3.2.3.4 1440-1605nm Phosphor Coated CCD Cameras For NIR Response

Features

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

Available Models

- USB models: SP503U-1550
  SP620U-1550
- Firewire models: GRAS20-1550
- Analog Camera: SP-1550M

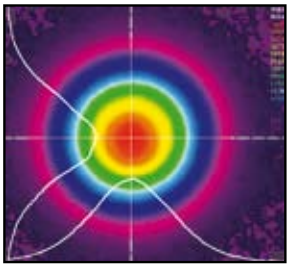
GRAS20-1550

SP503U-1550
SP620U-1550

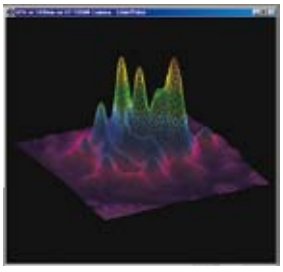
SP-1550

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.



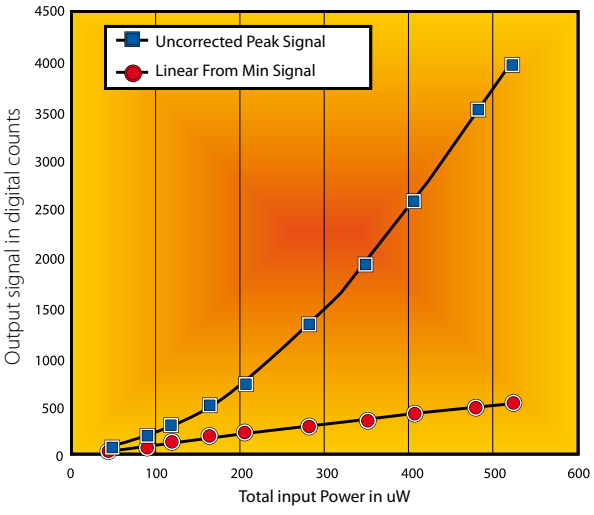
1550nm Fiber Output



1610nm OPO Output

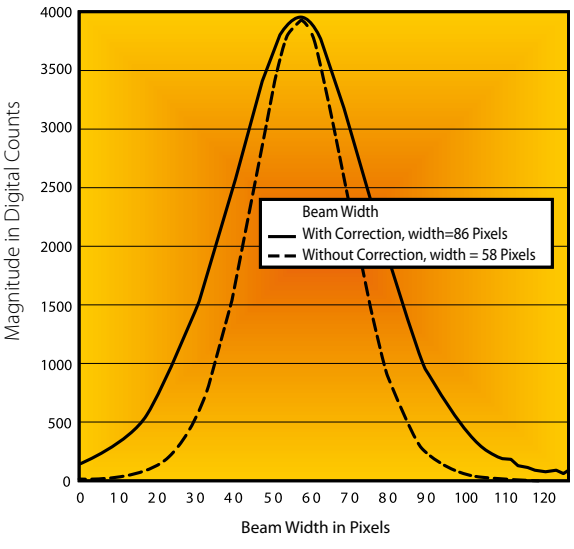
This illustration is a comparison of the cross-section of a beam with and without correction. As seen, the real width of the beam is much greater than would be observed without correction.

Non-Linearity of SP-1550M Camera at 1550nm



Non-linear output of the 1550 series cameras.

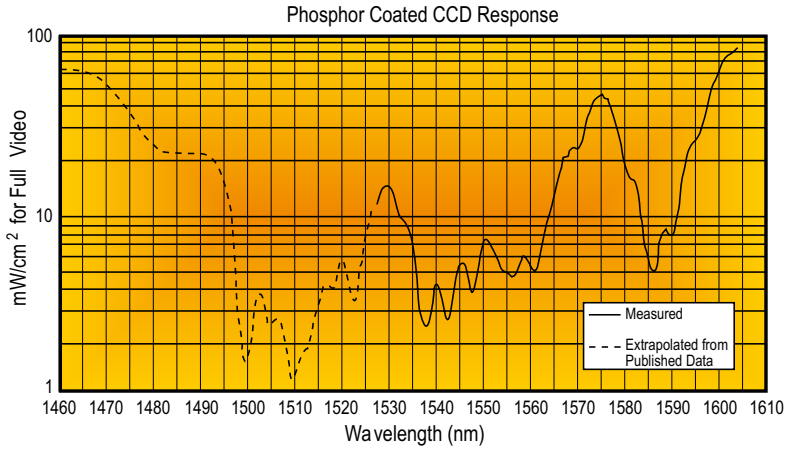
SP-1550M Camera: Comparison of Beam Shape with and without Correction Factor



Cross-section of a fiber beam with and without non-linearity 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.

