photonfy

by LEDMOTIVE

User Manual

PHOTONFY

Bluetooth Handheld spectrometer

Model No: SP-01-BLU

UM 450006-05

https://photonfy.com

Index

1.0 INTRODUCTION

Photonfy is the most complete, versatile, and affordable handheld spectrometer in the market. This user manual is designed to help you use both, the hardware, and the Android APP. This product has been designed with the non-professional user in mind, so you do not have to have a PhD. to take advantage of it. With our handheld spectrometer, you have a powerful light catcher with all the features and performance of a scientific-grade spectrometer.

APPLICATIONS

- Color measurements
- Quality lighting inspection for health, horticulture or artwork
- Photography and Film makers
- Flickering measurements
- Artificial light meter/analyzer
- Natural light recorder (dynamic light sequences)
- Instant spectral copy-paste or real-time light streaming (to any luminaire compatible with LEDMOTIVE technology)
- IoT Lighting networks

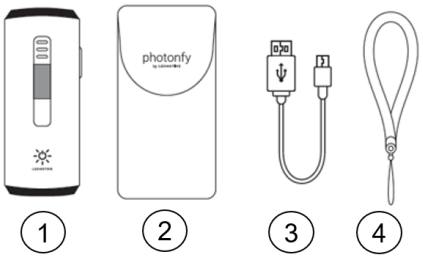
ADVANTAGES

- Factory-calibrated spectrometer device
- Automatic integration time option to capture static and dynamic light spectra
- Fast data processing
- Modern UX. Clear graphics and reports
- Light spectra database synchronization with LEDMOTIVE cloud platform
- Lifetime firmware updates
- Share spectral data with your colleagues. Make you spectra either private or public
- Bluetooth connectivity
- Free PHOTONFY APP compatible with Android OS

To get started, see the Software **Section 1**. For more precise information, refer to the sub-sections on software download and installation, using the Photonfy APP, menus and use. All the documentation related to the hardware operation is given in **Sections 2 and 3**. Technical and mechanical specifications in **sections 4 and 5**, maintenance, safety and legal statements can be found in **Sections 6 and 7**.

1.1 ORDERING INFORMATION

The box contains the following items:



(1) Handheld spectrometer SP-01-BLU

(2) Photonfy Soft pouch

(3) USB-to-Micro USB cable (30 cm)

(4) Neck strap

2.0 APP SOFTWARE

We have designed Photonfy with the finest user experience.

After following the steps below, you will soon be on your way to becoming a Photonfy user expert.

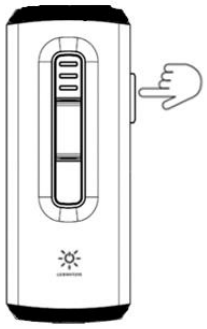
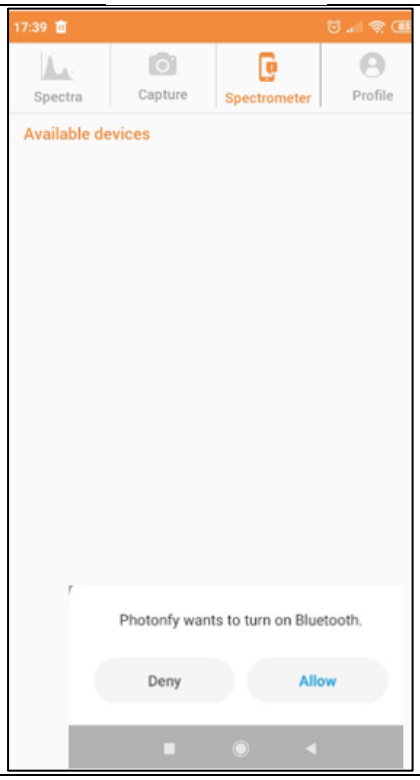
Get the latest version of Photonfy APP: GET IT ON Google Play

1. Download Android Photonfy APP from Google Play Store.
https://play.google.com/store/apps/details?id=com.photonfy.app

2. Or use the QR code to download the APP http://.app.photonfy.com

3. Install the APP in your Android smartphone and/or tablet. This APP is compatible with Android OS 9.0 and newer versions.

2.1 USING THE PHOTONFY APP

1. TURNING THE DEVICE ON • Turn on the handheld spectrometer with the lateral button ON/OFF.	
2. OPEN THE PHOTONFY APP • By default, the APP checks if Bluetooth connection is enabled. You may have to enable Bluetooth from the settings of your Android OS.	

Note: Please fully charge the battery before using it for the first time. When plugging-in the spectrometer for battery charge, the LED status indicator will start blinking every second. Wait until the green LED stops blinking. At this time the battery will be fully charged and the device is ready to use.

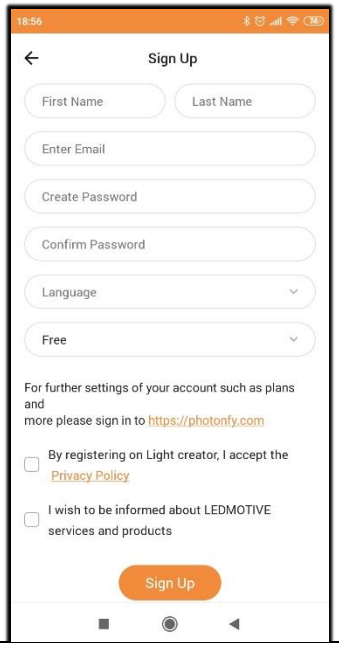
2.2 INITIAL SIGN IN / SIGN UP MENU

1. SIGN IN

- By default, the APP opens the **Sign in** screen.

2. SIGN UP

- New users without a **photonfy.com** account, should select **sign up** and create a new account. After that, **sign in** with the username and password provided.
- Check your email to activate the new account.



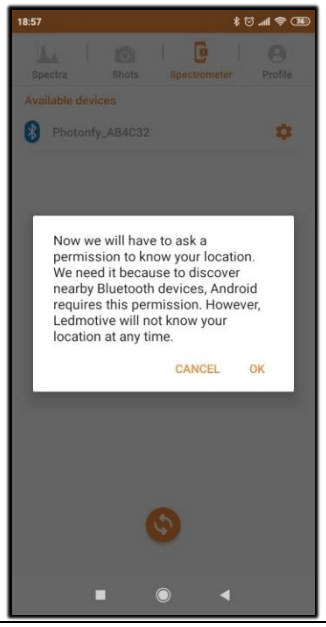
Note: You can skip the **sign in** menu by tapping the word “skip” located at top right of the **sign in** screen. This allows you to work in local mode. However, in this mode, the APP has a reduced set of functions to interact with the spectrometer.

