

# Operation MANUAL

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## METHAMETER - CH<sub>4</sub> concentration measurement unit



## LAMBDA CH<sub>4</sub>-meter: CH<sub>4</sub> concentration measurement unit

LAMBDA METHAMETER (CH<sub>4</sub>-METER) allows the measurement of the **concentration of CH<sub>4</sub> gas (0 – 100%) in outgas / exit gas** of the MINIFOR fermentor and bioreactor and the digital transfer of the data to the PC achieved through its **RS-485 interface**. The measured data can be visualized and recorded for example by the **industrial fermentation software SIAM**.

It does not require any additional connector, cable or side neck. Connected to the glass outgas condenser (or Peltier outgas condenser) of the MINIFOR laboratory fermentor and bioreactor, the CH<sub>4</sub>-METER measures the concentration of the CH<sub>4</sub> gas produced.

## LAMBDA Laboratory Instruments

LAMBDA Laboratory Instruments develops innovative, high quality lab-scale instruments with an excellent price to performance ratio for biotechnology, microbiology, food and agricultural, chemical and pharmaceutical industries, research and development as well as for general laboratory and research applications.



**LAMBDA MINIFOR** – highly innovative and compact fermentor/bioreactor system for laboratory scale fermentation and cell cultures.

**LAMBDA OMNICOLL** – fraction collector-sampler for unlimited number of fractions.

**LAMBDA PRECIFLOW, MULTIFLOW, HIFLOW, MAXIFLOW AND MEGAFLOW** peristaltic pumps – reliable, precise and extremely compact.

**LAMBDA SAFETY POWDER DOSER AND HI-DOSER** – allows automatic feeding of powders without spoon. Safe operation with hazardous material (GLP).

**LAMBDA VIT-FIT (HP)** polyvalent syringe pump with extremely robust mechanics – programmable infusion and filling from micro syringes to large volume syringes of 150 ml without adapter.

**LAMBDA MASSFLOW** – precise gas flow measurement and control with data acquisition option.

**LAMBDA PUMP-FLOW INTEGRATOR** – with LAMBDA pumps and doser allows the visualization and recording of the pumped volume.

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# 1 SETTING UP THE CH<sub>4</sub>-METER

## 1.1 Overview of CH<sub>4</sub>-METER connections

**Table 1** Connection overview of CH<sub>4</sub>-METER: Stand-alone instrument, with MINIFOR / PC software

	CH <sub>4</sub> -METER (stand-alone)	CH <sub>4</sub> -METER with MINIFOR	CH <sub>4</sub> -METER with PC software
<b>Remote control</b>	-	Pump remote control (analog and digital) cable (8 poles)	-
<b>RS-interface</b>	-	RS-485 interface (incorporated in CH <sub>4</sub> -METER)	RS-485 interface (incorporated in CH <sub>4</sub> -METER)
<b>PC connection</b>	-	Please refer <a href="#">MINIFOR operation manual</a>	USB or serial port
<b>MINIFOR connection</b>	-	<b>PUMP</b> - socket at the rear of MINIFOR control unit.	-
<b>1. REMOTE</b> (rear of CH <sub>4</sub> -METER)	-	<ul style="list-style-type: none"> <li>○ Connect one end of 8-pole remote control cable to the <b>PUMP</b>-socket at the rear of the <b>MINIFOR control unit</b>.</li> <li>○ Other end of the 8-pole remote control cable to <b>REMOTE</b>-socket at the rear of <b>CH<sub>4</sub>-METER</b>.</li> </ul>	<ul style="list-style-type: none"> <li>○ Connect the <b>RS-485 connection kit</b> to the <b>PC</b> with the help of the <b>USB</b> connector.</li> <li>○ Plug-in the other end of the connection kit (RS-485 connection cable) to the <b>REMOTE</b> socket of <b>CH<sub>4</sub>-METER</b></li> </ul>
<b>2. POWER</b> (rear of CH <sub>4</sub> -METER)	<ul style="list-style-type: none"> <li>○ Plug the connector of power supply cable into the <b>POWER</b>-socket (12 V) at the rear of <b>CH<sub>4</sub>-METER</b></li> <li>○ Universal plug-in power supply (100-240 V AC/50-60 Hz, 12 VDC, 12 W) to mains.</li> </ul>	-	<ul style="list-style-type: none"> <li>○ Plug the connector of power supply cable into the <b>POWER</b> - socket (12 V) at the rear of <b>CH<sub>4</sub>-METER</b>.</li> <li>○ Universal plug-in power supply (100-240 V AC/50-60 Hz, 12 VDC, 12 W) to mains.</li> </ul>
<b>3. IN nozzle</b> (rear of CH <sub>4</sub> -METER)	Connect the gas tubing line from <b>outgas / exit gas condenser</b> to the <b>IN nozzle</b> of CH <sub>4</sub> -METER and secure it with clamps.		
<b>4. OUT nozzle</b> (rear of CH <sub>4</sub> -METER)	Connect tubing to the <b>OUT nozzle</b> of <a href="#">CH<sub>4</sub>-METER</a> to lead the measured gas to <a href="#">CO<sub>2</sub>-METER</a> / <a href="#">O<sub>2</sub>-METER</a> / to measure total gas flow or others.		

