

   Default baud rate：9600bps Check bit：None Stop bit：1 bit

2. Protocol host send

Start Byte1	StartByte2	Command	Para1	Para2	LRCH	LRCL
0x42	0x4d	CMD	DATAH	DATAL	LRCH	LRCL

3. Instruction and state byte definitions

CMD	DATAH	DATAL	Note
0xe3	X	X	Passive reading
0xe0	0x00	0x00	Read firmware version
0xe1	CH	CL	Automatic calibration function
0xe4	PH	PL	Write single point calibration instruction
0xe5	0x00	0x00	Clear single point calibration instruction

Instruction is introduced

1) passive reading: example sending instruction 0x42 0x4D 0xE3 0x00 0x00 0x00 0x01 0x72

   Read CO2 concentration data, return bytes refer to the response protocol format in the following table

2) read firmware version:

   Returns software version information, as illustrated below

   Sending data: 0x42 0x4D 0xE0 0x00 0x00 0x00 0x01 0x6F

   Return data: 0x42 0x4D 0x00 0x0B '2' 0 '1' 8 '0' 3 '2' 2 'CH CL

3) automatic calibration function:

   Turning on automatic calibration requires 16bit data composed of CH and CL, in which high 4bit is the calibration period and low 12bit is the calibration data.

   If the period is set as 11 (0xB in hexadecimal) and the concentration is set as 400ppm(0x0190 in hexadecimal), then the written data should be 0xB190.Convert to double byte 0xB1,0x90.

   If the self-calibration is turned off, only set the period to 0 and the calibration concentration is arbitrary.

Turn on automatic calibration: 0x42 0x4D 0xE1 0xB1 0x90 0x02 0xB1

Turn off the self-calibration function: 0x42 0x4D 0xE1 0x01 0x90 0x02 0x01 Or 0x42 0x4D 0xE1 0x00 0x00 0x01 0x70

4) Specific instructions are as follows:

If the current display value is 500ppm and 400ppm is written, the sensor output data will become 400ppm

The sending instruction is: 0x42 0x4D 0xE4 0x01 0x90 0x02 0x04

Manual single point calibration requires the sensor to operate in a stable and constant concentration environment (such as a closed standard gas environment) for at least 15-20 minutes before sending instructions.

5) write single point calibration instruction:

Clear single point calibration data and restore original data.

Example send instruction 0x42 0x4D 0xE5 0x00 0x00 0x00 0x01 0x74

Query CO2 concentration instruction E3 response protocol format

sensor feedback

Byte No.	Index	Value	
0x00	Start character 1	0x42(fixed)	
0x01	Start character2	0x4d(fixed)	
0x02	Frame length high	.....	Frame length=2x3+2(data+check bytes)
0x03	Frame length low	.....	
0x04	Data 1 high	……	CO2 ppm
0x05	Data 1 low	……	
0x06	Data2 high	……	Calibration Parameter1
0x07	Data2 low	……	
0x08	Data3 high	……	Calibration Parameter2
0x09	Data3 low	……	
0x0a	Check code high	……	Check code=Start character 1+ Start character 2+……..+data 3 Low 8 bits *
0x0b	Check code low	……	

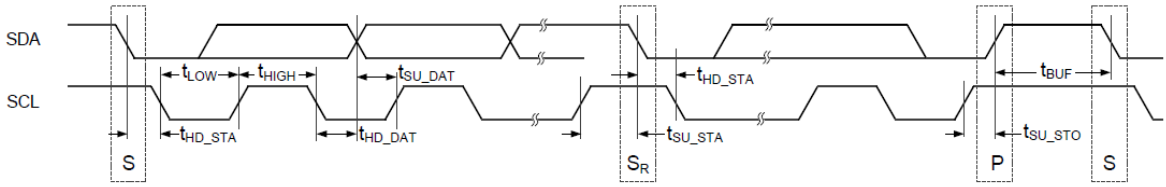
I2C Interface Protocol

1. Base Definition

1.1 Industry-standard NXP I2C bus interface

1.2 Data rate: 100ksps. Slave address(7 bit): 0x08

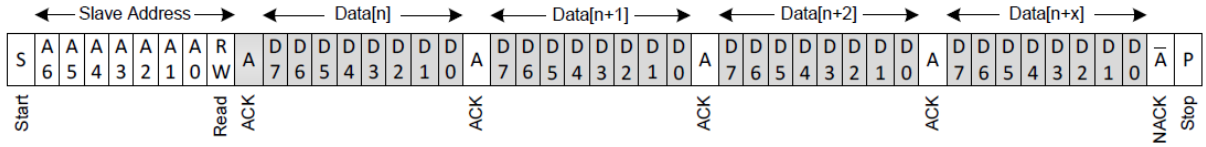
1.3 Sequence Diagram



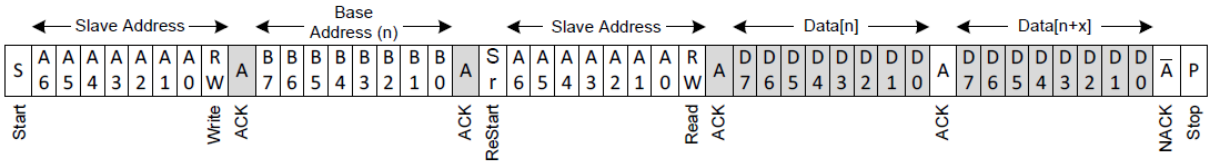
parameter	t_{HD_STA}	t_{LOW}	t_{HIGH}	t_{HD_DAT}	t_{SU_DAT}	t_{SU_STA}	t_{SU_STO}	t_{BUF}
Min	4.0	4.7	4.0	5.0	250	4.7	4.0	4.7
Unit	μs	μs	μs	μs	ns	μs	μs	μs

2. Operations

2.1 Master reads X bytes from slave buffer



2.2 Master sets the base address and reads X bytes from slave buffer.



3. Registers Definition

Register Number	Index	Value	
0x00	Start character 1	0x42(fixed)	
0x01	Start character2	0x4d(fixed)	
0x02	Frame length high	.....	Frame length=2x3+2(data+check bytes)
0x03	Frame length low	.....	
0x04	Data 1 high	……	CO2 ppm
0x05	Data 1 low	……	
0x06	Data2 high	……	Calibration Parameter1
0x07	Data2 low	……	
0x08	Data3 high	……	Calibration Parameter2
0x09	Data3 low	……	
0x0a	Check code high	……	Check code=Start character 1+ Start character 2+……..+data 3 Low 8 bits *
0x0b	Check code low	……	