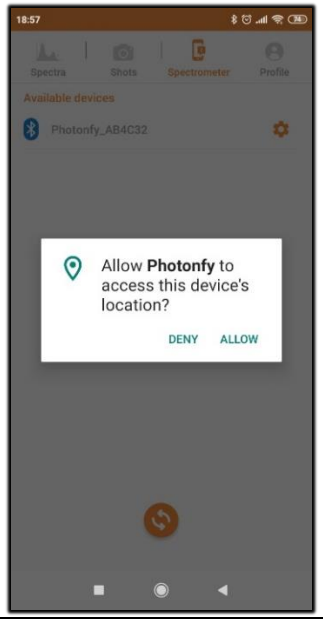
2.3 BLUETOOTH DISCOVERING, PAIRING AND CONNECTION

1. DISCOVERING

By default, the APP asks for permission to know the user location. This permission request is mandatory for the latest versions of Android OS to discover nearby Bluetooth devices.

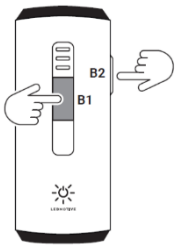
- Photonfy: (Press lateral button ON)
- Please, accept Bluetooth permission.
- Tap in the circular progress bar to start discovering spectrometer devices.

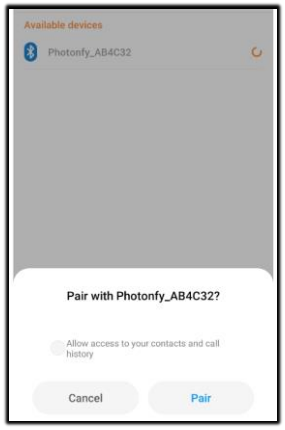




2. PAIRING (<u>only the first time</u>):

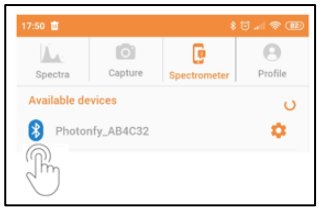
- Press the central button (B1) + lateral button (B2) during 5s. In this moment, the Blue LED will start blinking.
- Tap in the desired device and wait some seconds for pairing to complete.

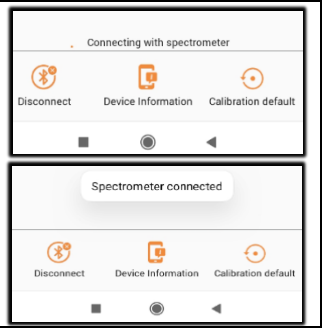




3. CONNECTION

- Please, tap in available devices to start the connection process.
- If the connection procedure is successful, the message “spectrometer connected” will be displayed.





Note: If the discover, pair or connection procedure is not possible, please check the Bluetooth interface (**mode: active)** in your smartphone or tablet and repeat all the previous steps.

2.4 MENUS

Spectra | Capture | Spectrometer | Profile	
	**Spectra**: shows the spectra files and video sequences captured and created by the user. **Capture**: captures static spectra or video sequences. **Spectrometer**: spectrometer configuration and calibration settings **Profile**: user profile settings

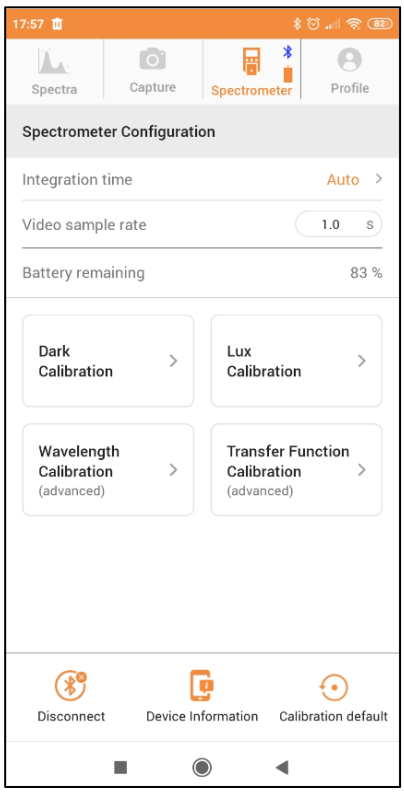
2.5 MENU SPECTROMETER

SPECTROMETER CONFIGURATION:

- **Integration time**: by default, configured in Automatic mode
- **Video sample rate**: by default, one frame every 1 second
- **Battery:** battery charge indicator (1% to 100%)

CALIBRATION:

- **Dark Calibration:** optional operation before taking a shot. Use if illuminance or temperature conditions have changed over time. See Calibration section.
- **Lux Calibration:** advanced option to recalibrate illuminance
- **Wavelength Calibration:** advanced option that updates sensor calibration coefficients. See Calibration section.
- **Transfer Function Calibration:** advanced calibration that corrects for the wavelength-dependent optical transmission along the optical path. See Calibration section.
- **Disconnect:** Bluetooth connect/disconnect option. See Bluetooth discovering, pairing and connection.
- **Device information:** For maintenance purposes. See sub-menu device information.
- **Calibration default:** reset calibration to the factory defaults. See Calibration section.