## 1.2 Power supply

The LAMBDA CH<sub>4</sub>-METER is powered by MINIFOR Fermentor-Bioreactor. The CH<sub>4</sub>-METER is connected with the corresponding 8-pole remote control cable (*Art. No. 4810*) to the “**PUMP**”-socket at the rear of the **MINIFOR** laboratory fermenter-bioreactor.

The other end of the 8-pole remote control cable (*Art. No. 4810*) is plugged into the “**REMOTE**”-socket at the rear of the **CH<sub>4</sub>-METER**.

When **used independently** of the MINIFOR laboratory bioreactor-fermentor, a universal **plug-in power supply** (100-240 V AC/50-60 Hz, 12 VDC, 12 W) is used (*Art. No. 4820*).

Connected to the power supply, all LEDs and the display of the CH<sub>4</sub>-METER light shortly. This allows a function control of all signal elements.

## 1.3 Measurement of CH<sub>4</sub> concentration in outgas / exit gas

The gas tubing line from **outgas / exit gas condenser** (glass or Peltier outgas condenser of MINIFOR fermentor-bioreactor) is connected to the “**IN**” **nozzle** at the rear of CH<sub>4</sub>-METER to measure the concentration of CH<sub>4</sub> (0-100%).

The concentration of CH<sub>4</sub> in outgas / exit gas can be measured in terms of **0 - 9.99% and 10.0 - 99.9%**.

The gas tubing from the “**OUT**” **nozzle** of CH<sub>4</sub>-METER can be connected to the other outgas concentration measurement instruments like O<sub>2</sub>-METER, CO<sub>2</sub>-METER (IN nozzle) or measure total gas flow with a MASSFLOW gas flow meter.

## 1.4 Control panel of CH<sub>4</sub>-METER

The CH<sub>4</sub>-METER also measures the concentration of CO<sub>2</sub> [%], concentration of C<sub>2</sub>H<sub>8</sub> [%] and the temperature (T) of outgas / exit gas gas line.

The control panel of the CH<sub>4</sub>-METER displays:

- CH<sub>4</sub> concentration of the measured outgas and the LED of **CH4 [%]** button is switched **ON**. The concentration of CH<sub>4</sub> [%] measurement ranges from 9.99% and 10.0 to 99.9%.
- CO<sub>2</sub> concentration of the measured outgas in terms of percentage (0 – 5.0 %), when the **CO2 [%]** button is pressed.
- C<sub>3</sub>H<sub>8</sub> concentration of the measured outgas in terms of percentage (0 – 2.0 %), when the **C3H8 [%]** button is pressed.
- Temperature of the measured outgas is displayed in terms of degree Celsius (0 – 55.0 °C), when the **T [°C]** button is pressed.

## 2 PC CONTROL & SOFTWARE

The measured CH<sub>4</sub> outgas concentration data can be visualized and recorded, for example by the industrial fermentation software SIAM.

