Operation MANUAL

METHAMETER - CH4 concentration measurement unit
LAMBDA METHAMETER (CH₄-METER) allows the measurement of the concentration of CH₄ 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 CH₄-METER measures the concentration of the CH₄ 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 fermenter/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 CH₄-METER

1.1 Overview of CH₄-METER connections

Table 1 Connection overview of CH₄-METER: Stand-alone instrument, with MINIFOR / PC software

<table>
<thead>
<tr>
<th>CH₄-METER (stand-alone)</th>
<th>CH₄-METER with MINIFOR</th>
<th>CH₄-METER with PC software</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote control</td>
<td>-</td>
<td>Pump remote control (analog and digital) cable (8 poles)</td>
</tr>
<tr>
<td>RS-interface</td>
<td>-</td>
<td>RS-485 interface (incorporated in CH₄-METER)</td>
</tr>
<tr>
<td>PC connection</td>
<td>-</td>
<td>Please refer MINIFOR operation manual</td>
</tr>
<tr>
<td>MINIFOR connection</td>
<td>-</td>
<td>PUMP - socket at the rear of MINIFOR control unit.</td>
</tr>
</tbody>
</table>

1. REMOTE (rear of CH₄-METER)

- Connect one end of 8-pole remote control cable to the PUMP-socket at the rear of the MINIFOR control unit.
- Other end of the 8-pole remote control cable to REMOTE-socket at the rear of CH₄-METER.
- Connect the RS-485 connection kit to the PC with the help of the USB connector.
- Plug-in the other end of the connection kit (RS-485 connection cable) to the REMOTE socket of CH₄-METER.

2. POWER (rear of CH₄-METER)

- Plugging the connector of power supply cable into the POWER-socket (12 V) at the rear of CH₄-METER
- Universal plug-in power supply (100-240 V AC/50-60 Hz, 12 VDC, 12 W) to mains.
- Connect the gas tubing line from outgas / exit gas condenser to the IN nozzle of CH₄-METER and secure it with clamps.

3. IN nozzle (rear of CH₄-METER)

Connect tubing to the OUT nozzle of CH₄-METER to lead the measured gas to CO₂-METER / O₂-METER / to measure total gas flow or others.
1.2 Power supply

The LAMBDA CH₄-METER is powered by MINIFOR Fermentor-Bioreactor. The CH₄-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 CH₄-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 CH₄-METER light shortly. This allows a function control of all signal elements.

1.3 Measurement of CH₄ 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 CH₄-METER to measure the concentration of CH₄ (0-100%).

The concentration of CH₄ 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 CH₄-METER can be connected to the other outgas concentration measurement instruments like O₂-METER, CO₂-METER (IN nozzle) or measure total gas flow with a MASSFLOW gas flow meter.

1.4 Control panel of CH₄-METER

The CH₄-METER also measures the concentration of CO₂ [%], concentration of C₂H₆ [%] and the temperature (T) of outgas / exit gas line.

The control panel of the CH₄-METER displays:

- CH₄ concentration of the measured outgas and the LED of CH₄ [%] button is switched ON. The concentration of CH₄ [%] measurement ranges from 9.99% and 10.0 to 99.9%.
- CO₂ concentration of the measured outgas in terms of percentage (0 – 5.0 %), when the CO₂ [%] button is pressed.
- C₃H₈ 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 CH₄ outgas concentration data can be visualized and recorded, for example by the industrial fermentation software SIAM.

2.1 Setting up the address of CH₄-METER

To look up/modify the instrument address:

- Disconnect the 8-pole remote control cable from CH₄-METER (when used together with the MINIFOR fermentor-bioreactor) or the power supply (stand-alone or PC).
- Press the CO₂ [%] button continuously and at the same time connect the 8-pole remote control cable to CH₄-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 CH₄-METER.
- To change the address, press the buttons Λ Λ Λ under the display until the desired number is obtained.
- To confirm and save the address, press the OK button.

2.2 PC connection

CH₄-METER with PC software:

CH₄-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.

CH₄-METER with MINIFOR:

CH₄-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 pCH₄ 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 CH₄ concentration measurement (0-100%)

**Accuracy:** ± 3% reading or 1 digit

**Measurement range:**
- [CH₄] 0 – 9.99 % and 10.0 – 99.9%
- [CO₂] 0 – 5.0 %
- [C₃H₈] 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)

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

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

<table>
<thead>
<tr>
<th>ART. NO.</th>
<th>ACCESSORIES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PC connection</td>
</tr>
<tr>
<td>4817-kit</td>
<td>RS-485 connection kit (for connection to a serial port or USB port)</td>
</tr>
<tr>
<td></td>
<td>Control</td>
</tr>
<tr>
<td>4810</td>
<td>Pump remote control (analog and digital) cable, 8 poles connector</td>
</tr>
<tr>
<td>800202</td>
<td>Quadruple plug box (power and RS-connection for up to 4 LAMBDA laboratory instruments)</td>
</tr>
<tr>
<td></td>
<td>Spare parts</td>
</tr>
<tr>
<td>4820</td>
<td>Plug-in power supply (12 V / 12 W) [Plug-type: AU, CH, EU, UK, US]</td>
</tr>
<tr>
<td>4815</td>
<td>Silicone tubing 3/5 mm (10 m)</td>
</tr>
<tr>
<td>800202</td>
<td>Quadruple plug box (power and RS-connection for up to 4 LAMBDA laboratory instruments)</td>
</tr>
<tr>
<td>800083</td>
<td>Electronic Peltier air output condenser (no water connection required)</td>
</tr>
<tr>
<td></td>
<td>Outgas concentration measurement</td>
</tr>
<tr>
<td>8080</td>
<td>OXYMETER (O₂-METER) O₂ concentration measurement (0-25%)</td>
</tr>
<tr>
<td>8081</td>
<td>CARBOMETER (CO₂-METER) CO₂ concentration measurement (0-100%)</td>
</tr>
<tr>
<td>8082</td>
<td>METHAMETER (CH₄-METER) CH₄ concentration measurement (0-100%)</td>
</tr>
</tbody>
</table>

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 fulfill these requirements will disqualify the customer from compensation.

Serial Number: ______________________________
Guarantee from: ______________________________
6 APPENDIX

6.1 RS communication protocol of LAMBDA CH$_4$-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)
- **z** command
- **qs** Checksum
- **c** carriage return CR (ASCII 0D)

6.1.3 Commands for CH$_4$-METER

- `#ssmmKqsc` send concentration of CO2 [%]
- `#ssmmOqsc` send concentration of CH4 [%]
- `#ssmmPqsc` send concentration of C3H8 [%]
- `#ssmmHqsc` send concentration of C3H8 [%]
- `#ssmmTqsc` send temperature [°C]
- `#ssmmGqsc` send the measure value of the concentration of CH4 [%]
- `#ssmmVqsc` send the measure value of the concentration of CH4 [%]

* 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)
<mmssKxxxxqsc value of CO₂ concentration (x.xx) [%]
<mmssOxxxxqsc value of CH₄ concentration (x.xx) [%]
<mmssPxxxxqsc value of CH₄ concentration (xx.x) [%]
<mmssHxxxxqsc value of C₃H₈ concentration (x.xx) [%]
<mmssTxxxxqsc value of temperature (xx.x) [° C]

Simulation of MASSFLOW in SIAM (commands G and V):
<mmssrxxxxqsc value of the concentration of CH₄ (xx.x) [%]

### 6.2 RS-connection scheme

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

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<td>RS 485 A (+) (*) (zero line connected to the contact no. 3)</td>
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* Figure 6.2-1 8 pole connector