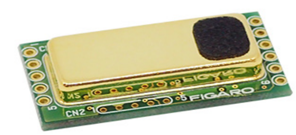
an ISO9001 company

Technical Information for the CDM7162 CO_2 Module



The **CDM7162** CO_2 module uses a nondispersive infrared (NDIR) sensor principle and compact optics to achieve excellent performance characteristics, including high accuracy and low power con-sumption. Stable long term operation and output are achieved by using dual IR detectors and Figaro's proprietary signal processing technology. Every module is individually calibrated and is provided with both a UART and I2C digital interface. The CDM7162 module is designed for simple integration into a user's products. It can be used in a wide range of applications such as ventilation controls for the improvement of energy savings and to assure a good indoor climate.

IMPORTANT NOTE: OPERATING CONDITIONS IN WHICH FIGARO SENSORS ARE USED WILL VARY WITH EACH CUSTOMER'S SPECIFIC APPLICATIONS. FIGARO STRONGLY RECOMMENDS CONSULTING OUR TECHNICAL STAFF BEFORE DEPLOYING FIGARO SENSORS IN YOUR APPLICATION AND, IN PARTICULAR, WHEN CUSTOMER'S TARGET GASES ARE NOT LISTED HEREIN. FIGARO CANNOT ASSUME ANY RESPONSIBILITY FOR ANY USE OF ITS SENSORS IN A PRODUCT OR APPLICATION FOR WHICH THE SENSOR HAS NOT BEEN SPECIFICALLY TESTED BY FIGARO.

1. Basic Information and Specifications

1-1 *Features*

* Small size
* Low power
* High accuracy
* Single light source, dual wavelength system

1-2 *Applications:*

* Indoor air quality control
* Fresh air ventilation
* Air conditioners
* Automatic fans and window openers

1-3 *Basic principle and structure*
Fig. 1 shows the basic principle of the dual wavelength system. Fig. 2 shows the basic structure of the module's optics.

This sensor is a single light source, dual wavelength system. The sensor employs two detectors with different optical filters in front of each detector. One detector measures the intensity of infrared light passing through the optical filter, transmitting only the infrared wavelength region absorbed by CO_2 (CO_2 absorption wavelength). The other detector measures the intensity of infrared light passing through the optical filter, transmitting only an infrared wavelength (3.8μm) not absorbed by CO_2 (i.e. a reference wavelength), and is thus unaffected by the constant presence of CO_2.

Accurate measurement of CO_2 concentration by CDM7162 is achieved by the module's microprocessor calculating CO_2 concentration from the difference between light intensity transmitted at the CO_2 absorption wavelength and at the reference wavelength.

Stable sensor output throughout a long period of operation is achieved by proprietary signal processing technology.

1-4 *Operating conditions & specifications*
(refer to Table 1)

1-5 *Absolute maximum ratings (refer to Table 2)*
Products using CDM7162 should be designed so that these maximum ratings are *never* exceeded.

1-6 *Dimensions (Fig. 3)*

1-7 *Functions*
CDM7162 has the following 6 major functions:

1-7-1 <u>CO_2 concentration output</u>
CDM7162 has two CO_2 concentration outputs. One is

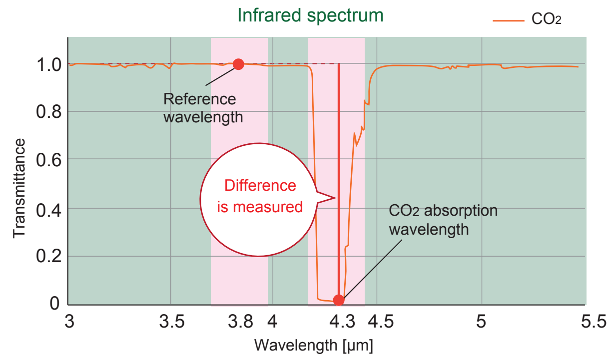


Fig. 1 - Basic principle for the dual wavelength system

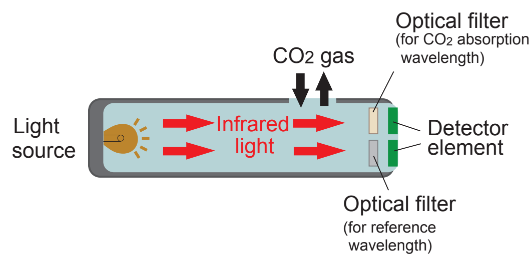


Fig. 2 - Basic structure of CDM7162 optics

Product name	Carbon dioxide (CO2) sensor module
Model No.	CDM7162-C00
Detection range	360~5,000ppm CO2
Operating principle	Non-dispersive infrared (NDIR)
Power supply	3.3±0.3V or 5.0±0.5V DC
Current consumption	75mA peak, 25mA avg. (@5V DC)
Accuracy (Note 1)	±(50ppm+3% of reading)
Pressure dependency	approx 1% of reading / kPa
Response time (T90)	90 sec. (diffusion)
Operating conditions	0~50˚C/0~85%RH (no condensation)
Storage conditions	-30~60˚C (tentative) /0~85%RH (no condensation)
Communication port	UART/ I2C (gas conc. output 360~65,535ppm)
Measurement interval	2 sec.
PWM output (1kHz)	0~100% duty cycle for 0~5,000ppm, CMOS output
Alarm output	CMOS output: High: CO2 conc. ≥1,000ppm Low : CO2 conc. < 900ppm
Dimensions	32 x 17 x 8.0 (mm)
Weight	approx. 3g

Table 1 - Specifications of CDM7162

Note 1: Accuracy is defined for a measuring range of 360 to 5,000ppm at an input voltage of 3.3±0.3V or 5.0±0.5VDC. It represents the accuracy at the time of factory test and does not represent accuracy after delivery from the factory. For long term accuracy, please refer to Fig. 5 - Long term stability of CDM7162.

PWM output (*please refer to Sec. 1-8-3 - Pin No.4*), the other is digital output through the communication port (*please refer to Sec. 3 - Communication*).