### 2.1 Setting up the address of CH<sub>4</sub>-METER

To look up/modify the instrument address:

- ✓ Disconnect the 8-pole remote control cable from CH<sub>4</sub>-METER (*when used together with the MINIFOR fermentor-bioreactor*) or the power supply (*stand-alone or PC*).
- ✓ Press the **CO<sub>2</sub> [%]** button continuously and at the same time connect the 8-pole remote control cable to CH<sub>4</sub>-METER (*when used together with the MINIFOR fermentor-bioreactor*) or the power supply (*stand-alone or PC*).
- ✓ The message “**A**” and two numbers will appear on the display. This number from 00 to 99 is the current address of the CH<sub>4</sub>-METER.
- ✓ To change the address, press the buttons **▲ ▲ ▲** under the display until the desired number is obtained.
- ✓ To confirm and save the address, press the **OK** button.

### 2.2 PC connection

**CH<sub>4</sub>-METER with PC software:**

CH<sub>4</sub>-METER with the RS-485 connection kit (*includes: RS-485 connection cable, RS-232/485 converter, Power supply for RS-232/485 converter and USB to RS-232 converter*) is connected to the USB port of the PC (when used independently of MINIFOR fermentor-bioreactor) for the control by software.

**CH<sub>4</sub>-METER with MINIFOR:**

CH<sub>4</sub>-METER is connected to the “**PUMP**”-socket at the rear of MINIFOR fermentor-bioreactor. MINIFOR fermentor-bioreactor is connected to the SIAM industrial fermentation software with the help of PC connection kit.

### 2.3 SIAM industrial fermentation software

[SIAM industrial fermentation software](#) is intended for the automation of fermentation and cell culture processes at laboratories.

When used together with MINIFOR fermentor-bioreactor, the SIAM industrial fermentation software allows to measure the amount of pCH<sub>4</sub> produced during laboratory fermentation processes, such as anaerobic digestion of organic waste in waste water or biogas production.

## 3 TECHNICAL SPECIFICATIONS

### 3.1 General specification

Type:	LAMBDA METHAMETER CH <sub>4</sub> concentration measurement (0-100%)
Accuracy:	± 3% reading or 1 digit
Measurement range:	
[CH <sub>4</sub> ]	0 – 9.99 % and 10.0 – 99.9%
[CO <sub>2</sub> ]	0 – 5.0 %
[C <sub>3</sub> H <sub>8</sub> ]	0 – 2.0 %
Temperature	0 – 55.0 °C
Interface:	RS-485
Power supply:	90–240 V/50–60 Hz AC plug-in power supply with DC 12V/12W output
Dimensions:	10.5 (H) x 8 (W) x 17 (D) cm
Weight:	0.6 kg
Safety:	CE, meets IEC 1010/1 norm for laboratory instruments
Operation temperature:	0-40 °C
Operation humidity:	0-90% RH, not condensing

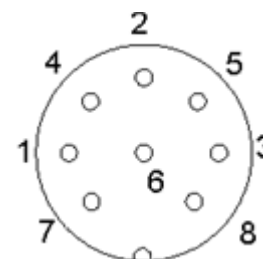


For safety reasons the voltage of the external signal must **not exceed** 48 V to earth!

### 3.2 Remote control (Inputs/outputs)

No.	Colour	Description
1	yellow	(+) input remote speed control 0-10V *)
2	grey	not used
3	green	earth, 0 V
4	brown	+ 12 V
5	white	(+) input remote ON/OFF; 0V = ON, 3–12 V = OFF (this logic can be inversed on demand)
6	pink	earth, ground (GND)
7	red	RS 485 B (-)
8	blue	RS 485 A (+)

\*) (zero line connected to the contact no. 3)



**Figure 3.2-1** 8 pole connector

## 4 ACCESSORIES

ART. NO.	ACCESSORIES
	<b>PC connection</b>
4817-kit	<i>RS-485 connection kit (for connection to a serial port or USB port)</i>
	<b>Control</b>
4810	<i>Pump remote control (analog and digital) cable, 8 poles connector</i>
800202	<i>Quadruple plug box (power and RS-connection for up to 4 LAMBDA laboratory instruments)</i>
	<b>Spare parts</b>
4820	<i>Plug-in power supply (12 V / 12 W) [Plug-type: AU, CH, EU, UK, US]</i>
4815	<i>Silicone tubing 3/5 mm (10 m)</i>
800202	<i>Quadruple plug box (power and RS-connection for up to 4 LAMBDA laboratory instruments)</i>
800083	<i>Electronic Peltier air output condenser (no water connection required)</i>
	<b>Outgas concentration measurement</b>
8080	<i>OXYMETER (O<sub>2</sub>-METER) O<sub>2</sub> concentration measurement (0-25%)</i>
8081	<i>CARBOMETER (CO<sub>2</sub>-METER) CO<sub>2</sub> concentration measurement (0-100%)</i>
8082	<i>METHAMETER (CH<sub>4</sub>-METER) CH<sub>4</sub> concentration measurement (0-100%)</i>

## 5 GUARANTEE

LAMBDA provides a two-year guarantee on material and manufacturing defects, if the instrument was used according to the operation manual.

