Pinout of the Connection Cable:

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:
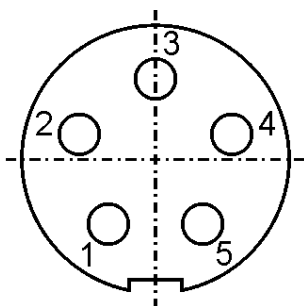
Signals on UART interface:

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.-%

Datasheet appendix
Incubator IR CO2 sensor

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 Interface 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 overview:

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_2 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_2 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_2-concentration [Vol.-% * 1000]
`SP`
Sensor temperature [°C *10]
`SP`
Air pressure [hPa]
`ETX`

Example:

Command string:	`STX`1100`ETX`
Sensor response:	`STX`7 12345 1200 376 980`ETX`
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
                        or
                        1   -   adjustment failed
                        ETX

Example:
Command string: STX120340ETX   (zero point adjustment to 0.04 Vol.-%)
Sensor response: STX0ETX   (adjustment successful)

The procedure for adjustment 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 CO_2 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
                       or
                       1   -   adjustment failed
                       ETX

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

The procedure for adjustment 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 H₂O Partial Pressure

The "Humidity Compensation H_2O 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: STX
                     Humidity [hPa * 10]   -   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 H_2O 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
(thickness chamber backplane minimum 1.0mm)
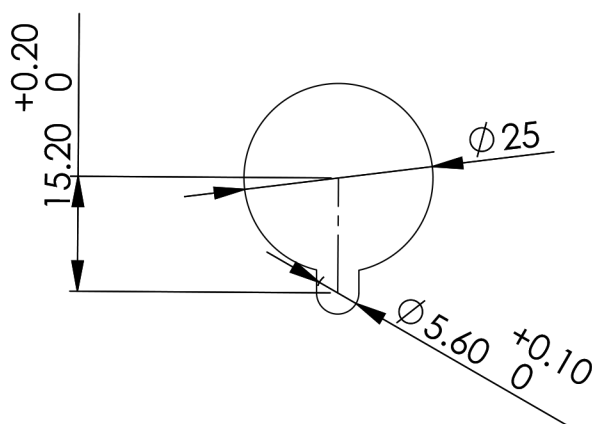
Pinout ESTO 712
1: 24V
2: RX
3: TX
4: GND
5: NC