1-7-2 Alarm signal output
CDM7162 has an alarm signal output. Please refer to *Sec 1-8-3. Pin No.3 (Alarm)* for further information about this signal.

1-7-3 Manual calibration function
CDM7162 has two manual calibration functions. One is air adjustment, the other is zero adjustment. With air adjustment, CO_2 concentration output is set at 400ppm, assuming the sensor is exposed to 400ppm CO_2 (*normal CO2 levels in clean air are approx. 400ppm*). With zero adjustment, CO_2 concentration output is set at 0ppm, assuming the sensor is exposed to 0ppm CO_2. For further details, please refer to *Sec 1-8-6. Pin No.7 (CAL)*.

1-7-4 Long term adjustment
Drift which may occur during a long period of operation is automatically adjusted by proprietary software called "Long Term Adjustment" (LTA). When LTA1 is enabled, the CO_2 concentration output signal is automatically adjusted if the output level in clean normal air is lower than the preset target concentration (default setting: 400ppm) during long term operation. When LTA2 is enabled, the CO_2 concentration output signal is automatically adjusted if the output level in clean normal air is higher than the preset target concentration. The default setting is ON for both LTA1 and LTA2. Please refer to the document *CDM7162 Communication Specifications* for more details.

1-7-5 Atmospheric pressure and altitude compensation
The CDM7162 has pressure and altitude dependency and compensation for atmospheric pressure and altitude is required to achieve high accuracy at different pressures or altitudes. The factory default setting of CDM7162 for atmospheric pressure and altitude is fixed at 1013.25hPa and 0m above sea level. For compensation, please refer to the document *CDM7162 Communication Specifications*.

1-7-6 Serial number readout
An individual serial number is shown on the sensor's label and is recorded in each sensor as well. The serial number can be read via serial communication for individual traceability control, eliminating the need for manual data entry of serial numbers and human input error.

1-8 *Pin configurations and functions (Table 3)*

1-8-1 Pin No.1 (VDD)
Since a voltage regulator is included in the sensor, input voltage variations within the range of 3.0~3.6V or 4.5~5.5VDC would not affect output voltage of the sensor.

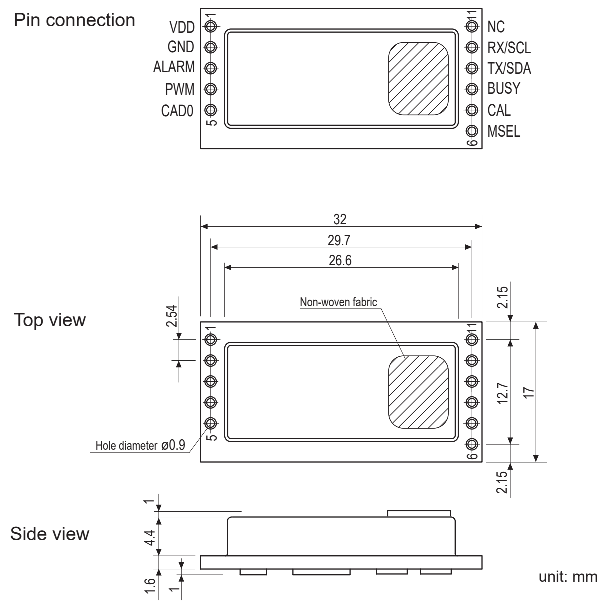


Fig. 3 - Dimensions of CDM7162

Item	Sign.	Min.	Max.	u/m
Source voltage	Vdd	-0.3	+6.0	V
Input voltage (CAD0,MSEL, CAL, Rx)	VIN	-0.3	VDD+0.3	V

Table 2 - Absolute maximum ratings for CDM7162

Pin No	Name	Description
1	VDD	Input voltage
2	GND	Common ground
3	ALARM(*)	Alarm output
4	PWM	PWM output
5	CAD0	I2C slave address selection input (internal pull up)
6	MSEL	Communication mode signal input I2C/UART (internal pull up)
7	CAL	Air/zero adjustment input (internal pull up)
8	BUSY(*)	BUSY signal output
9	Tx(*)/SDA	UART Tx output/ I2C SDA input/output
10	Rx/SCL	UART Rx input/ I2C SCL input
11	NC	not connected

(*) The maximum output current should be 4mA or less.

Table 3 - Pin configurations and functions of CDM7162

1-8-2 *Pin No.3 (ALARM)*
The factory settings of the alarm threshold are 1000ppm for alarm trigger and 900ppm for alarm reset. The thresholds are user-changable. Please refer to the document *CDM7162 Communication Specifications*.

1-8-3 *Pin No.4 (PWM)*
A pulse of 1kHz that corresponds to 0~5,000ppm CO_2 is output from Pin No.4. A PWM signal can be easily converted to analog voltage. Please refer to Fig.4 for an example circuit.

1-8-4 *Pin No.5 (CAD0)*
This port is for the selection of the least significant bit of the I2C slave address. By assigning High or Low to each slave, a maximum of 2 units of CDM7162 can be connected to one I2C bus. Since this pin is internally pulled up, if this port is not connected, High is input.

1-8-5 *Pin No.6 (MSEL)*
For I2C communication, this pin should be connected to Low. The MSEL pin is internally pulled up. If the MSEL pin is not connected, the UART interface is used.

1-8-6 *Pin No.7 (CAL)*
When Low voltage is applied to this port, calibration mode is activated. During normal operation (i.e. when calibration is not being performed), please connect to High or do not connect (open). (This pin is internally pulled up.)

When this pin is connected to Low for 4~10 sec., air adjustment is carried out assuming 400ppm exposure to the sensor.

When connected to Low for 12 sec. or longer, zero adjustment is carried out assuming 0ppm exposure to the sensor.

1-8-7 *Pin No.8 (BUSY)*
The sensor may not communicate for a short period (about 0.5 sec.) due to the internal processing. During the BUSY state, High signal is output. For more detail, please refer to the document *CDM7162 Communication Specifications*.

