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# OPERATOR'S MANUAL

  
**SPECTROLINE®**  
NDT

## AccuPRO™ Photometer/Radiometer XP-4000 & XP-2000



 **SPECTRO-UV**

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# 1. INTRODUCTION

## 1.1 GENERAL

The AccuPRO™ (XP-2000) and AccuPRO™ Plus (XP-4000) Meter Series features an advanced digital microprocessor-controlled readout unit calibrated to accurately detect and display light intensity readings.

The XP-2000 and XP-4000 (with attached sensor) feature UV, blue (XP-4000 only), and white light modes, and are used for fluorescent inspection (non-destructive testing).

The XP-4000 readout unit is calibrated for HID UV, visible, and blue light sources. It provides UV-A and blue light readings from 0-100 mW/cm<sup>2</sup>, visible light readings from 0-5,300 lux (0-500 fc), and is useful for NDT applications with simple, one-touch PEAK functionality to easily identify the strongest point of a light source.

## 1.2 FEATURES

- The meters are compact, lightweight and battery-operated for convenient use in the factory, field, or any other location where measurements need to be taken.
- The XP-2000 and XP-4000 readout units have a maximum 4-digit autoranging, color LCD screen.
- The sensor is loaded with low electrical impedance, making their linearity vastly superior to that of any other comparably priced radiometers.
- The sensors are provided with a special diffuser-sensor window that helps prevent filter degradation and ensures accurate lambertian or cosine response.

## INTERFACE

- *Simple, three-button interface*
- *Accurate to within a hundredth of a unit measurement (e.g., 28.96 mW/cm<sup>2</sup>)*
- *Intuitive user interface design*
- *Navigable screen prompts*
- *One touch PEAK reset*
- *Toggle between UV/Visible and Blue Light modes*

## HARDWARE

- *Sensor with 3-foot (0.9 m) electrical cord*
- *Superior band-pass interference filter provides excellent cosine response*
- *Press and hold the MENU button to turn the meter ON or OFF*
- *Powered by four AAA rechargeable nickel-metal hydride batteries with AC battery charger included*

## 1.3 PRECAUTIONS

- The AccuPRO is carefully designed to prevent accidental shock to the operator. However, no engineering design can render safe an instrument that is used carelessly. Therefore, the directions presented in this manual must be read carefully before any measurements are made. **Failure to follow directions could result in injury.**
- The UV sensor is designed for use in regions of the spectrum, notably the ultraviolet range, which may be hazardous to the eyes and/or skin. Ultraviolet protective eyewear and facewear are available from Spectro-UV (for instances when UV exposure is unavoidable).
- Do not leave the exposed sensor head under the light source any longer than necessary to take measurements. Prolonged exposure can result in premature aging of the sensor, necessitating more frequent recalibration to maintain accurate readings.
- See Section 10, Warranty, Maintenance and Battery information.
- **DO NOT CHARGE ALKALINE BATTERIES** (doing so may result in an explosion, potentially causing damage to the unit and/or operators). Only use the supplied batteries.

# 2. AccuPRO COMPONENTS

- Unpack and inspect the component(s) for possible damage in shipment. Save the shipping carton and packing materials for future storing or shipping of the AccuPRO components.
- Assure the sensor cable is undamaged and securely attached to the readout unit.
- Conduct a performance test as soon as possible. If any damage is noted, immediately notify the carrier and supplier (do not use the instrument).
- While charging, it is recommended to have the device turned OFF.