2.6 MENU CAPTURE

SPECTRA MENU

SEND TO

Opens the list of available user spaces to stream captured light spectrum (luminaires compatible with LEDMOTIVE technology required)

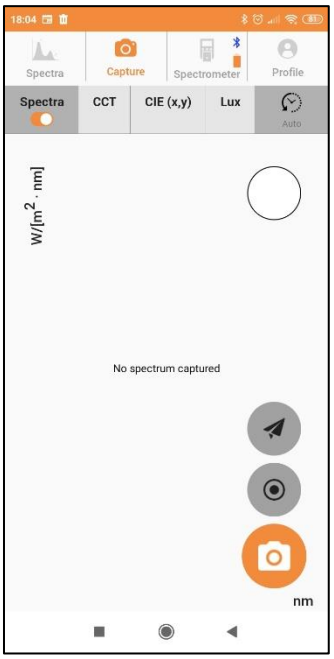
PLAY VIDEO

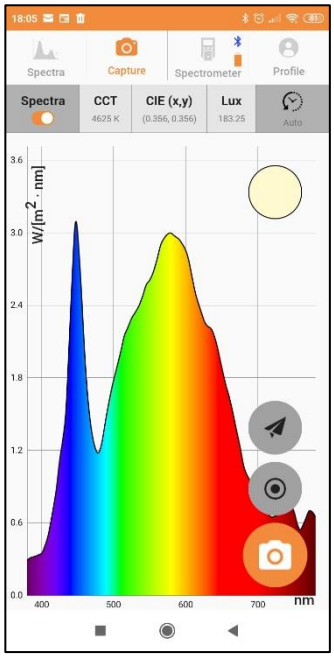
Play video (OFF)

Play video (ON)

SINGLE SPECTRUM

Capture single spectrum





INDICATORS

- CCT (K)
- CIE (x,y)
- Illuminance (lx)

CCT	CIE (x,y)	Lux
4625 K	(0.356, 0.356)	183.25

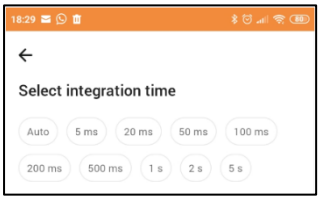
- Battery charge
- Bluetooth connection

OPERATIONAL MODE

Spectral power distribution measurement (SPD)

Flicker measurement mode

INTEGRATION TIME



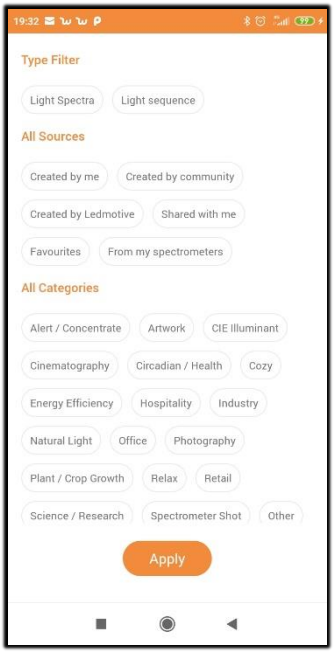
2.7 MENU SPECTRA

TYPE OF RECORDS

- **Shot:** capture a single spectrum.
- **Sequence:** capture a sequence of spectra at a user-defined framerate. Sometimes referred as “spectral videos”.

SEARCH FILE

Bar to search spectral shots or videos by name



Filter: The spectral database can be filtered by different attributes

CREATE SPECTRA FILE

Opens new window to create theoretical spectra or sequences from scratch

In this option spectra files are created from scratch using Ledmotive spectra file format, or using the tools: MOTO and CYCLO. Different metamers are specified by its CCT and the output metameric spectrum is selected after optimizing and filtering by some user-defined light parameters.

CREATE SPECTRA FILE :OPTIONS

From Photonfy cloud: Spectra files shared by Photonfy users and community

From File: imported Spectra file SSF format

From MOTO: Metamer Optimization Tool by LEDMOTIVE

From CYCLO: 24h cycle light optimizer by LEDMOTIVE.

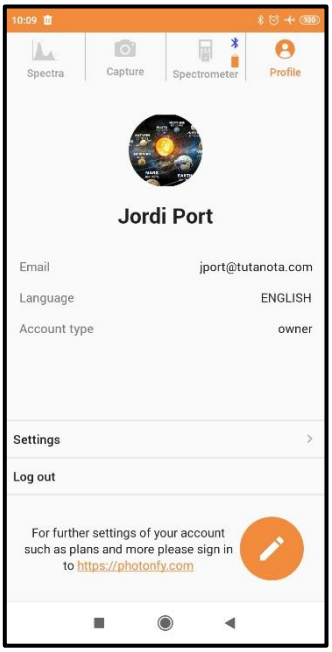
2.8 MENU PROFILE

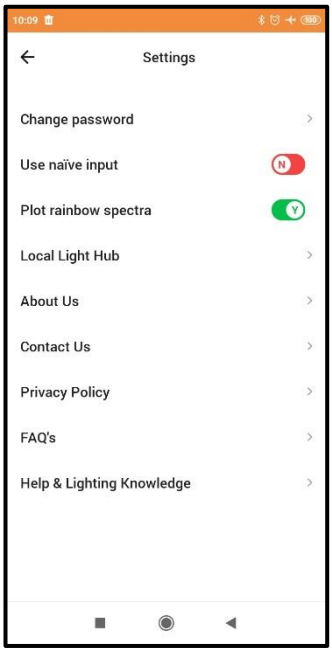
Edit options

- Update Name.
- Language (EN /ES).
- Update Profile photo.

User settings

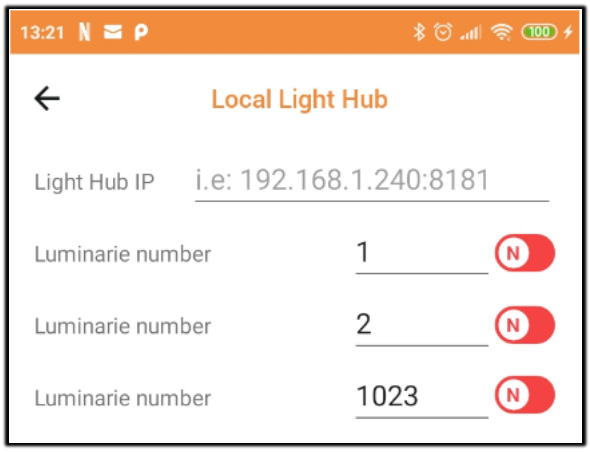
- Change Password.
- Use naïve input: Y/N.
- Plot rainbow spectra: Y/N
- Local Light Hub
- About Us / Contact Us.
- Privacy Policy.
- FAQ's: Frequent questions of about this product.
- Help & Lighting knowledge: Technical lighting terms used in Photonfy APP.





