MicroHybrid IR CO2 Incubator Sensor

MH-100

User Manual

Version 3

Contents

Introduction

This IR CO2 sensor has been specially optimized for the measurement of 5 Vol-% CO2 in cell incubators to manage ideal cell and tissue growth.

The sensor can be placed directly in the incubation chamber to measure the exact cell experienced environment. It determines the CO2 concentration based on its IR radiation.

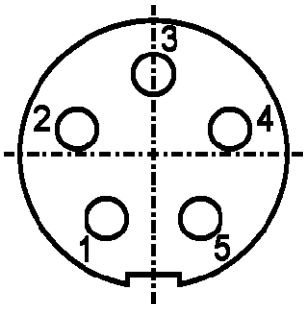
Specifications

- Measuring gas CO2
- Measurement range 0 – 20 Vol.-%
- Gas supply Diffusion
- Warm up time < 1 minute (start-up), < 15 minutes (full spec)
- Accuracy[1] ± 0,2 Vol.-% ± 2 % of reading
- Response time (t90) ≤ 30 s
- Digital resolution 0,001 Vol.-%
- Temperature dependence[2] ≤ ± 0,1 Vol.-%
- Pressure dependence[3] ≤ ± 0,05 Vol.-%
- Long term stability[4] ≤ ± 0,2 Vol.-% at 5 Vol.-% / year
- Humidity correction 0 … 200 hPa H2O
- Supply voltage 12 – 24 VDC
- Power consumption < 2 W
- Digital output RS232, Micro-Hybrid industrial protocol
- Analogue output 4 – 20 mA
- Operating temperature 0° C … 60° C
- Maximum temperature 190° C
- for heat sterilization (sensor only)[5]
- Humidity < 100 % relative humidity (rH), not condensing
- Storage temperature -25° C … 85° C

1 At 37° C, 1013 hPa, dry test gas, excludes calibration gas tolerance of ± 1 %
2 With compensation at 1 Vol.% … 20 Vol.% CO2 and 20° C … 60° C, 1013 hPa
3 With compensation at 600 – 1200 hPa, 37° C and 5 Vol.% CO2
4 Stability at 37° C, without heat sterilization
5 Maximum humidity ≤ 1 % rH, ≥ 85° C auto standby – no CO2 measurement

Connection Cable Pinout

Wire Colour	Pin Plug	Electrical Function
White	1	Vcc
Brown	2	RS232 Rx
Black	3	RS232 Tx
Blue	4	Common GND
Grey	5	Current output



Type Esto Female Connector Series 712

RS232 Interface

UART values	
-1000 / 1 mA	Sensor defect
-2000 / 2 mA	Initialization phase
-3000 / 3 mA	Currently no measurement possible
(-500) … 0 … 20000 … (100000) / (3.6 mA) … 0 mA … 20 mA … (21.6 mA)	Sensor OK ➔ CO_2-Concentration 0 … 20 Vol.-%

Notes:
If the CO2Meter wiring harness is used, the 4-20mA analog output is obtained from the loose wire not pinned into the serial connector.

It is up to the developer to poll the output signal for both the CO2 measurement and to create branch logic for UART/4-20mA signals that report a.) Initialization phase warm up, b.) sensor defect, and c.) no measurement (self-clean or shut down).

Standard RS232 Port Settings

- Baud rate: 9600
- Data bits: 8
- Parity: none
- Stop bit: 1
- Flow control: none

Timing

- Ready for communication after reset / power on: 3 s
- First measurement value after reset / power on: > 8 s
- Measurement data update rate: 1s

RS232 Command Protocol

No additional converters are required for communication with the sensor.
The communication is realized with help of ASCII characters. Transmitting and reading can be handled with terminal software like Windows® HyperTerminal.

A standard command string is shown below:

Start	Command (4 characters)	Parameter1	SP	Parameter2	Stop
STX (Hex 0x02)	"1100"	"0"	0x20	"0"	ETX (Hex 0x03)

The sensor response uses the same frame structure. The different values are separated with the Space character (SP - 0x20). All values are formatted as Integer.