## 2.1 AccuPRO™ PARTS

**AccuPRO™ Meter with Multi-Wavelength Sensor**  
XP-2000 (AccuPRO) and XP-4000 (AccuPRO Plus)



**Soft Carrying Case**  
XCC-200



**AC Battery Charger**  
(North American plug shown, see replacement parts for complete list)



**Rechargeable AAA Nickel-Metal Hydride batteries (4)**

COMPONENTS AND REPLACEMENT PARTS	
Part No.	Description
XP-2000	AccuPRO Dual Sensor (UV-A/VIS), Multilingual Display Meter
XP-4000	AccuPRO Plus 3-in-1 Sensor (UV-A/VIS/Blue), Multilingual Display Meter, Complete with (4) Rechargeable "AAA" Nickel-Metal Hydride Batteries, AC Charger and Carrying Case (100-120V/50-50Hz)
XCC-200	Soft Carrying Case
XP-2000/F	XP-2000 (with 230V/50Hz European Plug)
XP-2000/FB	XP-2000 with UK Plug (230V/50Hz)
XP-2000/FA	XP-2000 with Australia/China Plug (220-240V/50Hz)
XP-4000/F	XP-4000 with European Plug (230V/50Hz)

XP-400/FB	XP-4000 with UK Plug (230V/50Hz)
XP-4000/FA	XP-4000 with Australia/China Plug (220-240V/50Hz)
129450	AC Charger with North American Plug (120V/60Hz)
129451	AC Charger with European Plug (230V/50Hz)
129453	AC Charger with UK Plug (230V/50Hz)
129452	AC Charger with Australia/China Plug (220-240V/50Hz)

## 2.2 TECHNICAL SPECIFICATIONS

DIMENSIONS				
Part	Length	Width	Depth	Weight
Readout Unit	6 in (15.2 cm)	3.0 in (7.6 cm)	1.0 in (2.5cm)	8 oz (227 gm)
Sensor	3.0 in (7.6 cm)	2.0 in (5.1 cm)	0.5 in (1.25 cm)	5.6 oz (158.7gm)

## 2.3 ELECTRICAL SPECIFICATIONS

A full charge of the four nickel-metal hydride batteries (using the included AC battery charger) will take 8 hours and provide approximately 6 hours of active scanning.

## 2.4 OPTICAL ACCURACY AND CALIBRATION

The AccuPRO XP-2000 and XP-4000 readout units measure both ultraviolet and visible light. The AccuPRO Plus (XP-4000) also measures blue light. The LCD readout features  $\pm 0.2\%$  linearity with the sensor sending the linearity correction data to the readout unit during initial power-up. The sensor is designed with superior band-pass filters and the optical stacks are assembled in Class 100 clean workstations to ensure consistent results. For precise spectral coverage, these high-quality interference filters will effectively resist degradation. See Section 8 for additional calibration-related information.

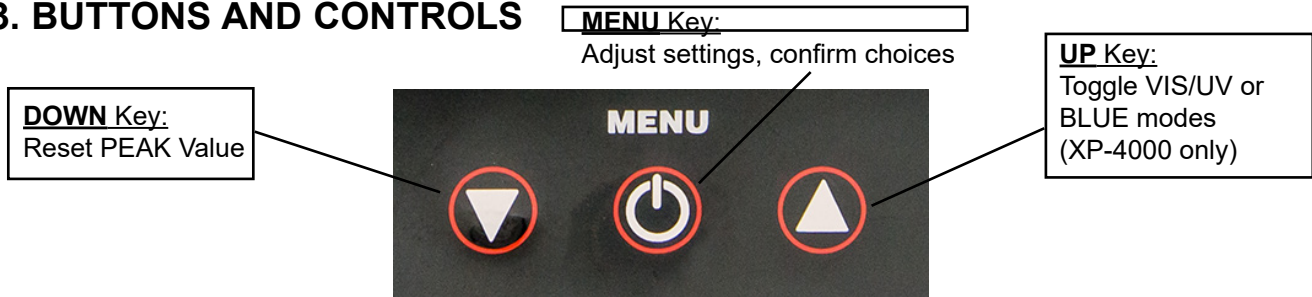
**If recalibration is required, Contact Spectro-UV at 1-866-230-7305 for assistance.**

## 2.5 ENVIRONMENTAL SPECIFICATIONS

The AccuPRO meter series components are designed to be safe under the following conditions:

- Indoor use;
- Altitude up to 2,000 m (6,562 ft.);
- Temperature 5°C to 40°C (41°F to 104°F);
- Maximum relative humidity 80% for temperatures up to 31°C (88°F) decreasing linearly to 50% relative humidity at 40°C (104°F);
- Mains supply voltage fluctuations not to exceed  $\pm 10\%$  of the nominal voltage;
- Installation Category II;
- Pollution Degree 2.

