

# ASTROMECHANICS

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## Light Pollution Meter PRO

Simple solution for monitoring sky brightness

[User manual](#)

## FEATURES

- Narrow-field sky meter with built-in lens;
- High-precision and stable readings;
- Handheld and stationary usage with PC;
- The software can store and analyze data;
- Measures the brightness of the night sky in magnitudes per square arcsecond;
- Infrared blocking filter restricts measurement to visual bandpass;
- Reliable electronic optical unit;
- Voltage step-up converter for stable power supply even from deeply discharged battery;
- Power-saving features (automatically shutdown after 10 s of inactivity);
- Reverse battery protection;
- Full metal body (black anodized aluminum);
- Mounting on a tripod possible without any additional parts (1/4" thread);
- Based on popular TSL237 sensor.

## USING

- Find out how good the night or site really is;
- Compare the sky brightness at different sites;
- Document the evolution of light pollution in your area;
- Monitor sky brightness continuously night-to-night, year-to-year;
- Determine greatest nights for finding the faintest DSO;
- Use the software to collect, analyze and store readings;
- Draw light pollution maps based on the received data;
- Investigate correlations between different astronomical events and sky brightness;
- Take this meter with you on a journey or use as stationary device in the observatory;
- The system is initially calibrated, but the basic constant can be easily changed using special software commands.

## PART 1: Specifications

Sensor	TSL237T ( <a href="#">datasheet</a> )
Optical filter: wavelength for max. transmittance	500 ± 5 nm
Lens: angle of view	≈ 10°
Meter precision	Each LPM PRO is factory-calibrated. The absolute precision of each device is believed to be ±0.10 mag/arcsec <sup>2</sup>
PC connection	USB serial cable (1.2 m) based on PL2303 chip;
Display	4-digit 7-segment LED display (red)
Body material	Aluminum (surface is black anodized)
Power source	10440 type Li-ion battery with 5V step-up unit; USB powered when connected to PC
Physical size	70 mm x 70 mm x 30 mm
Weight	170 g

