USER'S GUIDE

Vaisala CARBOCAP$^{®}$ Carbon Dioxide Calibrator for the GMP220 series probes
GMK220

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CHAPTER 1
GENERAL INFORMATION

Safety

Throughout the manual, important safety considerations are highlighted as follows:

WARNING	Warning alerts you to a serious hazard. If you do not read and follow instructions very carefully at this point, there is a risk of injury or even death.

CAUTION	Caution warns you of a potential hazard. If you do not read and follow instructions carefully at this point, the product could be damaged or important data could be lost.

NOTE	Note highlights important information on using the product.

Warranty

Vaisala issues a guarantee for the material and workmanship of this product under normal operating conditions for one year from the date of delivery. Exceptional operating conditions, damage due to careless handling or misapplication will void the guarantee.

CHAPTER 2
PRODUCT DESCRIPTION

Introduction

Although Vaisala's CO_2 instruments are inherently stable, periodical checkings should be performed according to the recommendations given in the relevant user's guide. The GMK220 calibrator (Figure 1) is intended for spot checking and two-point calibration of the carbon dioxide probes GMP221 and GMP222, which currently are used in Vaisala's GMT220 and GMM220 series CO_2 transmitters.

GMK220 can be used for

- spot checking with one reference gas
- two-point calibration with two reference gases

Spot checking can be carried out when there is a need to check if the probe is operating correctly. If adjustement is needed, two-point calibration shall be carried out.

GMK220 needs only the probes

For checking and calibration, the GMK220 needs only the probes, not the whole transmitter. The GMK220 calibrator calibrates and stores the calibration parameters to the non-volatile memory in the probes. This enables true interchangeability of the probes and forms a good basis for the continuous measurements with good traceability.

NOTE	The GMK220 can be used to calibrate the probes marked with a little star (*) in the probe label. A little star indicates that the probe has the program version compatible with the calibrator.

GMK220 Calibrator for the GMP220 Series Probes
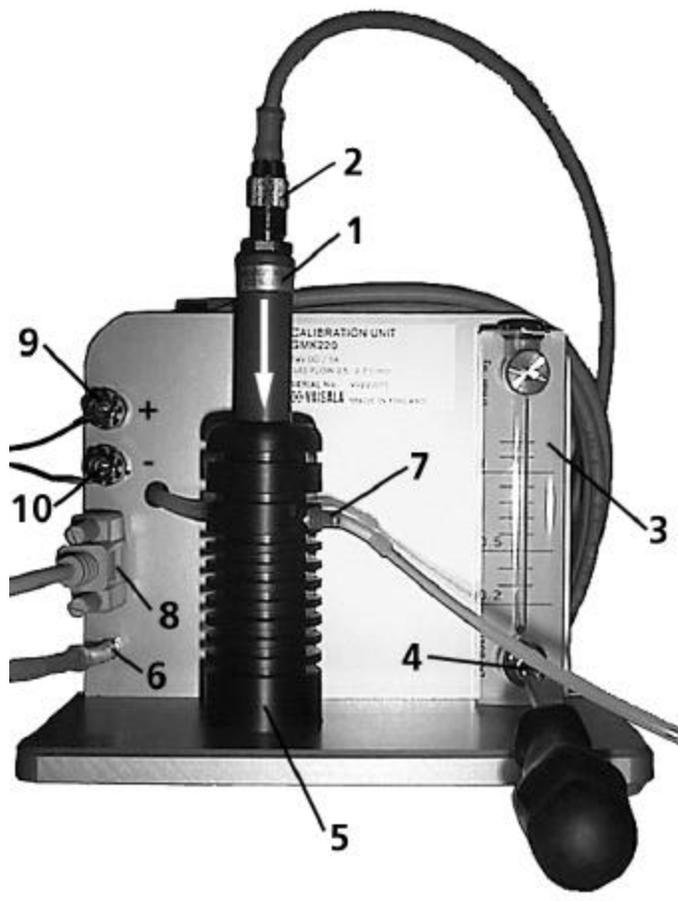
1. Probe to be checked (not included)
2. Probe connector and the cable
3. Rotameter
4. Flow adjustment screw
5. Chamber (including 0-ring 18.3x2.4 NBR 70 ShA,)
6. Gas inlet
7. Gas outlet
8. Serial cable (connects calibrator and PC)
9. 24 V Supply voltage in (+)
10. Ground (-)

Figure 1   GMK220 Calibrator.