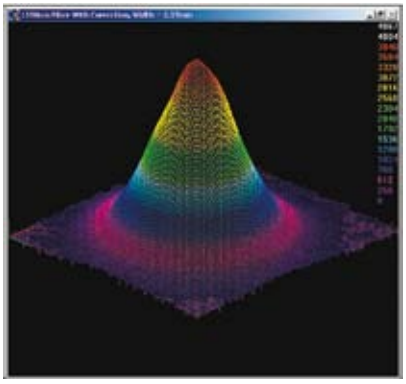


Signal required versus wavelength to achieve camera full signal illumination by anti-Stokes up conversion material.

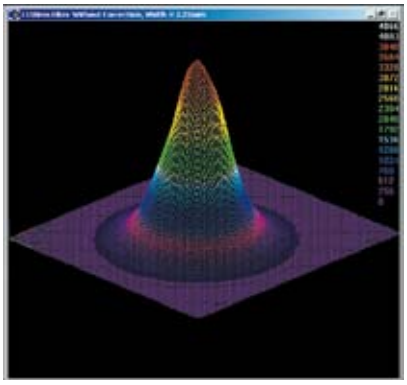
Phosphor Coated Cameras with Spiricon's BeamGage software

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.

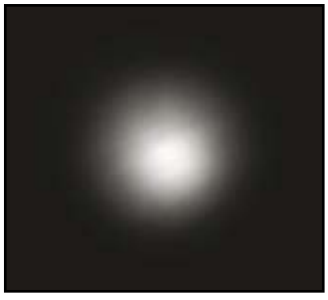
The two photos show the uncorrected and corrected camera beam shape in 3D. See the BeamGage section for additional information on the beam analyzer.



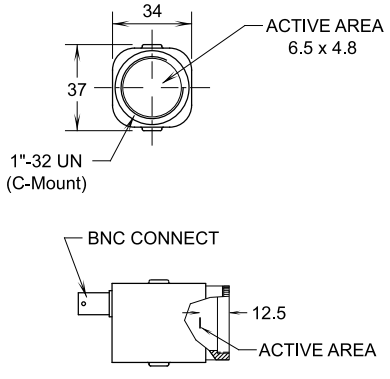
Beam profile of a fiber beam with non-linearity correction.



Beam profile of a fiber beam without non-linearity correction.



SP-1550M; RS-170 monitor display when used without a frame grabber.



Specifications: Phosphor Coated For NIR Response

Model	SP503U-1550	SP620U-1550	GRAS20-1550	SP-1550M
Application	NIR wavelengths, ½" format, low resolution	NIR wavelengths, 1/1.8" format, low resolution, adjustable ROI and binning	NIR wavelengths, 1/1.8" format, adjustable ROI	NIR wavelengths, ½" format
Spectral Response	1440 - 1605nm	1440 - 1605nm	1440 - 1605nm	1440 - 1605nm
Maximum beam size	6.3mm W x 4.7mm H	7.1mm W x 5.4mm H	7.1mm x 5.4mm	4.7mm x 5.4mm
Pixel spacing (1)	9.9µm x 9.9µm	4.4µm x 4.4µm	4.4µm x 4.4µm	8.4µm x 9.8µm
Number of effective pixels	640 x 480	1600 x 1200	1600 x 1200	640 x 480 pixels
Minimum system dynamic range (2)	~30 dB	~30 dB	~30dB	~30dB
Linearity with Power	±5%	±5%	±5%	±5%
Spatial Uniformity	±5%	±5%	±5%	±5%
Accuracy of beam width	±5% for beams larger than 0.6 mm			
Frame rates In 12 bit mode (3)	30 fps at full resolution 60 fps at 320x240	8 fps at full resolution 28 fps at 640x480 44 fps at 320x240	15Hz full res >60Hz with smaller ROI (3)	30 Hz
Shutter duration	30µs to multiple frame times			1/60 to 1/100,000 sec, 9 steps
Gain control	43:1 manual	29:1 manual	0db to 25db Manual control	Manual adjustment
Trigger	Supports both Trigger In and Strobe Out			N/A
Photodiode trigger	Consult Factory		N/A (consult factory)	N/A
Saturation intensity	7mW/cm² at 1550 nm			
Lowest measurable signal	~ 50µW/cm²			
Damage threshold	50W/cm²/0.1J/cm² with all filters installed for <100ns pulse width(4)		70 mW/cm² at 1550 nm	70 mW/cm² at 1550 nm
Dimensions and CCD recess	96X76X16mm; 4.5mm below surface	96X76X28mm; 4.5mm below surface	20mm x 44mm x 58mm Fixed C-mount	37mm x 34mm x 56mm CCD recess from surface 12.5mm, Adjustable
Operation mode	Interline transfer progressive scan CCD		Interline transfer progressive scan CCD	Interline Transfer interlaced CCD
Software supported	BeamGage		BeamGage	
PC interface	USB 2.0		IEEE 1394b	
Host system requirements			IEEE 1394 port or PCI-Express or CardBus Slot	

Notes:

(1) Despite the small pixel size, the spatial resolution will not exceed 50µm due to diffusion of the light by the phosphor coating.
(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 = +24dB.
(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.
(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/cm².