SUB-MENU: LOCAL LIGHT HUB

Advanced feature for interaction with any luminaire or light Hub (**LEDMOTIVE-enabled** luminaire required)



Note: L**ocal Light Hub option** requires luminaires and Ligh Hubs compatible with LEDMOTIVE™ technology. It allows you to replicate (bypass or preprocessing) the light measured with this spectrometer to interior rooms or spaces. For more information contact with LEDMOTIVE™ at https://www.ledmotive.com

3. HOW TO CREATE AND SHARE A REPORT

GENERAL REPORT

- Go to Menu Spectra.
- Open a spectral record.
- Generate report.

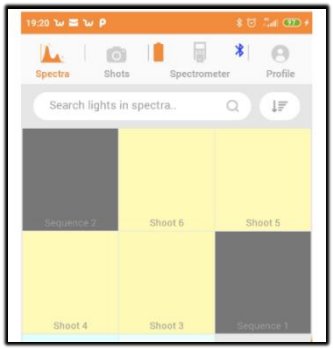
MAIN PROPERTIES

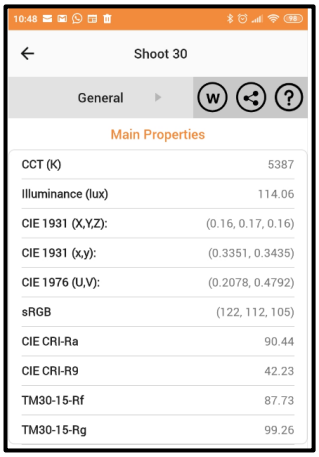
- **CCT** Correlated Color Temperature (K).
- **Illuminance** (lx).
- **CIE 1931 (X,Y,Z)** color space.
- **CIE 1931 (x,y)** coordinates.
- **CIE 1976 (U,V)** color space.
- **sRGB**: standard Red Green Blue color space to use on monitors.
- **CIE CRI-Ra** color rendering index. scale from 0 to 100 % General CRI is calculated as the average value of R1 through R8.
- **CIE CRI-R9** color rendering index.

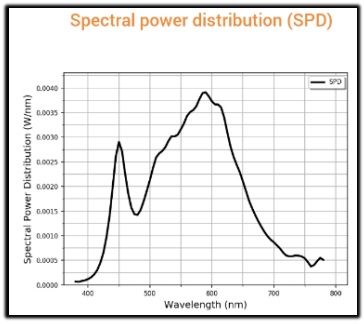
IES COLOR RENDITION

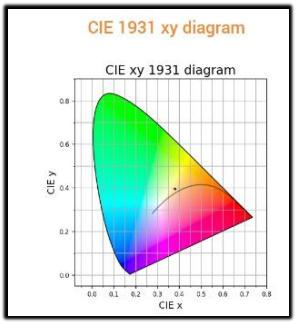
- **TM 30-18-Rf**: color rendition Fidelity (Rf).
- **TM 30-18-Rg**: color rendition Gamut (Rg).
- **SPD:** Spectral power distribution (380nm-780nm).
- **CIE 1931 xy diagram:** Colour coordinates (x,y).

- Shoot file properties







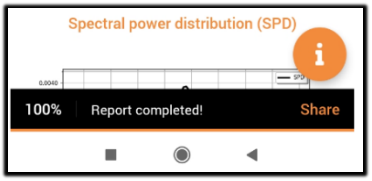


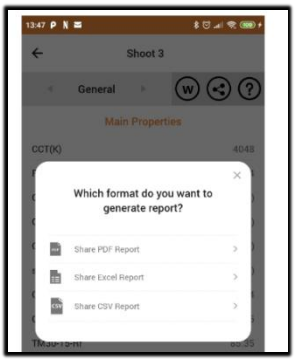
GENERATE REPORT

Report formats:
PDF, Excel, CSV

SHARE OPTIONS:

- WhatsApp
- Email
- File stored in folder





3.1 HOW TO CREATE A COLOR REPORT

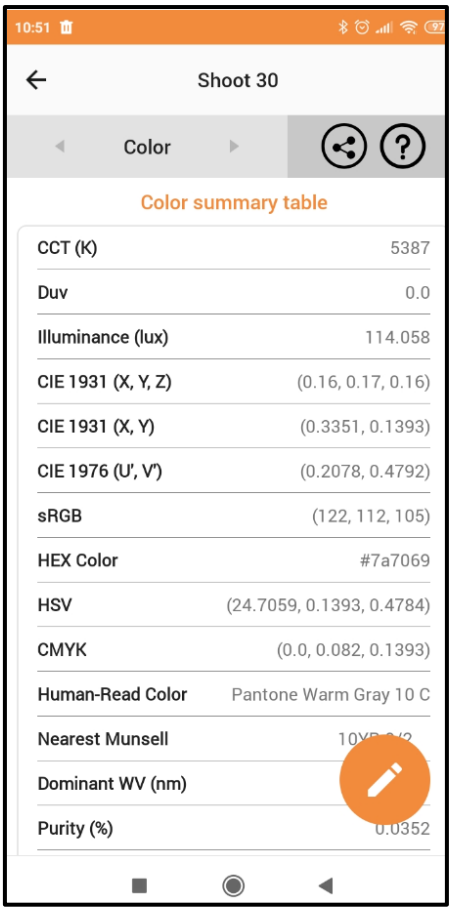
COLOR REPORT

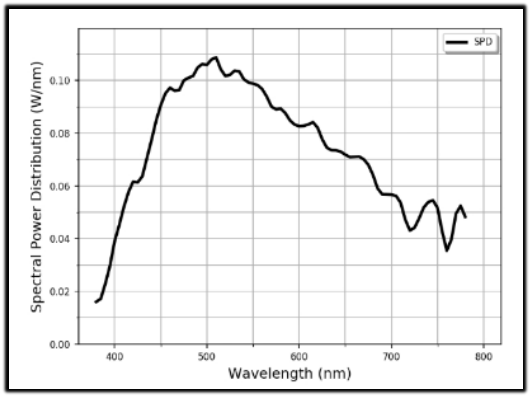
- Go to Menu Spectra.
- Open a spectral record.
- Move slider to Color.