Example: *Command 1* - Get Measurement Data

ASCII-String	STX	"1"	"1"	"0"	"0"	ETX
Hex	0x02	0x31	0x31	0x30	0x30	0x03

RS232 Commands

Command 1: Get Measurement Data

The “Get Measurement data” command provides the sensor serial number, the timestamp followed by the actual measuring value for CO2 concentration, sensor temperature and air pressure. The temperature and pressure values are used for internal compensation algorithms. The update rate for the measurement value is 1 second. At temperatures above 85 °C the sensor will automatically switch off the emitter. During this time no measurement is possible and the CO2 concentration value is fixed set to -3000. When the temperature drops below 85 °C the sensor restart automatically the measurement process.

Command string: “1100”
Parameter: none

Sensor response:
STX
Serial ID Sensor
SP
Timestamp [s * 2]
SP
CO2-concentration [Vol.-% * 1000]
SP
Sensor temperature [°C *10]
SP
Air pressure [hPa]
ETX

Example:
Command string: STX1100ETX
Sensor response: STX7 12345 1200 376 980ETX
Decoded string: SensorID = 7
Timestamp = 12345 ➔ /2 ➔ 6172.5 s ➔
1.7 h CO_2 concentration = 1.2 Vol.-%
Sensor temperature = 37.6 °C
Air pressure = 980 hPa

Parameter	Min Value	Max Value	Error Value
Serial ID Sensor	0	4294967295	-
Timestamp	0	4294967295	-
CO_2 - concentration	-500	100000	-1000
Temperature	-200	2500	-1000
Air pressure	800	1200	-1000

Command 2: Zero Point Adjustment

The “Zero Point Adjustment” command performs a recalculation of the calibration parameter to align the present CO_2 measurement concentration to the set concentration. The alignment is possible for a concentration range up to 0.5 Vol.-%. After a successful adjustment the new calibration parameter are save permanently in the sensor.

Command string:	“1203”
Parameter:	set concentration [Vol.-% * 1000] Possible Range (0 … 0.5 Vol.-%)
Sensor response:	STX 0 – Adjustment successful 1 – Adjustment failed

Example:

Command String1:	STX120340ETX	(zero point adjustment to 0.04 vol. %
Sensor response:	STX0ETX	(adjustment successful)

The procedure for adjustment of the calibration is as follows:

- The sensor should power for minimum 15 minutes in thermal const. atmosphere.
- Fixed in the final installation position.
- If using zero gas the nominal gas flow should not increase 1 Nl/min and the gas temperature should equal to sensor temperature.
- Wait until the concentration has stabilized.
- Send command 2 “zero point adjustment” with the zero point concentration as parameter.

Command 3: Change Baud Rate

The “Change Baud Rate” command allows adapting the sensor baud rate to the baud rate of the customer host systems. The new baud rate setting will be permanently saved in the sensor and activate at the next sensor restart.

Command string:	“1302”		
Parameter:	0	-	115200 Baud
	1	-	57600 Baud
	2	-	38400 Baud
	3	-	19200 Baud
	4	-	9600 Baud
	5	-	4800 Baud
	6	-	2400 Baud
Sensor response:	STX		
	0	-	adjustment successful
	or		
	1	-	adjustment failed
	ETX		

Command 4: Span Point Adjustment

The “Span Point Adjustment” command performs a recalculation of the calibration parameter to align the present CO2 measurement concentration to the set concentration. The alignment is possible for a concentration range from 0.5 Vol.-% up to 20 Vol.-%. After a successful adjustment the new calibration parameter are save permanently in the sensor.

Command string:	“1405”
Parameter:	set concentration [Vol.-% * 1000] Possible Range (0.5 … 20 Vol.-%)
Sensor response:	STX 0 adjustment successful 1 adjustment failed

Example:
Command string: STX14055000ETX (span point adjustment to 5.0 Vol.-%)
Sensor response: STX0ETX Adjustment Successful

The procedure for adjustment of the calibration is as follows:

- The sensor should power for minimum 15 minutes in thermal const. atmosphere.
- Fixed in the final installation position.
- If necessary perform a zero point adjustment first (Command 2: Zero Point Adjustment).
- The nominal gas flow should not increase 1 Nl/min and the gas temperature should equal to sensor temperature.
- Wait until the concentration has stabilized.
- Send command 4 “span point adjustment” with the reference concentration as parameter.

