

MACAM L202
AUTORANGING RADIOMETER
HANDBOOK

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1 INTRODUCTION

The Macam L202 digital radiometer is a portable instrument designed for accurate measurement of illuminance in Lux and screen luminance in cd.m^{-2} .

The photometer comprises of a hand held display unit, a detector with connecting cable, a cosine corrected diffuser ring, a luminance probe with shadow rings and an RS232 connection cable.

The display unit houses an autoranging amplifier, $4\frac{1}{2}$ digit liquid crystal display with back light illumination and PP3 type battery. The anodised aluminium body houses the large area silicon photodiode, detector amplifier, and specially selected colour filter glasses that adjust the detectors response to closely match the CIE $v(\lambda)$ photopic response. A profiled diffuser ring gives the detector an accurate cosine corrected angular response for illuminance measurements. The luminance probe interchanges with the cosine diffuser ring to enable contact measurements of CRT or LCD screen brightness. Shadow rings can be fitted around the probe to reduce background lighting effects.

A switch within the detector housing automatically changes the photometer calibration between Lux and cd.m^{-2} with an led illuminated to indicate which unit is selected.

2 SPECIFICATION:**DISPLAY UNIT**

Ranges: 3 full scale autoranging decades measuring
 from: 0 to 199.99 Lux or cd.m^{-2}
 and 0 to 1999.9 Lux or cd.m^{-2}
 and 0 to 19999 Lux or cd.m^{-2}
 Resolution 0,01 on range 1.

Accuracy: Measurement accuracy ± 1 digit with a
 linearity error of $<1\%$ from 1 to 20 000.
 Absolute calibration accuracy $\pm 5\%$ @ 20°C
 traceable to NPL standards.
 Refer to section 5 - Calibration Description.

Controls:

- ⊗ Display backlight on off button.
 Display backlight will switch off after a
 programmable delay, factory setting 60 secs.
- HOLD/RUN* Display is held at present reading until hold
 button is pressed again.
- Ⓚ Power on / off button
- ZERO* Initiates a zero or background measurement
 routine on all three ranges.
- STORE* Store the current reading
 (holding up to maximum of sixteen values).
- RECALL* Display previously stored values.
- STORE* (On detector) See front panel store button.

Connectors: 8 pin mini DIN type detector connector.
 3.5 mm socket RS232 connector.

Display: $4\frac{1}{2}$ digit lcd display. Character pitch 10 mm.

Display illumination: An yellow / green large area LED back light
 can be switched on to illuminate the display for
 readings in low ambient light situations.

Power supply: PP3 type 9V Lithium Manganese battery.

Temperature range: 0 to 40°C . 80% RH.

2 SPECIFICATION (continued):

Dimensions: 150 x 80 x 27mm. High impact polystyrene.

Weight: 400g including detector & battery.

DETECTOR

Model: PD222

Detector: 60mm² silicon photodiode.

Linearity error: <1% from 1 to 19999

Temperature coefficient: -0.10 %/°C

Temperature range: Operation: -25 to +75°C
Storage: -45 to +100°C

Detector assembly: Black anodised aluminium alloy housing.
The detector is connected to the display unit via a cable to a 8 pin mini DIN connector.

Spectral response: (Refer Figure 1). Coloured filter glasses adjust the detectors response to closely match the CIE $v(\lambda)$ photopic response.

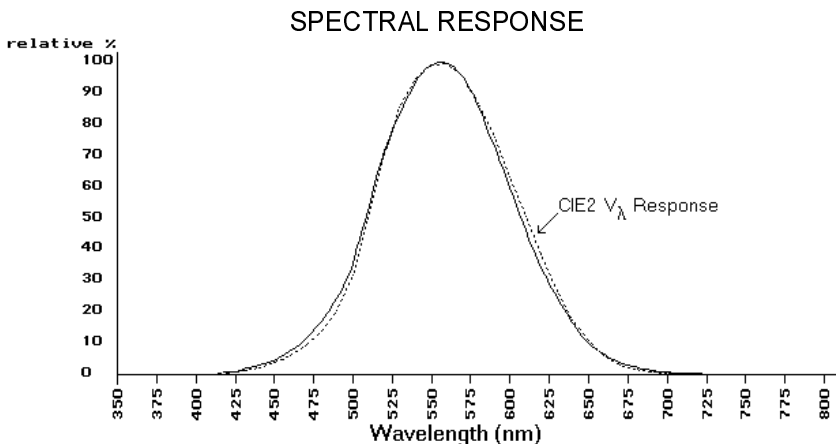


Figure 1 L202 Photometer with illuminance cosine ring

2 SPECIFICATION (continued):

ILLUMINANCE COSINE RING

Angular response: Accurately cosine corrected to Lamberts Cosine Law. Maximum error is less than $\pm 3\%$ from true response to 75° from normal incidence, reference figure 2.