COLOR PROPERTIES

- CCT correlated Color temperature (K).
- Flux (lm).
- CIE 1931 (X, Y, Z) color space.
- CIE 1931 (x, y) coordinates.
- CIE 1976 (U,V) color space.
- sRGB: standard Red Green Blue color space.
- HEX color: RGB color expressed as a six-digit HEX value.
- HSV: Hue, Saturation, and Value color model.
- CMYK: Cyan Magenta Yellow Black color model used in color printing.
- Human-read color: the closest match of a named color.
- Nearest MUNSELL: Munsell Color system.
- Dominant wv (nm): Dominant wavelength in nanometers (nm).

Example of color properties of a Shoot file





- Purity (%): the degree to which a color resembles its hue.

- CRI-Ra: scale from 0 to 100 % General CRI is calculated as the average value of R1 through R8.

IES COLOR RENDITION

- TM30-18-Rf: color rendition Fidelity (Rf).

- TM30-18-Rg: color rendition Gamut (Rg).

Spectral power distribution

- SPD (380nm-780nm).

CIE 1931 XY DIAGRAM

- xy Colour coordinates (x,y).

ANSI C78.377.2017

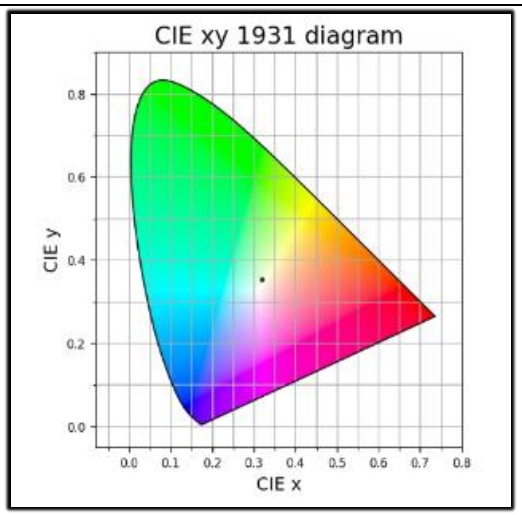
- American National Standard for Electric Lamps—Specifications for the Chromaticity requirements for general lighting with solid-state lighting products.

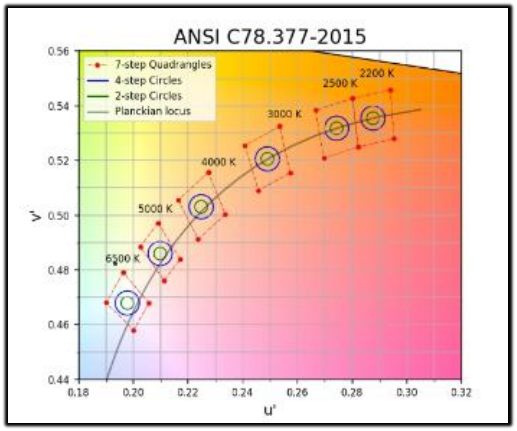
SPECIAL COLOR RENDERING INDEX

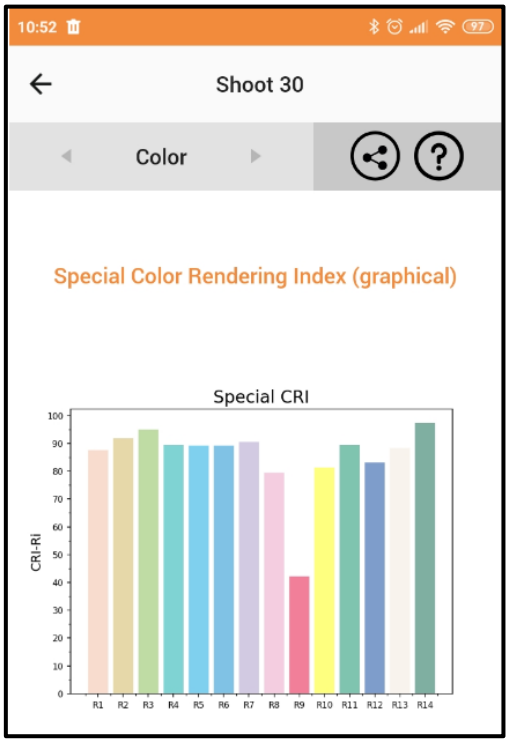
- Special CRI R1-R14 numbers.

CIE-Lab color

- CIELAB color space. **L** indicates lightness, **a** is the red/green coordinate, and **b** is the yellow/blue coordinate.





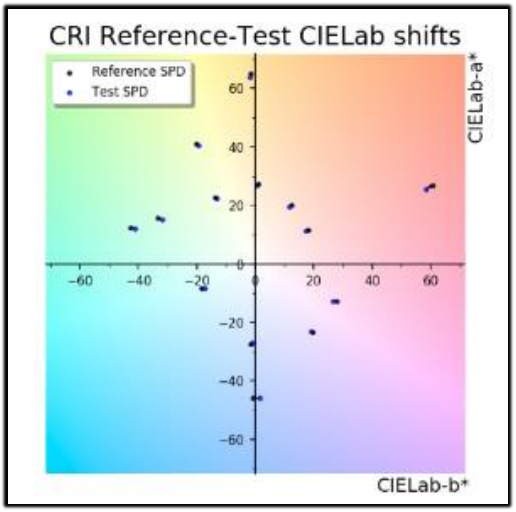


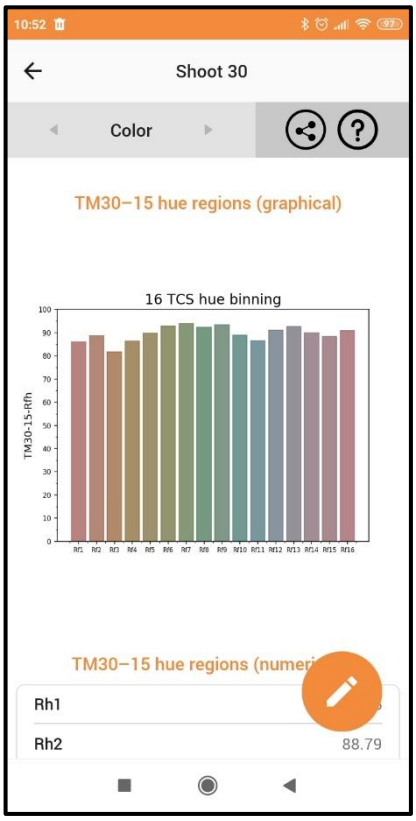
TM30-18 HUE REGIONS

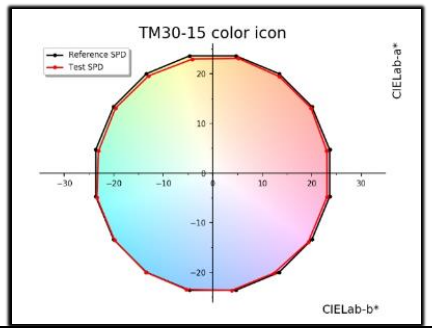
- Color shifts in the **a-b** space for the different TM30 hue regions.

