

LI-18

Radiation Indicator

Read-out unit and integrator for pyranometers.



User manual

Leiderdorp Instruments

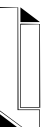
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Important user information

Reading this entire manual is recommended for full understanding of the use of this product.



The exclamation mark within an equilateral triangle is intended to alert the user to the presence of important operating and maintenance instructions in the literature accompanying the instrument.

Should you have any comments on this manual we will be pleased to receive them at:

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1. GENERAL INFORMATION

1.1 INTRODUCTION

The Radiation Indicator is a hand-held meter for the following types of sensors:

- pyranometers
- PAR-sensors
- UV-sensors
- LUX-sensors
- CUV-sensors
- UV-S-E-sensors

The Radiation Indicator displays the measured value in units appropriate to the type of sensor that is used. The calibration factor of the sensor is taken into account, therefore the read-out on the display is a calibrated value.

The Radiation Indicator can also integrate the measured values. Both manual reset and automatic reset of the integrator can be selected. The automatic reset occurs at midnight (according to the internal clock). The integrated values are stored in an internal memory. Up to 31 values can be stored in the memory.

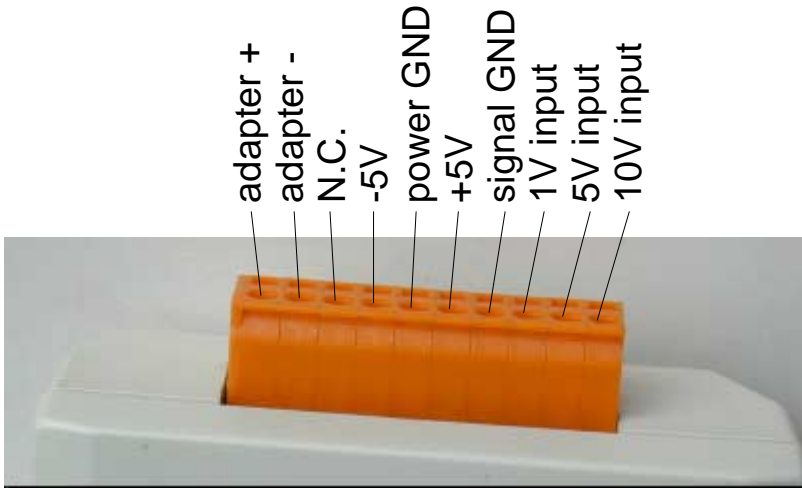
Both the actual measured value and the totals can be transmitted to a personal computer through a 'COM'-port. The Radiation Indicator is delivered with a PC program that enables you to log measured values on disk, display real-time values and graphs and read-out and store the integrated values. The data that is stored on disk can be processed with popular spreadsheets like Excel.

The Radiation Indicator can be powered with a battery or from the mains through an adapter. A standard 9 Volt battery will last for approximately 25 hours (see specifications).

1.2 CONNECTING THE SENSOR

All types of sensors are connected to the same connector on the Radiation Indicator. The connections are listed below.





Sensor type	sensor connections	LI-18 connections
Pyranometer	signal + signal - cable shield	1V input signal GND power GND
PAR sensor	signal + signal - GND/shield	1 V input signal GND power GND
Lux sensor	signal + signal - GND	1 V input signal GND power GND
UV-sensor	signal + signal - GND/shield +5V -5V	5 V input signal GND power GND +5V -5V
CUV sensor	signal + signal - GND/shield	1 V input signal GND power GND
UV-S-E sensor	signal + signal - GND/shield	10 V input signal GND power GND

1.3 POWER SUPPLY

Install a standard 9 Volt battery in the battery compartment in the bottom of the Radiation Indicator. The battery life-time depends on the type of sensor that is connected to the Radiation Indicator. If continuous read-out is required over a long period of time, an external mains-adapter can be connected to the Radiation Indicator. The maximum current drawn by the Radiation Indicator, including an UV-sensor is 50 mA. If there is no external load and the RS-232 interface is idle, the supply current is 15 mA. The adapter input voltage range is 8...24 Volt DC.



2. OPERATION GUIDE

There are two basic measuring functions in the Radiation Indicator:

- measuring the actual value ('direct')
- integrating the measured values ('integrate')

These two functions work for all types of sensors that can be connected. The operation mode of the Radiation Indicator can be selected through a menu.

