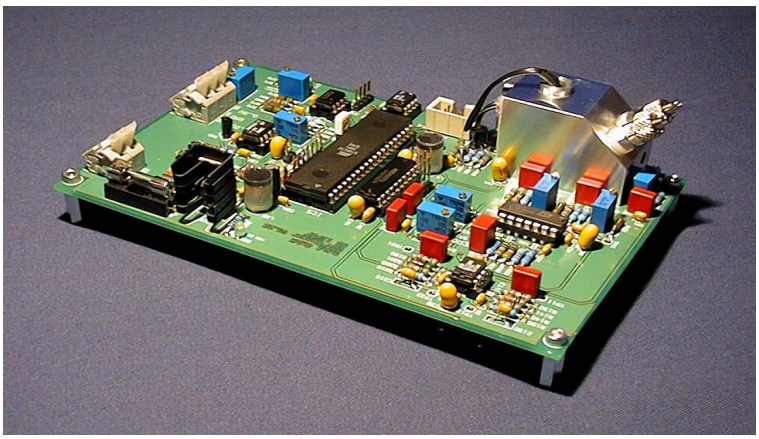
User Manual

CO_2-Sensor 10% / 30% / 100%

Release 1.23



List of Releases

Release	Date	Author	Remarks
1.0	15.12.1997	S.Otto	Basic software
1.1	01.06.1998	S.Otto	Minor modifications
1.2	01.10.1998	S.Otto	Revision of calibration
1.3	07.02.2001	S.Otto	New layout; change of address
1.4	13.02.2001	S.Otto	Transfer characteristic
1.5	21.08.2001	S.Otto	Adaptation to new software V1.23
1.6	11.07.2005	K.Techritz	1st English Version + minor modifications

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Datenmedia User Manual CO2-LC V1.6e.doc

Contents

1 Technical Data

Input voltage (Vcc)	12V DC; opt. 24V DC
Input current (Icc)	ca. 150mA
Cutout Value	200mA delayed
Signal-current loop interface	4mA..20mA (Resistive Load max. 100 Ohm at Vcc = 8V)
Signal-voltage interface	optional, adjustable to 0..4V Full Scale
Display Accuracy	±2% Full Scale
Temperature range	10°C..40°C
Compensation of temperature	integrated
Gas Connections	Screw coupling
Hose	Inner Diameter 3mm Outer Diameter 5mm Nylon/PVC/Neoprene, no Silicone-hose!
Gas-flow	≤ 1 Litre/minute; 0.35 Litre/minute recommended
Maximum Overpressure	0.5bar (measurement at normal pressure)
Measurement interval	approx. 1s, every 23s correction cycles for 7s
Step response [t_{90}]	approx. 10s @ 350ml/min; depending on flow-through
Dimensions	(100x160)mm^2 max. construction height 50mm
Weight	approx. 200g
Options	• Signal-voltage interface • Serial interfaces: RS232, RS422, RS485

2 Implementation

2.1 Electrical Connections

Kindly bear in mind to discharge possible electrostatic charges of your body at appropriate grounded devices (e.g. heater, grounded housing)!

All electrical connections must be established before switching on the electrical supply!

Avoid any mechanical forces of the cuvette (little aluminum block) on the circuit board!

Touch the circuit board at its edges only!

Connect the ground strap of the electrical supply with the connector *GND (see also chapter Connections)* and the anode with the connector *Vcc*. The used power supply must comply with the specifications referred to in the *Technical Data*. Connect the ground of the signal (separate terminal clamp but connected with supply ground) with the ground of the device to be fed. Voltage-fed plotting units (e.g. displays) must be connected with output *0..5V,* current-fed devices with output *+4..20mA*.

We recommend the connection with a shielded cable with a twisted pair (STP) grounded from both sides.

The CO_2-sensor is delivered calibrated with the values 4 and 20mA for the current interface and with concentration values of 0% and full scale {10% / 30% / 100%}.

