

MODEL 3D V2.0
ERYTHEMA UV & UVA INTENSITY METER
INSTRUCTION MANUAL

APRIL 1994

ERYTHEMA UV & ULTRAVIOLET-A INTENSITY METER

MODEL 3D V2.0

General description

This digital meter measures 2 characteristics of ultraviolet radiation.

When UV radiation (UVR) is incident on the Sunburning Ultraviolet (SUV) detector an accurate intensity of the sunburning effect of radiation with wavelengths as short as 270nm is measured. This includes solar radiation, monochromatic radiation and most artificial radiation sources. The intensity of the sunburning radiation is measured in Minimal Erythema Doses (MEDs) per hour.

With UVR striking the UVA detector an intensity in milliwatts per square centimeter is measured.

The meter has an analog output so SUV or UVA intensity can be recorded over a period of time.

An intensity hold and automatic shut off are other functions of the 3D meter.

Meaning of the meter reading and Calibration

Skin sensitivity for sunburn varies widely. An erythema dose of 1.0 will produce a minimum erythema (reddening) for fair Caucasians (type II skin) on skin areas not ordinarily subjected to UVR. A dose of $21 \pm 3 \text{ mJ/cm}^2$ at 297nm is a minimal erythema dose*.

The sunburn ultraviolet dose required to produce skin reddening (erythema) varies between people with the fair skinned more susceptible than the tanned or darker skinned.

The relative effect of different wavelengths in producing erythema is the same for all people. This relative spectral effectiveness is shown by the Erythema Action Spectrum curve in Figure 1. What varies between people is the absolute values of the radiant energy required to produce erythema. The meter's spectral sensitivity is like that of the skin's erythema action spectrum and its absolute sensitivity corresponds to that of type II skin; a very fair person may require half as much energy to sunburn and a very dark skinned person 5 to 10 times more energy.

The integral of the cross-multiplication of irradiating flux ($\text{W cm}^{-2} \text{ nm}^{-1}$) and the Erythema Action Spectrum (McKinlay and Diffey 1987) gives the Effective Power. It was established that:

$$1[\text{MED}/\text{HR}] = 5.83 \times 10^{-6} [\text{W cm}^{-2}] \text{ of Effective Power}$$

for an MED of 21 mJ per cm^2 effective dose.

The Erythema Action Spectrum is only one of many action spectra observed in nature, with similar slope and wavelength range. Thus, the 3D meter can indicate the effectiveness of solar radiation for the induction of sunburn, phytoplankton mortality, skin elastosis and thymine dimers among other effects. Also, the 3D meter can be used for global UV monitoring, especially in conjunction with information about ozone thickness, cloud cover and air pollution.

The 3D meter is initially calibrated by the manufacture, to show the biological effectiveness of the solar radiation, according to the McKinlay-Diffey Erythema Action Spectrum and 21 mJ/cm^2 to induce minimal skin redness. The detector is calibrated for a clear sky, 30° solar zenith angle, 2.7mm ozone column thickness, zero albedo, sea level and 25°C room temperature.

Operating Modes

SUV

* Ref.: J. Parrish et al. *Photochemistry and Photobiology*, vol. 36, p. 188

To turn the meter on and take readings using the SUV detector press the SUV button on the front panel. The displayed intensity has the units MED/HR. A maximum reading of 19.99 MED/HR can be displayed. The green flashing LED above the button indicates the SUV detector is active.

UVA

To turn on the meter and activate the UVA detector press the UVA button. The displayed intensity has the units mW/cm². A maximum reading of 19.99 mW/cm² can be displayed. The green flashing LED above the button indicates the UVA detector is active.

Both detectors can not read simaltaiously. You can switch between either detector at any time by selecting that detector.

Hold

The HOLD function is provided to freeze the current reading. Pressing the HOLD button any time the meter is turned on will freeze the current reading. The annunciator **HOLD** will appear on the left hand side of the LED display. To release the reading press the HOLD button once again and the display will be updated to the current intensity. Pressing the SUV or UVA button will also reset the HOLD function.

Turning the meter off resets the HOLD status and the last reading will not be retained. The HOLD function operates the same way for both the SUV and UVA detectors.

The HOLD function is useful if the detector needs to be in a place where the display can not be read. Once the detector is in place press the HOLD button. You can now move the detector and meter to a position where you can read the display. The automatic shut off is still operative when the HOLD function is active.

OFF/AUTOMATIC SHUT OFF

Turn the meter off by pressing the OFF button.

The meter will shut it self off after eight minutes if the UV intensity is approximately below 3.2 MED/HR or 3.2 mW/cm². This will help extend the life of the battery if the meter is accidentally left on. If you want to use the meter continuously in low intensity levels the automatic shut off can be disabled by removing JP3. See Figure 3 for JP3 location.

DETECTORS

The SUV detector has a ¼" diameter plug and the UVA detector has a smaller plug. The detectors can be used when mounted directly on the meter. Each detector has its own extension cable. The extension cable can be used if the detector is mounted in a light box or if a reading needs to be taken in a tight area where the meter will not fit.

The detectors are not waterproof and should be protected from moisture.