### 3. BUTTONS AND CONTROLS

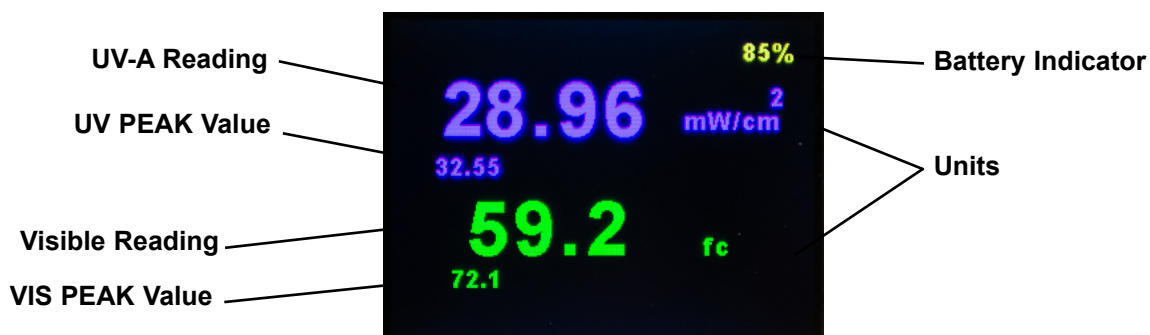


- The keypad on the readout meter is equipped with three pressure-sensitive buttons that provide easy access to all functions and features.
- Press and hold down the MENU (ON/OFF) button to turn the meter ON.
- The UP and DOWN arrows to the left and right of the MENU button provide access to all displays and features. Selected menu items appear highlighted in blue. Selected Menu items can be confirmed by pressing the MENU button once.
- Pressing the DOWN arrow (while in OPERATION MODE) will reset the PEAK value (highest recorded luminescence since last reset) for visible, UV, and if applicable, blue light sources. *If using the AccuPRO Plus (XP-4000), the UP arrow toggles between Visible/UV and blue light readouts.*
- Press and hold the MENU button in OPERATION mode to turn the unit OFF.
- Highlighting and selecting the BACK button will return the user to the previous screen without making any changes.

### 4. OPERATION—QUICK GUIDE

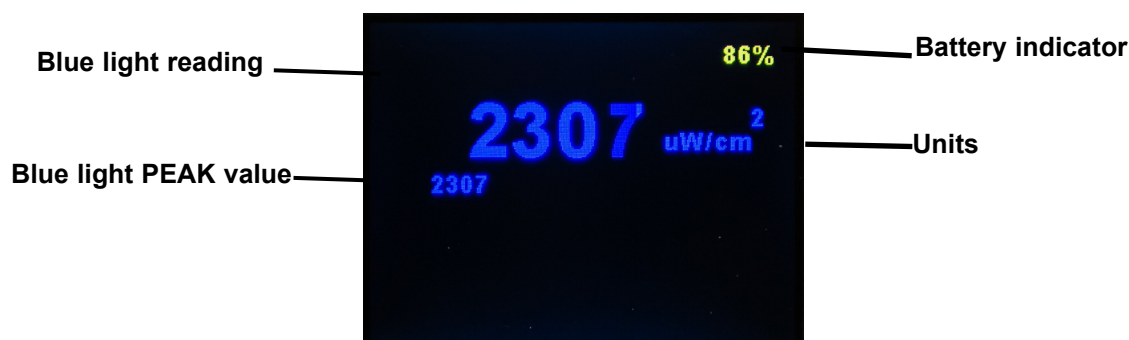
1. To turn the meter on, press and hold the MENU button for two seconds. It is recommended to fully charge the unit before use (see section 10.3).
2. The Spectroline® loading screen will appear as the unit powers ON. Information pertaining to your device will briefly appear as well. Select INFORMATION from the MAIN MENU screen to thoroughly examine information pertaining to your device (see Section 6).
3. After loading, the unit will boot directly to Operation mode, displaying visible and UV readings by default. To view levels of blue light with the AccuPro Plus (XP-4000), *press the UP button.*
4. To change meter display settings, press MENU. Then select the SETTINGS option. When highlighted, press MENU to enter SETTINGS menu (see SETTINGS section for details).
5. To take a measurement, enter Operation Mode. Shine a light source directly over the center of the sensor. The measurement will display on the interface screen.
6. The meter instantly displays light level data for each wavelength (intensity/unit area).
7. To turn off the meter, press and hold the MENU button for 2 seconds while in Operation mode. The display will then power off. Wait at least 30 seconds after the meter powers down before performing a RESTART (by pressing and holding MENU for 2 seconds). The AccuPRO will only power off from Operation mode, and not from the menus.
8. To both conserve battery life and preserve the sensitivity of the sensor head, utilize the "Set Auto-Off" function under the "SETTINGS" menu. (See section 6).

