

# MicroHybrid IR CO2 Incubator Sensor



## User Manual

**Version 3**

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## Introduction

This IR CO<sub>2</sub> sensor has been specially optimized for the measurement of 5 Vol.-% CO<sub>2</sub> 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 CO<sub>2</sub> concentration based on its IR radiation.

### Specifications

- Measuring gas CO<sub>2</sub>
- Measurement range 0 – 20 Vol.-%
- Gas supply Diffusion
- Warm up time < 1 minute (start-up), < 15 minutes (full spec)
- Accuracy<sup>1</sup>  $\pm 0,2 \text{ Vol.-%} \pm 2 \% \text{ of reading}$
- Response time (t<sub>90</sub>)  $\leq 30 \text{ s}$
- Digital resolution 0,001 Vol.-%
- Temperature dependence<sup>2</sup>  $\leq \pm 0,1 \text{ Vol.-%}$
- Pressure dependence<sup>3</sup>  $\leq \pm 0,05 \text{ Vol.-%}$
- Long term stability<sup>4</sup>  $\leq \pm 0,2 \text{ Vol.-% at } 5 \text{ Vol.-% / year}$
- Humidity correction 0 ... 200 hPa H<sub>2</sub>O
- 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)<sup>5</sup>
- 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  $\pm 1 \%$*

*2 With compensation at 1 Vol.% ... 20 Vol.% CO<sub>2</sub> and 20° C ... 60° C, 1013 hPa*

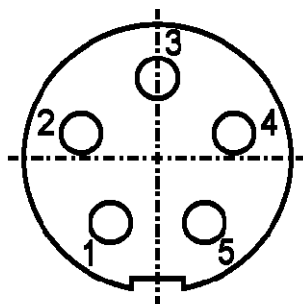
*3 With compensation at 600 – 1200 hPa, 37° C and 5 Vol.% CO<sub>2</sub>*

*4 Stability at 37° C, without heat sterilization*

*5 Maximum humidity  $\leq 1 \% \text{ rH}$ ,  $\geq 85^\circ \text{ C}$  auto standby – no CO<sub>2</sub> 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 <sub>2</sub> -Concentration 0 ... 20 Vol.-%

### Notes:

It is up to the developer to poll the output signal for both the CO<sub>2</sub> 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
<b>STX</b> (Hex 0x02)	"1100"	"0"	<b>0x20</b>	"0"	<b>ETX</b> (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	<b>STX</b>	"1"	"1"	"0"	"0"	<b>ETX</b>
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 CO<sub>2</sub> 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 CO<sub>2</sub> 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**  
CO<sub>2</sub>-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<sub>2</sub> 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 <sub>2</sub> - 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<sub>2</sub> 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 NI/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:	<b>STX</b>		
	0	-	adjustment successful
	or		
	1	-	adjustment failed
	<b>ETX</b>		

## Command 4: Span Point Adjustment

The “Span Point Adjustment” command performs a recalculation of the calibration parameter to align the present CO<sub>2</sub> 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: **STX**14055000**ETX** (span point adjustment to 5.0 Vol.-%)  
Sensor response: **STX**0**ETX** 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 NI/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<sub>2</sub>O Partial Pressure

The “Humidity Compensation H<sub>2</sub>O Partial Pressure” command performs an internal compensation algorithm to reduce the humidity influence of the CO<sub>2</sub> measurement. The humidity parameter stores temporarily in the sensor and all following CO<sub>2</sub> 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: **STX**  
Humidity [hPa \* 10] -received parameter  
**ETX**

*Example:*

Command string: **STX**1706590**ETX** (set current humidity to 59.0 hPa)  
Sensor response: **STX**590**ETX** (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 CO<sub>2</sub> measurement. This command is equal to command 5 “Humidity Compensation H<sub>2</sub>O Partial Pressure” with an additional conversion from temperature and relative humidity in absolute humidity. The humidity parameter stores temporarily in the sensor and all following CO<sub>2</sub> 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: **STX**180990 370**ETX** (set current humidity to 90 %rH at 37 °C)  
Sensor response: **STX**0**ETX** (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

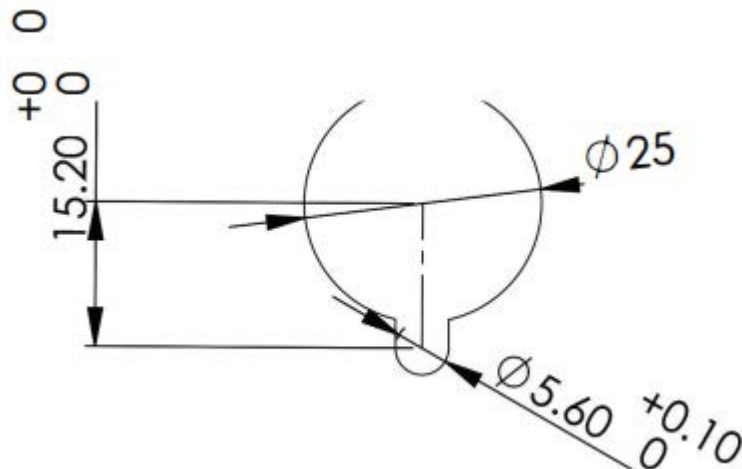
## Command 8: Set factory default

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)



## 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. For more information visit our website:

<https://www.co2meter.com/pages/terms-conditions>

### 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.



[Sales@CO2Meter.com](mailto:Sales@CO2Meter.com)

(877) 678 - 4259 (M-F 9:00am–5:00pm EST)

[www.CO2meter.com](http://www.CO2meter.com)

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