CAUTION	When handling the GMK220 calibrator, please be careful not to damage the board on the backside of the plate.

Additional equipment

The following additional equipment is needed for checking and calibration operations:

- Traceable reference gas/es as follows:

  spot checking: one gas with CO_2 concentration within the measuring range of the probe. Accuracy shall be 1% (or better).

  two-point calibration: two gases with CO_2 concentrations representing the low and high end of the probe's measuring range. See the requirements below.

- Pressure regulator (giving about 1 bar pressure)
- PC and a terminal software (e.g. Windows® Hyper Terminal)
- Power supply, 24 VDC/1A

In addition, values on the ambient temperature (with accuracy of $\pm$ 0,5 ºC) and barometric pressure (with accuracy of $\pm$ 1 hPa) are needed as input data during the checking or calibration procedure.

Requirements for the calibration gases

Low end calibration gas	N_2 gas with a purity of N50 (or better). Traceable to appropriate standards (for example NIST).
High end calibration gas	Mixture of CO_2 and N_2 gases. CO_2 concentration shall be 95...105 % of the measuring range of the probe. Accuracy shall be 1 % (or better). Traceable to appropriate standards (for example NIST).

CHAPTER 3
OPERATION

Spot checking

Spot checking is carried out when there is a need to check if the probe (GMP221 or GMP222) is operating correctly. The reference gas concentration must be within the measuring range of the probe to be checked. Please read requirements concerning the reference gases from *Chapter2 Additional equipment* before starting the operation.

Perform the spot checking according to the following instructions:

1. Connect the cable (item 2, Figure 1) to the probe to be tested.

2. Insert the probe into the chamber (item 5, Figure 1) so that the perforated filter cover is completely inside the chamber

3. Connect the PC to the calibrator with the serial cable (item 8, Figure 1). Check the connection set-up, the serial line settings for data transfer shall be

- 9600 baud
- parity: 8/None
- 1 stop bits

4. Connect the 24 VDC supply power to the connectors (items 9 and 10, Figure 1).

5. The following (or similar) text appears in the terminal window on the PC screen (program version number can be updated):

```
GMT220A - Version: STD 4.08
Copyright: Vaisala Oyj,1997-2000
>
>
```

6.   Let the calibrator settle for 10 minutes.

7.   Connect the reference gas and adjust the flow rate to 0.6 l/min with a screwdriver (item 4, Figure 1). Flush the chamber with the gas for 5 minutes.

8.   Input the ambient barometric pressure.

> **MF_PRESSURE XXXX<CR>**

where xxxx= pressure in hPa.

Example:

```
>MF_PRESSURE 1013<cr>
MF_PRESSURE=1013
>
```

9.   Input the ambient temperature.

> **MF_TEMP XXX<CR>**

where xxx = temperature is given in tenths of °C (25 °C = 250).

Example:

```
>MF_TEMP 250 <cr>
MF_TEMP=250
>
```

10. List the carbon dioxide concentration.

> **MF_MODE 2<CR>**

  Example:

```
>MF_MODE 2<cr>
MF_MODE=2
  1620.1
  1618.3
  1619.8
  1619.8
  ...
```

The carbon dioxide concentration (in ppm) is measured every 0.5 seconds.

11. Stop the output with the ESC-button (or by typing MF_MODE 0).

12. The difference between the average reading and the actual concentration of the reference gas shall be within the long term stability specifications of the probe. If there is need for calibration, please refer to the chapter *Two- point calibration.*

13. Disconnect the gas flow and remove the probe from the chamber.

NOTE	If the error of the output reading for some reason is more than 20%, please send the probe to Vaisala for service.

Two-point calibration

The reference gases used for the two-point calibration shall represent the low and high end of the probe's measuring range. Please, read recommendations concerning the reference gases in *Chapter 2 Additional equipment* before starting the operation.

Perform the two-point calibration according to the following instructions:

1. Connect the cable (item 2, Figure 1) to the probe to be tested.

2.   Insert the probe into the chamber (item 5, Figure 1) so that the perforated filter cover is completely inside the chamber.

3.   Connect the PC to the calibrator with the serial cable (item 8, Figure 1). Check the connection set-up, the serial line settings for data transfer shall be

- 9600 baud
- parity: 8/None
- 1 stop bits

4.   Connect the 24 VDC supply power to the connectors located on the right-hand side of the plate (items 9 and 10, Figure 1).