TM30-18 CIELAB TEST/REFERENCE COLOR ICON

- Visual description of hue and saturation changes. Daylight is represented as a perfect circle. Over-saturated colors can be interpreted as points that lie outside the perfect circle. In the same way, de-saturated colors lie inside the circle.







3.2 HOW TO CREATE A HEALTH REPORT

HEALTH REPORT

- Go to Menu Spectra.
- Open a spectral record.
- Move slider to Health.

Non-visual indicators

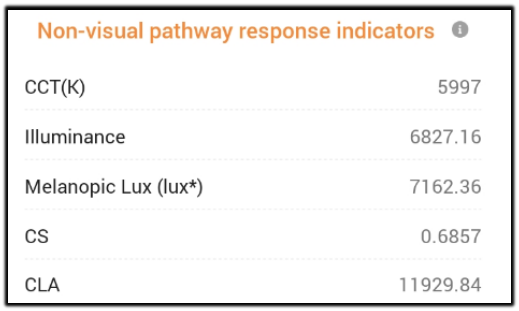
- **CCT**: Correlated Color temperature for white light sources used to describe the dominant color tone along the dimension from warm (yellows and reds) to cool (blue).

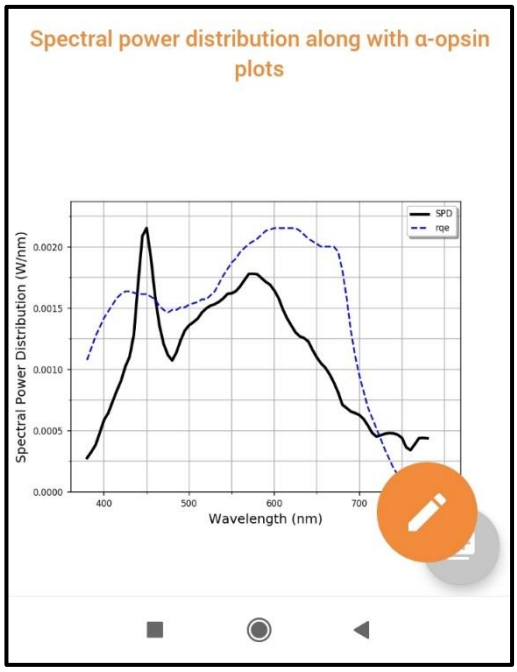
- **Illuminance**: is the amount of light (luminous flux) incident on a surface area. Illuminance is measured in foot-candles (lumens/square foot) or lux (lx, lumens/square meter)**.**

- **Melanopic Lux**: Non-visual effect of lighting that relates to the way that blue frequencies in daylight restrict the production of melatonin in the body's system until night when melatonin increase through the system and prepare the body to sleep. This is the Equivalent Melanopic Lux (EML).

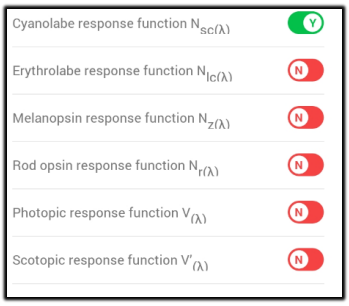
- **CS**: Circadian Stimulus (CS): is the calculated effectiveness of the spectrally weighted irradiance at the cornea from threshold (CS = 0.1) to saturation (CS = 0.7), assuming a fixed duration of exposure of 1 hour.

- **Circadian Light (CLA):** is the irradiance at the cornea weighted to reflect the spectral sensitivity of the human circadian system as measured by acute melatonin suppression after a 1-hour exposure.





ADDITIONAL PLOT OPTIONS



3.3 HOW TO CREATE A HORTICULTURE REPORT

PLANTS REPORT

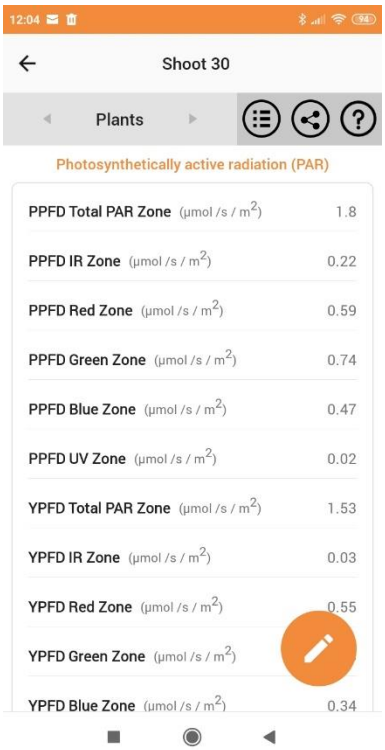
- Go to Menu Spectra.
- Open a spectral record.
- Move slider to Plants.

PHOTOSYNTHETIC PHOTON FLUX INDICATORS

- **PPFD Total Par Zone (400-700nm):** Total Photosynthetic photon flux density. Rate of flux of photons expressed in µmol/s.m² that actually arrives at the crop canopy in the Par zone (400 nm to 700 nm).
- **PPFD IR Zone (700-800nm):** Far red Photosynthetic photon flux density in the range of 700-800 nm.
- **PPFD Red Zone (600-700nm):** Photosynthetic photon flux density in the range of 600 to 700 nm.
- **PPFD Green Zone (500-600nm):** Photosynthetic photon flux density in the range of 500 to 600 nm.
- **PPFD Blue Zone (400-500nm):** Photosynthetic photon flux density in the range of 400 to 500 nm**.**
- **PPFD UV Zone (350-400nm):** UV Photosynthetic photon flux density in the range of 350-400 nm.