2.2 Gas Connections

Loosen the knurled nut of the hose connections on the top of the cuvette. Counter-turn the cuvette at the same time with the other hand.

Connect the knurled nut to the hoses. Push the hoses as far as possible on the connector and tighten the nuts hand-screwed (counter-turned again).

The connections for in- and output are arbitrary. The temperature of the gas should be identically to the ambient air temperature of the gas-sensor. The environment of the sensor-card should not be polluted with high CO_2 concentrations.

Avoid forces and momenta on the cuvette; while loosening and tightening of the connecting nut hold and counter-turn the cuvette with the other hand!

Provide the input with a filter to avoid soiling of the cuvette!

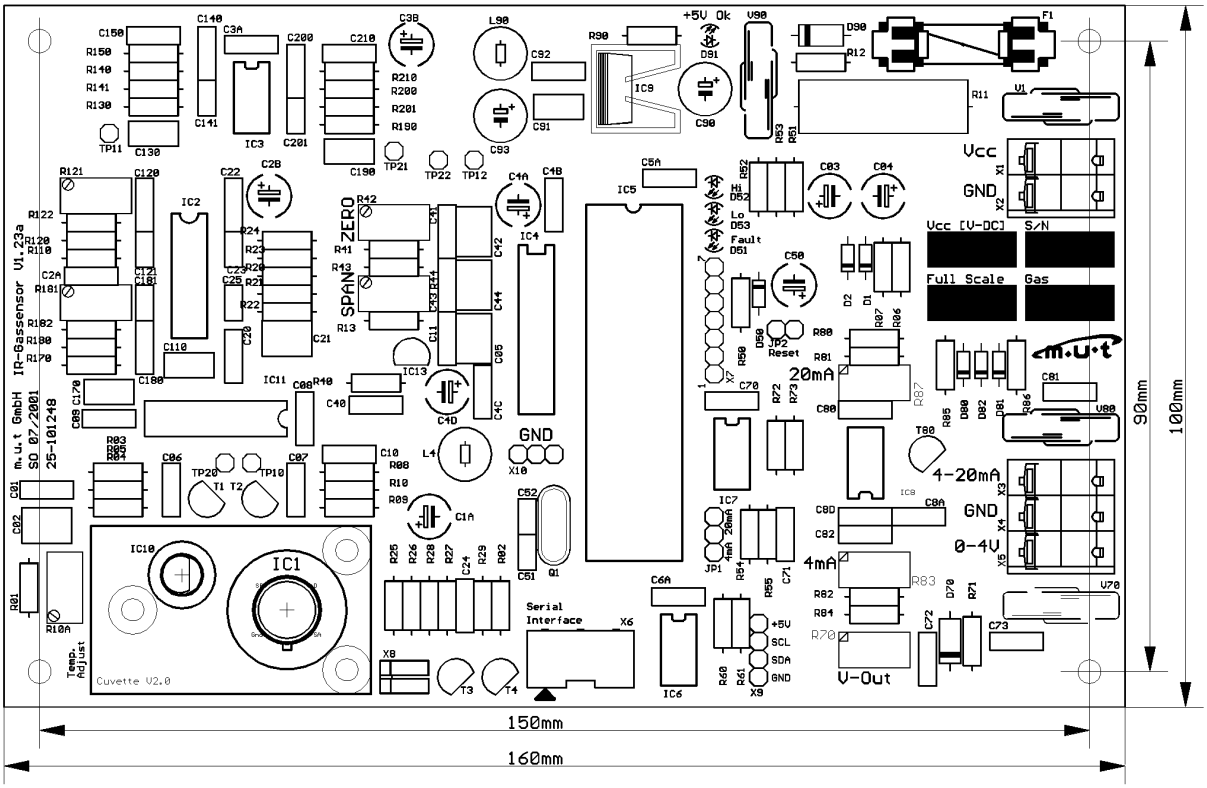
The maximum pressure may not be exceeded (see *Technical Data*)

