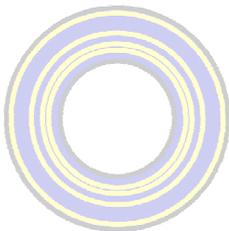

QUANTUM RADIOMETER

MODEL Q201

USER HANDBOOK



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IRRADIAN
Light Measurement Systems & Calibration

QUANTUM RADIOMETER

MODEL Q201

USER HANDBOOK

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1 INTRODUCTION

The Irradian portable digital Quantum radiometer model Q201 is a versatile direct reading instrument designed specifically for measuring photosynthetic active radiation (PAR) over the spectral range of 400 to 700 nm, in units of $\mu\text{mol.m}^{-2}.\text{s}^{-1}$ (micro Einstein. $\text{m}^{-2}.\text{s}^{-1}$).

The standard Q201 radiometer package comprises of a handheld display unit with battery, filtered, cosine-corrected detector with integral amplifier and interconnecting cable. The meter also includes a calibration certificate and carrying case for protection and transportation.

The Q201 may be used in applications such as Agriculture, Horticulture, Plant Growth studies, Biology, Liminology (with under water detectors).

2 SPECIFICATION:

DISPLAY UNIT

Controller:	80C51 based 8bit micro-processor with a 3.6864MHz clock.	
Memory	On board non volatile RAM for calibration factors and set-up parameters.	
Key Operation	3 switch key board.	
Power Switch	Microprocessor reset at switch on.	
Integration Time	0.33s.	
Conversion Scale	17 bit.	
Accuracy:	Measurement accuracy ± 1 digit with a linearity error of $< 1\%$.	
Display:	4½ digit lcd display. Character height 10mm.	
Power Supply:	9 volt 1200mAh, PP3 battery.	
Power Consumption:	Shut down mode	$< 5\mu\text{A}$.
	Operating	10 - 20mA.
Battery Life	~ 50 hours without backlight use.	
Range:	PAR	
	Full scale decade measuring from*:	
	0 to 1999.9 $\mu\text{mol.m}^{-2}.\text{s}^{-1}$.	
	Resolution 0.1 $\mu\text{mol.m}^{-2}.\text{s}^{-1}$.	
	* Other ranges available on request.	
Calibration	Absolute calibration accuracy; $\pm 7.5\%$ traceable to NPL standards.	

2 SPECIFICATION (continued):

Front Panel Controls:

ZERO Initiates a zero or background measurement.

HOLD/RUN Display is held at present reading until HOLD button is pressed again. Select to run or hold.

Ⓟ Power on / off button.

Connectors: 8 pin mini DIN type detector connector.
6 pin mini DIN type RS232 connector for factory use only.

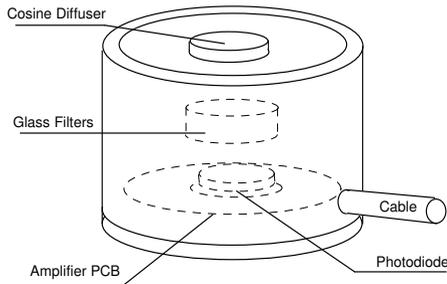
Temperature Range: 0 to 40°C. 80% RH.

Dimensions: 150 x 80 x 45mm.
High impact polystyrene.

Weight: Approximately 270g.

2 SPECIFICATION (continued):

DET201QR DETECTOR



The DET201QR quantum detector comprises of an aluminium housing, photodiode, PAR filter and PCB assembly.

Detector:	15mm ² High stability silicon photodiode.
Spectral Response:	Refer Figure 1.
Angular Response:	Accurately cosine corrected to Lambert's Cosine Law. Maximum error less than $\pm 5\%$ from true response to 70° from normal incidence, reference Section 5.
Temp. Coefficient:	<0.3 %/°C.
Amplifier Gain	5×10^4 V/A.
Current to Frequency	0 - 0.5Mhz.
Linearity Error:	<1% across range.
Temperature Range:	Operation: -10 to +60°C. Storage: -20 to +70°C.
Detector Housing:	Black anodised aluminium alloy housing. Multiple coloured filter glasses individually selected for close matching to PAR response. Specially profiled acrylic diffuser for high accuracy cosine angular response.
Cable:	1 metre cable to 8 pin mini DIN type connector.
Weight:	Approximately 140g.