Screw thread: 1"1/8 x 20TPI.

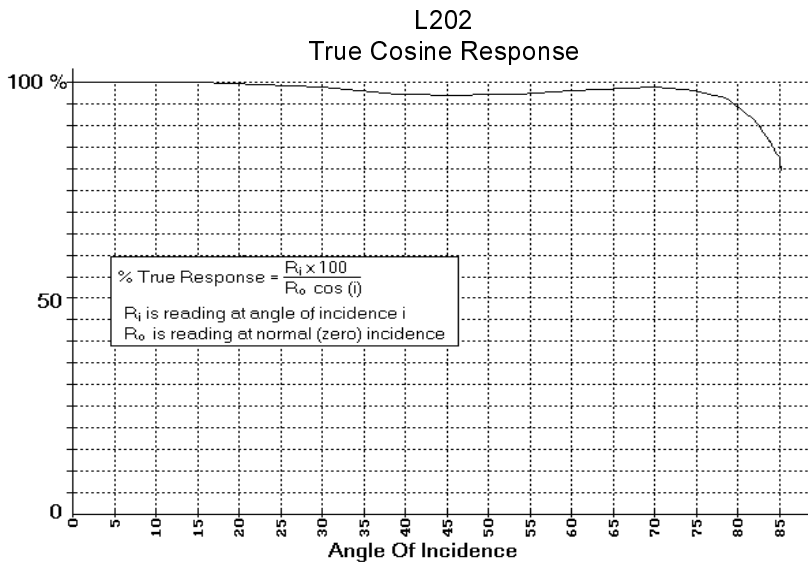
LUMINANCE PROBE

Design: Aluminium tube 10mm ϕ internal diameter, with aperture. Rubber O ring tip.

Screw thread: 1"1/8 x 20TPI.

3 COSINE ANGULAR RESPONSE

Lux is a measurement of the amount of light incident on a unit area, (lumens.m⁻²). Any detector will measure this reliably when measuring a beam of light perpendicular to the detectors surface, however, when measuring scattered light or light from an extended source the sensor must have an accurate response over its 180° field of view. This response should be proportional to the cosine of the angle of light incident on the detector, Lambert's Cosine Law. To ensure that the integration of light from all angles is correct, the cosine diffuser fitted to the front of the filter ring is profiled such that the angular response of the detector decreases with cos(i) as the angle between the source and detector increases from 0 to ±90°.



The cosine diffuser fitted to the detector is corrected to match the cosine response to within ±3.5% up to angles of 75°. This ensures that the meter accurately reads the light flux density whether it is measuring scattered light (from an overcast sky) or a point source (a single lamp in a dark room).

4 OPERATION

SETTING UP

With the unit OFF, plug the detector connector into the socket on the top of the display unit.

Note during operation the radiometer may autorange the display between the three ranges as the measurement signal exceeds the maximum or minimum measurement capability on each range.

ILLUMINANCE MEASUREMENTS

Ensure cosine diffuser ring is fully screwed onto the detector assembly for illuminance measurements. Note if the white cosine diffuser on the filter ring is marked or dirty, clean before use. The Lux led must be illuminated. Place the detector at the required measurement position ensuring that you do not block any light onto the detector and record the illuminance values.

LUMINANCE MEASUREMENTS

Remove the cosine diffuser ring and screw the luminance probe onto the detector assembly. If required slide a shadow ring onto the end of the probe. The cd/m^2 led must be illuminated. When measuring screen luminance gently place the probe onto the CRT or LCD with the rubber 'O' ring uniformly touching the screen. The shadow ring can be moved to touch the screen, thus removing any background reflections.