During measurements the gas must discharge freely.
Blockages of the gas-outlet will lead to errors in measurement due to pressure increase

Increased flow rates will lead to errors in measurement – amongst others due to pressure increase (see *Technical Data*)

3 Connections

3.1 Overview



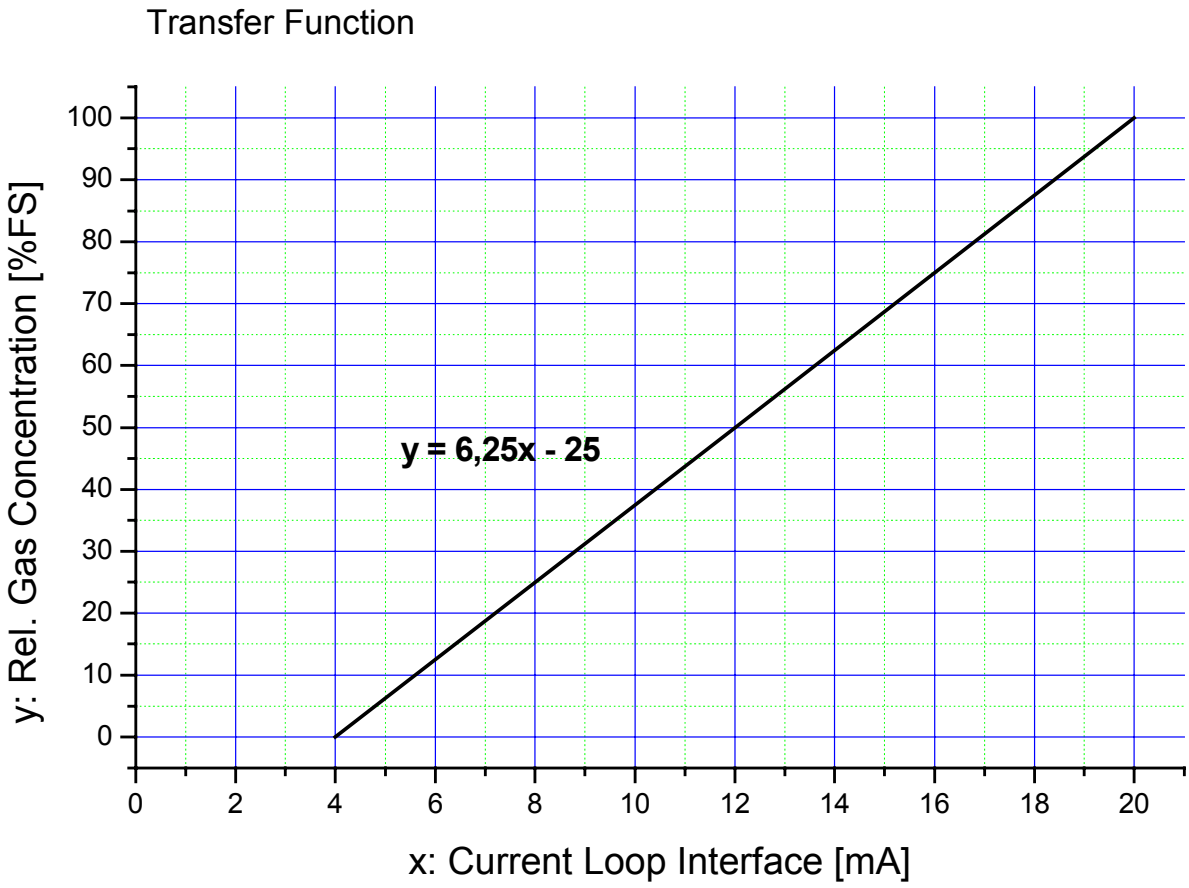
Name	Type	Description of Function
Vcc	Terminal clamp	Voltage-supply (8-12V DC)
GND	Terminal clamp	Ground connector for electrical supply
„4..20mA“	Terminal clamp	Current Loop output (positive Signal)
GND	Terminal clamp	Ground connector interface current/voltage (negative Signal)
„0..4V“	Terminal clamp	Voltage outlet (positive Signal), optionally!
JP1	Pin header	• force output to 4 mA on current loop interface (Jumper 4mA - center), adjustment with R83 • force output to 20 mA on current loop interface (Jumper 20mA - center), adjustment with R87 • current loop interface provides current proportional actual gas concentration (e.g. put Jumper on X10, factory-preset)
R42, „ZERO“	Potentiometer	Calibration (0% CO_2-adjustment)
R44, „SPAN“	Potentiometer	Calibration (full scale value; e.g. 100%)
R83, „4mA-Adjust“	Potentiometer	Calibration of current interface of 4mA (see also JP1)
R87, „20mA-Adjust“	Potentiometer	Calibration of current interface of 20mA (see also JP1)
D91	LED green	Electrical supply o.k.
D51	LED red	Disturbed measurement values e.g. by strong air draft or considerable change of temperature.
D52	LED yellow (HI)	Exceeding of maximum value (i.e. > 10%/30%/100%)
D53	LED yellow (LO)	Undershooting of minimum value (i.e. < 0%)
R70, „V-Out-Adjust“	Potentiometer	Adjustment of voltage output, optionally!