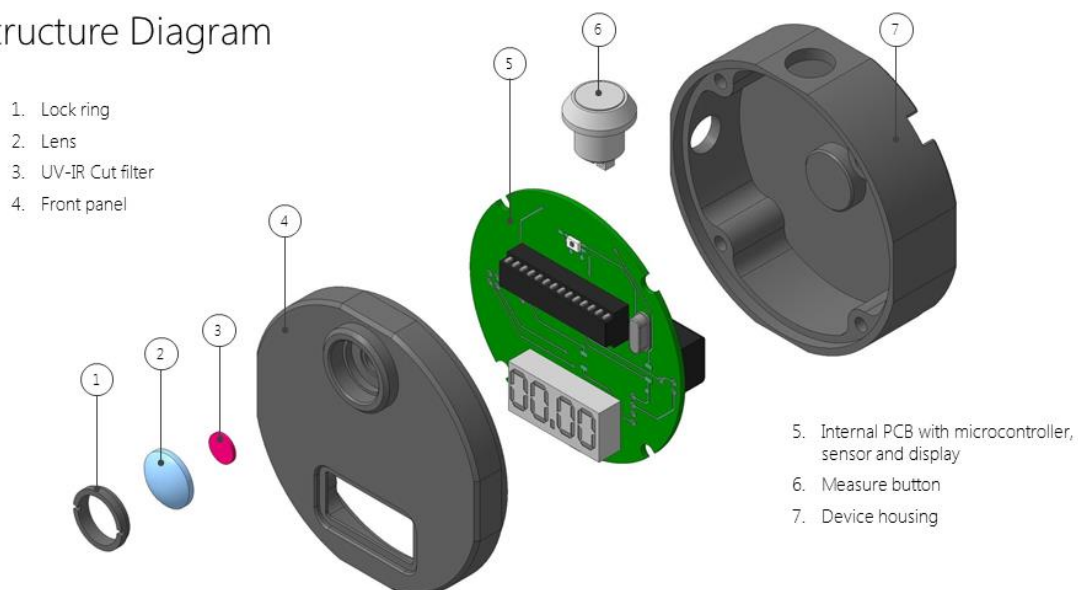


Front of device



Back of device

### Structure Diagram



Internal structure of Light Pollution Meter PRO

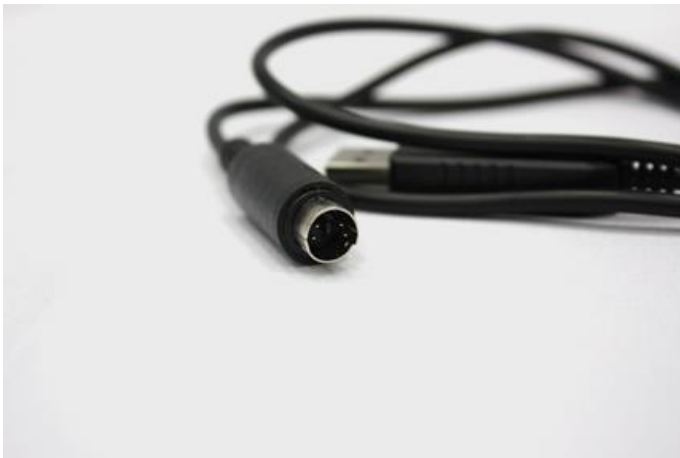
## PART 2: Unpacking and inspection

Carefully inspect the device after unpacking, make sure that it doesn't have any damage. Press the "Measure button" more than 2s to turn the device on. Value 00.00 will appear on the screen. Press and release the button to start measuring process. Note that available range is limited. Therefore, if the measurement is carried out in a bright light, an error message will be displayed ("E"). Close the lens by hand for a quick test.



Device check

Also check the availability of the USB cable. It is required to connect Light Pollution Meter PRO to a personal computer.



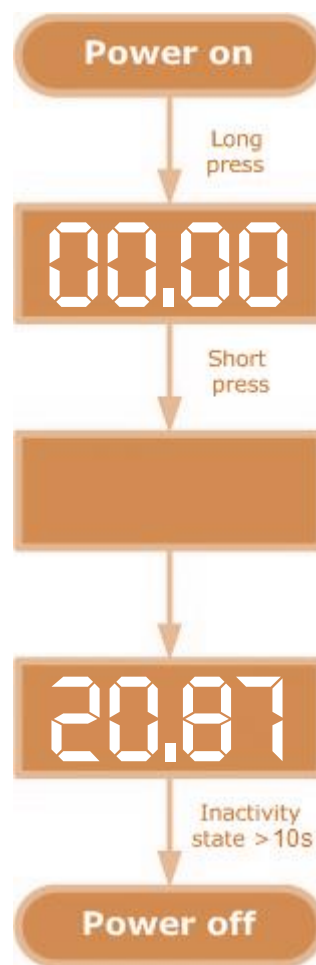
LPM PRO with USB cable

### PART 3: Manual using

Manual use of the device is not difficult. The device is calibrated and ready to work. Just point the lens toward selected part of the sky, for example, toward the zenith and press "Measure button". The corresponding value will appear on the screen. Make several measurements to get a more accurate result.

Note: under urban skies, a reading will be displayed almost immediately. Under the very dark conditions (no moon in the sky, far from civilization) the device may take up to a minute to complete its measurement. Maximum light sampling time: 120 seconds.

While the measurement process is in progress, the screen will be light off to avoid reflections from surrounding objects. For the same purpose, choose the right places to measure sky brightness. Stay away from any terrestrial light sources including all surfaces that can reflect part of light. For example, don't use the device standing close to the wall of your house.



Block diagram of the manual device operation

## PART 4: Understanding the results

Magnitudes per square arcsecond are a logarithmic measurement. Therefore large changes in sky brightness correspond to relatively small numerical changes. The following schematic gives a rough idea of how to interpret the readings (mag/arcsec<sup>2</sup>). Detailed description you can read [here](#).



Schematic view of light pollution effect

**Magnitudes** are an astronomical unit of measure for object brightness. Brighter objects have a lower magnitude and darker objects have a higher magnitude value. For example: a star that is 6th magnitude is brighter than a star that is 11th magnitude.

**Arcsecond** is the definition of an arc being divided up into seconds as follows:

- There are 360 degrees in a circle;
- There are 60 arcminutes in a degree, and 21600 arcminutes in a circle;
- There are 60 arcseconds in an arcminute, and 1296000 arcseconds in a circle.

**Square arcsecond (arcsec<sup>2</sup>)** is the area covered by a square measuring 1 arcsec × 1 arcsec.

**Magnitude per square arcsecond** is the definition of brightness in magnitudes spread out over one square arcsecond of the sky. For example: if we get a reading of 20.00 mag/arcsec<sup>2</sup>, that would be like saying that a light of a 20th magnitude star brightness was spread over one square arcsecond of the sky.

At the darkest sites, natural variations in conditions such as airglow and the brightness of the zodiacal light are limiting factors.



Airglow and zodiacal light

## PART 5: Connection to a personal computer

If you want to use Light Pollution Meter PRO as a stationary device on the observation site or in the observatory, you can easily connect it to your personal computer. This method will give you great opportunities for data processing. You can collect data for a long time, automatically save it to file and analyze it at any moment.



Wired connection

Use special USB -> Serial cable. This cable has a convenient mini-DIN connector for fast and correct connection to the device. Connect the other end to the USB port of your personal computer. Hardware connection successfully completed.



