

Calibrated Integrating Sphere Sensors

For Divergent Input Beams



Newport NIST traceable, calibrated integrating sphere detectors consist of the 819C and 819D series spheres, configured to measure diverging or collimated light sources, respectively. A Si, UV-enhanced Si or an InGaAs sensor are used. The available sphere sizes are between 2" and 5.3" sphere sizes. In this datasheet we will discuss the 819D series spheres for divergent input beams.

CAL2 models feature a built-in temperature sensor and OD1 attenuator sensor. When connected to power meter models 1938-R, 2938-R, 1919-R, 843-R/843-R-USB, 845-PE-RS, 844-PE-USB, they will automatically recognize the attenuator On/Off position and the detector head temperature.

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.

Note that the system calibration is no longer valid if any component is changed from the original calibrated configuration.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.



Features and Benefits

- 819D series spheres for divergent input beams
- 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

Calibrated Integrating Sphere Sensors for Diverging Input Beams

Specifications

IS Photodiode Sensors for Diverging Input Beams

No	Model	Spectral Range	Sphere Size	Power Range	Maximum Measurable Power	Input Port Size	Linearity with Power	Detector Type	Calibration Uncertainty Filter Out	Calibration Uncertainty Filter In
1	819D-UV-2-CALV2	200-1100 nm	2 inch	1nW to 0.45W	0.45W	0.5 Inch	±1 %	UV-enhanced silicon	200 to 300nm 3.2%	NA
									300 to 430nm 1.65%	
									430 to 1000nm 1.1%	
									1035 to 1065nm 4.3%	
2	819D-UV-5.3-CAL	200-1100 nm	5.3 inch	150nW to 3W	3W	0.5 Inch	±1 %	UV-enhanced silicon	200 to 300nm 3.2%	NA
									300 to 430nm 1.65%	
									430 to 1000nm 1.1%	
									1035 to 1065nm 4.3%	
3	819D-SL-2-CAL2V2	400-1100 nm	2 inch	10nW to 2.5W	2.5W	0.5 Inch	±1 %	Silicon	400 to 430nm 1.65%	400 to 430nm 1.65%
									430 to 1000nm 1.1%	430 to 1000nm 1.1%
									1035 to 1065nm 4.3%	1035 to 1065nm 4.3%
4	819D-SL-3.3-CAL2	400-1100 nm	3.3 inch	10nW to 4W	4W	0.5 Inch	±1 %	Silicon	400 to 430nm 1.65%	400 to 430nm 1.65%
									430 to 1000nm 1.1%	430 to 1000nm 1.1%
									1035 to 1065nm 4.3%	1035 to 1065nm 4.3%
5	819D-SL-5.3-CAL2	400-1100 nm	5.3 inch	150nW to 7.5W	7.5W	0.5 Inch	±1 %	Silicon	400 to 430nm 1.65%	400 to 430nm 1.65%
									430 to 1000nm 1.1%	430 to 1000nm 1.1%
									1035 to 1065nm 4.3%	1035 to 1065nm 4.3%
6	819D-IG-2-CAL2	800-1650 nm	2 inch	5nW to 7W	7W	0.5 Inch	±1 %	InGaAs	900 to 1430nm 2.4%	900 to 1430nm 2.4%
									1430 to 1600nm 2.6%	1430 to 1600nm 2.6%
7	819D-IG-3.3-CAL2	800-1650 nm	3.3 inch	10nW to 15W	15W	0.5 Inch	±1 %	InGaAs	900 to 1430nm 2.4%	900 to 1430nm 2.4%
									1430 to 1600nm 2.6%	1430 to 1600nm 2.6%
8	819D-IG-5.3-CAL2	800-1650 nm	5.3 inch	150nW to 30W	30W	0.5 Inch	±1 %	InGaAs	900 to 1430nm 2.4%	900 to 1430nm 2.4%
									1430 to 1600nm 2.6%	1430 to 1600nm 2.6%

IS Photodiode Sensors for Diverging Input Beams (continuation #1)