1-8-8 *Pin No. 9 (Tx/SDA)*
This port works as a Tx port for UART communication and as a SDA (data) port for I2C communication.

1-8-9 *Pin No. 10 (Rx/SCL)*
This port works as an Rx port for UART communication and as a SCL (clock) port for I2C communication.

1-9 *Installation and soldering conditions*
CDM7162 can be mounted on a mother printed circuit board by soldering the 0.9mmφ terminal holes of the sensor to pin strips of a 2.54mm pitch.

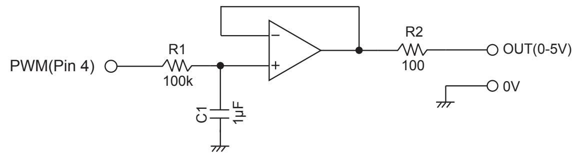


Fig. 4 - PWM signal conversion circuit

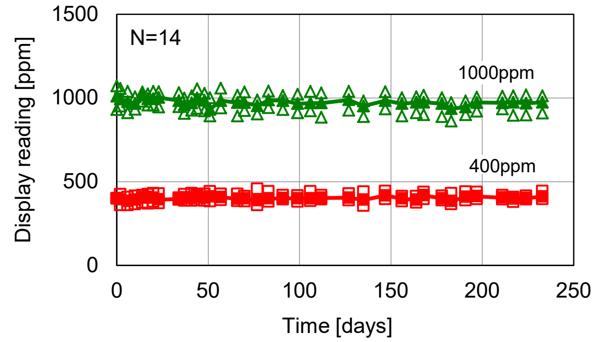


Fig. 5 - Long term stability

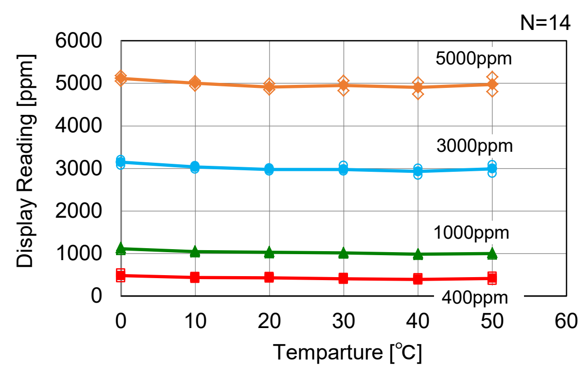


Fig. 6 - Temperature dependency

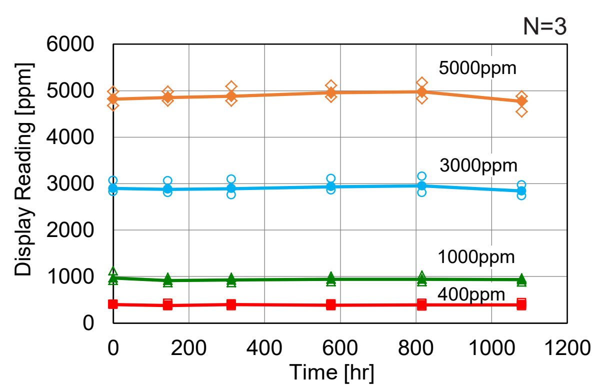


Fig. 7 - Durability to high temperature and high humidity

2. Reliability

2-1 *Long term stability*
Fig. 5 shows the long-term stability of the sensor. The test samples were operated with an input voltage of 5.0VDC. Y-axis shows the CO_2 concentration output at 400ppm and 1000ppm CO_2 and X-axis shows the days elapsed. The CO_2 concentration output remains stable over the test period.

2-2 *Temperature dependency*
Fig. 6 shows the effect of ambient temperature on the CDM7162. The samples were tested at 0 ~ 60˚C with an input voltage of 5.0VDC. The CDM7162 has stable characteristics over the operating temperature range.

2-3 *High temperature and high humidity test*
Fig. 7 shows the test result when the test samples were operated at 50˚C, 85%RH with an input voltage of 5.0VDC for more than 1000 hours. The sensors were conditioned at room temperature for 1 hour prior to each measurement of the CO_2 concentration output. The test result demonstrates that there is no significant influence from high temperature and high humidity conditions.

2-4 *High/Low temperature test*
Fig. 8-1 shows the test result when the samples were operated at 60˚C with an input voltage of 5.0VDC for more than 1000 hours. The sensors were conditioned at room temperature for 1 hour prior to each measurement of the CO_2 concentration output. The test result demonstrates that there is no significant influence from high temperature conditions.

Fig. 8-2 shows the test result when the samples were operated at -10˚C with an input voltage of 5.0VDC for more than 1000 hours. The sensors were conditioned at room temperature for 1 hour prior to each measurement of the CO_2 concentration output. The test result demonstrates that there is no significant influence from low temperature conditions.

2-5 *Corrosion test*
The effect of corrosive gases on the sensor was evaluated. Two different tests were carried out with the test samples operating at rated input voltage:
1) Exposure to 3ppm H_2S for 10 days at 40˚C, 75%RH
2) Exposure to 10ppm SO_2 for 10 days at 40˚C, 95%RH
After exposure to the test gas, CO_2 concentration output was measured.
Fig. 9-1 and Fig. 9-2 show the durability test results for H_2S and SO_2 respectively. The test results demonstrate that there is no significant effect on the sensor from this corrosive gas test.