Mini-DIN socket

Also you can use a tripod for long-term monitoring. Light Pollution Meter PRO has 1/4" threaded hole and may be mounted on standard photographic tripod without problems.



Light Pollution Meter PRO mounted on a tripod

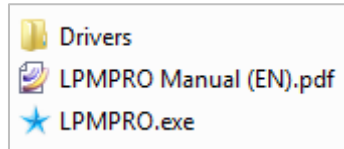


## PART 6: Software installation

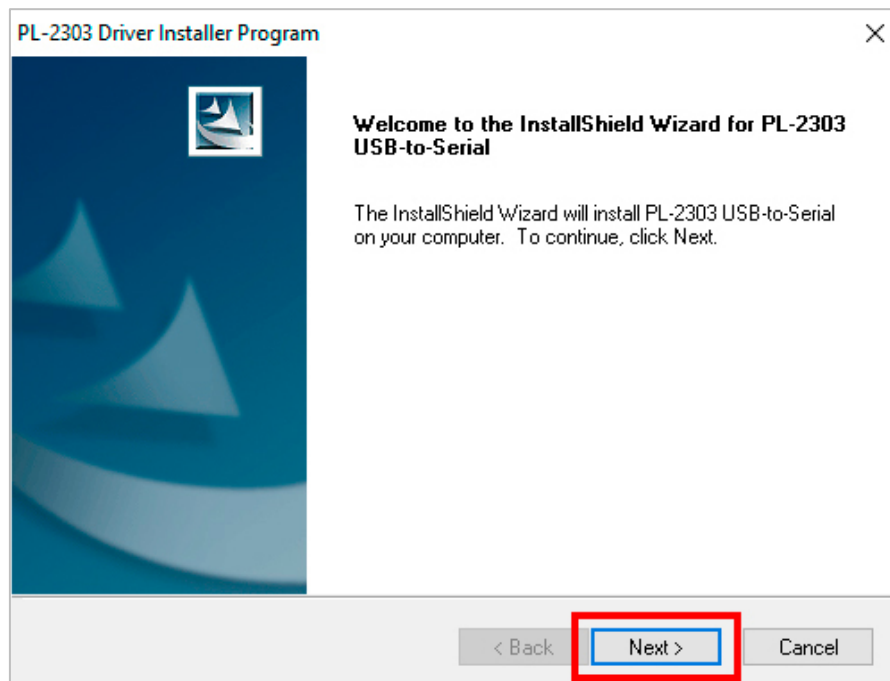
The software doesn't require high performance from the user's computer. Required software components:

- Microsoft Windows XP/Vista/7/8/10;

The installation process is very simple. Just unzip an archive to the destination folder. Contents of the folder will look like this:



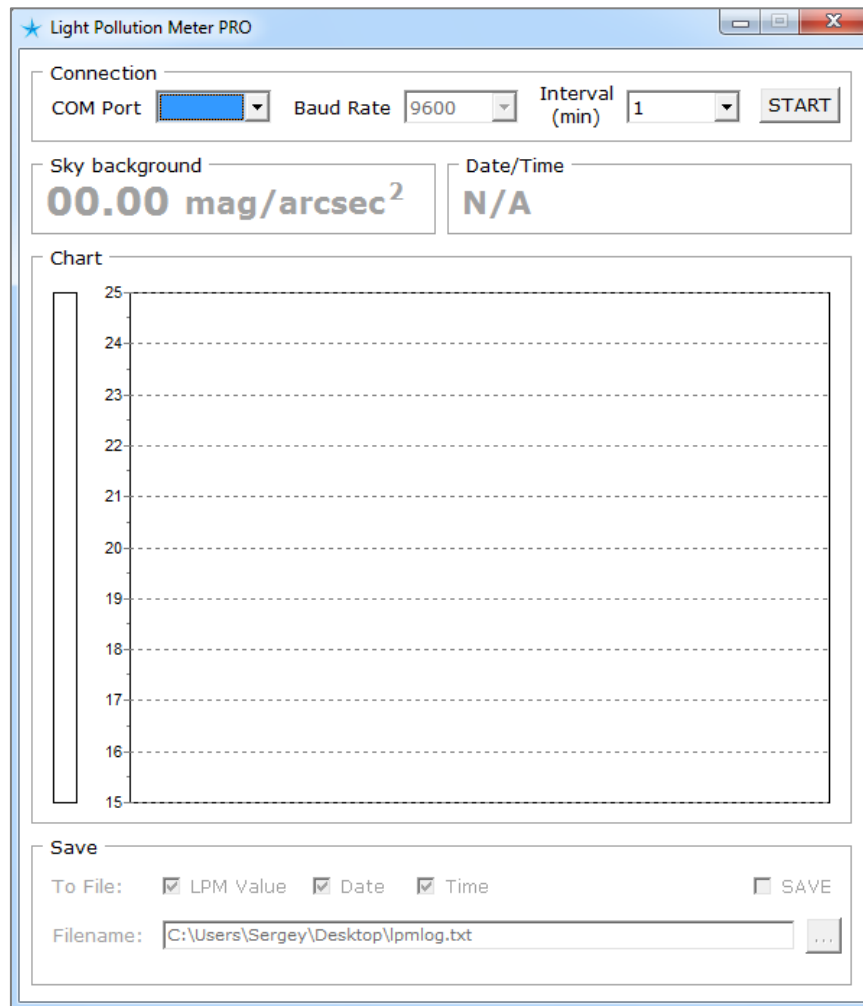
Before launching the application, you must install PL2303 driver for communicating with Light Pollution Meter PRO. The operating system can automatically install this driver when the device is connected. If this doesn't happen, you can install the driver manually from the "Drivers" folder. Run the installation wizard and follow the instructions that appear on the screen.