2 SPECIFICATION (continued):

DET201QR Detector
Typical Spectral response

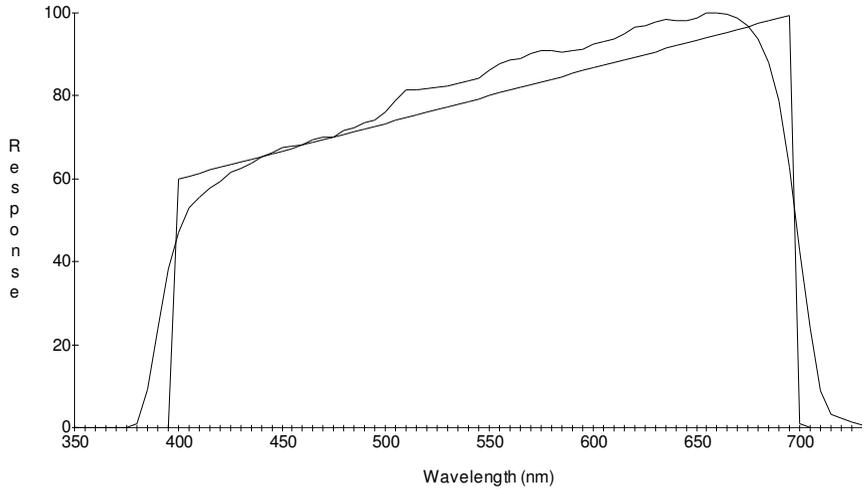


Figure 1

3 OPERATION

SETTING UP

- 1) With the unit OFF, plug the detector four way connector into the socket on the top of the display unit.
- 2) Note: Clean the white diffuser on the detector if it is marked or dirty.
- 3) Press and release the power switch on the Q201 display key pad. The micro controller will initiate, with the display momentarily showing:-



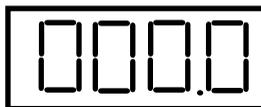
The radiometer display will now change to show the PAR value. A typical display is shown below.



- 4) For radiometric measurements the correct units are $\mu\text{mol.m}^{-2}.\text{s}^{-1}$ (equivalent to micro Einstein. $\text{m}^{-2}.\text{s}^{-1}$).
- 5) It is recommended that the radiometer amplifier is nulled periodically. Place the light cover over the detector. Press and release the *ZERO* switch, the display will momentarily show:-



- 6) The micro controller will now measure the amplifier offset and store the value in the non-volatile memory. All subsequent measurements will first have this offset subtracted before displaying the measurement. At the end of the nulling sequence the display will show:-



3 OPERATION (continued):

- 7) Remove the light cover from the detector. The equipment is now ready for use.

At any time the measuring process can be halted by pressing the HOLD button.

If the light level fluctuations are large and any one reading causes the detector amplifier to overload at this range, the display will show:-



4 PAR MEASUREMENTS

The Q201 radiometer measures the number of quanta (photons) of light between 400nm and 700nm incident on the diffuser input to the detector, per second. Measurement units are in $\mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$ (which is equivalent to $\mu\text{Einstein}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$).

Conversion from quantum units to number of photons is found from the relationship; $1 \mu\text{mol}\cdot\text{m}^{-2}\cdot\text{s}^{-1} = 6.02 \times 10^{17} \text{ quanta}\cdot\text{m}^{-2}\cdot\text{s}^{-1}$

For most applications the measurement plane is horizontal and a cosine corrected diffuser is fitted to the front of the detector assembly. If the working surface is not horizontal then placing the detector on or parallel to the worktop is a more representative measurement of irradiance.

Note that all the light sources in the hemisphere above the detector will contribute to the measurement. The sources may be obvious, lamps or windows or even walls or other reflecting surfaces. Take care not to shadow the detector during all measurements.