Command 5: Humidity Compensation H_2O Partial Pressure

The “Humidity Compensation H2O Partial Pressure” command performs an internal compensation algorithm to reduce the humidity influence of the CO2 measurement. The humidity parameter stores temporarily in the sensor and all following CO2 measuring values are compensated with the last setting. After power on or sensor reset the humidity value is automatic set to 0 hPa (compensation off). If the humidity parameter is out of possible input range, the last valid value will transmit as sensor response.

Command string:	“1706”
Parameter:	Humidity [hPa * 10] Possible Range (0 … 200 hPa)
Sensor response: Humidity [hPa * 10]	STX -received parameter ETX

Example:

Command string:	STX1706590ETX (set current humidity to 59.0 hPa)
Sensor response:	STX590ETX (confirm received value)

Command 6: Humidity Compensation %RH and Temperature

The “Humidity Compensation %RH and Temperature” command performs an internal compensation algorithm to reduce the humidity influence of the CO2 measurement. This command is equal to command 5 “Humidity Compensation H2O Partial Pressure” with an additional conversion form temperature and relative humidity in absolute humidity. The humidity parameter stores temporarily in the sensor and all following CO2 measuring values are compensated with the last setting. After power on or sensor reset the humidity value is automatic set to 0 hPa (compensation off).

Command string:	“1809”
Parameter1:	relative humidity [%rH] Possible Range (0 … 100 %rH)
Parameter2:	temperature [°C * 10] Possible Range (0 … 600)
Sensor response:	STX 0 - adjustment successful or 1 - adjustment failed ETX

Example:

Command string:	STX180990 370ETX (set current humidity to 90 %rH at 37 °C)
Sensor response:	STX0ETX (confirm received value)

Command 7: Sensor Reset

The "Sensor Reset" command performs a software reset and a reinitialization off all sensor parameter.

Command string:	"1908"
Parameter:	none
Sensor response:	none

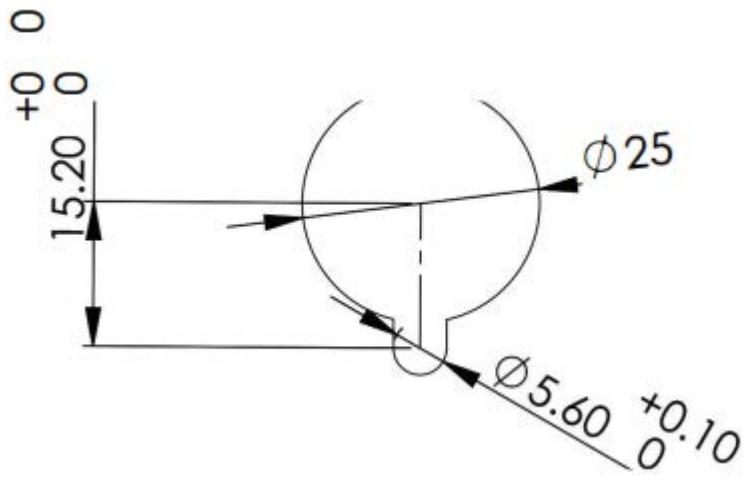
Command 8: Set factory default

The command "Set Factory Default" set all sensor parameter and calibration parameter to factory default values. All user defined settings are deleted.

Command string:	“”5005”
Parameter:	none
Sensor response:	STX 0 - adjustment successful or 1 - adjustment failed ETX