Driver installer window

## PART 7: Software usage

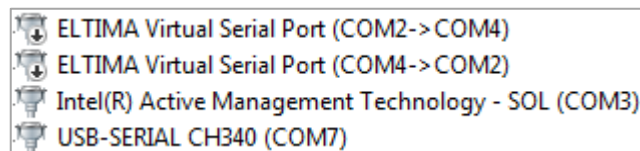
After installation is completed launch the **LPMPRO.exe**.



Main window

You need to configure several parameters in this window:

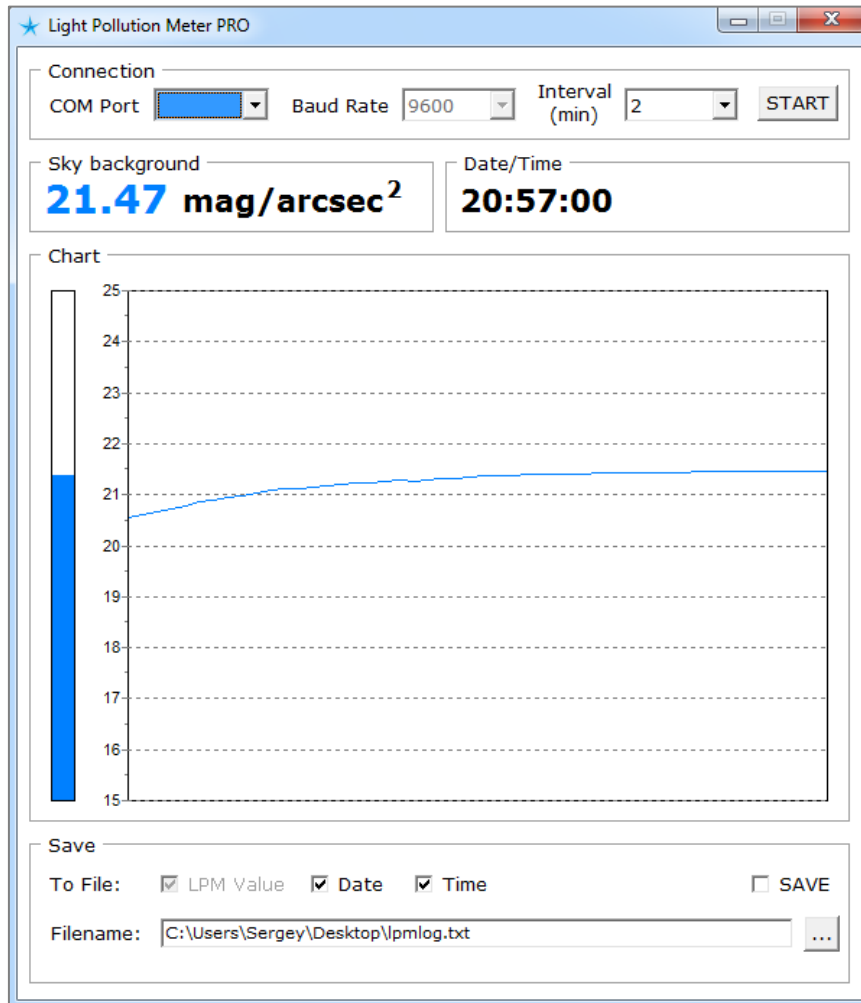
- COM Port – a virtual port created by operating system for the connected device (COM7 for example). You can find the port number in the Windows Device Manager. If drop-down list doesn't contain port number, enter it manually. Then click on **START** button.