3.2 Transfer characteristics

The outlet current (4-20mA) measured at terminal clamps „+4..20mA“ and „GND“ is directly proportional to the measured concentration of gas.

Current	Relative Gas-concentration	Example: 30%-CO_2-Sensor	Example: 100%-CO_2-Sensor
4mA	0%	0% CO_2	0% CO_2
12mA	50% of maximum value	15% CO_2	50% CO_2
20mA	100% of maximum value	30% CO_2	100% CO_2

The maximum value may be abbreviated with „FS“ (Full Scale).



4 Adjustment of signal outputs

4.1 Current output

The 4-20mA-current interface must be calibrated in following order:

1. Connect a current-measuring instrument/ampere meter or a current sink to the terminal clamp *X3* (+4..20mA) and *X4* (GND)
2. 4mA-Adjustment:
   The jumper must be fitted on the pin header *JP1* connecting the inner and the outer pin „4mA“. Then adjust *R83* (4mA-Adjust) until the measuring instrument shows 4.00 mA.
3. 20mA-Adjustment:
   The jumper must be position on the pin header *JP1* connecting the inner and the outer pin „20mA“. Then adjust R87 (20mA-Adjust) until the measuring instrument shows 20.0mA.
4. Measuring position
   The jumper must be connected to the pin header *X10* (presetting by factory). The current outlet now supplies the current proportionally to the measured gas-concentration, exceeding/undershooting of approx. 0.1mA is overflow resp. underflow range)

4.2 Voltage outlet

The adjustment of the voltage signal is done via the *R70* (V-Out-Adjust). The voltage outlet *„0..4V“* can be adjusted for an indicating device/plotting unit (e.g. built-in digital voltmeter).

The voltage outlet may only be loaded high-resistive.

5 Calibration

5.1 Remarks

Kindly proceed the calibration following the following two chapters by all means.

Calibration-tests like changing of the length of the cuvette, adjustment of the detector or adjustments of potentiometers that are not designated for purpose require a new calibration in our factory.

A calibration must be proceeded in following order:

1. Calibration/test of the current interface on 4.00mA
2. Calibration/test of the current interface on 20.0mA
3. Calibration/test of the sensor on 0% gas
4. Calibration/test of the sensor on full scale gas concentration

5.2 Setting of zero-point

Also for the calibration please bear in mind the data conc. maximum pressure and maximum gas flow mentioned in the *Technical Data!*

Before proceeding a gas-calibration either the voltage or the current interface should be calibrated!

Prior to a calibration the CO_2-sensor should be operated for at least 30 minutes in stable room temperature.