No	Model	Max. Power (W) vs Wavelength (nm) Responsivity (Ma/w) with Attenuator 1938/2938	Max. Power (W) vs Wavelength (nm) Responsivity (Ma/w) with Attenuator 1936/2936	Max. Power (W) vs Wavelength (nm) Responsivity (Ma/w) with Attenuator 1919-R/843- R/844-PE-USB	Max. Power (W) vs Wavelength (nm) Responsivity (Ma/w) with Attenuator 845-PE-RS	Max. Power (W) vs Wavelength (nm) Responsivity (Ma/w) without Attenuator 1938/2938	Max. Power (W) vs Wavelength (nm) Responsivity (Ma/w) without Attenuator 1936/2936	Max. Power (W) vs Wavelength (nm) Responsivity (Ma/w) without Attenuator 1919-R/843- R/844-PE-USB	Max. Power (W) vs Wavelength (nm) Responsivity (Ma/w) without Attenuator 845-PE-RS
1	819D-UV-2-CALV2	NA	NA	NA	NA	200-400 0.45W	200-400 0.45W	200-400 0.35W	200-400 0.45W
						401-1050 0.1W	401-1050 0.1W	401-1050 0.08W	401-1050 0.1W
						1051-1100 0.15W	1051-1100 0.15W	1051-1100 0.13W	1051-1100 0.15W
2	819D-UV-5.3-CAL	NA	NA	NA	NA	200-400 3W	200-400 3W	200-400 2.5W	200-400 3W
						401-1000 0.9W	401-1000 0.9W	401-1000 0.8W	401-1000 0.9W
						>1050 1.5W	>1050 1.5W	>1050 1.5W	>1050 1.5W
3	819-SL-2-CAL2V2	400-750 2W	400-750 2W	400-750 1.5W	400-750 2W	400-750 0.3W	400-750 0.3W	400-750 0.25	400-750 0.3W
		751-1100 1.3W	751-1100 1.3W	751-1100 1W	751-1100 1.3W	751-1100 0.2W	751-1100 0.2W	751-1100 0.15W	751-1100 0.2W
4	819D-SL-3.3-CAL2	400-700 4W	400-700 4W	400-700 3.5W	400-700 4W	400-700 0.45W	400-700 0.45W	400-700 0.35W	400-700 0.45W
		701-1100 2W	701-1100 2W	701-1100 2W	701-1100 2W	701-1100 0.25W	701-1100 0.25W	701-1100 0.22W	701-1100 0.25W
5	819D-SL-5.3-CAL2	400-750 7.5W	400-750 7.5W	400-750 4.5W	400-750 7.5W	400-750 0.8W	400-750 0.8W	400-750 0.3W	400-750 0.8W
		751-1100 6W	751-1100 6W	751-1100 2.5W	751-1100 6W	751-1100 0.6W	751-1100 0.6W	751-1100 0.2W	751-1100 0.6W
6	819D-IG-2-CAL2	800-1000 7W	800-1000 7W	800-1000 1.4W	800-1000 4W	800-1000 1W	800-1000 1W	800-1000 0.5W	800-1000 1W
		1001-1650 3.5	1001-1650 3.5	1001-1650 0.7	1001-1650 2W	1001-1650 5W	1001-1650 5W	1001-1650 0.25W	1001-1650 0.5W
7	819D-IG-3.3-CAL2	800-1050 15W	800-1050 15W	800-1050 15W	800-1050 15W	800-1050 3W	800-1050 3W	800-1050 1W	800-1050 3W
		1051-1200 11W	1051-1200 11W	1051-1200 11W	1051-1200 11W	1051-1200 2.5W	1051-1200 2.5W	1051-1200 0.8W	1051-1200 2.5W
		1201-1650 9W	1201-1650 9W	1201-1650 9W	1201-1650 9W	1201-1650 1.8W	1201-1650 1.8W	1201-1650 0.6W	1201-1650 1.8W
8	819D-IG-5.3-CAL2	800-950 30W	800-950 30W	800-950 20W	800-950 30W	800-950 5W	800-950 5W	800-950 3W	800-950 5W
		951-1100 20W	951-1100 20W	951-1100 15W	951-1100 20W	951-1650 2W	951-1650 2W	951-1650 1.5W	951-1650 2W
		1101-1650 14W	1101-1650 14W	1101-1650 10W	1101-1650 14W				

IS Photodiode Sensors for Diverging Input Beams (continuation #2)