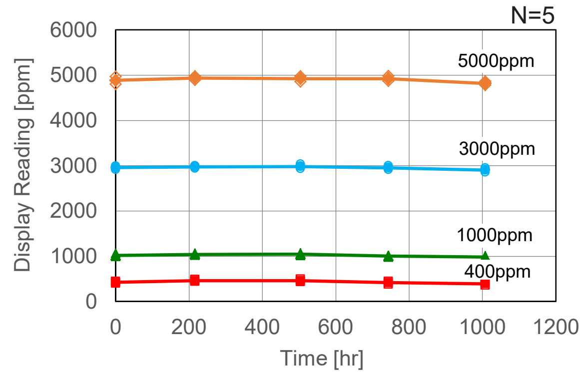


Fig. 8-1- Durability to high temperature (60˚C)

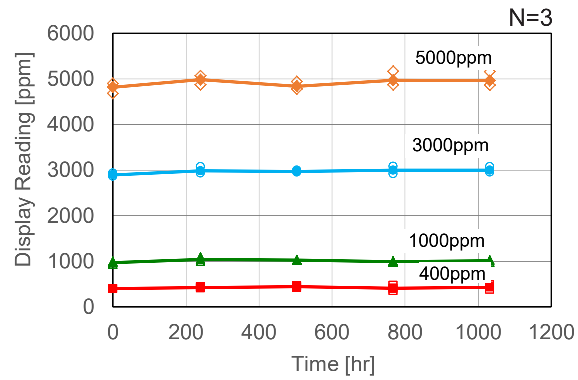


Fig. 8-2- Durability to low temperature (-10˚C)

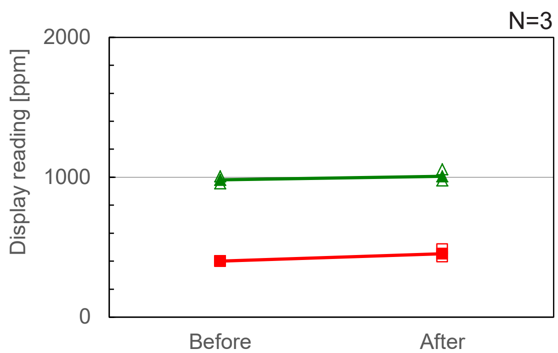


Fig. 9-1 - Corrosion test against H_2S

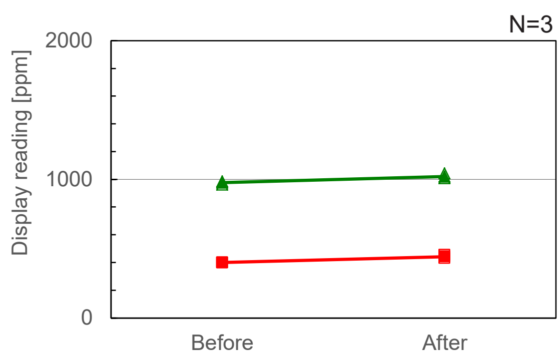


Fig. 9-2 - Corrosion test against SO_2

2-6 *Dust test*
Durability against dust exposure was tested. Five different types of dust as specified by JIS Z 8901 were dropped onto the sensor with an input voltage of 5.0VDC continuously for 15 minutes under conditions of 26˚C/60%RH. Fig. 10 shows the CO_2 concentration output before and after the dust test. This demonstrates that there is no significant influence on sensor performance from this dust exposure test.

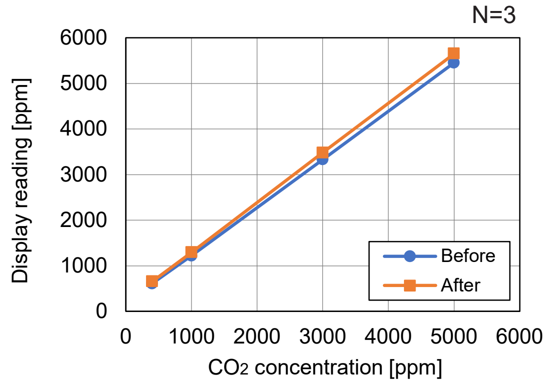


Fig. 10 - Durability against dust

2-7 *Vibration/Drop impact test*
Resistance against vibration on the sensor was verified by the vibration test. Two different tests were carried out:
1) Fixed frequency of 16.7Hz, 3mm PP, for 1 hour each in x-y-z direction
2) Variable frequency of 10~65Hz, 1.5mm PP, for 2 hours each in x-y-z direction

Fig. 11-1 and Fig. 11-2 show the CO_2 concentration output before and after test 1) and test 2) respectively. The test results demonstrate that there is no significant influence on the sensor performance from this vibration test.

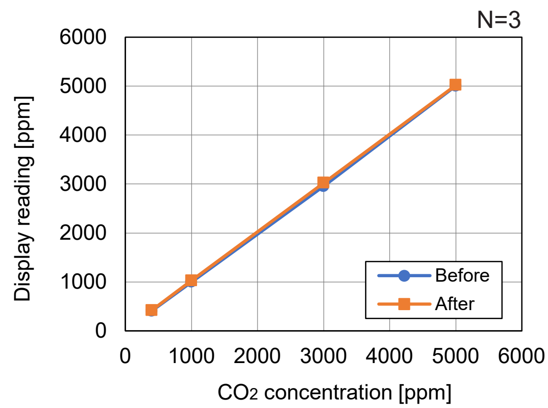


Fig. 11-1 - Vibration test (fixed frequency)

Resistance to drop impact was also tested. Test samples were dropped freely onto a concrete plate 5 times from a height of 1m. The test results demonstrate that there is no significant effect on the sensor performance from this drop impact test.

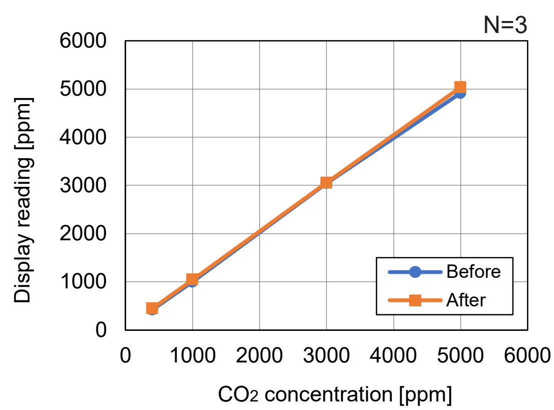


Fig. 11-2 - Vibration test (variable frequency)

3. Communication
The sensor is provided with both UART and I2C digital interfaces. There are two operating modes:
1) continuous operating mode
2) power down mode.

