

Tools for Measuring Nighttime Light Levels

Sky Quality Meter (SQM-L)

- Measures the brightness of the night sky overhead
- Units: Magnitudes per square arcsecond (mag/arcsec²)
- Lower number = brighter sky (this trips people up)
- Widely used by astronomers, IDA, parks, and researchers.
- Typical values:
 - 21.7–22.0 → pristine dark sky
 - 21.0 → rural sky
 - 19–20 → suburban sky
 - 17–18 → bright urban sky
- Unihedron SQM-L (\$155 + S&H or [Amazon](#)) – well-reviewed, used by dark-sky groups. [See the video](#) and [How-to page](#)



Lux Meter

- Measures the amount of light falling on a surface
 - Higher number = brighter
 - Footcandle (.093 lux) is another measurement unit
- Nighttime reference points:
 - Truly dark natural area: <0.01 lux
 - Full moon: ~0.1–0.3 lux
 - Residential street lighting: 5–20 lux
 - Gas station: 300–500 lux
- Good for:
 - Measuring light trespass
 - Comparing before/after lighting changes
 - Code compliance.
- [Urceri MT-912](#) or [Dr.meter LX1330B](#) - popular on Amazon
- Oppl Light Master G4/IV (\$40) - uses app, also measures CCT (*does not seem to be available on June 7, 2026*)



All-sky Camera System

- Use a fisheye lens to capture the entire sky
- Software maps brightness across the sky dome
- Used by: national parks, researchers, Dark Sky Place applications
- Measures: sky brightness, directionality (horizons vs zenith), changes over time

Drone

- High-resolution mapping and data accuracy. Calibrations & sensors provide accurate data.
- Vertical & horizontal data collection: capture data from various angles to measure both upward light pollution (skyglow) and downward illumination.

Night Sky Quality Survey

Sky quality meter survey

Hold a [Unihedron Sky Quality Meter-Lens](#) (SQM-L) above your head, point the photometer at the zenith (straight up), and push the button. The screen displays a number in magnitudes per square arcsecond (mpsas).

Measuring and recording

- Record all measurements on a copy of DarkSky's [standardized spreadsheet](#)
- Include these locations
 - Darkest spots
 - Brightest spots
 - Popular accessible places where people view the night sky.
- When and where
 - Measure at each location several times during the year
 - Under a clear, open sky with no clouds.
 - When the moon is below the horizon.
 - Under [astronomical darkness](#)
 - NOT underneath a light source or anything that might block the sky.
- Per location, per visit: take at least six measurements and discard the first.
- Record any unusual conditions (wildfire smoke, fog, snow cover, storms, etc.).

Reporting

- Create a map that shows the measurement locations
- Use this [standard spreadsheet](#) to compile measurements throughout the year.
- Consider sharing your data with [Globe at Night](#).

Bortle scale interpretation

Follow the [questions on this chart](#) to reveal the Bortle class your sky falls under. This may need to be done at different locations if brightness varies across Bortle classes. To locate objects in the sky, get advice and help from amateur astronomers and nearby astronomy clubs.

Photographic evidence

Photographs help verify that the quantitative SQM-L measurements are accurate. They also help document whether light domes are visible along the horizon, which the SQM-L device may not detect. Keep track of these details for each photo:

- | | |
|--------------------|-------------------|
| • Photographer | • Aperture |
| • Location | • Focal Length |
| • Phenomenon Shown | • ISO Speed |
| • Camera | • Special Editing |
| • Exposure | |

Source: <https://darksky.org/resources/guides-and-how-tos/how-to-conduct-a-night-sky-quality-survey/>

Measuring Artificial Light at Night (ALAN) on the Ground

Protocol

1. Define Objectives - **What** do you want to know?
 - ground illuminance, façade spill, occupant exposure, spectral composition, etc.
2. Select Metrics & Instruments - **How** will you measure?
 - calibrated lux meters, spectrometers, dataloggers, or imaging radiometers.
 - How will you calibrate your instruments to make sure they stay accurate?
3. Establish Sampling Geometry - **Where** will you measure?
 - Horizontal grid for ground level, to cover the area of interest systematically
 - Vertical measurements at building façades/windows at typical human eye height.
4. Plan the Timing - **When** will you measure?
 - Time of day - during true night, after astronomical twilight.
 - How often? Several times throughout the year
5. Record Data points
 - Date and Time
 - Location number
 - Illuminance: in lux
 - Environment - weather, temperature, cloud cover, reflective surfaces, obstructions
6. Analyze the Data
 - Compute spatial averages, temporal variation, and spectral metrics relevant for your research question.

Location Data

- Precise location - address, latitude/longitude
- Light sources
 - Type: incandescent, LED, metal halide, sodium, mercury vapor, etc.
 - Brightness rating: in lumens
 - Shielding: none, partial, or full?
(no light emitted above 90° from the horizontal plane)
 - Color rating: CCT - Warm = 3000 Kelvin or less
- Controls: timer, motion-activator, dimmer
- Purpose: business, residential, public space

Comparison of Light Measurement Units

LUMENS - the brightness emitted by a light source

- 150 - household flashlight
- 800 - a traditional 60-watt bulb
- 900 - car headlight, low beam halogen
- 700-2000 - outdoor spotlight or floodlight
- 2000-4000 - streetlight
- 4000 - car headlight, high beam xenon

LUX - the amount of light falling on a surface, how brightly a surface is lit

- 100,000 - Bright Summer Day
- 10,000 - Full Daylight
- 1,000 - Overcast Day
- 300-500 - Traditional Office Lighting
- 50-100 - Common Stairway
- 10 - Twilight
- <1 - Full Moon

Common Guidelines for Outdoor Lighting Levels

- ★ Residential Street/Pathways: 3–6 lux (minimum).
- ★ Park/Recreational Paths: 2–10 lux.
- ★ Active Pedestrian Walkways: 10–20 lux.
- ★ Parking Lots: 5–20 lux (average), or up to 50 lux for high-security.
- ★ Exterior Residential Spaces (Patios): 10–30 lux.
- ★ Entryways/Active Areas: 100–300 lux.

WATTS - the electrical energy a light bulb consumes, not its brightness.

KELVINS - the color temperature of light from warm to cool

- 1500 - candlelight
- 3000 - warm
- 3500 - white
- 4000-4500 - cool
- 6500 - daylight
- 10,000 - clear blue sky

2200-2500	2700-3000		4000-4100		5000-6500
Amber	Soft	<< Warm <<	Neutral	>> Cool >>	Daylight