Note the area being measured by the probe, 9mm ϕ , must be uniform, otherwise the meter will average the luminance from the part of the screen being measured.

ZEROING THE PHOTOMETER

It is good practice to zero the photometer prior to use. Cover the luminance probe or cosine ring and press the zero button. Continue blocking the detector whilst the display shows - b g - (background). The zero operation is complete when the display shows a reading of 00.00 (Lux or cd/m^2).

4 OPERATION (continued)

STORING AND RECALLING MEASUREMENT VALUES

The L202 photometer has sixteen memory locations for storing data.

To display the last stored value, press and hold the recall button. The display will show the location number and the measurement value. The corresponding led will illuminate the units (either Lux or cd/m²).

To recall previous values press and release the recall key. The display will decrement through each location in turn.

There are two options for storing a measurement value, pressing the store key on the photometer or pressing the store key on the base of the detector. The memory locations are incremented after each store command. Note that if you recall a previous value it will be overwritten with the next store button press.

CONVERSION FACTORS

1 Lux = 0.292 fc (footcandle)

1 cd.m⁻² = 0.0929 fL (footLambert)

5 CALIBRATION DESCRIPTION

The L202 photometer should always display a valid calibration label.

As with all measuring equipment a routine calibration is recommended, typically annually, but with frequent use by a number of different users a shorter recalibration period may be necessary

Macam Photometrics hold a number of tungsten halogen lamps and a silicon photodiode which are routinely calibrated by the National Physics Laboratory in the UK.

During manufacture the photopic filter is scanned with the filter glasses selected for the best match to the CIE photopic response.

The meter is calibrated for illuminance at 100 Lux using a lamp of colour temperature $2855\text{K} \pm 10\text{K}$ and for luminance at 100cd.m^{-2} using a uniform luminance standard source.

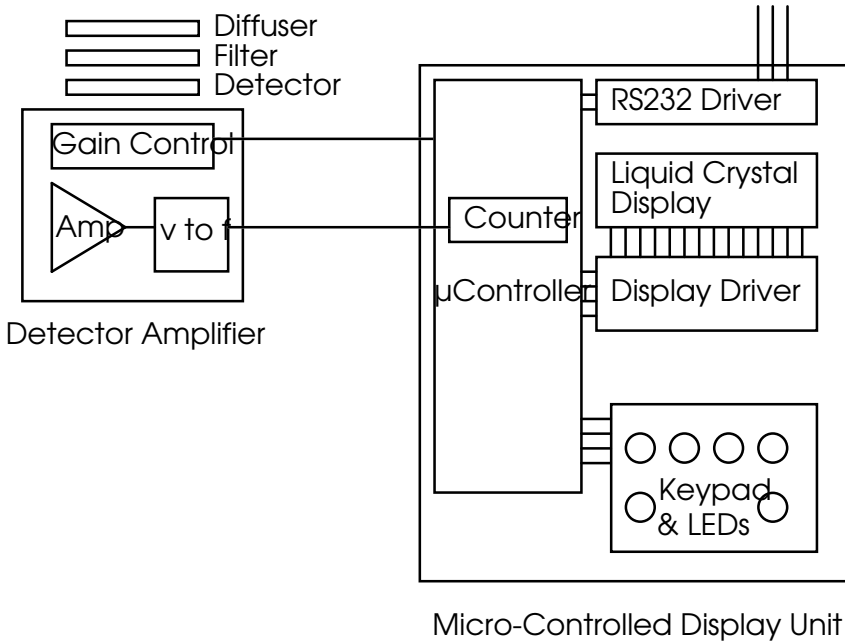
Contact Macam for any calibration requirements for this product and for further information.

6 MAINTENANCE AND BATTERY REPLACEMENT

The L202 is a precision measurement instrument and should be treated with care. The detector and accessories should always be kept clean.

- 1) Switch off the photometer before changing the battery.
- 2) Slide open the battery compartment on the back of the photometer and pull out the battery. Disconnect from the battery clip
- 3) Replace with a Lithium Manganese size PP3 9 volt battery.
- 4) Place battery inside compartment and slide cover closed.
- 5) Note it will be necessary to switch on and off the photometer before normal operation will commence.

