

### 3.3.4.2.1 Phosphor Coated CCD Cameras For NIR Response

#### Features

- 1440-1605nm Wavelengths
- NIR Telecom mode field analysis
- NIR Laser beam analysis

#### Available Models

- USB models: SP907-1550  
SP928-1550
- Large Format: LT665-1550

SP907-1550  
SP928-1550

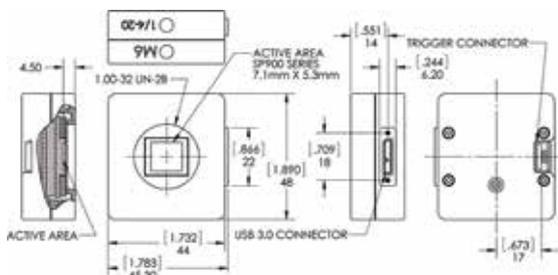


LT665-1550

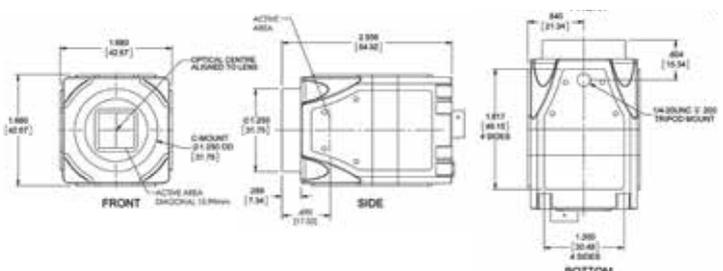


Model	SP907-1550	SP928-1550	LT665-1550
Application	NIR wavelengths, 1/1.8" format, low resolution	NIR wavelengths, 1/1.8" format, low resolution	NIR wavelengths, 1" format, higher resolution
Spectral response	1440 - 1605nm	1440 - 1605nm	1440 - 1605nm
Active area	7.1mm x 5.3mm	7.1mm x 5.3mm	12.5mm x 10mm
Beam sizes	600µm - 5.3mm	600µm - 5.3mm	600µm - 9.9mm
Pixel spacing <sup>(1)</sup>	7.38µm x 7.38µm	3.69µm x 3.69µm	4.54µm x 4.54µm
Number of effective pixels	964 x 724	1928 x 1448	2752 x 2192
Minimum system dynamic range <sup>(2)</sup>	~30 dB	~30 dB	~30 dB
Linearity with power	±5%	±5%	±5%
Accuracy of beam width	±5%	±5%	±5%
Frame rates in 12 bit mode <sup>(3) (5)</sup>	23 fps at full resolution	13 fps at full resolution	27 fps at full resolution
Shutter duration	30µs to multiple frames	30µs to multiple frames	31µs to multiple frames
Gain control	0 dB to 24 dB	0 dB to 24 dB	0.8 dB to 56 dB
Trigger	Supports both trigger and strobe out	Supports both trigger and strobe out	Supports both trigger and strobe out
Photodiode trigger	InGaAs response: SP90409	InGaAs response: SP90409	InGaAs response: SP90409
Saturation intensity <sup>(1)</sup>	7mW/cm <sup>2</sup> at 1550nm		
Lowest measurable signal <sup>(1)</sup>	50µW/cm <sup>2</sup>		
Damage threshold	50W/cm <sup>2</sup> / 0.1J/cm <sup>2</sup> with all filters installed for < 100ns pulse width <sup>(4)</sup>		
Dimensions	48mm x 44mm x 20.2mm	48mm x 44mm x 20.2mm	43mm x 43mm x 65mm
CCD recess	4.5mm	4.5mm	17.5mm
Operation mode	Interline transfer CCD	Interline transfer CCD	Quad Tap interline transfer CCD
PC interface	USB 3.0	USB 3.0	USB 3.0
OS supported	Windows 7 (64) and Windows 10		
<b>Ordering Information</b>			
Supported software	Item	P/N	Item
BeamGage Professional	BGP-USB-SP907-1550-OSI	<b>SP90420</b> <sup>(6)</sup>	BGP-USB-SP928-1550-OSI
BeamGage Standard	BGS-USB-SP907-1550-OSI	<b>SP90419</b> <sup>(6)</sup>	BGS-USB-SP928-1550-OSI
			<b>SP90424</b> <sup>(6)</sup>
			<b>SP90423</b> <sup>(6)</sup>
			BGP-USB3-LT665-1550
			<b>SP90385</b> <sup>(6)</sup>
			BGS-USB3-LT665-1550
			<b>SP90384</b> <sup>(6)</sup>
Notes:	<p>(1) Despite the small pixel size, the spatial resolution will not exceed 50µm due to diffusion of the light by the phosphor coating.</p> <p>(2) Signal to noise ratio is degraded due to the gamma of the phosphor's response. Averaging or summing of up to 256 frames improves dynamic range by up to 16x = +24 dB.</p> <p>(3) In normal (non-shuttered) camera operation, the frame rate is the fastest rate at which the laser may pulse and the camera can still separate one pulse from the next. With electronic shutter operation, higher rate laser pulses can be split out by matching the laser repetition to the shutter speed.</p> <p>(4) This is the damage threshold of the filter glass of the filters. Assuming all filters mounted with ND1 (red housing) filter in the front. Distortion of the beam may occur with average power densities as low as 5W/cm<sup>2</sup>.</p> <p>(5) Comes with USB 3.0 cable, Trigger cable and 3 ND filters.</p> <p>(6) Comes with USB 3.0 cable, Power with Trigger cable and 3 ND filters.</p>		