BATTERY REPLACEMENT

The meter is powered by a standard 9 volt Alkaline battery. In the event the **BAT** annunciator appears on the LCD it is time to replace the battery. To replace the battery remove the detectors from the meter. Using the supplied 0.050 inch allen wrench remove the two button head allen screws on the top of the case. Seperate the top and bottom covers. Remove the battery from the battery cradle and replace it. Hold the bottom cover in one hand and the top cover in the other hand. Insert the grove on the bottom edge of the top case into its mating grove on the bottom case. Make certain the analog output jack aligns with its hole on the bottom cover. Press the top cover down on the bottom cover and replace the screws.

ANALOG OUTPUT

An analog output is provided at the bottom of the meter. This allows the user to contiuiosly monitor and record the intensity irradiated on the active detector. Recording can be accomplished by a strip chart recorder or an A/D card connected to a computer.

Plug the supplied plug into the analog plug into the analog lead is positive and negative. The the analog output is or

Model 3D V2 Specifications

Meter

SUV
 0...19.99
 UVA
 0...19.99
 Resolution
 0.01
 Display
 LCD 3¹/₂
 Operating
 0 to +50° C
 Operating Environment
 Analog output
 0.1Volt/(mW/cm²)
 Power consumption
 <300 uA
 Power source
 9 volt alkaline battery
 Functions

HOLD
 AUTO SHUT OFF

near zero reading

BAT

Accessories included

detector

Optional accessory

analog output

Size

Weight

Detectors

SUV

Spectral Response
 Cosine Response
 Connector
 Operating Temperature
 Weight

Figure 1
 0-60 degrees +/- 5%, Figure 2
 1/4" plug
 -10 to +60° C
 1.6 oz.

UVA

Spectral Response
 Cosine Response
 Connector
 Operating Temperature
 Weight

Figure 1
 0-60 degrees +/- 5%, Figure 2
 0.141" plug
 -10 to +60° C
 1.2 oz.

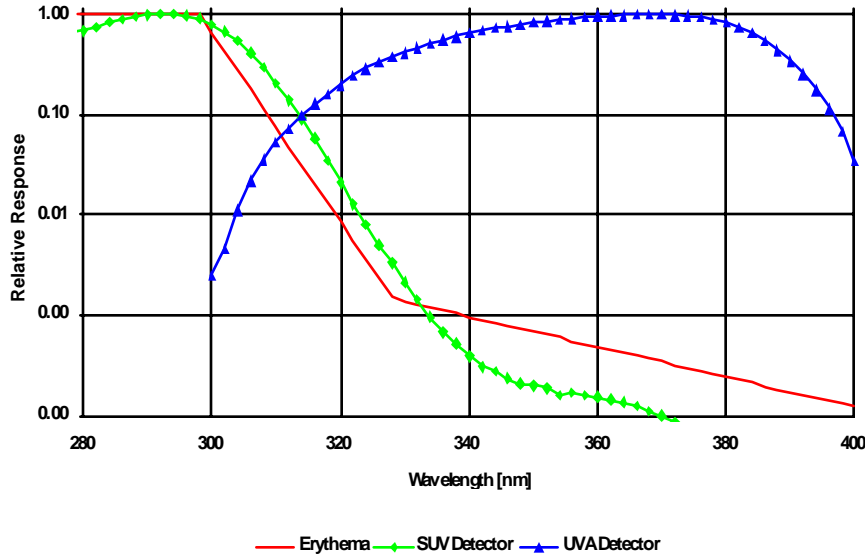


Figure 1 Typical SUV and UVA Detector Response

0.141 inch phone output jack. The red the black lead is calibration factor for 0.1[Volt/(MED/HR)] 0.1[Volt/(mW/cm²)].

meter

Readout range
 MED/HR
 Readout range
 mW/cm²

MED/HR or mW/cm²

digit
 temperature

with

each

for

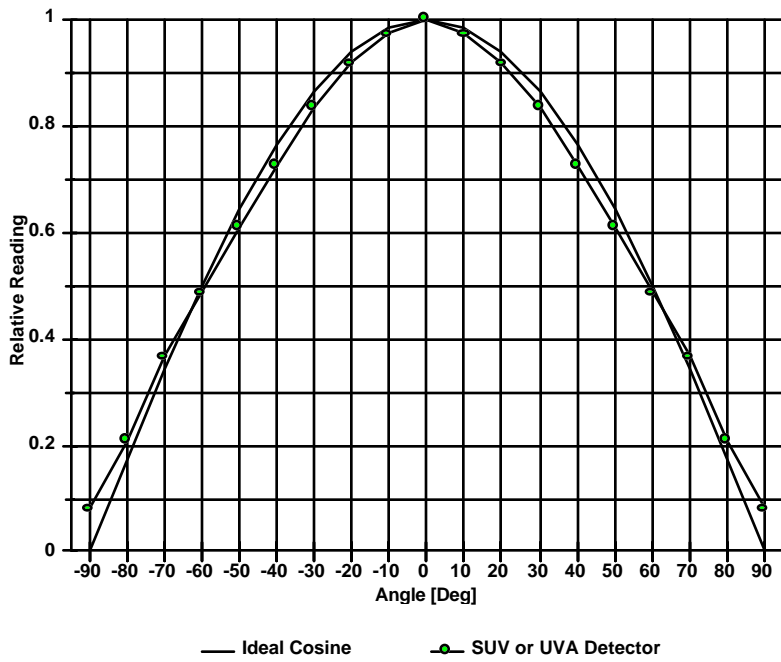


Figure 2. Typical Detector Cosine Response