OPERATION MANUAL

LUMO - Light Control Unit

# LAMBDA LUMO LIGHT CONTROL UNIT FOR PHOTOTROPHIC CULTURES

LUMO light control unit together with the MINIFOR laboratory bioreactor for submerged phototrophic microorganisms:

- Optimal light intensity achieved with LUMO light control unit
- LED light with high light intensity and low radiant heat emitted to the medium (no or less medium cooling)
- Manual or automatic timer to simulate day/light rhythm
- Free selectable wavelength according to the culture requirement (e.g.: LEDs red or blue or warm white)
- Precise control over light intensity, photoperiod and spectral distribution

The LUMO light control unit can also be used as a stand-alone instrument.

LAMBDA Laboratory Instruments

LAMBDA is developer and producer of special laboratory instruments mainly for biotechnology, microbiology, food and agricultural, chemical and pharmaceutical research and development as well as for general laboratory and research applications.
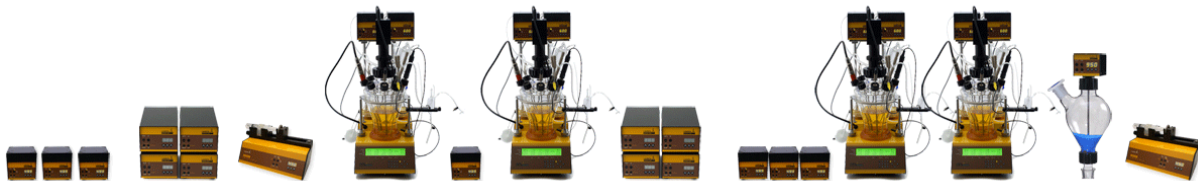
LAMBDA MINIFOR – highly innovative and compact fermenter/bioreactor system for laboratory scale fermentation and cell cultures

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

LAMBDA PRECIFLOW, MULTIFLOW, HIFLOW and MAXIFLOW PUMP – reliable, precise and extremely compact peristaltic pumps for laboratories.

LAMBDA SAFETY POWDER DOSER – allows automatic feeding of powders without spoon. Safe operation with hazardous material. Optimal for use under quality systems GLP / GMP.

LAMBDA VIT-FIT 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 dosing instruments allows the visualization and recording of the pumped volume as a function of time

LAMBDA LUMO LIGHT CONTOL UNIT – programmable light intensity controller for phototrophic cultures

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1   SETTING UP OF LUMO CONTROL UNIT

1.1   Connections

LUMO light control unit can be used as a stand-alone instrument, with PC control software (e.g.: PNet) or used together with LAMBDA MINIFOR laboratory bioreactor.

Table 1 Connection overview of LUMO light control unit: Stand-alone instrument, with MINIFOR fermentor-bioreactor or controlled by PC software

	LUMO (stand-alone)	LUMO with MINIFOR	LUMO with PC software
Remote control	-	Pump remote control (analog and digital) cable (8 poles)	-
RS-interface	-	RS-485 interface (included in LUMO)	RS-485 interface (included in LUMO)
PC connection	-	Please refer MINIFOR operation manual	USB or serial port
MINIFOR connection	-	**PUMP** - socket at the rear of MINIFOR control unit	-
1. REMOTE (rear of LUMO light control unit)	-	o Connect one end of 8-pole remote control cable to the **PUMP** - socket at the rear of the **MINIFOR control unit** o Other end of the 8-pole remote control cable to **REMOTE**-socket at the rear of **LUMO** light control unit	o Connect the **RS-485 connection kit** to the **PC** with the help of the **USB** connector. o Plug-in the other end of the connection kit (RS-485 connection cable) to the **REMOTE** socket of **LUMO** light control unit
3. OUT socket (rear of LUMO light control unit)	Plug-in the 8-pole connector of **LED light source** to the **OUT** socket at the rear of the LUMO light control unit.		
4. POWER (rear of LUMO light control unit)	o Plug the connector of power supply cable into the **POWER** - socket (12 V) at the rear of **LUMO** light control unit o Universal plug-in power supply (100-240 V AC/50-60 Hz, 12 VDC, ~65 W) to mains		

When used together with the **LAMBDA MINIFOR laboratory bioreactor,** the LUMO control unit is connected with the corresponding **8-pole cable** to the **"PUMP"**- socket at the rear of the MINIFOR laboratory fermenter-bioreactor. The other side of the cable is plugged into the **"REMOTE"** - socket at the rear of the **LUMO** programmable light intensity controller.

Plug-in the LED light source connection (8-pole) to the socket **"OUT"** at the rear of the LUMO control unit.

Connect the power supply into the corresponding socket **"POWER"** at the rear of the LUMO control unit and plug-in the universal power supply (100-240 V AC/50-60 Hz, 12 VDC, ~65W) to the AC mains.