List of available COM ports

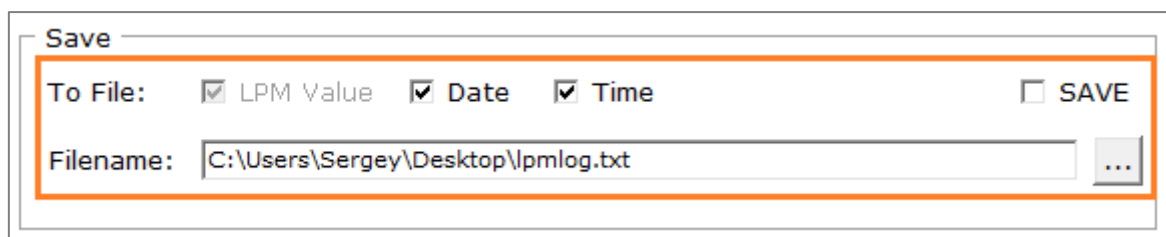
- Timer interval (in seconds). Available values: 1, 2, 5, 10, 15, 30, 60, 120, 180, 240, 300, 600 seconds. After the specified time interval the software will send a request to LPM PRO and when the measurement is completed, it will receive readings from the device.

If the connection was successful all visual controls will be enabled. The program window has very simple and user friendly interface. The program displays last readings, time and chart with all measurements received during the current session. Timer interval may be changed at any time, just select new value and press **START** button again.



Main window

If you want to save readings, choose **SAVE** option. File will be saved in the root application folder by default. You can change save destination folder by **Save Dialog** call. Press the button with dots and specify a new file name. You can also enable or disable Date and Time save.