No	Model	Power Range 1938/ 2938	Power Range 1936/ 2936	Power Range 1919-R/ 843-R/ 844-PE-USB	Power Range 845-PE-RS	Maximum Beam Divergence deg°	Sensitivity to Beam Divergence ±%	Power Noise Level 1938/2938	Power Noise Level 1936/2936	Maximum Pulse Energy With / Without Attenuator	Accuracy vs Wavelength	Compliance
1	819D-UV-2-CALV2	1nW-0.45W	1nW-0.45W	1nW-0.35W	1nW-0.45W	<30°	1.5%	0.05nW	0.05nW	Without Attenuator = 150nJ	200 - 270 ±10%	CE, UKCA, China RoHS
											271 - 980 ±5%	
											981 - 1100 ±7	
2	819D-UV-5.3-CAL	150nW-3W	150nW-3W	150nW-2.5W	150nW-3W	<30° <50°	1.5% 3.0%	7.5nW	7.5nW	Without Attenuator = 200nJ	200 - 270 ±10%	CE, UKCA, China RoHS
											271 - 980 ±5%	
											981 - 1100 ±7	
3	819D-SL-2-CAL2V2	10nW-2.5W	10nW-2.5W	10nW-2W	10nW-5W	<20°	1.5%	0.5nW	0.5nW	With Attenuator = 4μJ, Without Attenuator = 400nJ	400 - 1000 ±5%	CE, UKCA, China RoHS
											1001 - 1100 ±7%	
4	819D-SL-3.3-CAL2	10nW-4W	10nW-4W	10nW-3.5W	10nW-4W	<20°	1.5%	0.5nW	0.5nW	With Attenuator = 6μJ, Without Attenuator = 600nJ	400 - 1000 ±5%	CE, UKCA, China RoHS
											1001 - 1100 ±7%	
5	819D-SL-5.3-CAL2	150nW-7.5W	150nW-7.5W	150nW-4.5W	150nW-7.5W	<40° <50°	1.5% 2.0%	7.5nW	7.5nW	With Attenuator = 9μJ, Without Attenuator = 900nJ	400 - 1000 ±5%	CE, UKCA, China RoHS
											1001 - 1100 ±7%	
6	819D-IG-2-CAL2-	200nW-7W	200nW-7W	200nW-1.4W	200nW-4W	<30°	1.5%	10nW	10nW	With Attenuator = 40μJ, Without Attenuator = 4μJ	900 - 1650 ±5%	CE, UKCA, China RoHS
7	819D-IG-3.3-CAL2	10nW-15W	10nW-15W	10nW-15W	10nW-15W	<20°	1.5%	0.5nW	0.5nW	With Attenuator = 60μJ, Without Attenuator = 6μJ	900 - 1650 ±5%	CE, UKCA, China RoHS
8	819D-IG-5.3-CAL2	150nW-30W	150nW-30W	150nW-20W	150nW-30W	<30° <50°	1.5% 2.0%	7.5nW	7.5nW	With Attenuator = 90μJ, Without Attenuator = 9μJ	900 - 1650 ±5%	CE, UKCA, China RoHS

Maximum Power Calculation

One key specification in calculating the maximum power handling capability is the detector saturation current.

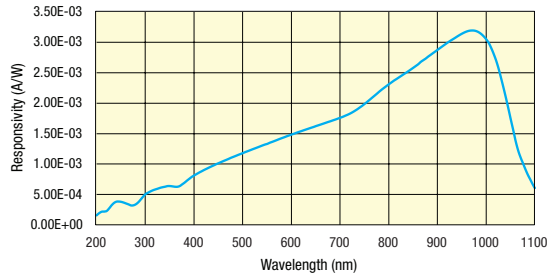
Typical values of a UV silicon, a Si, and a InGaAs photodiode are approximately 100 μA, 2.5 mA, and 10 mA, respectively. Dividing the detector responsivity, R, by the saturation current density will result in the saturation power. Since the detector responsivity is wavelength dependent, so is the saturation 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.