SP907/SP928 - 1550



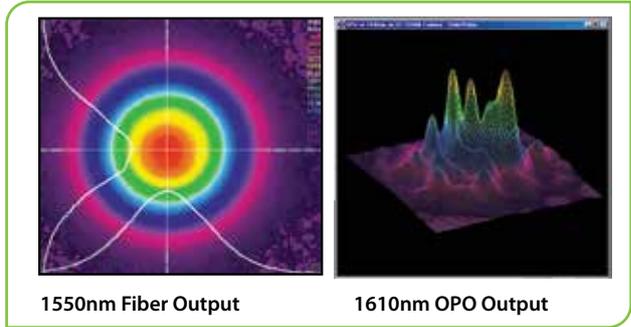
LT665 - 1550



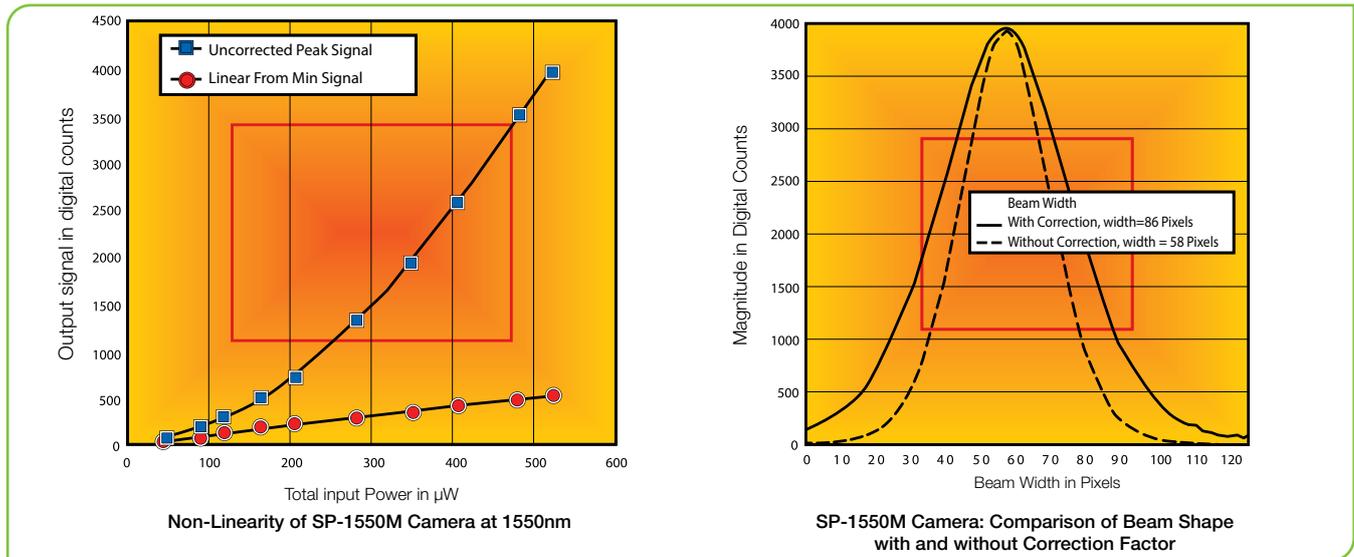
### 3.3.4.2 1440-1605nm Cameras

#### Phosphor Coating Technology

The up-conversion from NIR to visible light in the 1550 series cameras is nonlinear. The anti-Stokes phosphor coating produces visible photons at a rate roughly the square of the input signal. This is shown dramatically where the camera total output increases dramatically faster than a linear output shown in the bottom line. The CCD camera saturation in the center of a beam, the up-converted visible signal drops as the square of the input signal. Thus the lower signal wings of a beam are suppressed, resulting in the appearance and measurement of a beam width much smaller than actual.

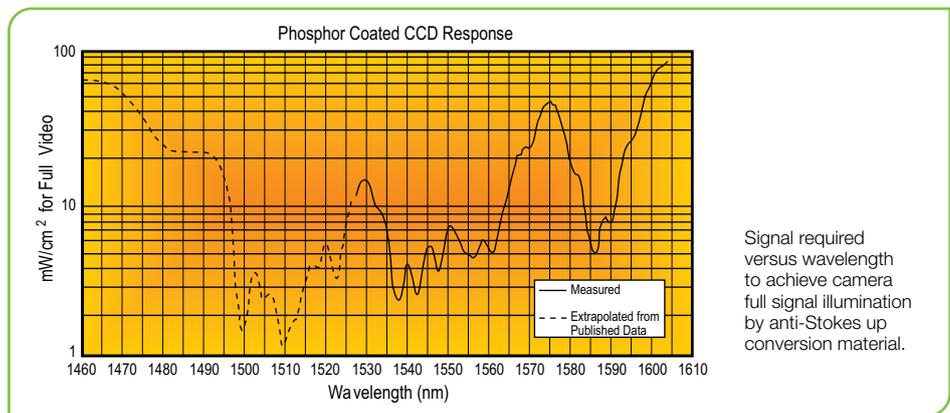


This illustration is a comparison of the cross-section of a beam with and without correction. As seen, the real width of the beam is much greater than would be observed without correction.



#### Wavelength Response

The anti-Stokes up-conversion efficiency is very wavelength dependent. This graph shows the typical spectral response curve of a new, high response coating. As seen, we have calibrated the response from 1527nm to 1605nm. We have extrapolated the shorter wavelength region by comparing our measured response to data published over the entire range.



#### Phosphor Coated Cameras with Spiricon's BeamGage software

Spiricon's engineers have carefully measured the non-linearity of the signal generated by the Phosphor Coated series cameras. The software in the BeamGage incorporates an algorithm to correct for the non-linearity. This illustration shows the linearity obtained, showing in the top line that the low level signals drop linearly, rather than at the square of the input, seen in the lower line. The two photos show the uncorrected and corrected camera beam shape in 3D. See the BeamGage section for additional information on the beam analyzer.