#### Operation Mode for Visible and UV Light Sources





## Operation Mode for Blue Light Sources



## 5. USING AccuPRO

### 5.1 ON/OFF

Press and hold the MENU button to turn the meter ON. The Boot Screen (below) will load, followed briefly by the Information Screen. (See Section 7 for details about the Information Screen).



### 5.2 OPERATION MODE

When turned on, the AccuPRO automatically enters Operation Mode and begins displaying light readings for white light (555nm) and UV (365nm) wavelengths. *If using the AccuPRO Plus (XP-4000), press the UP arrow to toggle between this display and blue light (450nm) readout.*

### 5.3 SENSOR READOUTS AND PEAK VALUE

Moving the sensor head will cause the readout values to increase or decrease depending on the levels of illumination, with the highest recorded value stored automatically as the PEAK value in the lower left of the readout screen. *Images on pages 5 and 6 detail each readout screen.*

Shine the light source being measured directly over the center of the sensor for the most accurate readings.

The PEAK value stores the maximum luminosity recorded since the last reset. Simply press the DOWN arrow in operational mode to reset the PEAK value to zero across visible, UV, and if applicable, blue light readouts.

### 5.4 SENSOR WAVELENGTHS & RANGES

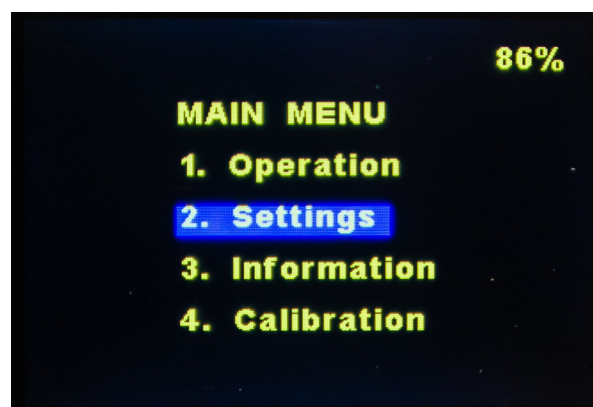
The single sensor attached to the AccuPRO will display UV-A (365nm) readings as well as visible light (555nm). In addition, the AccuPRO Plus will also display blue light at the wavelength of 450nm.

Meter will display "XXXX" should readings in any measured portion of the spectrum exceed the figures below:

