3.8 High-Power Applications

3.8.1 High-Power NanoScan

Photon's High-Power NanoScan can measure focused CO_2 laser beams up to 5 kilowatts. The High-Power NanoScan is equipped with a pyroelectric detector with nickel \ gold slits and drum. A cooling fan mounted on the scan head body provides additional heat management. With the new "peak connect" algorithm and the software controlled variable scan speed, the High-Power NanoScan is ideal for measuring lasers operating with pulse width modulation (PWM) power control. Measurement of Q-switched lasers and other higher frequency pulsed lasers is also possible using this feature.

What Can be Measured?

Photon's High-Power NanoScan is designed to measure "high-power" laser beams that were previously impossible to measure with standard NanoScan products. High-Power is a fairly indistinct term that means different things in different contexts. For our purposes, "high-power" is defined as between 100W and 5000W, however the High- Power NanoScan will not be able to measure this power range for all wavelengths. High-Power laser beams are handled by using reflective materials, and the level of reflectivity, and thus its inverse, absorption, are dependent on the wavelength of the laser light.

In general the long infrared wavelengths, such as that of the carbon dioxide laser at 10.6microns, are highly reflective. These allow for the highest power measurements up to the maximum levels of several kilowatts. When measuring these lasers and power levels the principle concern is the heat buildup in the scan head. The surfaces of the measurement drum and slits are better than 98% reflective to this wavelength, and thus only 2% of the incident power will be absorbed by the scanhead and heat it up. Nonetheless, at 5000W this represents a heat load of 100W that will raise the temperature of the internal components, which may cause damage to the detector and encoder electronics. The High-Power NanoScan is designed to be used for short-term measurements at these power levels. The beam should only be incident on the scan head for a few seconds. The software is equipped with a record mode that makes it easy to make a short measurement and then review the data while the scanhead is allowed to cool down.

Measuring high-power beams can be tricky. The lasers have the potential to damage the scan head, and any reflected light can be dangerous to both the operator and the surroundings. The High-Power NanoScan can measure these beams because it uses a combination of highly reflective components with high thermal dissipation capability. It is important to manage the reflected beam so that it neither reenters the laser cavity nor sends stray beams into the surrounding area.

The High-Power NanoScan scan head has been shown to be able to handle power densities of 3.2MWcm^{-2} at 10.6µm, the power density of a 200µm beam at 1kW. At the shorter wavelengths of the other common industrial lasers, Nd:YAG and DPSS, the upper limits are little less, due to the slightly lower reflection of the components at wavelengths around 1000nm. Visible and UV lasers can also be measured, but these will have lower limits yet.
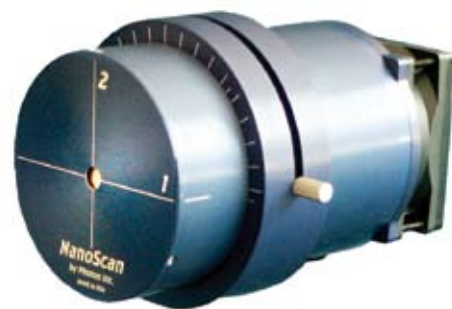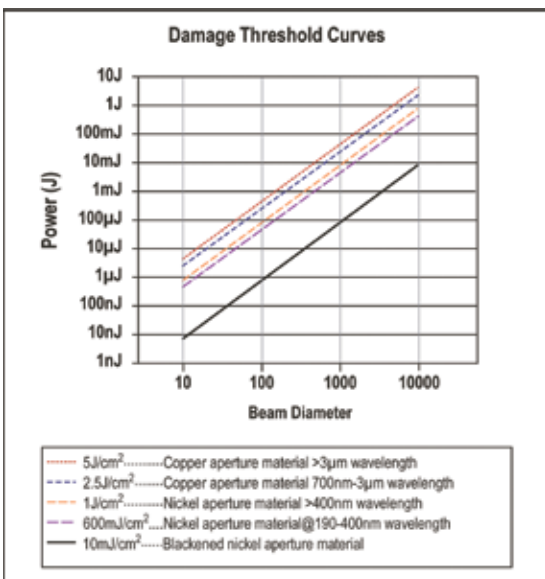
High-Power NanoScan with cooling fan

Minimum Beam Size per Pulse Frequency

NanoScan	Large Drum (HP)			
Rotation Rate (Hz)	1.25	2.50	5.00	10.00
Slit Speed (µm/msec)	233.25	466.50	933.01	1866.01
Data Points per Profile	15	15	15	15
Pulse Frequency (kHz)	Minimum Beam Diameter in µm			
0.5	6998	13995	N/A	N/A
1	3499	6998	13995	N/A
2	1749	3499	6998	13995
3	1166	2333	4665	9330
4	875	1749	3499	6998
5	700	1400	2799	5598
6	583	1166	2333	4665
7	500	1000	1999	3999
8	437	875	1749	3499
9	389	778	1555	3110
10	350	700	1400	2799
11	318	636	1272	2545
12	292	583	1166	2333
13	269	538	1077	2153
14	250	500	1000	1999
15	233	467	933	1866
16	219	437	875	1749
17	206	412	823	1646
18	194	389	778	1555
19	184	368	737	1473
20	175	350	700	1400
21	167	333	666	1333
22	159	318	636	1272
23	152	304	608	1217
24	146	292	583	1166
25	140	280	560	1120
50	70	140	280	560
100	35	70	140	280
150	23	47	93	187