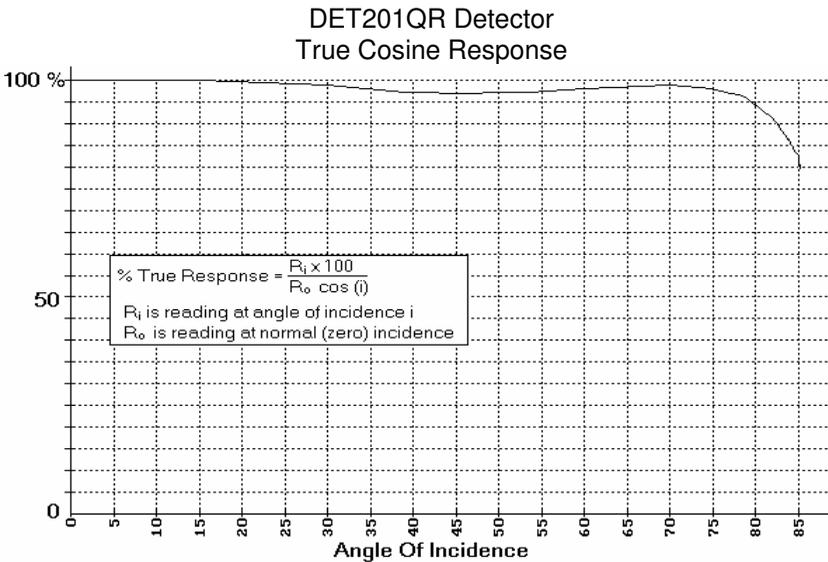
5 BATTERY REPLACEMENT

- 1) Switch off the radiometer before changing the battery.
- 2) Slide open the battery compartment on the back of the radiometer and pull out the battery. Disconnect from the battery clip.
- 3) Replace with a 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 radiometer before normal operation will commence.

6 COSINE ANGULAR RESPONSE

Quantum irradiance is a measurement of the amount of light incident on a unit area ($\mu\text{mol.m}^{-2}.\text{s}^{-1}$). 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. More importantly, this response should be proportional to the cosine of the angle of light incident on the detector. This comes from the fact that the projected area of any surface at an angle of i is proportional to $\cos(i)$.

To ensure that the integration of light from all angles is correct, the cosine diffuser matches the angular response so that response of the detector decreases with $\cos(i)$ as the angle between the source and detector increases from 0 to 90°.



Irradian's cosine diffusers are corrected to match the cosine response to within $\pm 5\%$ up to angles of 70°. This ensures that the meter correctly reads the visible light flux density whether it is measuring scattered light (from an overcast sky) or a point source (a single lamp in a dark room).

7 CALIBRATION DESCRIPTION

Irradian holds a number of tungsten halogen lamps, photometers and silicon photodiodes which are routinely calibrated by the National Physics Laboratory in the UK.

PAR Calibration is carried out using a solar simulated uniform source and an Irradian spectroradiometer (model SR9910-V7).

During manufacture each detector has its spectral response measured. Changes are made to the filter glasses if the peak wavelength or filter bandwidth exceed the specification limits. A graph of the final filter/detector response is provided. The data is also available on request for importing to a spreadsheet.

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.

