

Spectroradiometers for Classifying Solar Simulators



SR-3501

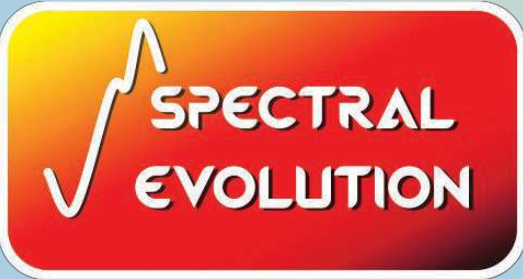
SR-1901

SR-1901PT

|                                         |                                                                                                                 |                                                          |                                                                     |
|-----------------------------------------|-----------------------------------------------------------------------------------------------------------------|----------------------------------------------------------|---------------------------------------------------------------------|
| Spectral Range                          | 280–2500nm                                                                                                      | 280–1900nm                                               | 280–1900nm                                                          |
| Spectral Resolution                     | 4nm (@ 280-1000nm)<br>9.5nm @ 1500nm<br>7nm @ 2100nm                                                            | 4nm (@280-1000nm)<br>10nm @ 1000-1900nm                  | 4nm (@280-1000nm)<br>10nm @ 1000-1900nm                             |
| Sampling Interval                       | Data output in 1nm increments;<br>2221 channels reported                                                        | Data output in 1nm increments;<br>1621 channels reported | Data output in 1nm increments;<br>1621 channels reported            |
| Si Photodiode Detector                  | 512 element Si array<br>(280–1000nm)                                                                            | 512 element Si array<br>(280–1000nm)                     | 512 element Si array<br>(280–1000nm)                                |
| InGaAs Photodiode Detectors (TE-cooled) | 256 element extended wavelength array<br>(970–1900nm)<br>256 element extended wavelength array<br>(1900-2500nm) | 256 element extended wavelength array<br>(970–1900nm)    | 256 element extended wavelength array<br>(970–1900nm)               |
| Suggested FOV Options                   | Right angle diffuser with fiberoptic, integrating sphere                                                        | Right angle diffuser with fiberoptic, integrating sphere | Right angle diffuser with internal phototrigger, integrating sphere |
| Calibration                             | Factory calibrated to NIST traceable irradiance source                                                          | Factory calibrated to NIST traceable irradiance source   | Factory calibrated to NIST traceable irradiance source              |
| Integration Time                        | 1 -1000 ms                                                                                                      | 1-1000 ms                                                | 1-50 ms                                                             |
| Wavelength Reproducibility              | 0.1nm                                                                                                           | 0.1nm                                                    | 0.1nm                                                               |
| Wavelength Accuracy                     | ±0.5 bandwidth                                                                                                  | ±0.5 bandwidth                                           | ±0.5 bandwidth                                                      |
| Communications interface                | USB or Class I Bluetooth – laptop or PDA compatible                                                             | USB or Class I Bluetooth – laptop or PDA compatible      | USB or Class I Bluetooth – laptop or PDA compatible                 |
| Size                                    | 8.5" x 11" x 3.5"                                                                                               | 8.5" x 11" x 3.5"                                        | 8.5" x 11" x 3.5"                                                   |
| A/D Converter                           | 16 bit                                                                                                          | 16 bit                                                   | 16 bit                                                              |
| Weight                                  | 7.5 lbs                                                                                                         | 7.5 lbs                                                  | 7.5lbs                                                              |
| Power                                   | 7.5V, 23W                                                                                                       | 7.5V, 18W                                                | 7.5V, 15W                                                           |
| Spectral Match                          | AM0, AM1.5, AM 1.5 global tilt                                                                                  | AM0, AM1.5, AM15 global tilt                             | AM0, AM1.5, AM 1.5 global tilt                                      |
| TTL                                     | Yes                                                                                                             | Yes                                                      | Yes                                                                 |
| Phototriggering                         | No                                                                                                              | No                                                       | Yes                                                                 |



Classifying Continuous and Pulsed Solar Simulators with Portable Spectroradiometers



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# Test solar simulators for spectral match, uniformity, and stability