After a short beep signal, numbers on the display of LAMBDA LUMO control unit will light and indicate the value of the intensity of light by percentage (0-100 %).

The **green LED** above the **"OUT"** socket at the rear of the LUMO control unit will be illuminated, when the socket receives proper signal to control the LED light source.

1.2   ON/OFF button

By pressing the **ON/OFF** button, the LUMO control unit is switched ON or OFF. The internal memory will show the last used value or setting.

1.3   Setting of the light intensity

In the LUMO control unit, buttons **Λ Λ Λ** below the LED display allows to select the desired value from **0 to 100**, corresponding to **0 to 100%** of the light intensity.

2   PROGRAMMING OF THE LUMO LIGHT CONTOL UNIT

Up to 99 pairs of **time and light intensity** settings (in terms of percentage) can be programmed on the LUMO control unit. The programming mode is accessed by simultaneously pressing the buttons **REMOTE** and **RUN**. The indication *"PGM"* appears on the display.

*Remark: If you repeat this simultaneous pressing of the **REMOTE** and **RUN** buttons, the memory will be cleared and the indication **"cLE"** will appear on the display. To enter the programming mode again, press the **REMOTE** and **RUN** buttons again until **"PGM"** appears.*

- Press the **ON/OFF** button. The indication *"F01"* will appear for a short time on the display indicating that you can set the first light intensity percentage (from 0 to 100 %).
- Set the desired **light intensity value** of the first program step by pressing the buttons **Λ Λ Λ** below the LED display (from 0 to 100, corresponding to 0 to 100% of light intensity).
- Press the **ON/OFF** button. The indication *"t01"* will appear for a few seconds on the display indicating that you can program the time period of the first step in minutes. Select the desired time period of the first program step by pressing the buttons **Λ Λ Λ** below the display (from 0 to 999 minutes in 1 minute steps).
- Press the **ON/OFF** button. The indication *"F02"* will briefly appear on the display. You can now enter the desired light intensity of the second program step. After this, press the

ON/OFF button again. The symbol *"t02"* will briefly appear on the display. You can now set the time of the second program step.

▪ In a similar way up to 99 program steps can be entered.

▪ After having entered the time of the last step, press the **ON/OFF** button. The light intensity percentage (000) of the next step **which will not be programmed** appears on the display.

▪ Press both **REMOTE** and **RUN** buttons simultaneously until the indication *"c01"* appears on the display. This indicates that the program will be executed only once and the LUMO light control unit will switch OFF the light source afterwards.

▪ If you wish to repeat the same program 3 times, increase the cycle number to *"c03"* by pressing the buttons **Λ Λ Λ** below the display (from 0 to 99 cycles). The program can be repeated up to 99 times, indicated by *"c99"*. If 0 is entered for the cycle number *"c00"*, the program will run continuously (infinite loop).

▪ Press the **ON/OFF** button, until the indication *"END"* appears on the display to confirm and save the program.

It is possible to review the program by proceeding in the same way as during programming but without modifying it.

Remark: It is not possible to end the program after programming the time data.

To **start** the program, press the **RUN** button. The RUN and ON/OFF LEDs are switched ON.

To **stop** the running program definitively, press the **RUN** button. The RUN and ON/OFF LEDs are switched OFF.

It is possible to switch OFF the light intensity by pressing the ON/OFF button. This allows reaction in emergency situations. The **time basis** in the microprocessor is **not stopped** during this intervention, so that the total time of the running steps and of the whole program will not be affected. When the program step time has elapsed, the LUMO light control unit will automatically go on with the next program step. Thus, the program is not modified by this emergency intervention.

Remark: Do not forget to switch ON the LUMO light control again (by pressing the ON/OFF button), after finishing the intervention.

3   REMOTE CONTROLS

3.1   ON/OFF remote control

By interlinking the contacts no. 4 and 5 of the socket at the rear of the LUMO light control unit (see figure 5.4−1 and section 5.4*),* the light control unit will be blocked and the ON/OFF LED will be switched OFF.

The same effect will be obtained by applying a voltage of 3 to 12 V DC to the contact no. 5 (0 line must be connected to contact no. 3).

Remark: In some cases, a reversed logic for the remote control might be desired. Please contact us at support@lambda-instruments.com *in this case.*

3.2   Remote control of the LUMO light control unit

The LAMBDA LUMO light control unit can be controlled over the whole range by an external signal (0-10 V, option 0-20 or 4-20 mA). The plus pole of the signal is connected to the contact no.1, 0 line to the contact no.3.

Press the button **REMOTE** on the front panel. The corresponding LED diode will go ON and the display will indicate the approximate voltage of the external signal. This indication may become unstable when no external connection is made and indicates the high sensitivity of the electronics.