To change register value in I2C communication, it is necessary to write the register value after switching to power down mode.

3-1 *UART communication*
3-1-1 Connection
Please connect the system (Master) and CDM7162 (Slave) as shown in Fig.12.

3-1-2 Basic operation
When CDM7162 is reset with the MSEL pin being set to High, the sensor starts operation in the UART communication mode. When the sensor is unable to communicate during internal processing, the BUSY terminal will output a High signal. The external controller (Master) should monitor the terminal output to check for the status of communication.

CDM7162					System
Pin No	Terminal	Function	Condition		Terminal/State
1	VDD	Power	5V DC	—	VDD
2	GND	-	-	—	GND
3	ALARM	Alarm	output	—	Connect when needed (digital input)
4	PWM	Concentration display (level)	output	—	Connect when needed
5	CAD0	I2C slave address (least significant bit)	input	N.C.	
6	MSEL	UART selection	input	N.C.	
7	CAL	Calibration	input	N.C.	
8	BUSY	Busy signal	output	—	Connect when needed (digital input)
9	Tx/SDA	Tx	output	→	Rx
10	Rx/SCL	Rx	input	←	Tx

Fig. 12 - UART connections

3-1-2-1 *Communication parameters (Table 4)*

Communication speed	9600bps
Parity	No
Start bit	1 bit
Stop bit	1 bit
Bit length	8
Flow control	No

Table 4- UART communication parameters

3-1-2-2 *Protocol*
The communication protocol of CDM7162 is similar to but not fully compatible with Modbus protocol. With Modbus protocol, the master always sends messages and the slave responds to them. The external controller serves as the master device (Master) and the CDM7162 serves as the slave device (Slave).

The transmission procedure is as follows:

1) The master sends a command message to the slave.
2) The slave checks if the device address in the received message matches its own address.

When the addresses match, the slave performs processing according to the function code and sends back a response message. When the addresses do not match, the slave discards the received message and waits for the next message.

Note:
Please insert a space corresponding to 3.5 bytes or more before and after messages. Please do not include space characters of 1.5 bytes or more between bytes within a message.

3-1-2-3 *Structure of message (Table 5)*
The command message from Master and the response message from Slave consist of four parts: Device address, Function code, Data section, and Error check code. They are sent in this order.

No.	Name	Byte
1	Device address [*1]	1
2	Function code	1
3	Data section	2~17
4	Error check code [*2]	2

[*1] Please fix "FEH" for device address
[*2] Please calculate error check code using CRC-16 method. Please refer to document *CDM7162 Communication Specifications*

Table 5 - UART message structure

Command Group	Function
Modbus common command	CO_2 concentration readout User calibration
CDM7162 unique command	CO_2 concentration readout Alarm threshold change Altitude pressure compensation User calibration

Table 6 - UART function commands

Message from Master

	Device code	Function code	Data part (1)	Data part (2)	Data part (3)	Data part (4)	Error check (1)	Error check (2)
CO_2 concentration readout	FE	04	00	03	00	01	D5	C5

Readout start address (Data part (1)–(2)); Number of readout words (Data part (3)–(4))

Response from Slave

	Device code	Function code	Data part (1)	Data part (2)	Data part (3)	Error check (1)	Error check (2)
CO_2 concentration readout	FE	04	02	06	5B	EF	7F

Number of readout bytes (Data part (1)); CO2 concentration (hexidecimal number) (Data part (2)–(3))

Table 7 - Modbus common command for CO_2 concentration readout (example)

Message from Master

	Device code	Function code	Data part (1)	Data part (2)	Data part (3)	Error check (1)	Error check (2)
CO_2 concentration readout	FE	44	00	08	02	9F	25

Response from Slave

	Device code	Function code	Data part (1)	Data part (2)	Data part (3)	Error check (1)	Error check (2)
CO_2 concentration readout	FE	44	02	06	59	7B	7E

Number of readout bytes (Data part (1)); CO2 concentration (0659H=1625ppm) (Data part (2)–(3))

Table 8 - CDM7162 unique command for CO_2 concentration readout (example)

There are two kinds of function commands:

1) similar to Modbus (Modbus common command)
2) a specially designed command for CDM7162 (CDM7162 unique command). (*see Table 6*)

Notes:

1) For both kinds of commands, the Master always sends messages and the Slave responds to them.
2) The CDM7162 unique command can access the CO_2 concentration readout-only area the same as the Modbus common command. In addition, CDM7162 unique command can access the registered memory area which is shown in *Sec. 3-2-5*.

3-1-2-4 *Message example*

3-1-2-4-1 *Example of Modbus common command for CO_2 concentration readout (Table 7)*

3-1-2-4-2 *Example of CDM7162 unique command for CO_2 concentration readout (Table 8)*

Note:

Please refer to the document *CDM7162 Communication Specifications* for how to make an error check code (CRC-16 calculation method).

3-2 *I2C communication*

3-2-1 *Connection*

Please connect the system (Master) and CDM7162 (Slave) as shown in Fig. 13.

When Low voltage is applied to the MSEL pin, CDM7162 starts operation in I2C communication mode.

3-2-2 *Basic operation*

Operating sequence from the Master side

1. Transmit "Start Condition" to Slave
2. Transmit Slave address
3. Acknowledge (Ack.) is transmitted from Slave (CDM7162) back to the Master
4. Transmit Register address to Slave
5. Acknowledge (Ack.) is transmitted from Slave (CDM7162) back to Master
6. Repeat steps 4 and 5
7. Send "Stop Condition" to Slave

CDM7162					System
Pin No	Terminal	Function	Condition		Terminal/State
1	VDD	Power	5V DC	—	VDD
2	GND	-	-	—	GND
3	ALARM	Alarm	output	—	Connect when needed (digital input)
4	PWM	Concentration display (level)	output	—	Connect when needed
5	CAD0	I2C slave address (least significant bit)	input	—	Connect when needed (digital input)
6	MSEL	UART selection	input	—	Low level
7	CAL	Calibration	input	N.C.	
8	BUSY	Busy signal	output	—	Digital input
9	Tx/SDA	I2C data signal SDA	input/output	←→	SDA
10	Rx/SCL	I2C clock signal SCL	input	←	SCL

Fig. 13 - I2C connections

3-2-3 *Address and register*
Address and register consist of 1 byte (=8 bits). Data with 2 bytes or longer will be transmitted from the highest-order bit (big endian).