Mechanical Interface

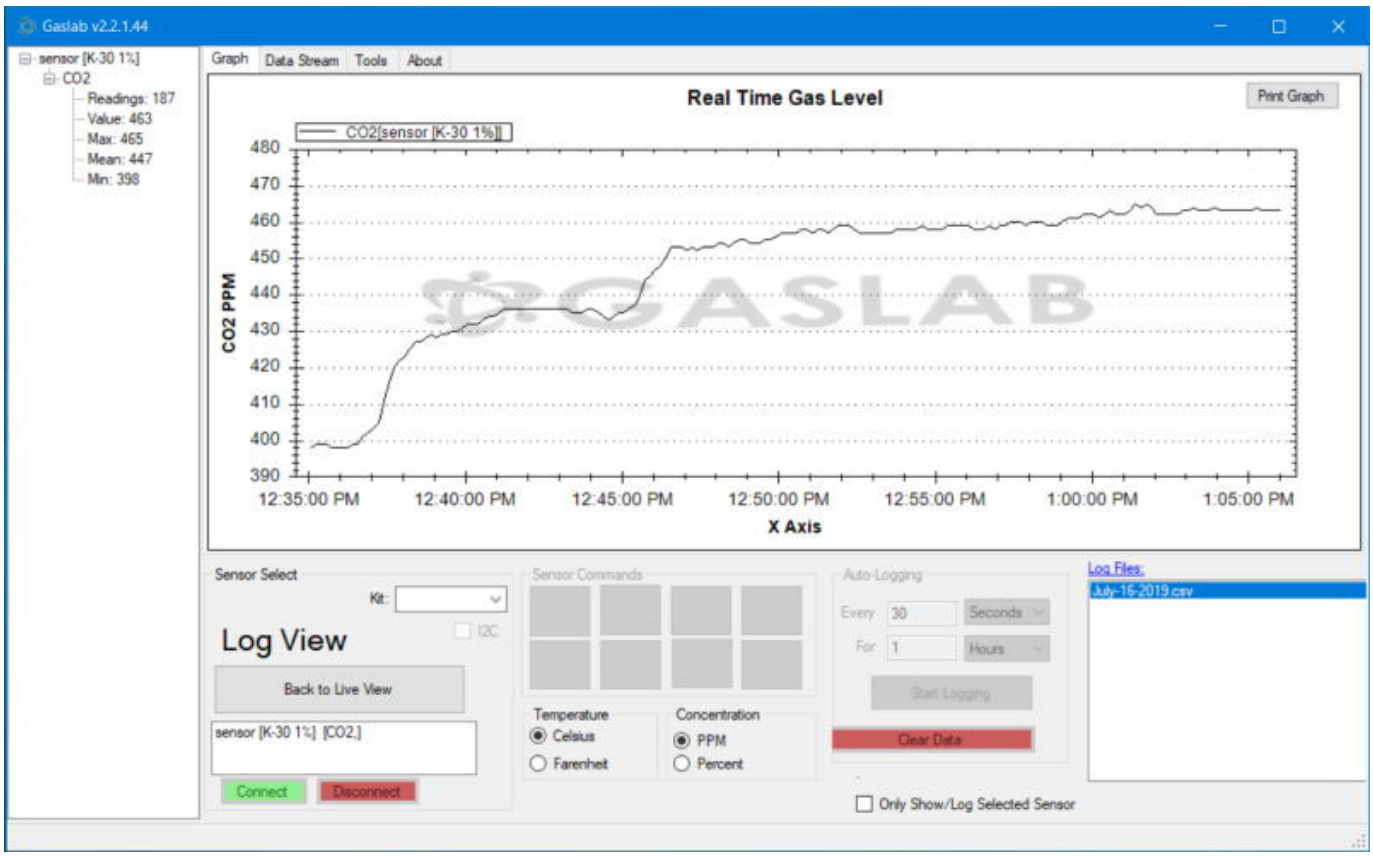
(Minimum thickness of chamber backplane 1.0mm)



GasLab® Software

GasLab software is available for free from CO2Meter.com. It allows the user to read the data from the sensor via a USB wiring harness included in the MH-101 Development Kit.

The Wiring Harness provides RS232 connectivity via a USB to 9-pin FTDI serial connector and 4-20mA from a pigtail. It includes 120 VAC to 12 VDC power supply. Using the wiring harness lets you quickly test and configure the sensor as well as graph raw data and log it for later analysis.



You can download the GasLab software here:
https://gaslab.com/pages/software-downloads

For more information on using the GasLab software refer to the manual on the download page.

Warranty and Support

Support

The quickest way to obtain technical support is via email. Please include a clear, concise definition of the problem and any relevant troubleshooting information or steps taken so far, so we can duplicate the problem and quickly respond to your inquiry.

Warranty

The sensor comes with a 90 day warranty starting from the date it was shipped to the buyer.

Contact Us

If the troubleshooting guide above does not help you solving your problem or for more information, please contact us using the information below.

Edaphic Scientific Pty Ltd
www.edaphic.com.au
info@edaphic.com.au