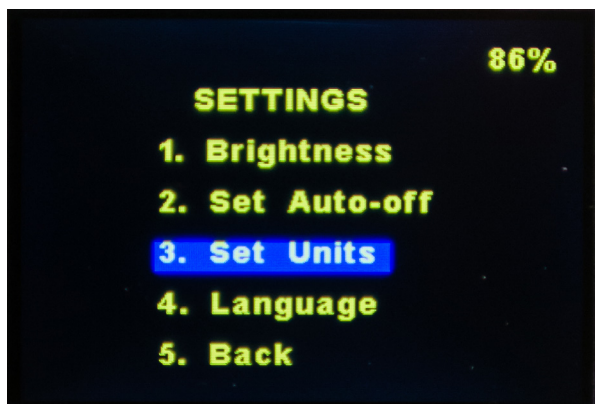
Model No.	Wavelengths Recorded	Range
XP-2000	UV-A/VIS UV-A (365nm) Irradiance Visible (555nm) Illuminance	0–100 mW/cm <sup>2</sup> 0–5,300 Lux 0–500 fc
XP-4000	UV-A/VIS/Blue UV-A (365nm) Irradiance Visible (555nm) Illuminance Blue (450nm)	0–100 mW/cm <sup>2</sup> 0–5,300 Lux 0–500 fc 0–100 mW/cm <sup>2</sup>

## 6. CUSTOMIZING SETTINGS

Press MENU, then press the DOWN arrow. Select the SETTINGS option. Press MENU again to enter the SETTINGS menu as shown below:



The SETTINGS menu contains the options displayed below:



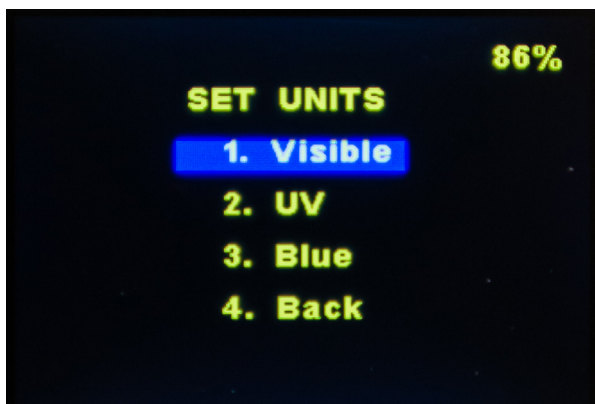
Press UP or DOWN to highlight the feature to be modified and MENU to access the next screen. Highlight BACK and press MENU to return to OPERATION mode.

### 6.1 CHANGING UNITS OF MEASUREMENT

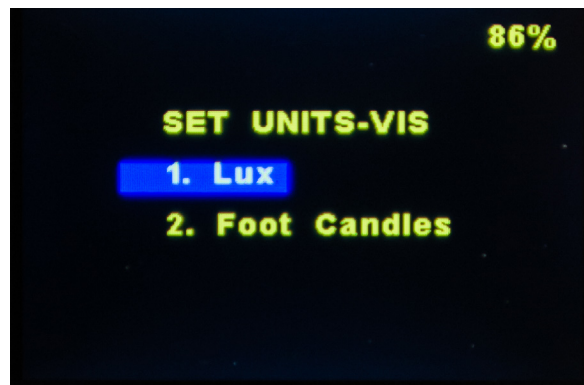
The AccuPRO provides users the capability of setting the default visible light unit of measure to either foot-candles (fc) or Lux.

UV and blue light source intensity units will autorange from  $\mu\text{W}/\text{cm}^2$  to  $\text{mW}/\text{cm}^2$ .

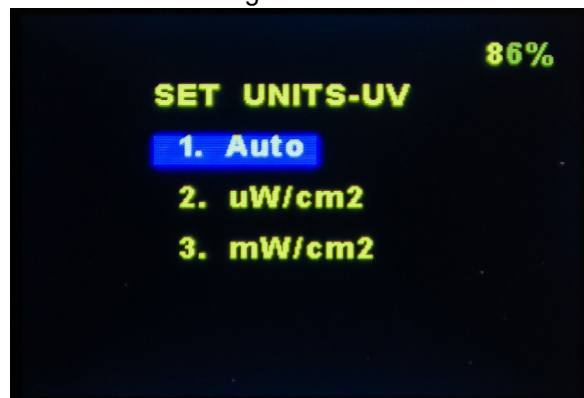
To adjust units, highlight and select SET UNITS from the SETTINGS menu. Press MENU to move to the next screen, as shown below. Vis (Visible), UV, and Blue (on XP-4000 only) will be listed, along with the BACK button to return to the previous screen.