5.   The following (or similar) text appears in the terminal window on the PC screen (number of the program version can be updated):

```
GMT220A - Version: STD 4.08
Copyright: Vaisala Oyj, Matti Kokki, 1997-2000

>
```
6.   Let the calibrator settle for 10 minutes.

7.   Connect the low-end gas and adjust the flow rate of 0.6 l/min with a screwdriver (item 4, Figure 1). Flush the chamber with the gas for 5 minutes.

8.   Give the password by typing

PASSWORD 5120<CR>

9. Give the input data for the calibration.

> **CALICALI L \<sample quantity>\<CO$_2$ concentration >**
> **\<P$_{ambient}$ >\<T$_{ambient}$>\<cr>**

where CO_2 concentration is given in ppm, $P_{ambient}$ is pressure given in hPa and $T_{ambient}$ is temperature given in °C.

The sample quantity determines the number of measurements of which averages are calculated. The sample quantity is recommended to be at least 200.

NOTE	The character after the CALICALI command is case-sensitive i.e. it has to be given as capital letter (CALICALI L).

Example:

```
>CALICALI L 200 0 1013 23<cr>
Calibration start - Length is 200 samples (it takes
about 107 seconds)
You can interrupt operation by CTRL-C
1297.5    550.4      382.7           445.5        32.5
1295.2    554.5      482.0           445.9        32.5
...
1298.1    561.7      603.5           449.6        32.5
1296.9    557.3      523.4           454.2        32.5

Noise measurement ready

Res Avg = 470.491219
Res Std = 82.244873
FR Avg  = 447.789145
FR Std  = 2.355181
Rx Avg  = 1296.441917
Rx Std  = 1.870829
Tx Avg  = 554.371452
Tx Std  = 3.844639

Low gas (     0 ppm) measurement done. Start high gas.

>
```

10. As the calibration at low end is completed, the software asks to change to the high gas.

11. Adjust the flow rate of the high end gas to 0.6 l/min with a screwdriver (item 4, Figure 1). Flush the chamber with the gas for 5 minutes.

12. Give the input data for the calibration.

> **CALICALI H <sample quantity><CO$_2$ concentration >**
> **<P$_{ambient}$ ><T$_{ambient}$><cr>**

where CO$_2$ concentration is given in ppm, P$_{ambient}$ is given in hPa and T$_{ambient}$ is given in °C.

The sample quantity determines the number of measurements of which averages are calculated. The sample quantity is recommended to be at least 200.

NOTE	The character after the CALICALI command is case-sensitive i.e. it has to be given as capital letter (CALICALI H).

Example:

```
>CALICALI H 200 30000 1013 25<cr>
Calibration start - Length is 200 samples (it takes
about 107 seconds)
You can interrupt operation by CTRL-C
1139.3   1219.3         1.0             1.4         32.5
1137.6   1217.3         1.0             1.3         32.5
...
1137.7   1219.7         1.0             1.1         32.5
1137.0   1216.8         1.0             1.1         32.5

Noise measurement ready

Res Avg = 0.999947
Res Std = 0.001777
FR Avg  = 1.165917
FR Std  = 0.101676
Rx Avg  = 1138.306737
Rx Std  = 1.732051
Tx Avg  = 1218.396783
Tx Std  = 1.837117
PC_METHOD=3
PC_R0=1138.306737
PC_T0=485.501432
PC_RS=1138.306737
PC_TS=1958.435059

High gas ( 30000.0 ppm) ready. Two point calibration
completed.

>
```

13. As the calibration is completed, save the calibration parameters to the non-volatile memory in the probe.

PROBE_SAVE<CR>

```
>PROBE_SAVE<cr >
```

New calibration parameters are now saved in the probe.

14. Disconnect the gas flow and remove the probe from the chamber.

After two-point calibration it is recommended to ensure the correct operation of the probe by carrying out a spot checking procedure using both low and high end gases. The readings should be within the accuracy specifications of the transmitter.

CHAPTER 4
TECHNICAL DATA

Operating temperature range   +15...30ºC

Dimensions   20 x 18 x 16 (height) cm

Materials
    Metal frame   Anodised aluminium
    Probe chamber   POM plastic
    Transmitter body   ABS plastic
Weight   about 2,5 kg
Supply voltage   24 VDC

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