If the operation mode 'integrate' is selected, either manual reset or automatic reset of the integrated value is possible. If manual reset is specified, the integration goes on until the value is reset to zero by pressing the '+' and '-' key simultaneously for more than 2 seconds (there is a maximum to the integrated value, see specifications). If automatic reset is selected, the integrated value is set to zero at midnight (according to the internal clock). After either a manual or an automatic reset, the integrated value is stored in an internal memory. Up to 31 values can be stored in this memory. The memory contents can be read-back from the display and can be transmitted to a P.C. If it is attempted to store more than 31 values, the oldest value will be over-written. No error messages are generated. At the moment the operation mode 'integrate' is selected, the memory can be cleared. Integration starts at the moment the 'integrate' mode is selected.

The settings for the sensor type, the internal clock, the sensor calibration factor and the modes as described above are entered as follows:

In general, to change a setting, start with pressing 'SELECT'. The Radiation Indicator then displays a menu item. If you want to select that menu, press SELECT again. If you want to go on to another menu item, press '+' to go forward, '-' to go backward. Then, at the desired menu, press 'SELECT'.

Changes within a menu item are also made by pressing '+' or '-'. When finished, press 'SELECT'.

When changes are being made, the Radiation Indicator does not measure! The integrator will not give the correct values.

After the Radiation Indicator is switched on, the display shows the selected sensor type and the calibration factor for approximately 10 seconds. This allows you to check if this is still correct.

After approximately 10 seconds, or as soon as any of the keys is pressed, the display will show the measured value for the sensor type and measuring mode that are selected (here shown: the default factory setting 'pyranometer', direct measuring mode).

HH:MM:SS DIRECT +xxxxx W/m ²
--

This screen shows the time according to the internal clock, the measuring mode ('DIRECT' in the direct measuring mode and either 'ACTUAL' or 'ELAPSED' in the integrating mode) and the measured value. The internal clock is reset to zero when the Radiation Indicator is switched off.

The selected sensor type can be changed as follows:

-press SELECT, the display now shows:

CHANGE SENSOR TYPE



-activate this option by pressing the SELECT pushbutton again.

PYRANOMETER

-the current selection is shown
-now change the selection with the '+' or '-' key
-the following sensor types are shown:

PAR SENSOR

UVA SENSOR

UVB SENSOR

LUX SENSOR

CUV SENSOR

UV-S-E SENSOR

The sensor type can be selected by pressing SELECT.

If the sensor type is selected, the calibration factor for this sensor has to be entered. The calibration factors for all types of sensors are stored in non-volatile memory, so the values are retained even if the battery is removed from the meter. If you changed the sensor type in the above menu, the Radiation Indicator will automatically ask for a new calibration factor (or confirmation of the factor that is stored in the memory).

-use the '+' and '-' key to increase, respectively decrease the calibration factor. The longer the keys are pressed the faster the value will change.
-when done, press SELECT

I.e. if 'Pyranometer' was selected:

ENTER CAL.FAC.
1000W/m2=xx.xxmV

PAR sensor selected:

ENTER CAL.FAC.
1uE/sm2=xx.xxuV



UVA sensor selected:

ENTER CAL.FAC.
1W/m²nm=x.xxx V

UVB sensor selected:

ENTER CAL.FAC.
1W/m²nm=xx.xx V

LUX sensor selected:

ENTER CAL.FAC.
1Lux= x.xx μV

CUV sensor selected:

ENTER CAL.FAC.
1 W/m²= xxx μV

UV-S-E sensor selected:

ENTER CAL.FAC.
1 W/m²= x.xx V

If the calibration factor of the current selected sensor type has to be changed, this can also be done directly by entering the 'SET CAL.FAC.' menu item. To go to this menu, press SELECT when the Radiation Indicator is measuring. The first menu item appears:

CHANGE
SENSOR TYPE

Press '+' to go on to the next item:

NEW CALIBRATION
COEFFICIENT

Press SELECT to activate this menu. Depending on the type of sensor that is selected, the screen in which the calibration coefficient for that sensor type can be set appears (here: pyranometer):

ENTER CAL.FAC.
1000W/m²=xx.xxmV

Press '+' or '-' to adjust the value and press SELECT to start measuring using the new factor.

Other menu's in the system are:

SET MEASURING
MODE



To select 'DIRECT' or 'INTEGRATE'.

```
SET RESET  
METHOD
```

To select manual or automatic reset.

```
SET TIME
```

To set the internal clock.