High-Power NanoScan Configurations

Detector Type	Power Range	Wavelength	Aperture	Slits	Scan Head Size
Pyroelectric	~1W - ~5W upper limit dependent on wavelength	190nm - > 100µm	9mm	5µm	100mm
Pyroelectric Large Aperture	~1W - ~5W upper limit dependent on wavelength	190nm - > 100µm	20mm	10µm	100mm

High-Power NanoScan

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NanoScan Acquisition and Analysis Software

*Feature		NanoScan Standard	NanoScan Professional (all features in Standard plus)
Controls			
Source	ScanHead Select, Gain, Filter, Sampling Resolution, AutoFind, Rotation Frequency, Record Mode	●	
Capture	Averaging, Rotation, Magnification, CW or Pulse Modes, Divergence, Gaussian Fit, Reference Position, Recompute	●	
Regions of Interest (ROI)	Single or Multiple, Automatic or Manual, Colors	●	
Profiles	Vertical Scale (1´, 10´, 100´), Logarithmic Scale, Z & PAN (Automatic or Manual)	●	
Computation: ISO 13694, ISO 11146	D_{slit}, (13.5%, 50% 2 User Selectable Clip Levels), $D_{4\sigma}$, Width ratios, Centroid Position, Peak Position, Centroid Separation, Peak Separation, Irradiance, Gaussian Fit, Ellipticity, Divergence, Total Power, Pulse Frequency, % power	●	
	Continuous, Rolling, Finite	●	
Pointing	Centroid or Peak, Accumulate Mode, Beam Indicator, Graph Center, Colors	●	
2D/3D	2D or 3D Mode, Linear or Logarithmic Scale, Resolution, Fill Contours, Solid Surface, or Wireframe, Clip Level Colors	●	
Charts	Chart Select, Parameter Select, Aperture Select, Update Rate, Start and Clear	●	
Logging	File Path/Name, Delimiter, Update Rate	●	
M^2	Rail Setup: Com Port and Length, Connect/Disconnect, Rail Control	●	
Views			
Profiles	Displays Beam Profiles for each axis, with optional Gaussian Overlays	●	
Results	Displays Values and Statistics for Selected results	●	
Pointing	Displays the XY position of the Centroid or Peak for each ROI , with optional overlays and Accumulate Mode	●	
Charts	Displays Time Charts for User-selected results	●	
2D/3D	Displays pseudo 2D/3D Beam Profile	●	
M^2 Wizard	An interactive procedure for measuring M2 by the Rayleigh Method	●	
File Saving			
NanoScan Data Files		●	
Text Files			
Data Logging			
Log to File		●	
Reports			
NanoScan Report			
Automation Interface			
ActiveX Automation Server			●
Minimum System Requirements			
PC computer running windows7 (32/64) Laptop or Desktop			
Core CPU 2GHz or better			
1 USB 2.0 port			
At least 250MB free HDD space			
1440x900 Display Resolution or greater			
Add-in PCI/PCI-Express graphics card w/hardware acceleration			
DVD-ROM drive			

* Download the NanoScan Acquisition and Analysis Software Manual for a complete description of all Software Features

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Optional Automation Interface

For customer who want to incorporate the NanoScan2 into an automated procedure or to create a customized user interface, the PRO versionscanheads include an ActiveX Automation Server that can be used by an Automation Client written in Visual Basic for Applications (VBA), C/C++ or by an application which supports ActiveX Automation, such as Microsoft Excel, Microsoft Word or National Instruments' LabVIEW. The software package include example of programs written in Excel and LabVIEW in theautomation folder.

Ordering information

Item	Description	P/N
USB HP-NS/9/5-STD	High-Power Pyroelectric NanoScan with 9mm aperture and 5µm slits. Comes with the Standard Edition software. Use to measure spots 20µm and larger. Works with CW and pulsed beams with rates greater than 2kHz. Actual minimum pulse rate is dependent on beam size and scan rate. USB	PH00399
USB HP-NS/9/5-PRO	High-Power Pyroelectric NanoScan with 9mm aperture and 5µm slits. Comes with the Professional Edition software. Use to measure spots 20µm and larger. Works with CW and pulsed beams with rates greater than 2kHz. Actual minimum pulse rate is dependent on beam size and scan rate. USB	PH00028
USB HP-NS/20/10-STD	High-Power Pyroelectric NanoScan with 20mm aperture and 10µm slits. Comes with the Standard Edition software. Use to measure spots 50µm and larger. Works with CW and pulsed beams with rates greater than 2kHz. Actual minimum pulse rate is dependent on beam size and scan rate. USB	PH00398
USB HP-NS/20/10-PRO	High-Power Pyroelectric NanoScan with 20mm aperture and 10µm slits. Comes with the Professional Edition software. Use to measure spots 50µm and larger. Works with CW and pulsed beams with rates greater than 2kHz. Actual minimum pulse rate is dependent on beam size and scan rate. USB	PH00027

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