PHOTOSYNTHETIC PHOTON FLUX (PPF)

- PPFD is the rate flow of photons within the photosynthetically active radiation (PAR) range, from 400 nm to 700 nm (ANSI/ASABE S640 JUL2017). It is calculated by multiplying the luminaire SPD by the unweighted PPF action spectrum and summing the total. It represents CO2 assimilation per mole of incident photons, and is analogous to luminaire lumens.

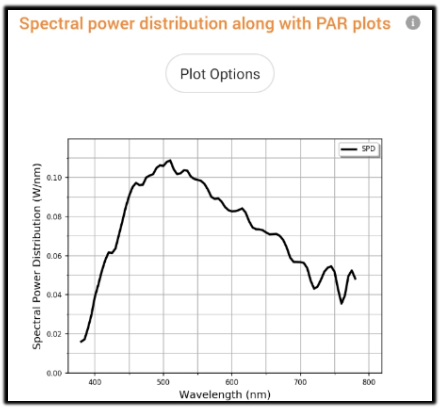


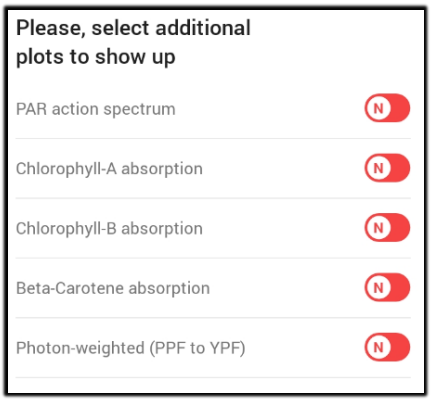
Yield Photon Flux (YPF)

YPF weights the spectral characteristics of photons based on plant's photosynthetic response.

YIELD PHOTON FLUX INDICATORS

- **YPFD Total Par Zone (400-700nm):** weights the spectral characteristics of photons in the Par zone.
- **YPFD IR Zone (700-800nm):** weights the spectral characteristics of photons in the far red range.
- **YPFD Red Zone (600-700nm):** weights the spectral characteristics of photons in the range from 600 to 700nm.
- **YPFD Green Zone (500-600nm):** weights the spectral characteristics of photons in the range from 500 to 600nm.
- **YPFD Blue Zone (360-500nm):** weights the spectral characteristics of photons in the range from 360 to 500nm.
- **YPFD UV Zone (350-400nm):** weights the spectral characteristics of photons in the UV range.
- **Red/Blue**: (ratio) indicates the effects on the growth productivity related to stem elongation and leaf expansion. Blue light has significant effects on the morphology of plants aside from Photo-synthesis.
- **Red/Far-red**: (ratio) indicates the effects on the growth productivity related to flowering, setting winter buds and vegetative growth.
- **Daily Light Integral (DLI)** the aggregate amount of PAR light that a surface receives over the course of a day. It is a very useful metric to determine if a particular location receives sufficient amounts of light for plants to grow well. Low light plants require between 5-10 mol/m2/day, medium light plants 10-15 mol/m2/day, and high light plants will require more than 15 mol/m2/day.





CONVERSION FACTORS

$$\eta_v(T) = \frac{\int_{\lambda_1}^{\lambda_2} B(\lambda,T)\,683\,[\mathrm{lm/W}]\,y(\lambda)\,d\lambda}{\int_{\lambda_1}^{\lambda_2} B(\lambda,T)\,d\lambda},$$

$$\eta_{\mathrm{photon}}(T) = \frac{\int_{\lambda_1}^{\lambda_2} B(\lambda,T)\,\frac{\lambda}{hcN_A}\,d\lambda}{\int_{\lambda_1}^{\lambda_2} B(\lambda,T)\,d\lambda},$$

$$\eta_{\mathrm{PAR}}(T) = \frac{\int_{\lambda_1}^{\lambda_2} B(\lambda,T)\,d\lambda}{\int_0^{\infty} B(\lambda,T)\,d\lambda},$$

Where B(λ,T) is the black-body spectrum according to Planck's law, y(λ) is the standard luminosity function V(λ), λ1, λ2 represent the wavelength range (400 700 nm) of PAR, h is Plack constant, c is the velocity of light, 683 is the constant and NA is the Avogadro constant. The value of V(λ) is 0.999997 at 555.016 nm, so that a value of 683/0.999997 = 683.002 is the multiplicative constant.

3.4 HOW TO CREATE AN ARTWORK REPORT

GENERAL REPORT

- Go to Menu Spectra.
- Open a spectral record.
- Move slider to Artwork.

CIE DAMAGE FUNCTIONS $s_{df}(\lambda)$

Damage function curves for materials which follow an exponential decay with the increase of wavelength. depend on the type of material (water colors, oil paint, paper, textile materials, etc).

THRESHOLD EXPOSURE LEVEL

Photon energy threshold in lux-hours that the object can bear, to avoid a photochemical reaction in the material, thus showing the color change.

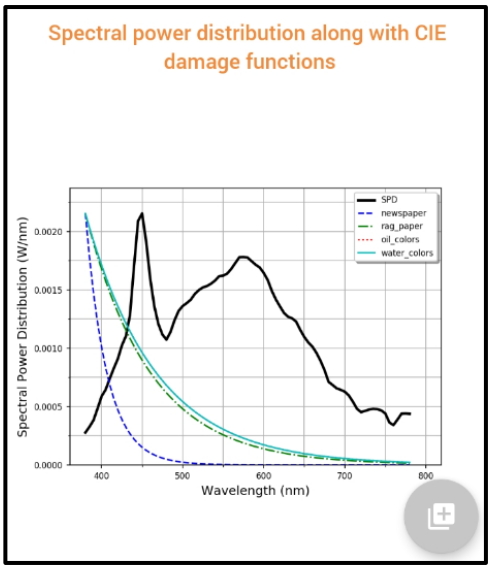
POTENTIAL DAMAGE VALUE (mW/lm)

Damage effect of the light spectrum on the material under a certain exposure, in which the illuminance in **lux**, exposure time **t** and Spectral Power Distribution are known.

The thermal effect of infrared in the light source dry, deform and crack the materials. The UV radiation is a chemical effect, which will cause the fading and discoloration of the material.