Graphs

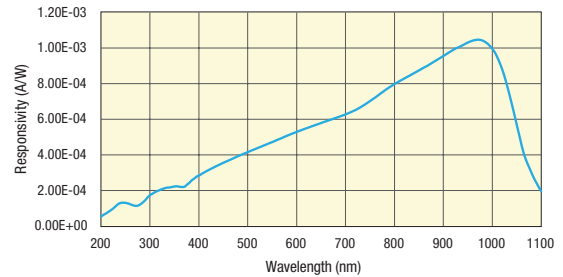
1. 819D-UV-2-CALV2

Responsivity 819D-UV-2-CALV2 - Filter Out



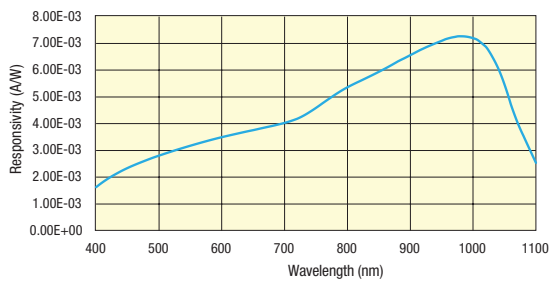
2. 819D-UV-5.3-CAL

Responsivity 819D-UV-5.3-CAL - Filter Out

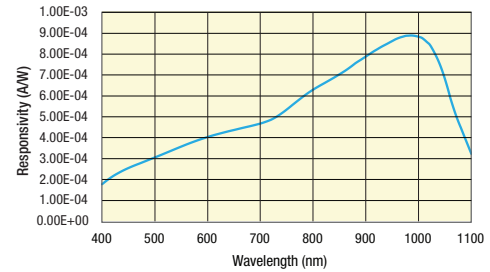


3. 819D-SL-2-CAL2V2

Responsivity 819D-SL-2-CAL2V2 - Filter Out

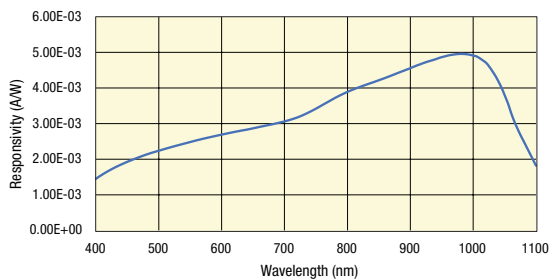


Responsivity 819D-SL-2-CAL2V2 - Filter In

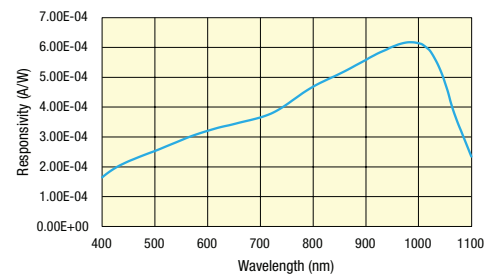


4. 819D-SL-3.3-CAL2

Responsivity 819D-SL-3.3-CAL2 - Filter Out

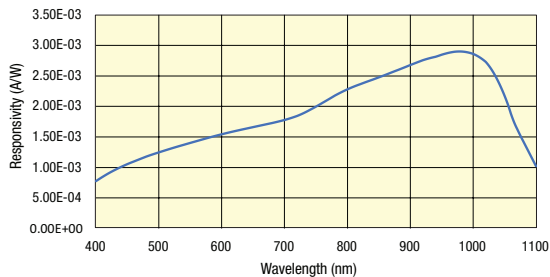


Responsivity 819D-SL-3.3-CAL2 - Filter In

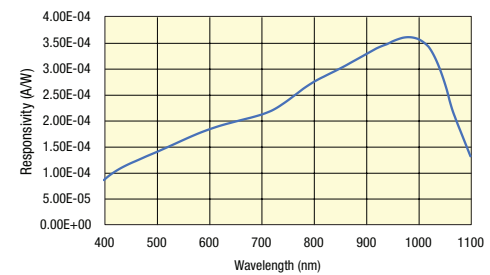


5. 819D-SL-5.3-CAL2

Responsivity 819D-SL-5.3-CAL2 - Filter Out

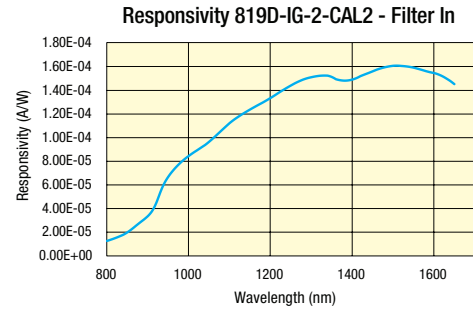
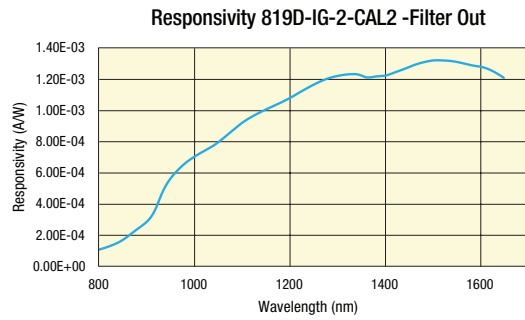


Responsivity 819D-SL-5.3-CAL2 - Filter In

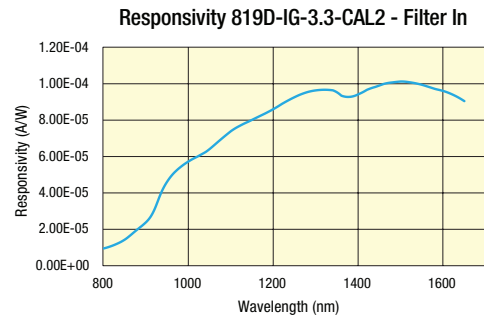
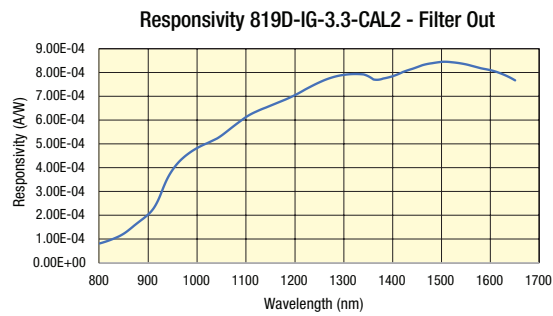