7 BLOCK DIAGRAM



8 PROGRAMMING VIA THE RS232 INTERFACE

Serial Port Settings: 4800 baud, no handshaking

Single letter commands

- H Toggles hold/go
- Z Zeros light meter
- B Toggles backlight
- x Sets detector amplifier to maximum gain range, 199.99
- y Sets detector amplifier to middle gain range, 1999.9
- z Sets detector amplifier to minimum gain range, 19999
- R Resets amplifier to autogain
- s Sends data continuously via the RS232
- o Sends one set of data via the RS232
- V Uploads signal data stored in memory

8 PROGRAMMING VIA THE RS232 INTERFACE (continued)

8.1 Windows 3.1 & Windows 95

Setting up remote control via Microsoft TERMINAL.EXE

1. Connect the cable between the RS232 socket on the light meter and the COM port on the PC.
2. Switch on the light meter.
3. Run *Terminal* programme.
4. Go to the *Settings / Communications* screen and set the baud to 4800 and the COM port to suit.
5. Go to the *Settings / Text Transfers* and select *Line at a time with 1/10th second delay*.
6. Check the RS232 link by a switch to the manual range, LED on using the command 'S', (capital S).
7. Reset to the auto range, LED off using the command 'R', (capital R).
8. Type 'o' for one packet of data and 's' for continuous data. Type 's' to stop the data flow.
9. To save the terminal setup go to *File / Save As* and save the settings. When restarting the programme the settings can be reloaded with *File / Load filename*. Now actions 4 and 5 can be omitted.

Logging data continuously to a file using Microsoft TERMINAL.EXE

1. Run the Terminal programme with the correct settings.
2. Set up the radiometer and send the command 's' via Terminal to transmit data continuously from the radiometer.
3. Go to *Transfers / Receive Text File*. Enter filename for the stored data (e.g. log1.txt).
4. On entering the file name, Terminal will now store all the readings transmitted from the radiometer in a file *log1.txt*. The file is saved to the computer by pressing STOP on the terminal screen.

8 PROGRAMMING VIA THE RS232 INTERFACE (continued)

8.2 Windows 95 & Windows 98

Setting up remote control via Microsoft HYPERTERMINAL.EXE

1. Connect the cable between the RS232 socket on the light meter and the COM port on the PC.
2. Switch on the light meter.
3. Run the *HyperTerminal* programme.
4. Enter a name for the session (e.g. L202 etc.).
5. Select the type of connection required, either option 'direct to com 1' or 'direct to com 2' depending on which com port is to be used.
6. Enter the details for the serial connection: 4800 bits per second, 8 data bits, no parity, 1 stop bit and no flow control.
7. Click the properties icon or select via the *File / Properties* option to display the properties window.
8. Select the *Settings* tab and select Auto detect for the *Emulation* setting.
9. Click the *ASCII Setup* button. Enter 100 into the box marked *Line delay*. No other options are necessary. Click on OK to return to the main window.
10. Check the RS232 link by downloading a reading using the command 'o', (lowercase o). This also allows auto detect to correctly identify the meter settings, showing 4800 8-N-1 next to the Auto detect message in the status bar. A reading should appear in the main window if the connection has been made successfully.
11. To save the terminal setup go to *File / Save As* and save settings. When restarting the programme the settings can be loaded directly by double-clicking on the *.ht icon that has been created. Now actions 4 to 9 can be omitted.

8 PROGRAMMING VIA THE RS232 INTERFACE (continued)

Logging data to a file using Microsoft HYPERTERMINAL.EXE

1. Run the HyperTerminal programme with the correct settings.
2. Set up the radiometer and send the command 's' via HyperTerminal to transmit data continuously from the radiometer.
3. Go to *Transfer / Capture Text*. Enter the filename for the stored data and the location to save to. (e.g. C:\HyperTerminal\Capture.txt).
4. Press the *start* button to store all the readings transmitted from the radiometer in a file *Capture.txt*. The status bar will now show a highlighted 'Capture' message. The file is saved to the computer by selecting *Transfer / Capture Text / Stop*.
5. Send the command 's' again via HyperTerminal to stop the continuous transmission of data from the radiometer.

Macam Photometrics Ltd.
10 Kelvin Square
Houstoun Industrial Estate
Livingston
Scotland EH54 5PF

Telephone: 01506 437-391
Facsimile: 01506 438-543
E-mail: info@macam.com
Web: www.macam.com