3.3   PC control

When the instrument has been equipped with the **optional RS-232 or RS-485 interface**, it can be controlled digitally, e.g. from a PC.

To look up/modify the instrument address:

- ✓ Disconnect the 8-pole cable from LUMO unit.
- ✓ Press the **ADRS** button continuously and at the same time connect the 8-pole cable to LUMO unit again.
- ✓ The message *"A"* and two numbers will appear on the display. This number from 00 to 99 is the current address of the LUMO measurement unit.
- ✓ 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. Technical specifications

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

4   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: _____

5 APPENDIX

5.1 RS communication protocol for LAMBDA LUMO light control unit

5.1.1 Format of data sent by the PC to the LUMO control unit and back

Data sent by the PC: *#ss mm a ddd qs c*
Data sent back by the LUMO control unit: *<mm ss a ddd qs c*
Data sent back by the Integrator: *<mm ss a xxxx qs c*

where,

is the first sign of a command sent by PC (master)
<   is the first sign of a message sent by LUMO light intensity controller (slave)
ss   is the address of the LUMO light intensity controller
mm   is the address of the PC
a   is the command (see below)
ddd   is the light intensity (3 ASCII numbers from 0 to 9; sent from the highest order digit to the lowest order digit)
xxxx   is the integrator value in HEX format (4 ASCII signs of the type 0…9ABCDEF)
qs   is the control sum in HEX format (2 ASCII signs of the type 0…9ABCDEF)
c   is the end sign cr (carriage return)
          The LUMO light intensity controller will fulfill the task and block any manual command on the front panel.

5.1.2 Commands

*# ss mm **r** ddd qs c*   sets the light intensity (3 digits), the front panel is blocked
*# ss mm **s** qs c*   the light source is stopped (light intensity 0%)
*# ss mm **g** qs c*   activates the local command of the light intensity controller
*# ss mm **V** qs c*   state of the LUMO light intensity controller (reads the set value)
*# ss mm **G** qs c*   to send the measured light intensity to the PC
*# **ss** mm **n** qs c*   reset (sets the INTEGRATOR to zero)
*# **ss** mm **i** qs c*   start of integration
*# **ss** mm **e** qs c*   stop of integration
*# **ss** mm **I** qs c*   sends the integrated value (positive-negative)
*# **ss** mm **N** qs c*   sends the integrated value **"I"** and sets the integrator to zero (both registers)

When the instrument is controlled by the RS-communication, the buttons on the panel are blocked and the REMOTE LED is blinking.

5.1.3 Checksum control

The PC sends: #0201r023ED*cr*

The control sum (checksum) *qs* is made in the following way (only the **last byte** (2 ASCII characters of the type 0…9ABCDEF) is taken):

#	0	2	0	1	r	2	3	E	D	*cr*
23h	+30h	+32h	+30h	+31h	+72h	+30h	+32h	=45h	44h	0dh

5.1.4 Format of the data transmission

Speed: 2400 Bd (Baud)
                8 data bits, odd parity, 1 stop bit

5.2 Examples

Address of the PC: 01
Address of the light intensity controller: 02

The PC sends: #0201r023ED*cr*
The light intensity controller will set the intensity to 23%

The PC sends: #0201M33*cr*
The answer of light intensity controller (set value):   <0102M023E1*cr*

The PC sends: #0201s59*cr*
The light intensity controller stops (light intensity is 0%).

The PC sends: #0201g4D*cr*
The light intensity controller will go to the local command (front panel is activated).

5.3 How to set the address of the LUMO light control unit?

The digital control requires an attribution of an appropriate address to the LUMO light control unit. To look up/modify the instrument address, please refer the section 3.3 PC control

5.4 RS-connection scheme

The 8-pole DIN connector **"REMOTE"** is used for the remote control and RS-485
connection. When the optional RS-485 interface is available the pins are used as follows:

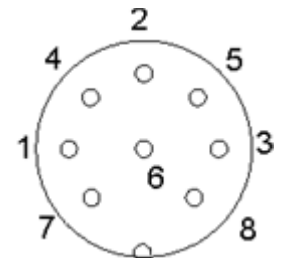| No.	Colour	Description
1	yellow	(+) input remote speed control 0-10V *)
2	grey	Impulse signal (0 and 12V)
3	green	earth, 0 V
4	brown	+ 12 V
5	white	(+) input remote ON/OFF; 0V = ON, 3–12 V = OFF *(this logic can be inversed on demand)*
6	pink	earth, ground (GND)
7	red	RS B (-)
8	blue	RS A (+) *) (zero line connected to the contact no. 3)*

Figure 5.4-1 8-pole connector

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