- Relative specific sensitivity of newspaper.
- Relative specific sensitivity of rag paper.
- Relative specific sensitivity of oil colors.
- Relative specific sensitivity of textile.
- Relative specific sensitivity of water colors.

Note: A prolongued exposure of artwork to light will cause irreversible or permanent color damage such as fading, dis-coloration and darkening.



Threshold exposure (ts, in hours) table for the selected SPD for the given illuminance

Material	Potential Damage (mW/lm)	Theshold exposure @XXX lux (ts inhours)
Newspaper	0.0	0.0
Rag paper	0.0	0.0
Oil colors on canvas	0.0	0.0
Textile materials	0.0	0.0
Water colors on paper rag	0.0	0.0

4.0 TECHNICAL SPECIFICATIONS

Absolute maximum ratings

	MIN	MAX	UNIT
Voltage operation	4.5	5.5	V
Battery capacity	500	550	mAh

Operating conditions

	MIN	TYP	MAX	UNIT
Nominal voltage operation	4.5	5	5.5	V
Power operation	450	500	550	mW
Battery charge current	80	100	200	mA
Temperature range	5	-	50	ºC
Spectral range	380	-	780	nm
Spectral resolution		12		nm
wavelength accuracy *		+- 1		nm
Integration time	5	-	5000	ms
Illuminance range	5	-	55000	lux
Illuminance accuracy		±8		%
x,y Color accuracy CIE 1931		± 0.0025		%
CCT accuracy		±3		%
CRI (Ra) accuracy		±1		%
Measurement mode		Single, continuous, subtract background		
Flicker Frequency Range	5	-	100	Hz
Wavelength temperature dependence		-0.1 / + 0.1 nm		ºC
Battery duration**	24	30	48	Hours

*(assumes stable input light source)
**(assumes ON mode / no Bluetooth connection / only LED ON)

4.1 COMMUNICATION SPECIFICATIONS

Wireless Communication protocol	Bluetooth 4.2 Smart Ready Compliant
Certifications Bluetooth module	Bluetooth, CE, FCC and IC, Japan and South-Korea qualified
Control software for smartphones	*photonfy* Android APP. This APP is compatible with Android OS 9.0 and newer https://play.google.com/store/apps/details?id=com.photonfy .app

5.0 MECHANICAL SPECIFICATIONS

Dimensions (mm)	92.8 (H) x 38.2 (W) x 20.5 mm (D)
Weight	55 g
Screw thread adapter for tripod	Standard 1/4"-20 UNC Thread size

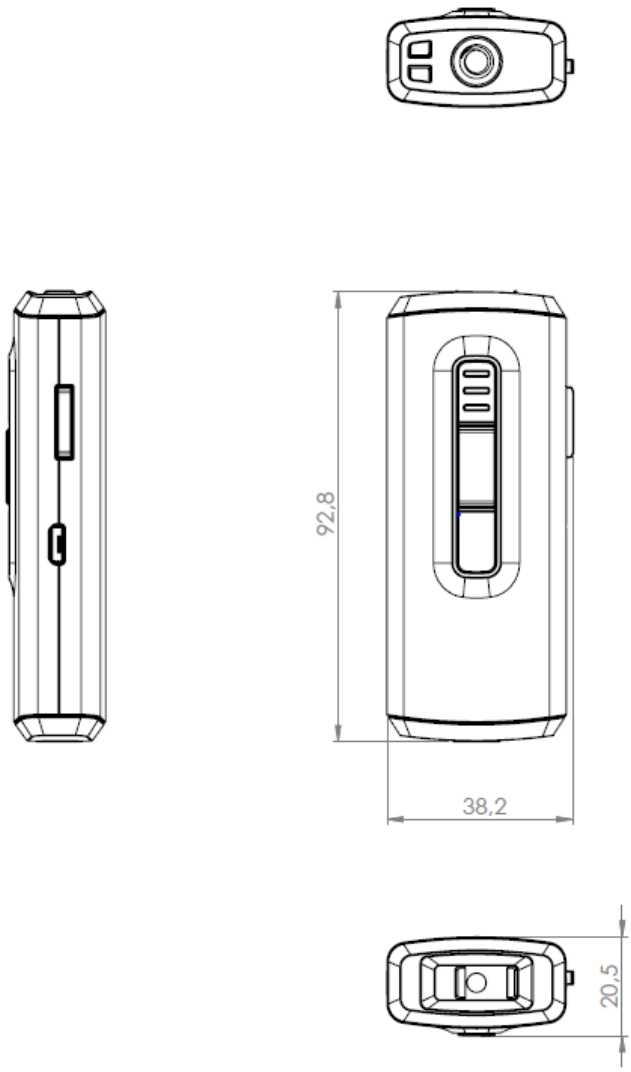


Figure 2. Photonfy mechanical dimensions. All dimensions are in millimeters (mm)

6.0 MAINTENANCE

- If a fingerprint mark or dirt is observed on the diffuser, you may clean it. Before cleaning, disconnect/turn-off the device. Wipe the surface of the diffuser gently with a dry cloth.
- Do not open, disassemble, or manipulate the device.

7.0 WARNING AND SAFETY

- *Photonfy* is designed for use in dry indoor and outdoor spaces. It is not resistant to water and must be protected from adverse weather conditions (heat and humidity).
- To avoid damage, do not expose it to spray, liquids, dust, or chemical products.
- Keep in a dry place and store in the soft pouch.
- Maneuver the spectrometer carefully. It has sensitive electronic components inside.
- This device contains a certified rechargeable LiPo battery in conformity with IEC 62133-2:2017 and UN38.3. Do not attempt to replace the battery yourself to avoid damaging the battery or the device.
- Charge this device only with the included micro USB cable Type-B in a PC, laptop or certified USB smartphone charger.
- Use only a certified USB smartphone charger for the country of use to ensure that safety and performance requirements are met.
- After charging is complete, disconnect the USB cable from the device. Do not charge the device longer than 12 hours.

8.0 DISPOSAL

- In accordance with EU Directive WEEE (Waste Electrical and Electronic Equipment), the device must not be disposed of with another household waste.
- At the end of their life, it must be taken to the appropriate local facility available for the disposal or recycling of the electronic parts.

9.0 WARRANTY

- This product has passed the proper EU regulations and directives. LEDMOTIVE offers a two-year limited warranty.

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