3-2-3-1 *Bit configuration of Slave address (1 byte) (Table9)*
Within one byte, the highest 7 bits are used for the slave address, and the least significant bit is used to select Read or Write.

b7~b1: Slave address

where:

b1 corresponds to H/L of CAD0 port (5 pin)

b1 = 0 for CAD0 = Low,

b1 = 1 for CAD0 = High

b0=1 for Read

b0=0 for Write

examples:

Slave address to Write with CAD0=Low

11010000

Slave address to Read with CAD0=High

11010011

3-2-3-2 *Bit configuration of Register address (1 byte) (Table 10)*

3-2-3-3 *Bit configuration of Data (1 byte) (Table 11)*

Slave address							Read or Write
1	1	0	1	0	0	CAD0	R/W
b7	b6	b5	b4	b3	b2	b1	b0
(MSB)							**(LSB)**

Table 9 - Bit configuration of slave address

A7	A6	A5	A4	A3	A2	A1	A0
b7	b6	b5	b4	b3	b2	b1	b0
(MSB)							**(LSB)**

Table 10 - Bit configuration of register address (1byte)

D7	D6	D5	D4	D3	D2	D1	D0
b7	b6	b5	b4	b3	b2	b1	b0
(MSB)							**(LSB)**

Table 11 - Bit configuration of data (1byte)

3-2-4-1 *Write command*
Fig.14 shows the data transfer sequence for the Write command. In this sequence, “06H” is written at register address “01H” for setting continuous operating mode. When CAD0=Low, the Slave address is 110100.

For details about the Start bit, Stop bit, ACK, and NACK, please refer to the document *CDM7162 Communication Specifications*.

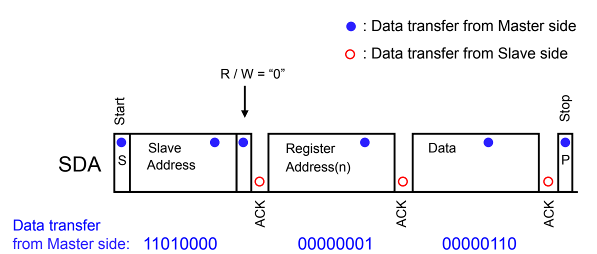


Fig. 14 - Data transfer sequence for Write command

3-2-4-2 *Read command*

There are two Read commands:

1) current address read command
2) random read command.

Fig.15 shows the random read command. The data transmission sequence shows how CO_2 concentration is read from CDM7162. The random Read comand assigns "03H" as the register address and reads 2 bytes from the address.

3-2-5 *Register memory map (Table 12, 13)*

Please refer to the document *CDM7162 Communication Specifications* for information about each register value, functions, and factory default setting.

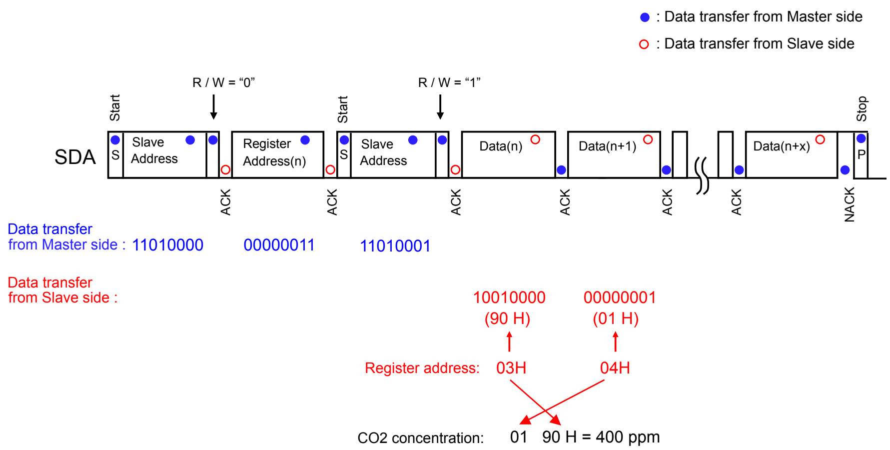


Fig. 15 - Data transfer sequence for random Read command

Address	Name	REG/EEP	Function	Description
00H	RST	REG	Sofware reset	Resets the module
01H	CTL	EEP	Operating mode	Specifies operating mode
02H	ST1	REG	Status register	Monitors the operating status--read-only
03H	DAL	REG	Low-order CO2 concentration data	Read-only
04H	DAH	REG	High-order CO2 concentration data	Read-only
09H	HPA	EEP	Atmospheric pressure	Specifies atmospheric pressure
0AH	HIT	EEP	Altitude	Specifies altitude
0CH	ALHI	EEP	Upper limit concentration for alarm signal	Specifies upper limit cocentration for alarm signal
0DH	ALLO	EEP	Lower limit concentration for alarm signal	Specifies lower limit concentration for alarm signal
0EH	CAL	REG	User calibration	User calibration with I2C
0FH	FUNC	EEP	PWM output	Specifies properties of PWM function, enables/ disables PWM, compensates atmospehric pressure and altitude
10H	ERROR	REG	Self diagnosis (error output)	Read-only
12H	AJCON	EEP	CO2 concentration for user calibration	Specifies CO2 concentration (400ppm default)