Graphs continued

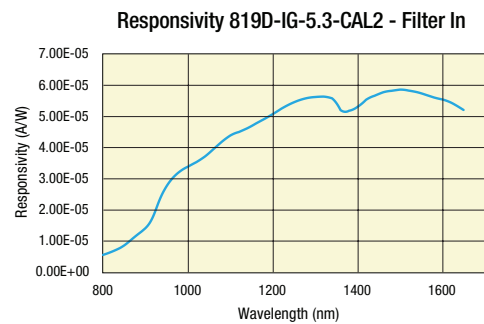
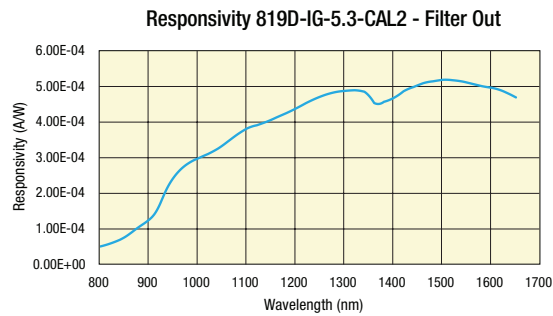
6. 819D-IG-2-CAL2



7. 819D-IG-3.3-CAL2

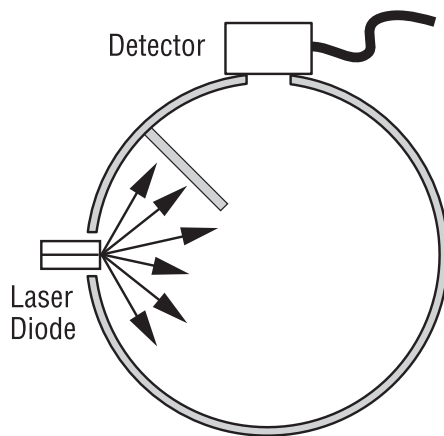


8. 819D-IG-5.3-CAL2

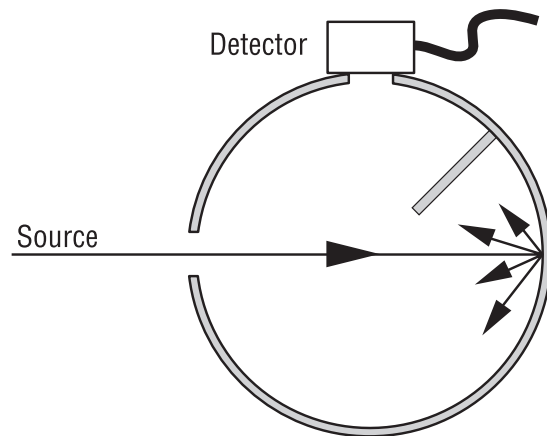


One of the major advantages of using an integrating sphere is to diffuse the input beam so that the detector readings are insensitive to errors caused by detector positioning or problems associated with overfilling, or saturation of the active area of the detector. The detector should see a completely 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.

Ordering Information

819D Divergent Light Sphere Sensors

No.	Model	Description
1	819D-UV-2-CALv2	Integrating sphere detector, diverging beam, 2", 200-1100 nm
2	819D-UV-5.3-CAL	Integrating sphere detector, diverging beam, 5.3", 200-1100 nm
3	819D-SL-2-CAL2V2	Integrating sphere detector for diverging beam, 2", 400-1100 nm
4	819D-SL-3.3-CAL2	Integrating sphere detector, diverging beam, 3.3", 400-1100 nm
5	819D-SL-5.3-CAL2	Integrating sphere detector, diverging beam, 5.3", 400-1100 nm
6	819D-IG-2-CAL2	Integrating sphere detector, diverging beam, 2", 800-1650 nm
7	819D-IG-3.3-CAL2	Integrating sphere detector, diverging beam, 3.3", 800-1650 nm
8	819D-IG-5.3-CAL2	Integrating sphere detector, diverging beam, 5.3", 800-1650 nm