Select the desired portion of the spectrum using MENU, then use the arrow keys to select the desired units. The following example displays the options for visible light:



The example below shows the available units for ultraviolet and blue light:



Upon pressing MENU, a brief confirmation screen will display (e.g., "Units set to Lux") before returning to the main menu. Simply press MENU again to return to Operation Mode which will display the new units.

### 6.2 ADJUSTING BRIGHTNESS

To change the brightness of the screen, enter the SETTINGS menu. Select BRIGHTNESS. Press MENU to access brightness settings and choose either BRIGHTER or DARKER (see example below). When selecting the level of brightness, consider the ambient light conditions, user preferences, and battery conservation.



Press the **MENU** button until desired brightness level is attained. Press **BACK** to confirm and exit.

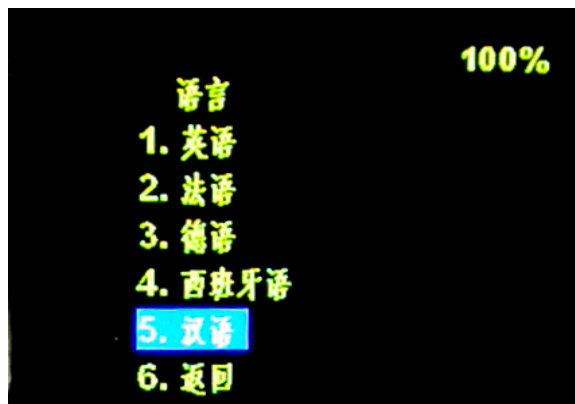
### 6.3 LANGUAGE OPTIONS

All interactive features and displays of the AccuPRO and AccuPRO Plus are available in English, Spanish, German, French, and Chinese. Enter the SETTINGS menu and select the LANGUAGE option to enter the selection menu displayed below. Upon selection of the desired language, the language menu will refresh and appear in the newly selected language format.

**NOTE:** Should the language accidentally be changed to one which you cannot understand, the first (highest) option on the menu will revert to English as seen below.



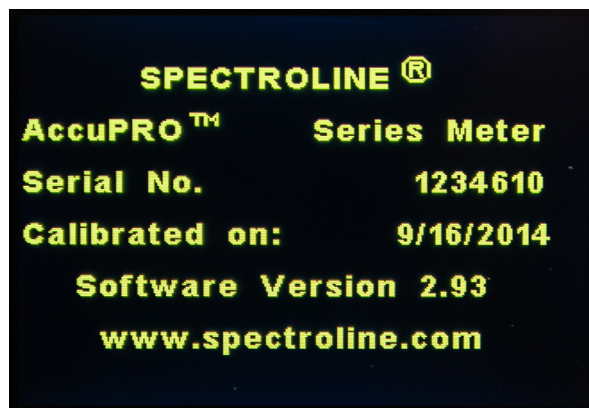
The languages and their corresponding numbers match across all language settings. If you accidentally happen to select a language difficult to understand (for instance, Chinese), select Option Number 1 to revert back to the default English language setting. The same process is applicable to the other languages in the selection.



### 7. INFORMATION

The INFORMATION Screen can be accessed in the Main Menu. By default, the INFORMATION Screen briefly displays during startup. To closely examine the data on the INFORMATION Screen, select INFORMATION from the Main Menu.

The serial number of your device, the date of your device's most recent calibration, and the software version installed on your device is available on the INFORMATION screen.

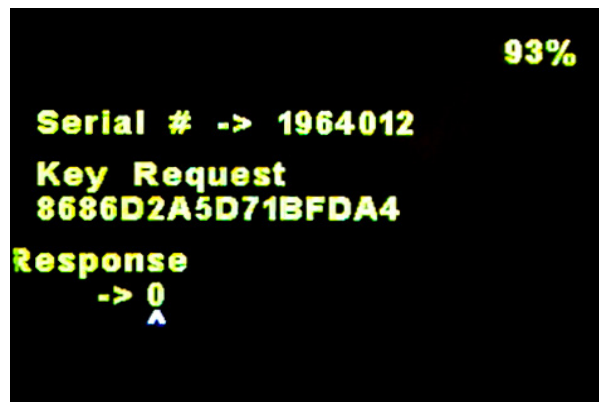


To return to OPERATION Mode, select the BACK option.