2.1 DIRECT MEASURING MODE

Depending on the type of sensor, one of the following screens is displayed when measuring 'direct'.

(Pyranometer)

```
HH:MM:SS DIRECT  
+XXXX W/m2
```

(PAR-sensor)

```
HH:MM:SS DIRECT  
+XXXX  $\mu\text{E}/\text{sm}^2$ 
```

(UVA-sensor)

```
HH:MM:SS DIRECT  
+X.XXXX W/m2
```

(UVB-sensor)

```
HH:MM:SS DIRECT  
+X.XXXX W/m2
```

(LUX-sensor)

```
HH:MM:SS DIRECT  
+XXX.XX kLux
```

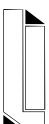
(CUV-sensor)

```
HH:MM:SS DIRECT  
+XXX.XX W/m2
```

(UV-S-E-sensor)

```
HH:MM:SS DIRECT  
+X.XXXX W/m2
```

The Radiation Indicator can transmit the measured values to a computer. There are no other functions available in this mode.



2.2 INTEGRATING

In the integrating mode, both the actual and the integrated measured values are available. When entering this mode the following screen appears:

(Pyranometer)

```
HH:MM:SS ACTUAL
+XXXX W/m2
```

The actual measured value is shown. The integration is running but the total is not shown.

Press '-' to change the information that is displayed:

```
HH:MM:SS ELAPSED
+XXXXXX Whr/m2
```

Now, the elapsed time since the start of the integration and the total measured value are shown. After the first automatic reset, the total elapsed time equals the time of day since the reset takes place at midnight (assuming the internal clock has been set correctly).

The integrated value has a maximum of 2147483648 (2^{31}). If the integrated value increases to a value with more than 7 figures, the units will be shifted off the display to allow this value to be displayed.

To return to the 'ACTUAL' screen, press '+'.

If 'manual reset' is selected, the reset is performed by holding down the '+' and '-' key simultaneously for more than 2 seconds. Each time the Radiation Indicator is reset, the total measured value is stored in the internal memory, and a new integration cycle is started. The display shows the 'ELAPSED' time after a reset (both manual and automatic).

The memory contents can be read back as follows:
-in the 'ACTUAL' screen, press '-' twice

```
MEMORY -01
XXXXXXXX Whr/m2
```

The stored totals are displayed with the appropriate units.

-press '-' to see more:

```
MEMORY -02
XXXXXXXX
```

-'+' and '-' can be used to scroll through the memory, and to bring you back to the measuring screen.

```
HH:MM:SS ACTUAL
+XXXX W/m2
```



In the 'integrate' mode the measured values can be transmitted to a computer without disturbing the integration process.

3. COMPUTER INTERFACE

The Radiation Indicator can be connected to the COM-port of a Personal Computer. By sending commands to the Radiation Indicator the P.C. can obtain the measured values from the Radiation Indicator. The commands and responses are listed below.

Command description	Command code	Response description	Response code
Start sending measured values real-time	SRT(CR)	Each time a value is measured (see specifications), it is transmitted to the P.C.	XXXXX.X(CR)
Stop sending values	STP(CR)	Stops the Radiation Indicator sending data	(ACK)(CR)
Send single value	SSV(CR)	Radiation Indicator sends a single value to the P.C.	XXXXX.X(CR)
Send integrated values	SIV(CR)	Sends the stored integrator values, starting with memory 0	XXXXXXXX.XX(CR) XXXXXXXX.XX(CR) XXXXXXXX.XX(CR) (ACK)(CR)

When changes are being made to the settings of the Radiation Indicator, the inputs are not measured. Hence, transmission of data is suspended until the Radiation Indicator is in one of the measuring modes again.

When the RS232 interface has been idle for more than 12.5 seconds, the interface will be shut down to preserve the battery. To activate the interface, the external equipment (ie the PC) must send two or more CR characters, and then wait for at least 0.5 seconds before a command is transmitted to the Radiation Indicator. The line is assumed to be idle when there is no communication from the Radiation Indicator to the PC, nor from the PC to the Radiation Indicator.

4. PC SOFTWARE LI-18

A PC program that utilizes the commands above and stores the measured values on disk, is delivered with the Radiation Indicator. The data that is stored on disk can be read-in by popular spreadsheets for analysis.