For the zero-point setting you should ideally use a 100% nitrogen gas (e.g. purity better 3.5 i.e. better 99.95%). Rinse the cuvette thoroughly with the calibration-gas and either adjust the gas-flow to minimum or interrupt the flow before setting the calibration values. (The gas flowing out of the gas-container cools down considerably during its expansion and therefore adulterates the measured value.)

The current outlet *4-20mA* shall now generate a current flow from 4mA towards *GND.*

Please make sure that a resistive load (internal resistance typ. 100Ohm) is connected between the current outlet and the ground connector *GND.*

Adjust the Potentiometers *R42.* (ZERO) to a current flow of > 4mA . Then reduce the current slowly to 4mA. Stop the procedure when reaching the value and the yellow LED D53 (LO) is lid. Further adjustments change the calibration parameters without visible changes of current.

The circuit needs to stabilize after changes of settings, therefore please observe the value for approx. 20 seconds.

5.3 Setting of concentration

5.3.1 Calibration-gas

In principle it is possible to proceed the calibration (after setting of zero-point) with a gas of any concentration. However, the calibration is the more accurate the higher the concentration of the second calibration-gas. Therefore we recommend a calibration with 100% CO_2 for the 100%-version respectively 30% CO_2 (ideally in N_2) fort the 30%-version.

Generally the desired current value is calculated as follows:

$$I_{required} = 4mA + 16mA \cdot \frac{Conc_{CG}}{Conc_{FS}}$$

desired value for the calibration

Symbol	Dimension	Description
$I_{required}$	mA	required output current at concentration C_{CG}
$Conc_{CG}$	%CO_2	concentration of calibration gas (e.g. 30% CO_2)
$Conc_{FS}$	%CO_2	full scale concentration of gas sensor (e.g. 100% CO_2)

Example:

$Conc_{CG}$	30%
$Conc_{FS}$	100%
$I_{required}$	8.8mA

5.3.2 Pressure-correction

It needs to be considered that generally the declaration of the concentration of the calibration-gas ($Conc_{CG}$) is based on normal pressure (1013.25 mbar) and standard temperature (298 K). Due to the integrated temperature-compensation the difference in pressure needs to be calculated.

The gas temperature should be identical with the environment temperature. In case the calibration is done under circumstances different to the standard circumstances the value shown by the sensor-card needs to be calculated newly with following formula to calculate the needed concentration of the calibration-gas.

$$Conc_{DV} = \frac{Conc_{CG} \cdot P}{1013{,}25 mbar} \cdot$$

Symbol	Dimension	Description
$Conc_{DV}$	%CO2	Displayed gas concentration
$Conc_{CG}$	$\%CO_2$	concentration of calibration gas (e.g. 30% CO_2)
P	mbar	pressure of gas inside cuvette (i.e. typically ambient pressure)

Example:

$Conc_{CG}$	30%
P	1000mbar
$Conc_{DV}$	29.6 %

If you calibrate your sensor with a premixed gas of 30% CO_2 with the gas exhausted to ambient pressure of 1000mbar the displayed gas concentration shall be 29.6% (instead of 30%) ! With a gas sensor of 30% full scale this means one obtains an output current of 19.8mA (instead of 20.0mA).

5.3.3 Calibration procedure

The sensor board must be taken into operation half an hour prior calibration.

Also for the calibration please bear in mind the data conc. maximum pressure and maximum gas flow mentioned in the *Technical Data!*

Rinse the cuvette thoroughly with the calibration-gas and either adjust the gas-flow to minimum or interrupt the flow before setting the calibration values. (The gas flowing out of the gas-container cools down considerably during its expansion and therefore adulterates the measured value.) The current outlet shall now generate a current flow towards *GND* that conforms with the desired value calculated in the last two chapters. Adjust the desired value via the potentiometer *R44* (SPAN). If the desired value is 20mA, you should do the adjustment from a lower value as 20mA represents the possible maximum current value. A higher adjustment would lead to wrong calibration.

The circuit needs to stabilize after changes of settings, therefore please observe the value for approx. 20 seconds.