Table 12 - Register table

Address	Name	D7	D6	D5	D4	D3	D2	D1	D0
00H	RST	-	-	-	-	-	-	-	REST
01H	CTL	-	-	-	-	-	CTL2	CTL1	CTL0
02H	ST1	BUSY	ALARM	-	-	-	-	CAD0	MSEL
03H	DAL	D7	D6	D5	D4	D3	D2	D1	D0
04H	DAH	-	D14	D13	D12	D11	D10	D9	D8
09H	HPA	Hpa7	Hpa6	Hpa5	Hpa4	Hpa3	Hpa2	Hpa1	Hpa0
0AH	HIT	Hit7	Hit6	Hit5	Hit4	Hit3	Hit2	Hit1	Hit0
0CH	ALHI	Alhi7	Alhi6	Alhi5	Alhi4	Alhi3	Alhi2	Alhi1	Alhi0
0DH	ALLO	Allo7	Allo6	Allo5	Allo4	Allo3	Allo2	Allo1	Allo0
0EH	CAL	-	-	-	-	-	-	Zero-A	Air-A
0FH	FUNC	-	-	-	-	PWMR	HPAE	-	PWME
10H	ERROR	-	-	-	-	-	-	-	Error0
12H	AJCON	Ajcon7	Ajcon6	Ajcon5	Ajcon4	Ajcon3	Ajcon2	Ajcon1	Ajcon0

Table 13 - Register map

4. Housing Design

CO_2 gas enters the chamber of CDM7162 through a pin hole under the non-woven fabric as shown in Fig. 3. For gas diffusion, it is recommended to separate the device housing from the top of the non-woven fabric by 5mm or more. If quicker response is required, it is recommended that the gas inlet of the sensor be located at the device's slits/opening. It is also recommended to make a small compartment with slits in at least two sides as shown in Fig. 16.

Heat is generated at the internal optical source of CDM7162. If a temperature sensor is located near the gas sensor, the temperature sensor may not show the correct ambient temperature. In this case, it is recommended to locate a temperature sensor where there is no thermal influence by CDM7162. Maintain enough distance from the CO_2 sensor or separate the temperature sensor from the CO_2 sensor (e.g. by using a thermal insulator).

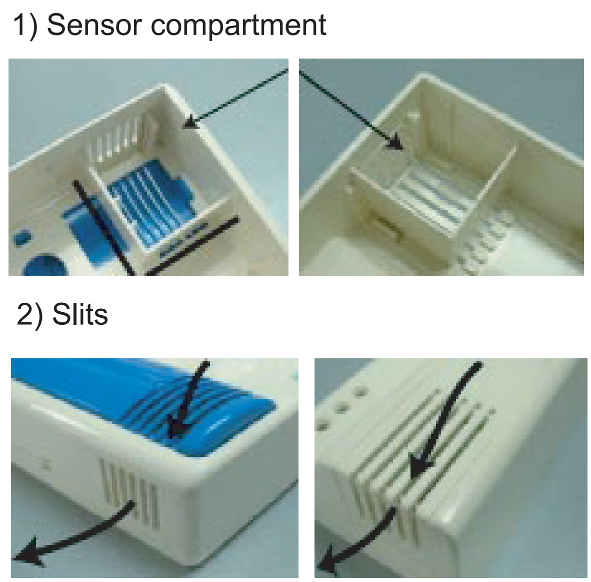


Fig. 16 - Example housing design

5. Packing

There are two types of packaging.
1) 50pcs. of CDM7162 are packed in an antistatic tray. 10 trays (CDM7162: 50pcs. x 10 trays) wrapped with antistatic bubble cushioning wrap are packed in a carton box.
2) 50pcs. of CDM7162 individually wrapped with antistatic bubble cushioning wrap are packed in an inner box (25pcs. x 2 layers). 10 inner boxes (CDM7162: 50pcs. x 10 boxes) are packed in a carton box. (Fig. 17)

6. Maintenance

The CDM7162 employs a single light source, dual wavelength system and proprietary signal processing technology to achieve stable long term operation. As a result, there is no need for maintenance when used for typical indoor air quality control applications. For customers who need more accurate measurement, the sensor has a function for air adjustment and zero adjustment that can be used for periodic manual cal-ibration. For more details, please refer to *Sec. 1-8-6 Pin No.7 (CAL)*.

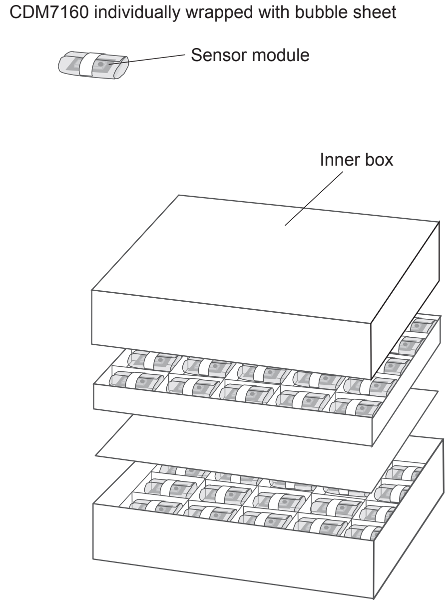
7. Handling Precautions

7-1 *Protection against ESD (Electro Static Discharge)*
Since a semiconductor device is built into the sensor, there is the possibility of electrostatic breakdown of parts due to static electricity. For this reason, please observe the following precautions during handling:
- Handling of products should be performed in an environment where static electricity is not easily generated (*for example, relative humidity 40% RH or more*).
- Wear a grounded wrist band when working.
- Take measures against static electric discharge from containers and other materials that may come in contact with the sensor.