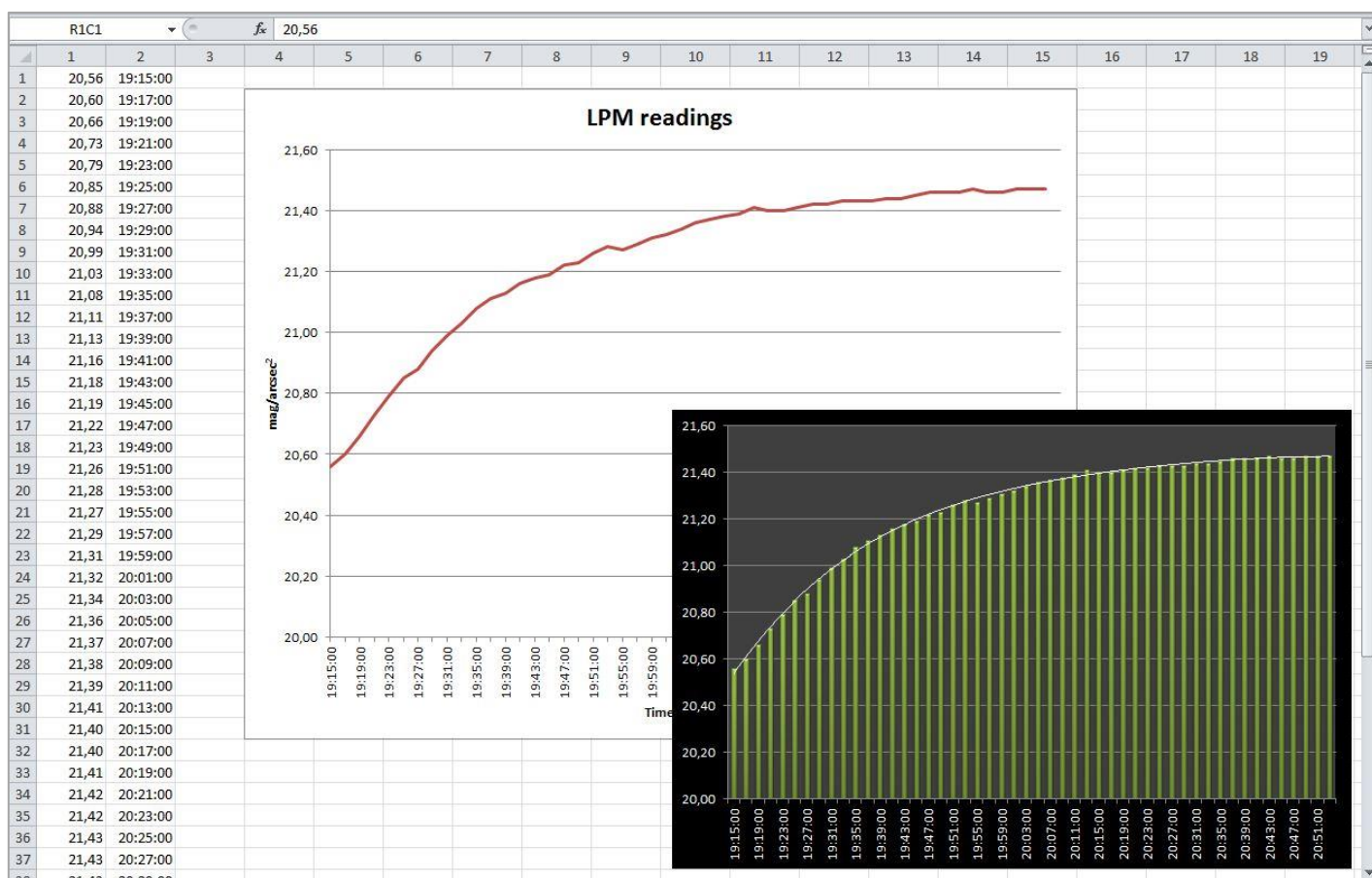
Save options

The contents of saved file will look as shown below.

20,56	19:15:00	15.02.2018
20,60	19:17:00	15.02.2018
20,66	19:19:00	15.02.2018
20,73	19:21:00	15.02.2018
20,79	19:23:00	15.02.2018
20,85	19:25:00	15.02.2018
20,88	19:27:00	15.02.2018
20,94	19:29:00	15.02.2018
20,99	19:31:00	15.02.2018
21,03	19:33:00	15.02.2018
21,08	19:35:00	15.02.2018
21,11	19:37:00	15.02.2018
21,13	19:39:00	15.02.2018
21,16	19:41:00	15.02.2018
21,18	19:43:00	15.02.2018

The contents of saved file depending on the settings

The saved file can be used for analysis in third-party software. MS Excel is a great solution. Build charts, use mathematical calculations, export data to different formats and much more! Powerful software, available even to the beginner. If you don't know how to start, read the help information about text data import and charts building.



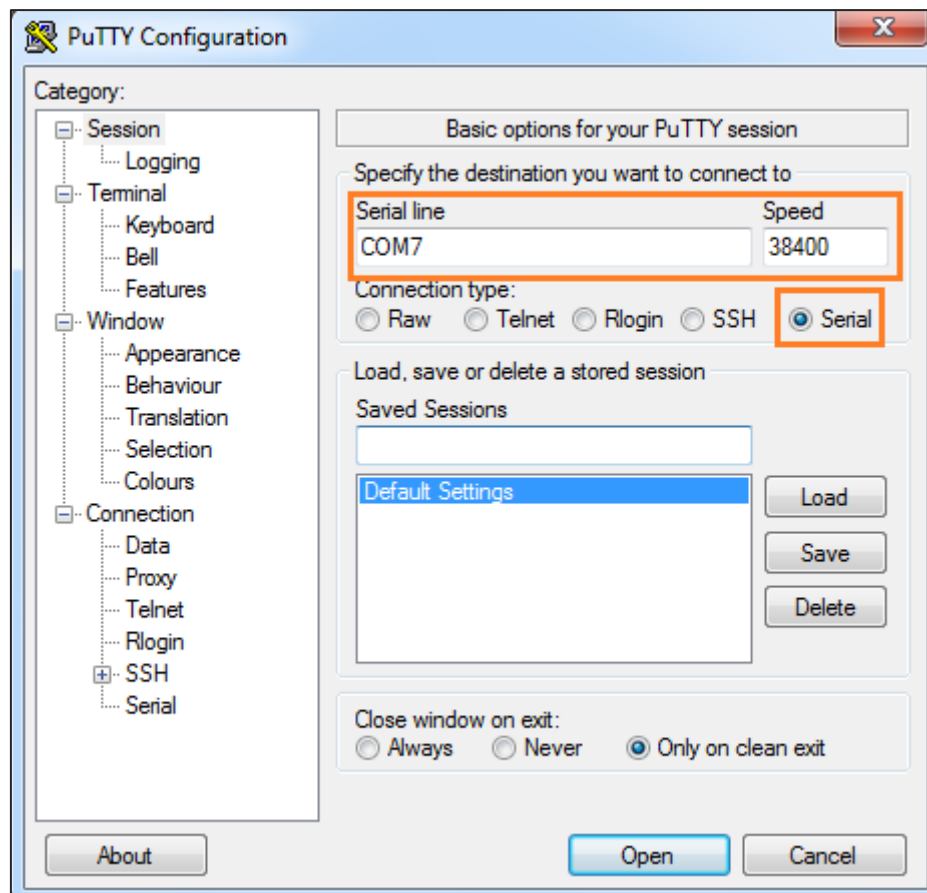
Data analysis in MS Excel

## PART 8: Communication protocol description

User level software communicates with Light Pollution Meter PRO via a simple commands transfer protocol. Commands transmit as a specially formed text units. You can use this protocol autonomously or embed it in your software products. You can use a development environment that allows you to interact with COM ports.