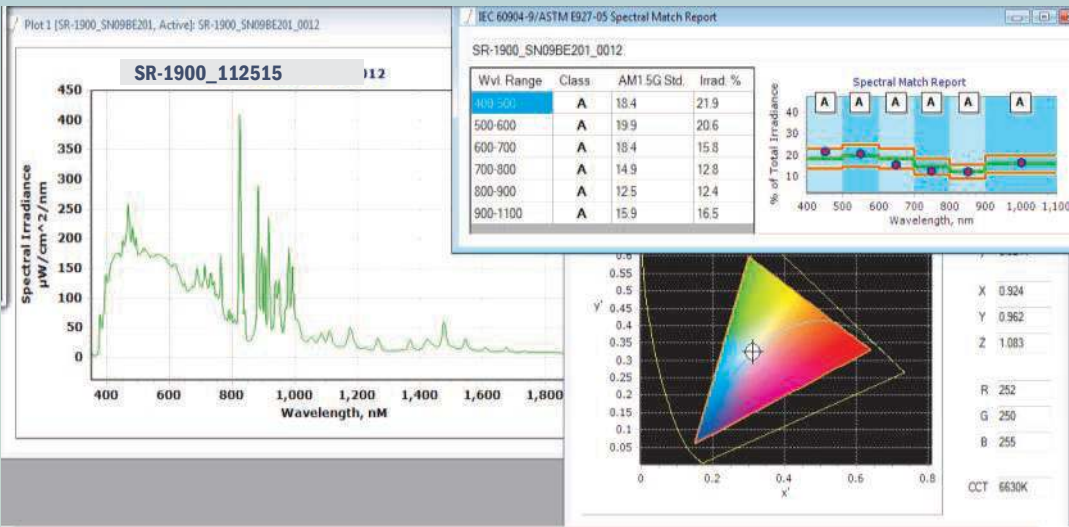
## Continuous

Spectral Evolution spectroradiometers provide accurate, affordable solar simulator measurement for validating the classification of any commercial continuous or pulsed solar simulators.

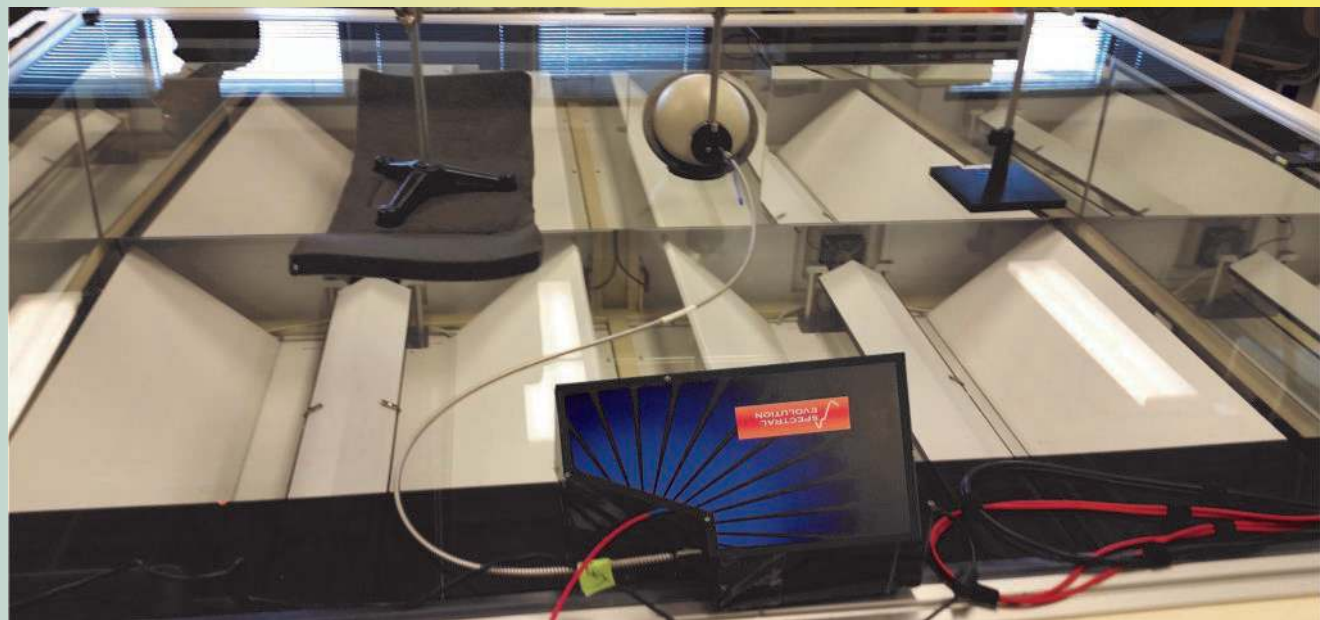
Solar simulators are used by PV module and solar panel manufacturers to ensure that their products deliver the promised power and performance over an extended period of time—often 25 years. Uncertainty or error in power and performance ratings can have an impact on a manufacturers profit. To ensure that they are providing accurate ratings, solar manufacturers use solar simulators to test cells, modules and panels by reproducing outdoor operating conditions in natural sunlight. Solar simulators can be either continuous (steady-state) or pulsed (short or long pulsed).