### 8. CALIBRATION

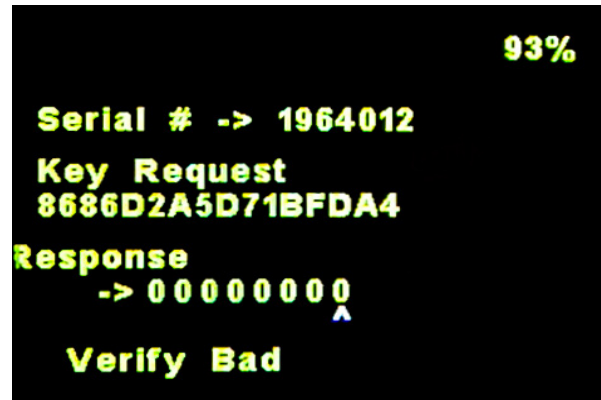
The fourth and final option on the Main Menu is Calibration. Calibration requires a precise configuration, and cannot be performed with the device alone. Contact customer service at 1-866-230-7305 if you believe your AccuPRO may require calibration.

There is no need to enter this menu under normal circumstances. However, should you arrive on the calibration screen shown below, simply press MENU repeatedly to exit.

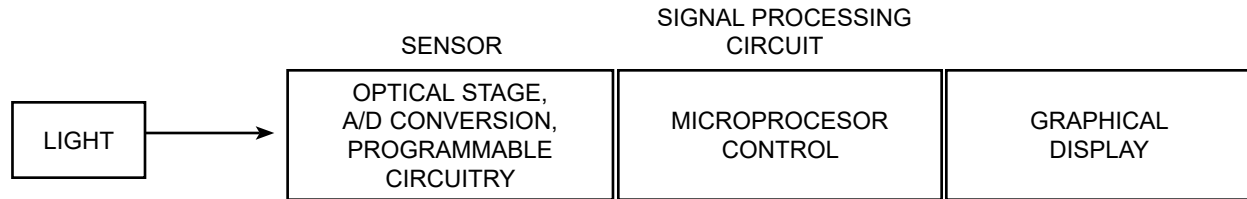




Zeroes will appear in the *Response* field each time the **MENU** button is pressed. The text "**Verify Bad**" will display (as shown below) and the device will then automatically exit the calibration screen, returning to the Main Menu by default.



## 9. THEORY OF OPERATION



### THE INPUT OPTICS

The lambertian (cosine) response of the sensor head is desirable for many measurement applications, especially those where the angle from the source to the detector is variable or those situations where the angle from the source is "extended," such as in the measurement of a fluorescent lamp at distances comparable to or shorter than its length. In the latter case, the extended source provides radiation from many angles, all of which must be properly "weighted" as to their effectiveness on the plane represented by the sensor surface.

In actual practice, it is difficult to make a sensor conform to the ideal response over the entire solid angle of  $2\pi$  steradians. The sensor units of the AccuPRO meter minimize this problem by being outfitted with optimal transmission diffusing materials for various spectral regions. These diffusion materials are mounted close to the surface of the sensors so that the oblique rays are not obstructed. The spectral range is selected by adding an appropriate UV interference filter within the optical stack before the sensor cell assembly.

### THE SENSOR CELL

#### *Photovoltaic Operation*

When a p-n junction is operated with no externally applied voltage, it is considered to be operating in the photovoltaic mode. Under this zero applied voltage condition and low levels of incident light, the p-n junction will generate a current proportional to the light power incident on the active surface.