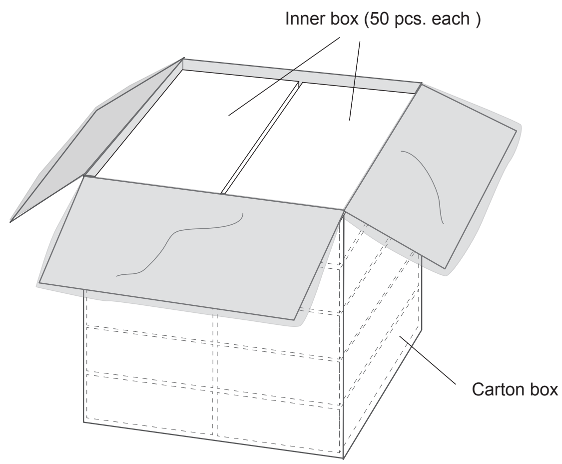
7-2 *Storage in environments where organic solvents may be present*
If the sensor is stored/used in an atmosphere containing alcohols, acetone, volatile oils etc., such gases may affect sensor characteristics. In addition, if the sensor is stored for a long period, please keep it hermetically sealed with packing material that does not generate such gases.

7-3 *Contamination by alkali and inorganic metals*
Contamination by alkali metals (especially salt spray) or inorganic substances may greatly change the characteristics of the sensor.

7-4 *Chlorine/corrosive gas*
Sensor performance may be affected if the sensor is stored/used in an atmosphere containing chlorine/corrosive gas.



Quantity per inner box: 50 pcs. (25 pcs. x 2 layers)



Quantity per carton box: 500 pcs. (50 pcs. x 10 inner boxes)
Fig. 17 - Packing type 2) of CDM7162

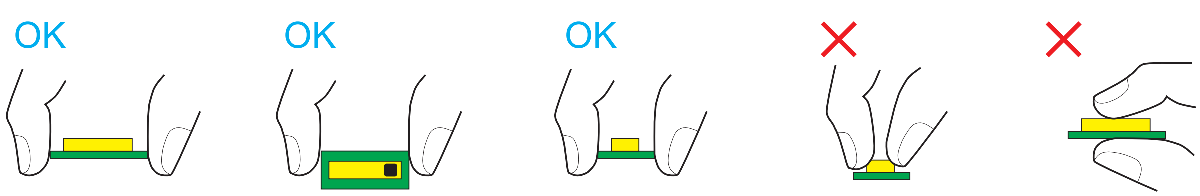


Fig. 18 - Proper handling of CDM7162

7-5 *Contact with water*
Sensor performance may be affected due to soaking or splashing the sensor with water.

7-6 *Influence of excessive voltage*
If higher than rated voltage is applied to the sensor, failure may occur or sensor characteristics may be affected even if failure does not occur. Sensors that have experienced excessive voltage should never be used.

7-7 *Water condensation*
When the sensor is exposed to dew condensation, sensor characteristics may change and may possibly lead to malfunction. Please avoid using and storing under conditions that may result in dew condensation as well as temperature and humidity conditions outside of the specification range.

7-8 *Impact of shock and mechanical stress*
Although sensors may not fail due to the impact of a fall, characteristics may still be affected. Sensors that have experienced even a single occurrence of such shock should not be used. In addition, mechanical stress (such as stress to the optical cell or substrate, vibration shock, etc.) may lead to reduced accuracy. When handling, the optical cell should never be touched. (Fig.18)

7-9 *Dust*
A dustproof filter is installed so that dust does not enter the sensor. Nevertheless, please be careful especially when installing the sensor in a place with a lot of dust (such as a ventilation duct).

7-10 *Influence of airflow*
The ambient temperature around the sensor may temporarily drop when it is exposed to strong airflow, which in turn may affect sensor characteristics.

7-11 *Soldering of terminals*
This sensor is mounted by soldering the pins to a hole of 0.9mm diameter at 2.54 mm pitch. For hand soldering conditions, 350˚C within 5 seconds is recommended.

7-12 *Storage for extended periods*
When stored for a long period (e.g. one month or more), it is recommended that the sensor be kept hermetically sealed in an aluminum bag (Lamisip, etc.) that does not generate miscellaneous gas.

8. Frequently Asked Questions

Q1: *Is it possible to measure CO_2 concentrations higher than 5,000ppm?*
A: The measured CO_2 concentration output through serial communication is available for concentration ranges higher than 5,000ppm. However, accuracy may be less than specifications above 5,000ppm. The maximum PWM output range is 5,000ppm.

Q2: *Is it possible to measure a low range less than 400ppm?*
A: CO_2 concentration range less than 360ppm cannot be measured under the default settings. CO_2 concentration output less than 360ppm is available by altering the default settings. However, accuracy may be less than specifications at less than 360ppm.

Q3: *What kind of component is used for the optical source and detector element?*
A: A incandescent lamp is used as an optical source and a photodiode is used for the detector element.

Q4: *There is a hysteresis by 100ppm between the high and low alarm thresholds. Is it possible to change the hysteresis?*
A: Yes, hysteresis can be changed. Please refer to “ALHI and ALLO” register of *Register and EEPROM* in the document *CDM7162 Communication Specifications*.

Q5: *Can the sensor be operated by 3V?*
A: Yes. CDM7162 can be operated with an input voltage of either 3.0 ~ 3.6VDC or 4.5 ~ 5.5VDC.

Q6: *Can analog output be obtained?*
A: By converting the PWM output signal, an analog output voltage can be easily made. Please refer to Fig. 4 in *Sec. 1-8-3 Pin No.4 (PWM).*

Q7: *What is the sensor's life expectancy?*
A: Expected sensor life of CDM7162 is 10 years or more.

IMPORTANT NOTICE

This product is designed for use in indoor air quality control systems, including variable air volume systems and demand controlled ventilation systems. Please consult Figaro prior to use of this product in other applications. This product is not designed and authorized for use as a critical component in life support applications wherein a failure or malfunction of the products may result in injury or threat to life.

Figaro Engineering Inc. reserves the right to make changes without notice to this product to improve reliability, functioning or design.

Before purchasing this product, please read the Warranty Statements shown in our webpage by scanning this QR code.

https://www.figaro.co.jp/en/pdf/Limited_Warranty_en.pdf

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