8 CARE AND MAINTENANCE

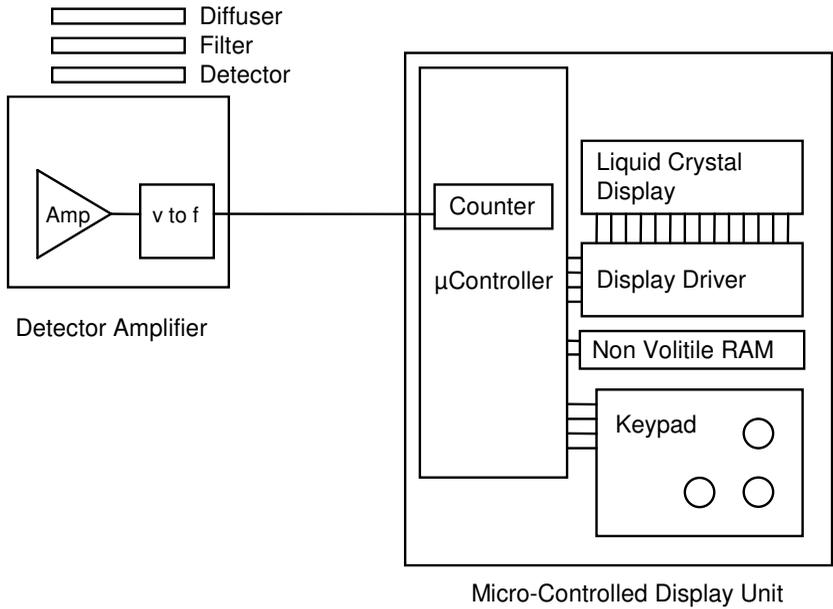
- 1) The Q201 display unit can be cleaned using a moist cloth with detergent. Do not use solvent or alcohol to clean surfaces.
- 2) The diffuser on the detector should be kept clean at all times.
- 3) The radiometer is a precision instrument, protect from shocks.
- 4) Avoid supporting the detector by the multi core cable.

9 OPTIONAL ACCESSORIES

The following items are available from Irradian:

- Levelling Plate (Three adjustable feet and built in spirit bubble).
- Waterproof Cosine and 4π detectors.
- Extension cables.

IO BLOCK DIAGRAM



11 ENVIRONMENTAL CARE, RECYCLING & DISPOSAL

The purpose of the European Commission WEEE directive (Waste Electrical and Electronic Equipment; 2002/96/EC) is to ensure that electrical and electronic products are recycled using the best treatments, recovery and recycling techniques that are currently available. This is so that high health standards and a lasting environmental protection can be achieved and maintained.

This product has been designed and manufactured using high quality materials and components, many of which can be recycled and reused.

Please remember to observe the local regulations that govern both the disposal of the packaging materials accompanying this product and any used batteries.

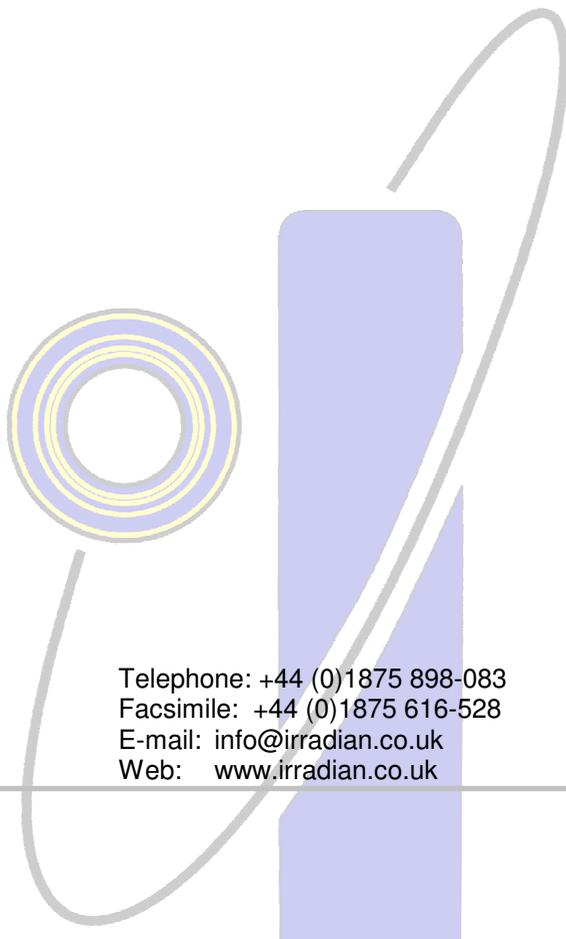


DO NOT DISPOSE OF THIS PRODUCT IN YOUR GENERAL WASTE BIN.

Please inform yourself about your local WEEE collection system which is available for electrical and electronic products that are marked with the symbol shown here.

When disposing of this meter, please use one of the following options:

- 1) Use your local designated WEEE collection facilities to dispose of the complete product (including cables, detectors, filters & accessories).
- 2) Return the complete product back to Irradian, marking it clearly as intended for WEEE disposal.



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