This photon-induced current, or photocurrent, will divide between the diode parallel dynamic resistance and the parallel load resistance. The dynamic resistance is normally a high value and is an inverse exponential function of forward voltage. The direction of current flow will produce a voltage across the diode that opposes the band-gap potential of the photodiode junction, thus forward biasing it. As a result, the value of the diode dynamic resistance ( $R_d$ ) drops exponentially as the irradiance increases and the photo generated voltage is a quasilogarithmic function of diode irradiance when the external load resistance is considered. Another major disadvantage is that  $R_d$  typically has a wide spread of values over different production batches.

One way of achieving sufficiently low load resistance and eliminating the effect of the diode parallel resistance is to feed the photocurrent into the virtual ground of an operational amplifier. The output voltage is the result of the photocurrent being driven by the amplifier through the feedback resistor and the input impedance  $R_{in} = R_f/A$  where  $A$  is the open loop gain and  $R_f$  the feedback resistor. This circuit has a linear response and is low noise due to the almost complete elimination of leakage current with the zero bias. This results in a proportional voltage being presented to the signal conditioning section of the electronics.

## 10. WARRANTY, MAINTENANCE AND BATTERY REPLACEMENT

### 10.1 WARRANTY

The warranty policy for the AccuPRO is provided on the Certificate of Limited Warranty enclosed separately with each unit.

**NOTE:** For assistance of any kind, including help with a meter under warranty, contact the Customer Service Department at Spectro-UV. In the United States and Canada, call toll-free 1-866-230-7305. Include the model number, serial number and date of purchase. If return of the unit is deemed necessary, shipping instructions will be provided. If an estimate of charges for nonwarranty work or other service work is required, a quote will be furnished upon evaluation of the unit. Out-of-warranty service work will not be performed without customer approval.

### 10.2 PREVENTIVE MAINTENANCE

- Immediately clean all spilled materials from the unit and wipe dry. If necessary, moisten a cloth with soap and water to clean plastic surfaces and the sensor head. The sensor surface should be rinsed with ethanol to remove any residual soap and/or organic contaminants.
- Whenever possible, avoid exposure or use in areas that are subject to temperature and humidity extremes, vibration or mechanical shock, dust or corrosive fumes, or strong electrical or electromagnetic interference.
- It is recommended that the unit be returned to the factory or a recognized Spectroline AccuPRO calibration service center for a complete overall check and recalibration at least every 6 or 12 months, depending on your facility's Standard Operating Procedures. Before returning the units to our factory, contact the Customer Service Department for shipping instructions.
- When the AccuPRO is not in use, store it in a location free from temperature extremes, dust or corrosive fumes, and vibration or mechanical shock.
- If storing for an extended period, place the AccuPRO in its carrying case.

### 10.3 BATTERY SAFETY AND CHARGING

1. The AccuPRO radiometer must be charged overnight or for at least 8 hours when the battery is replaced or after a battery reset (removal and re-installation of the same battery).
2. **CAUTION:** Do not use alkaline batteries in the AccuPRO as they may explode causing damage to the circuitry and possibly the operators. Only use the 700mAh, 1.2V rechargeable batteries provided with the AccuPRO and available from Spectroline® (P/N: 129227).
3. The AccuPRO should be charged with the power OFF. Charging the unit for long periods while operating is not advised because it will cause the charging/display circuit to malfunction. Should this take place, the unit will need to charge for 8+ hours while turned off for the circuit to reset.
4. The battery indicator will turn red at 30%. It is recommended that the AccuPRO be powered down and charged when it reaches this level. At 10% battery life, the unit will automatically power down.
5. Disconnect the charger from the meter when not in use.
6. While charging, it is recommended to have the device turned OFF.
7. **Off-State Discharge Rate:** The AccuPRO™ battery will naturally discharge approximately 3-4% per day – even when the unit is turned off. Be sure to keep an accurate and up-to-date charging schedule.

### CHARGING

- Plug battery charger into AC power outlet.
- Firmly connect charger to port located on the right side of the unit, just below the screen.
- Battery percentage, located in the top right corner of the screen, will begin to increase as the unit charges. It might be necessary to change screens for the battery readout to update.
- A full charge will take 8 hours and is good for approximately 6 hours of operation.
- While charging, it is recommended to have the device turned OFF.