For continuous solar simulators — the SR-3501 and SR-1901 can collect spectral data using a right angle diffuser and compare the measured light to the Class A, B, and C specifications for spectral match, uniformity, and stability over time. The instruments include a NIST-traceable irradiance calibration to ensure accurate and reproducible measurements. The spectroradiometers measure for the ability of the simulator to meet standards for spectral match, spatial uniformity and temporal stability.

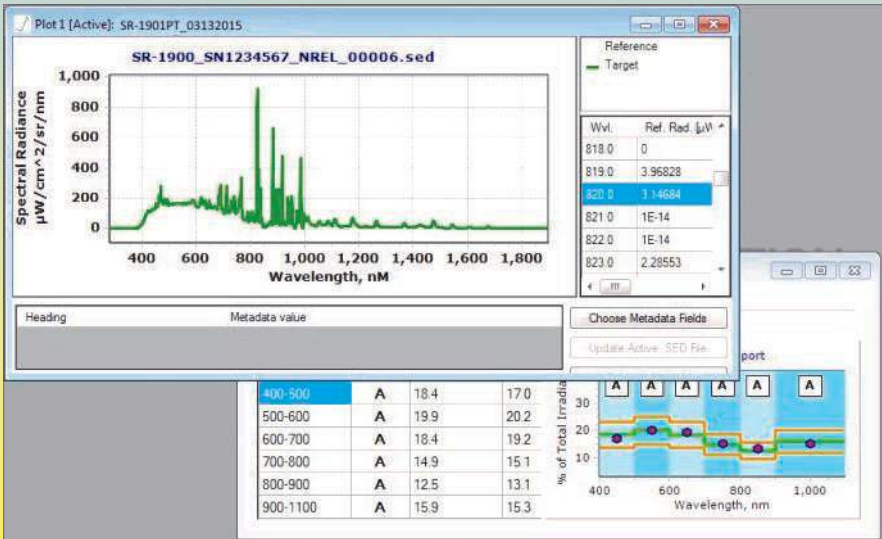
The SR-3501 uses three detectors (1 silicon photodiode array detector and 2 InGaAs array detectors) to cover the spectral range from 280-2500nm. The SR-1901 uses a silicon photodiode array detector and a single InGaAs array detector to cover the spectral range from 280-1900nm.



Our exclusive DARWin SP Data Acquisition software includes pull down menus to access our simulator classification report and CIE color chart. Above, the SR-1901 was used to classify a solar simulator according to IEC60904-9/ASTM E927-05. The software contains subroutines to analyze class performance and create spectral match reports as seen here.



## Pulsed



DARWin SP provides similar capabilities for pulse /flash solar simulators for spectral match reports, uniformity reports, and stability over time reports. Above is an example of a spectral match for the SR-1901PT. Below is a sample report for spectral uniformity that integrates total energy detected over a user-defined wavelength.

The SR-3501 and SR-1901 are designed for use with continuous solar simulators; the SR-1901PT (pictured) is designed for classifying pulsed (sometimes called flash) simulators. Our spectroradiometers can be configured with a straight or right angle diffuser for solar simulator measurement and classification. The SR-1901PT includes a phototriggger sensor integrated into the cosine corrected right angle diffuser.

For pulsed solar simulators, Spectral Evolution offers the revolutionary SR-1901PT. This spectroradiometer is able to classify both long and short pulse solar simulators to IEC and ASTM standards. Pulsed solar simulators apply a flash-type illumination for a short duration. Engineers using pulsed solar simulators to test cells, panels, and modules for spectral match, uniformity, and stability over time, like pulsed simulators because they are accurate, faster, and have less impact on the module/panel being tested. It's also easier to fit the testing into a production process.

The SR-1901PT measures spectral match to ensure that the simulator is outputting the equivalent of natural sunlight to established standards. They measure uniformity to ensure that the simulator is providing the amount of light it promises over the entire area it covers. It measures stability to ensure that the amount of light provided is constant over time.

Equipped (like all Spectral Evolution instruments) with our DARWin SP Data Acquisition software, the SR-1901PT can produce a spectral match report showing system classification, a spectral uniformity report including an integration utility that allows the user to integrate total energy detected over a user-defined wavelength range, and a spectral stability report. Using this information, a solar simulator can be aligned and corrected with minor adjustments to maximize key benefits.

The SR-1901PT has a spectral range of 280-1900nm. It features adjustable integration and scan averaging time, internal phototriggger with SMA-905 port, 0-100 millisecond trigger delay increment, external TTL triggering input port, and NIST-traceable irradiance calibration.