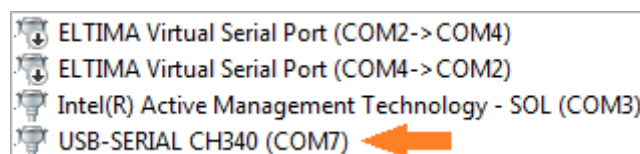
Use any terminal utility that allows you to connect to COM port associated with Light Pollution Meter PRO (**PUTTY** for example). It's lightweight easy to use software with rich functionality.

Open **PUTTY**, choose connection method (Serial), configure serial line (COM port name) and speed as shown in the figure below. Then click **Open**.

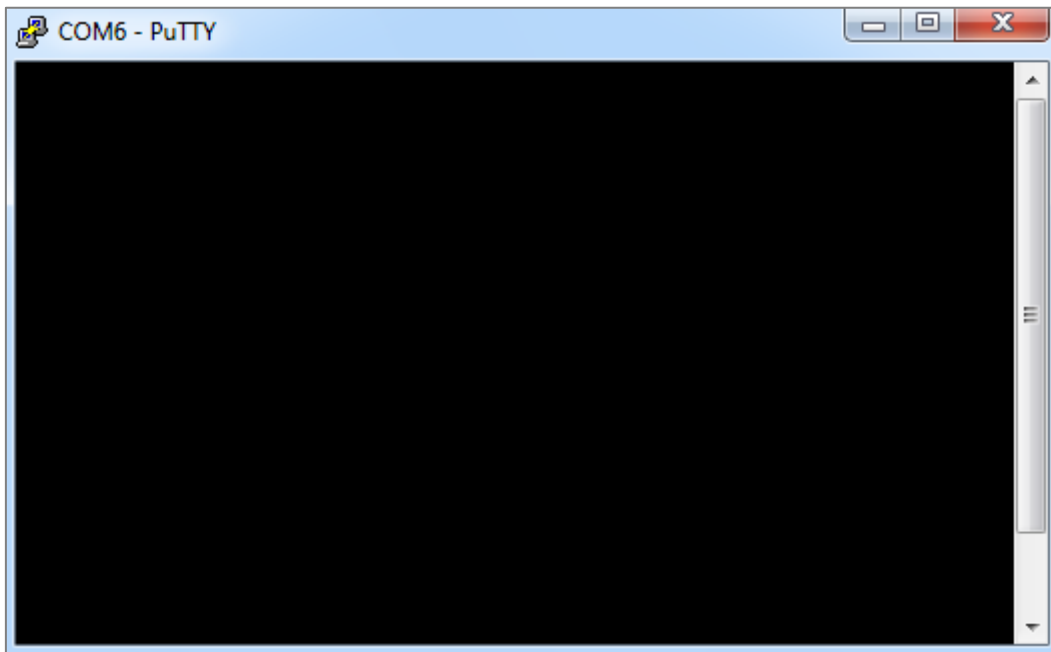


PUTTY configuration

You can find the port name in the Windows Device Manager.



