

# Calibrated Integrating Sphere Sensors

INTEGRATING SPHERE SYSTEM WITH NIST TRACEABLE CALIBRATION



- Integrating spheres are calibrated and traceable to NIST standards
- Smallest calibration uncertainty specification in market
- Maximum power measurement up to 10 watts and higher
- Wavelengths covered 200 - 1650 nm

Newport's NIST traceable, calibrated integrating sphere detectors consist of the 819C and 819D series spheres, configured to measure diverging or collimated light sources, respectively. Calibrated integrating sphere detectors are available with a Si, UV-enhanced Si or an InGaAs sensor. The available sphere sizes are 2", 3.3" or 5.3" diameters.

The spheres with a silicon photodiode are suitable for measurements ranging from 400 – 1100 nm, while the models with an InGaAs detector are suitable for approximately 800 – 1650 nm range. The UV version is optimized for wavelengths between approximately 200 - 400 nm, even though it is calibrated up to 1100 nm. All the spheres come with an SMA fiber optic connector on the North pole as a standard feature, allowing a small amount of light pickoff for wavelength measurement or any further analysis without affecting the overall system calibration.

To maintain accuracy and guarantee performance Newport recommends annual integrating sphere detector calibration. Newport offers calibration services including the new Z540.3 compliant calibration.

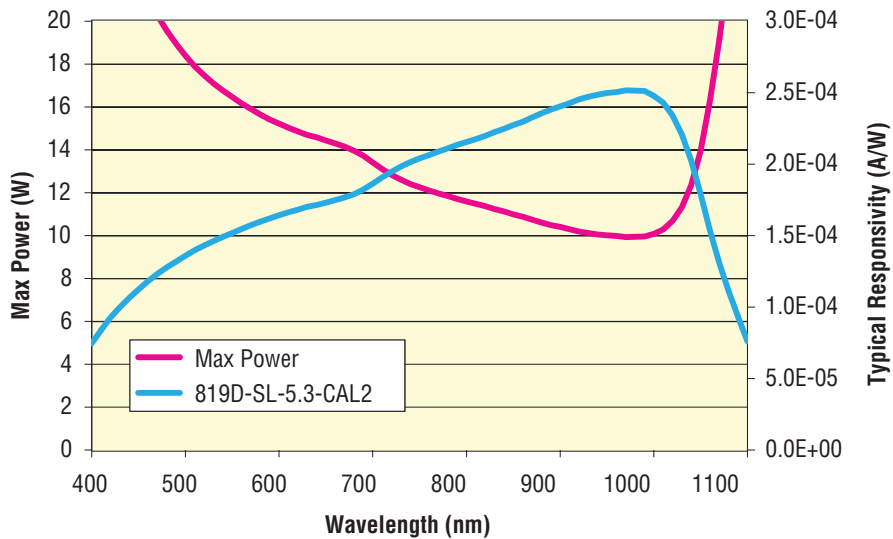
Note that the system calibration is no longer valid if any component is changed from the original calibrated configuration. For a very high power level, elevated temperature of the integrating sphere system can affect the measurement accuracy, so the sphere must be properly cooled. Check with Newport for the complete list of integrating sphere detectors.

**NEW** Now available are UV (down to 200 nm) calibrated integrating sphere detector models and high power silicon based sphere detectors that can handle up to 10 watts of optical power! -CAL2 models feature a built-in temperature sensor and OD1 attenuator sensor. When connected to power meter models 1830-R, 1918-R, 1936-R, or 2936-R, they will automatically recognize the attenuator On/Off position and the detector head temperature.

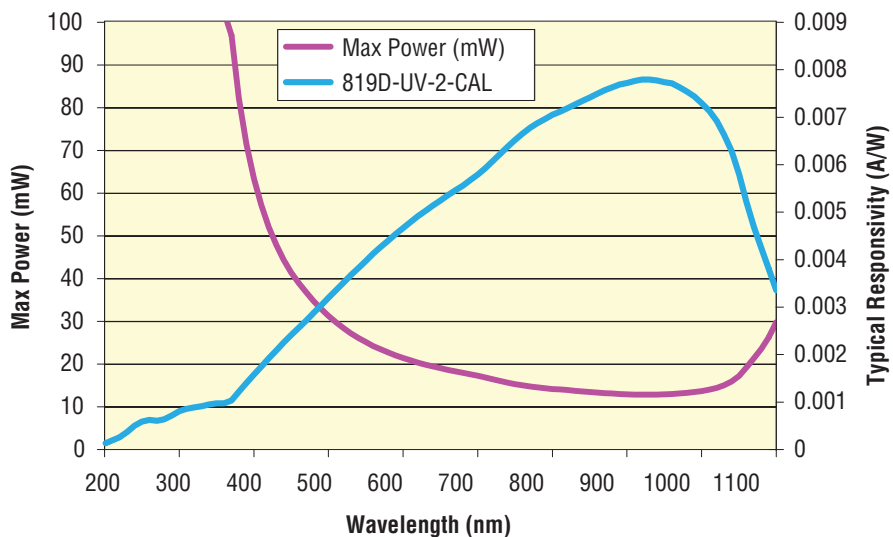
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## Maximum Power Calculation

One key specification in calculating the maximum power handling capability is the detector saturation current. Typical values of a UV silicon, a Si, and a InGaAs photodiode are approximately 100  $\mu$ A, 2.5 mA, and 10 mA, respectively. Dividing the detector responsivity, R, by the saturation current density will result in the saturation power. Since the detector responsivity is wavelength dependent, so is the saturation power level, as shown in the plot. When the responsivity is the maximum, the maximum power before saturation is the lowest. Also make sure to have a proper heat sink to the sphere for the most accurate measurement, when working with a high power light source.