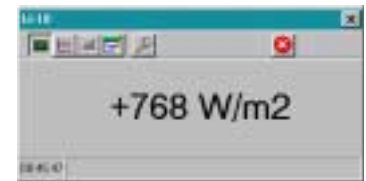


The Radiation Indicator must be connected to the PC by means of an RS-232 cable (9-pin 1:1). The cable can be obtained from Leiderdorp Instruments or your local representative. Connect the meter to either COM1: or COM2:.

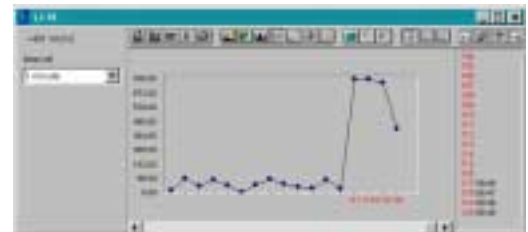
The software comes on a CD-ROM. Install the program by double-clicking 'setup' and follow the instructions.

The software offers the following functions:

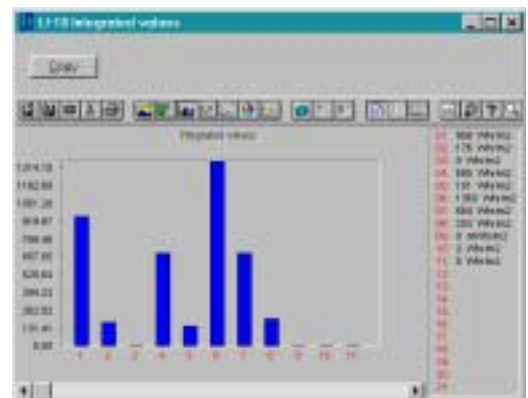
- see the real-time measured value in a window
- see a real-time graph
- store the data on disk
- select the sample interval for the graph and for the data logging
- read the 31 integrator registers and export the values to the clipboard for subsequent processing



Real-time value.



Real-time graph.



Integrator values.

The software is easy to use. It runs under Windows 95/98/2000.

5. SPECIFICATIONS

- General:
 - Display: 16x2 characters
 - Controls: ON/OFF switch and 3 control knobs ('SELECT', '+' and '-')
 - Connector: WAGO series 231
 - complies with IPX0 (not protected against ingress of water)
- Power supply:
 - Standard 9-Volt battery or mains-adapter (8 - 24 VDC, 50mA max.)
 - battery life-time: 25 hours minimal (Alkaline battery, no RS232 communications)
- A/D conversion:
 - resolution 1:10.000
 - offset <5µV over -20...40°C
 - linearity error <1LSB
 - Temperature coefficient <0.01%/°C
 - conversion rate: > 10 samples per second



- Sensor inputs
 - pyranometer: 3 mV FS...30mV FS
 - par-sensor: 1 mV FS...10 mV FS
 - UVA-sensor: 0.5 V FS...5 V FS
 - UVB-sensor: 1.5 V FS...15 V FS
 - lux-sensor: 1 mV FS...10 mV FS
 - UV-S-E: 1 V FS...10 V FS
- Functions
 - actual or integrated value read-out
 - integrator reset-method: manual or automatic
 - internal clock
 - internal storage of last 30 measured integration values
- Integrator
 - Update of integrated value every two seconds.
 - Maximal integration value for all sensor types 2^{31}
- Computer port
 - RS-232 standard
 - 9600 baud, 8 databits, no parity, 1 stopbit
 - 9-pin sub-D connector
- Weight
 - 450 g.
- Dimensions
 - 100x197x50 mm³ (WxLxH)

Measuring and display ranges:

	Pyranometer	PAR-sensor	UVA-sensor	UVB-sensor	UV-S-E	LUX-sensor
minimum full scale input range*	3 mV	1 mV	500 mV	1.5 V	1 V	1 mV
maximum full scale input range*	30 mV	10 mV	5 V	15 V	10 V	12 mV
display range	-300-1500 W/m ²	0-5000 μ E/m ² s	0-3 W/m ² nm	0-600 mW/m ² nm	0-	0-100 kLux
display resolution	1 W/m ²	2 μ E/m ² s	0.5 mW/m ² nm	0.2 mW/m ² nm	1 W/m ²	0.05 kLux
integrator maximum	2^{31} Whr/m ²	2^{31} mE/m ²	2^{31} Whr/m ² nm	2^{31} Whr/m ² nm	2^{31} Whr/m ²	2^{31} Luxhr

*:minimum and maximum full scale sensor output voltages.