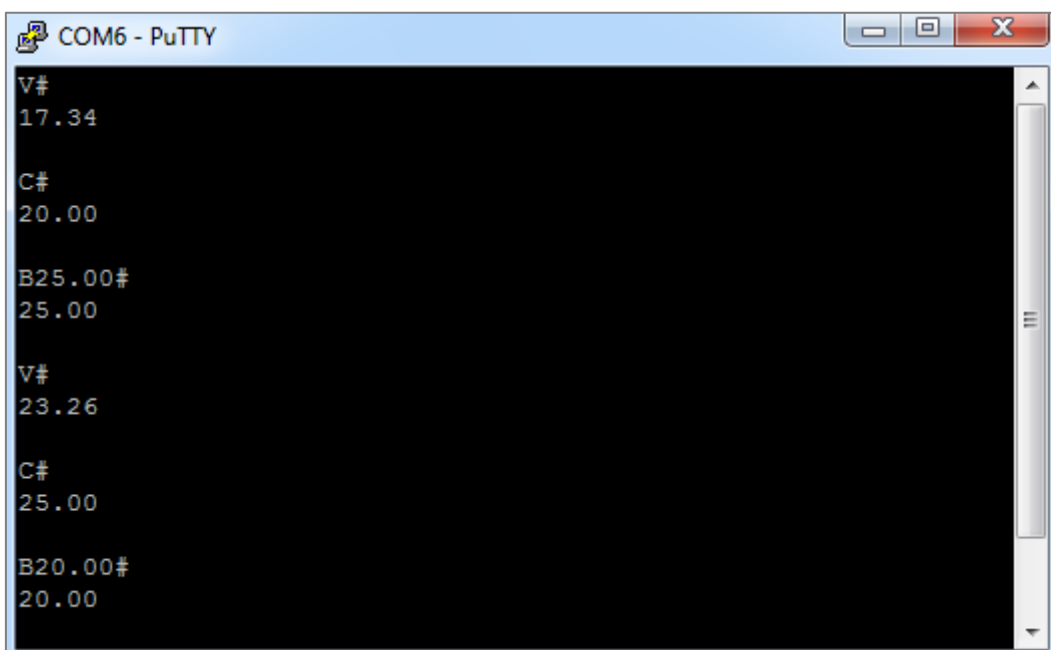
List of available COM ports



Terminal window

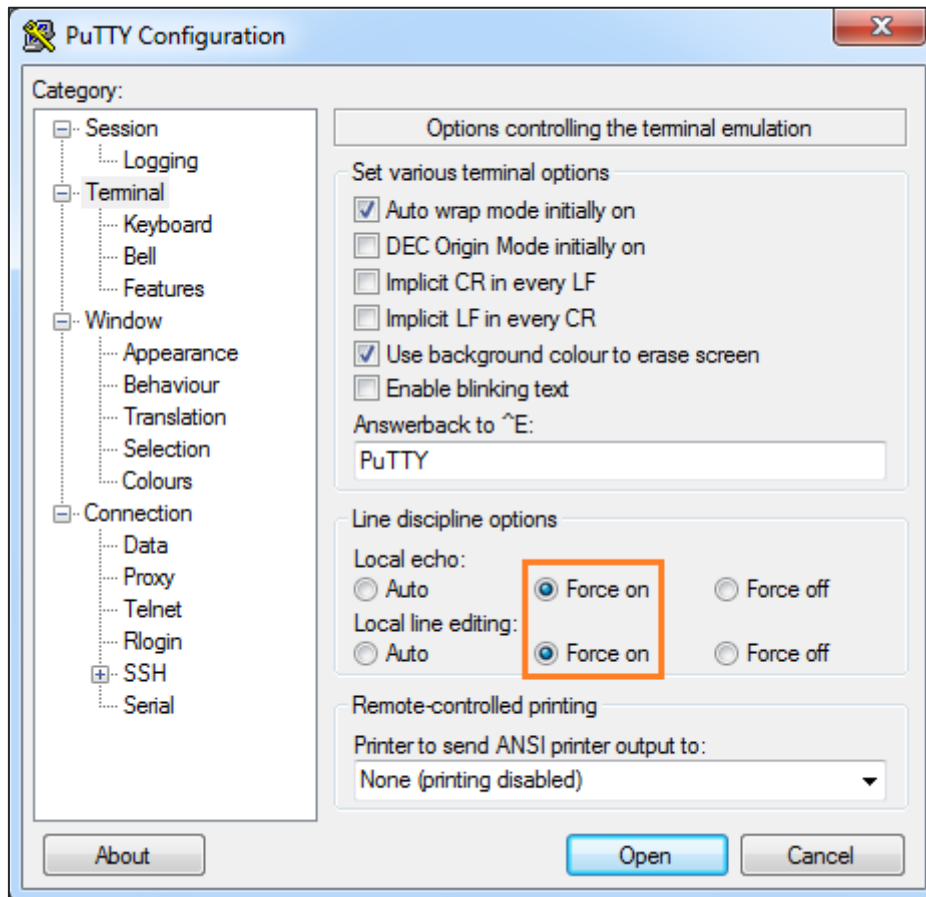
Now you can try to type some commands. All commands terminate by # symbol. List of available commands and their syntax is shown in the table.

V#	Get readings by serial (V# → 20.87#). The basic command to retrieve data from the device.
C#	Check <b>base value</b> in EEPROM (non-volatile memory of the chip) (C# → 20.00) $mpsas = base - 2.5 * \lg(freq)$ where mpsas - mag/arcsec <sup>2</sup> ; freq – TSL237 output frequency.
BXX.XX#	Write <b>base value</b> to EEPROM (non-volatile memory of the chip) (B19.85# → 19.85).  This command is used for factory calibration. We strongly recommend you <b>DO NOT CHANGE</b> this value without need. Do it only if you want to recalibrate the device and you have all necessary equipment and knowledge.



Protocol test in PUTTY

If you have problems with command line make sure that the following settings are enabled.



Line discipline options

## PART 9: Care of your Light Pollution Meter PRO

- Avoid dropping, immersing, and compressing;
- Keep lens and faceplate clean;
- Ensure that the battery still has useful capacity;
- The LPM PRO should not be negatively affected by dew during normal operation except for the reduction in received light by the sensor. Make sure that the sensor faceplate has been wiped before making measurements;
- During storage, make sure that the pushbutton is not being continuously pressed since the meter will draw current from the battery and drain it in that situation;
- Avoid pointing the device at the Sun

Warranty: 1 year.