Conditions of guarantee:

- The instrument must be returned with a complete description of the defect or problem. In order to send back the equipment for repair, you will need a returns authorization number from LAMBDA.
- The customer will send the instrument to our service office.
- Damage or loss of items during transport will not be compensated for by LAMBDA.
- Failure to fulfil these requirements will disqualify the customer from compensation.

Serial Number: \_\_\_\_\_

Guarantee from: \_\_\_\_\_



## 6 APPENDIX

### 6.1 RS communication protocol of LAMBDA CH<sub>4</sub>-METER

#### 6.1.1 Communication settings:

Speed:	2400 Baud
Data format:	8 bit, odd parity, 1 stop bit
Transmit-Receive switching:	DTR (usually automatic switching)
Transmit-Receive interval:	10 ms

#### 6.1.2 Data format for transmission from the computer (master):

# ss mm z qs c      send data

where:

ss	is the address of the slave receiver
mm	is the address of the transmitter (master)
<b>z</b>	command
qs	Checksum
c	carriage return CR (ASCII 0D)

#### 6.1.3 Commands for CH<sub>4</sub>-METER

#ssmm <b>K</b> qsc	send concentration of CO <sub>2</sub> [%]
#ssmm <b>O</b> qsc	send concentration of CH <sub>4</sub> [%]
#ssmm <b>P</b> qsc	send concentration of CH <sub>4</sub> [%]
#ssmm <b>H</b> qsc	send concentration of C <sub>3</sub> H <sub>8</sub> [%]
#ssmm <b>T</b> qsc	send temperature [° C]
#ssmm <b>G</b> qsc	send the measure value of the concentration of CH <sub>4</sub> [%]
#ssmm <b>V</b> qsc	send the measure value of the concentration of CH <sub>4</sub> [%]

\* Commands **G** and **V** allow MASSFLOW simulation in SIAM

#### 6.1.4 Data format for transmission to the computer (master):

< mm ss a xxxx qs c

where:

a	indicator variables (1 character ASCII)
xxxx	data (4 ASCII number 0.....9 - transmission from high to low)
qs	checksum in hexadecimal format (2 ASCII symbols 0.....9 A B C D E F)
c	carriage return CR (ASCII 0D)

<mmss <b>K</b> xxxxqsc	value of CO <sub>2</sub> concentration (x.xx) [%]
<mmss <b>O</b> xxxxqsc	value of CH <sub>4</sub> concentration (x.xx) [%]
<mmss <b>P</b> xxxxqsc	value of CH <sub>4</sub> concentration (xx.x) [%]
<mmss <b>H</b> xxxxqsc	value of C <sub>3</sub> H <sub>8</sub> concentration (x.xx) [%]
<mmss <b>T</b> xxxxqsc	value of temperature (xx.x) [° C]

Simulation of MASSFLOW in SIAM (commands G and V):

<mmssrxxxxqsc      value of the concentration of CH<sub>4</sub> (xx.x) [%]

## 6.2 RS-connection scheme

The 8-pole DIN connector "REMOTE" is used for the remote control and RS-485 connection.

No.	Colour	Description
1	yellow	(+) input remote speed control 0-10V *)
2	grey	not used
3	green	earth, 0 V
4	brown	+ 12 V
5	white	(+) input remote ON/OFF; 0V = ON, 3–12 V = OFF (this logic can be inversed on demand)
6	pink	earth, ground (GND)
7	red	RS 485 B (-)
8	blue	RS 485 A (+)

\*) (zero line connected to the contact no. 3)

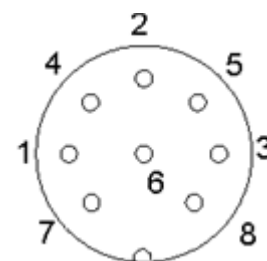


Figure 6.2-1 8 pole connector



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