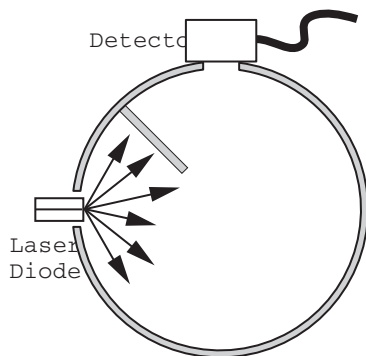
Plot of the maximum power (red) and the typical responsivity (blue), as a function of wavelength, of Model 819D-SL-5.3-CAL2.



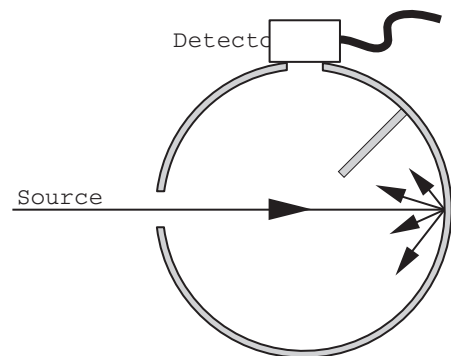
Plot of the maximum power (red) and the typical responsivity (blue), as a function of wavelength, of Model 819C-UV-2-CAL.

## Divergent vs. Collimating Beam Input Considerations

One of the major advantages of using an integrating sphere is to diffuse the input beam so that the detector readings are insensitive to errors caused by detector positioning or problems associated with overfilling, or saturation of the active area of the detector. The detector should see a completely diffused input field. Then, a key technical consideration, when deciding which configuration one has to choose, is whether the input beam will directly hit the detector, influencing the optical power at the detector. For this purpose, each integrating sphere includes a baffle.



819D integrating sphere configuration is ideal for divergent beam source such as an output beam from a laser diode.



819C integrating sphere configuration is ideal for a collimated beam source such as a collimated laser beam.



The 1830-R is an ideal meter for use with our integrating sphere sensors.

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## SPECIFICATIONS

Model	Spectral Range	Calibration Uncertainty	Power Range	Sphere Size	Input Port Size	Detector Type
819C-UV-2-CAL	200 to 1100 nm	4% @ 200-250 nm 2.5% @ 251 - 950 nm 5% 951 - 1100 nm	100 nW - 100 mW @ 350 nm	2 in.	0.5 in.	UV-enhanced Silicon
819C-UV-5.3-CAL	220 to 1100 nm	3% @ 220-829 nm 3.5% @ 830 - 959 nm 3% 960 - 1100 nm	100 nW - 500 mW @ 350 nm	5.3 in.	1.0 in.	
819C-SL-2-CAL2		2.5% @ 400 - 1000 nm 3% 1001 - 1100 nm	100 nW - 2.0 W	2 in.	0.5 in.	Silicon
819C-SL-3.3-CAL	400 to 1100 nm	1.5% @ 400-550 nm 1% @ 551 - 950 nm 1.5% 951 - 1010 nm 3% 1011 - 1100 nm	100 nW - 170 mW	3.3 in.	1.0 in.	Silicon
819C-SL-5.3-CAL2		2.5% @ 400 - 1000 nm 3% 1001 - 1100 nm	100 nW - 4.0 W	5.3 in.	1.0 in.	Silicon
819C-IG-2-CAL	800 to 1650 nm	5% @ 800-910 nm 2% @ 911-1650 nm	100 nW - 1.5 W	2 in.	0.5 in.	InGaAs
819C-IG-3.3-CAL	910 to 1650 nm	5% @ 910-950 nm 2% @ 951-1650 nm	100 nW - 3.5 W	3.3 in.	1.0 in.	InGaAs
819C-IG-5.3-CAL	860 to 1650 nm	5% @ 860-920 nm 2% @ 921-1650 nm	1 $\mu$ W - 4.5 W	5.3 in.	1.0 in.	InGaAs
819D-UV-2-CAL	200 to 1100 nm	4% @ 200-250 nm 2.5% @ 251 - 950 nm 5% 951 - 1100 nm	100 nW - 100 mW @ 350 nm	2 in.	0.5 in.	UV-enhanced Silicon
819D-UV-5.3-CAL	220 to 1100 nm	3% @ 220-829 nm 3.5% @ 830 - 959 nm 3% 960 - 1100 nm	100 nW - 500 mW @ 350 nm	5.3 in.	0.5 in.	
819D-SL-2-CAL2		2.5% @ 400 - 1000 nm 3% 1001 - 1100 nm	100 nW - 2.0 W	2 in.		
819D-SL-3.3-CAL	400 to 1100 nm	1.5% @ 400-440 nm 1% @ 441 - 950 nm 1.5% 951 - 1000 nm 3% 1001 - 1100 nm	100 nW - 180 mW	3.3 in.		Silicon
819D-SL-5.3-CAL2		2.5% @ 400 - 1000 nm 3% 1001 - 1100 nm	100 nW - 10.0 W	5.3 in.	0.5 in.	
819D-IG-2-CAL	910 to 1650 nm	5% @ 910-960 nm 2% @ 961-1650 nm	100 nW - 2.5 W	2 in.		
819D-IG-3.3-CAL	910 to 1650 nm	5% @ 910-950 nm 2% @ 951-1650 nm	100 nW - 4.0 W	3.3 in.		InGaAs
819D-IG-5.3-CAL	930 to 1650 nm	5% @ 930-950 nm 2% @ 951-1650 nm	1 $\mu$ W - 9.0 W	5.3 in.		



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